THE

ENGINEERING JOURNAL

THE JOURNAL OF THE ENGINEERING INSTITUTE OF CANADA

"TO FACILITATE THE ACQUIREMENT AND INTERCHANGE OF PROFESSIONAL KNOWLEDGE AMONG ITS MEMBERS, TO PROMOTE THEIR PROFESSIONAL INTERESTS, TO ENCOURAGE ORIGINAL RESEARCH, TO DEVELOP AND MAINTAIN HIGH STANDARDS IN THE ENGINEERING PROFESSION AND TO ENHANCE THE USEFULNESS OF THE PROFESSION TO THE PUBLIC"

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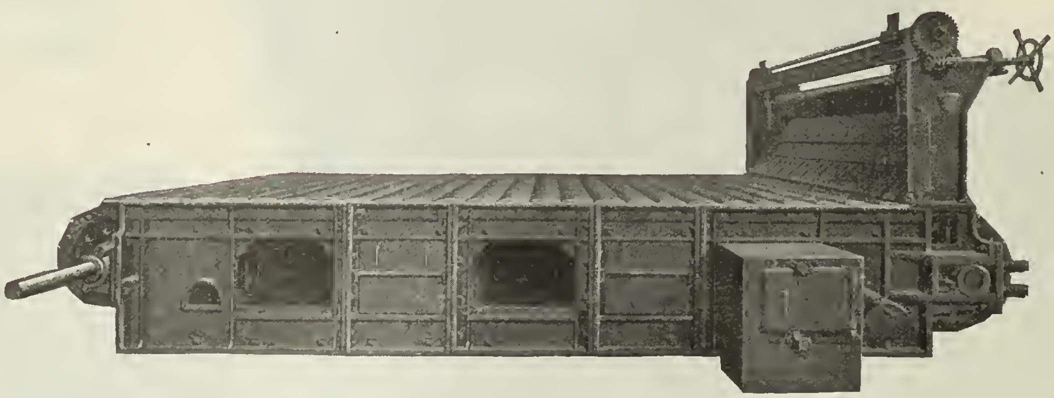

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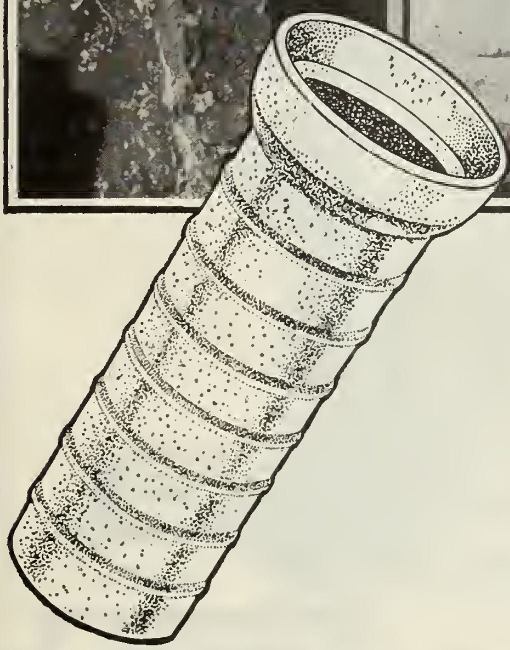

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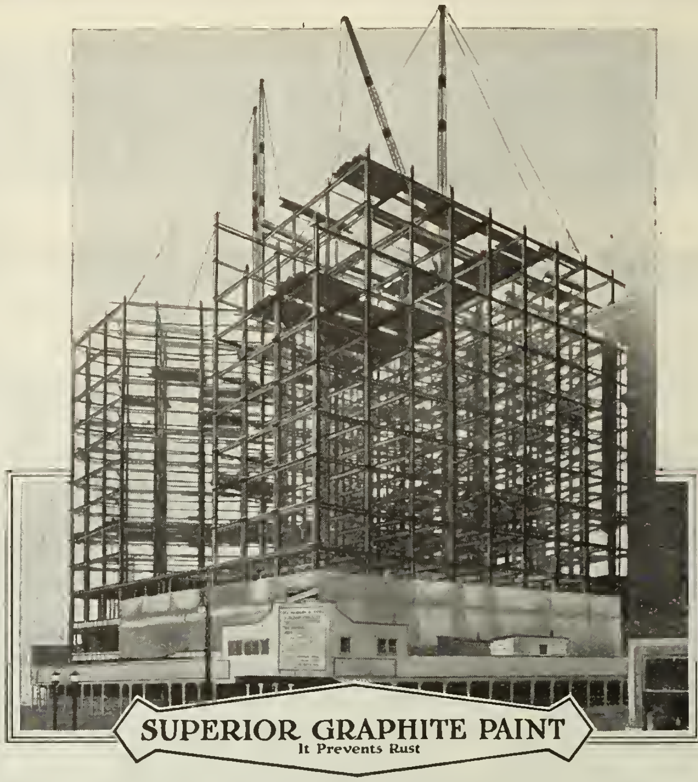

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The Use of the Aeroplane in Surveying and Engineering

Its application to Engineering Works, with Special Reference to Forest Surveys and Right-of-Way Reconnaissance Surveys

Ellwood Wilson, M.E.I.C., M.C.S.F.E., M.S.A.F.,
Managing Director, Fairchild Aerial Surveys Company (of Canada) Limited. Chief Forester, Laurentide Company, Limited

Paper read before the Montreal Branch of The Engineering Institute of Canada, November 8th, 1923.

The rapid development of aerial photography since the war has opened up an entirely new field. The use of the aeroplane in engineering work is something which appeals most decidedly to the imagination. When one thinks of the labour entailed in carrying out surveys across the desert, in mountainous country, or in the interminable wastes of Canada, with all the hardships and physical toil which these entail, the aeroplane certainly offers a blessed relief. Added to the ease with which all this work can be carried out is the extreme rapidity with which results can be obtained. Take, for instance, the matter of forest surveys. Fifty square miles a month for a party of eight to ten men, all of whom had had long experience in this particular kind of work, was considered excellent. Now it is possible to do more than this in a day.

Extensive Field for Aerial Photography in Engineering

A tremendous field is thus opened up for all sorts of preliminary engineering. Reconnaissance for railroad rights-of-way, for the location of transmission lines, and for the location of sites for power development, maps of difficult and inaccessible regions, maps for town planning and suburban development, can all be made with the aeroplane and the aerial camera. Those for whom line maps or blue prints are very difficult to read, understand at once an aerial mosaic or a vertical photograph.

In the purchase of land from farmers for reforestation purposes a few minutes explanation of an aerial photograph makes it practically intelligible, and the naive remarks made by these people are very interesting. After looking at a photograph for a few moments a man who cannot read or write would say, "Why, there's where I cut my fire wood last winter," or "That is my barn," or "That is the fence I built recently".

In explaining projects to boards of directors, or to prospective investors, the photographs are of the utmost value, showing as they do every possible detail, and carrying to the mind of the man who is examining them a conviction of their accuracy, which is often more or less absent when reading a report or looking at a map made by an engineer in the field. Seeing the photograph a man finds himself practically in contact with the location without having had to see it through another man's eyes or coloured by his personal idiosyncrasy.

Engineers often approach the question of aerial photography from entirely the wrong angle. Their first reaction to it is to question its accuracy, purely on theoretical grounds. They say that the aeroplane does not always fly at the same altitude, and even if it does, that if the ground is rough one portion of the picture will have a different scale from some other portion. Also, the camera may not be exactly level at the moment of exposure, the plane may not be flying in a practically straight line, or there may be some other objection. These things are all true in some degree, but means are rapidly being found for the elimination of these sources of error. Cameras are now being kept vertical by the use of a simple gyroscope. If the altitude of the plane varies a little, photographs are enlarged or reduced in order to correct this source of error, and where one portion of the photograph shows a different scale from another the two portions are rephotographed so as to bring the whole thing to the same scale. The degree of accuracy is like that of a ground survey, entirely dependent on the amount of money which one wishes to spend. Take for instance the survey of a farm or a piece of waste land where the value may be from 50 cents to $20.00 an acre. No one in his right mind would wish to survey such ground with a limit of error closer than one in two or three hundred, whereas in a large city where the value of the land might run into many dollars per square foot, an accuracy of one in five thousand would be reasonable.

Accuracy of Maps prepared from Aerial Photographs

The accuracy of a map made from aerial photographs depends entirely on the amount of the ground control required, and can be carried practically to any point desired. Where ground maps of sufficient accuracy are available, they are used for control, the photographs being enlarged or reduced to fit the necessary traverses. Where maps are not available, a rough mosaic is made from the photographs which shows the easiest route for making a traverse, which is always closed, or a series of traverses. Depending on the accuracy required, these are made with a plane table or transit and plotted to the scale of the finished map. The photographs are then adjusted on this. Where less accuracy is required the Bagley method can be used. Experiments are being carried on to get control entirely by flying and this method gives hope of success. In India great difficulty has been encountered in flying straight parallel lines in making photographs for mosaics. In our work we have had very little trouble in doing this, the photographers being trained for such work. In a mosaic of 175 square miles only two small gaps occurred.

A question which is very often overlooked in this connection is, what really constitutes accuracy in the use of a map or plan? Suppose a map is prepared in the field with the most extreme accuracy possible, and it is desired to scale this map for the purpose of finding the horizontal distance between two points. The closest one can read a scale without the help of a magnifying glass is one eightieth or one one-hundredth of an inch, and depending upon the scale of the map one one-hundredth of an inch may mean anything from one foot to 105 feet, so that, after all, spending large sums of money to obtain extreme accuracy in the field is of no practical use unless demanded by the use to which the map is to be put. There are also two points to be considered in the making of maps. Most often maps are required of a section of country which shall show its features, boundaries, roads and so forth, but its location as part of the earth's surface is of no value whatever. For instance, most maps for engineering layouts are of this kind. Also maps of estates, timber tracts, farm surveys, city subdivisions, etc. Maps of regions are entirely different. These must fit into a general map of the country and must be located by latitude and longitude, and be related to the surface of the globe.

Fig. No. 1. Aerial photograph of LaGabelle Rapids, St. Maurice River. Site of hydro-electric development of St. Maurice Power Company, Limited, July 1922.*

Secrecy of Preliminary Surveys a Valuable Feature

Everyone knows how difficult and expensive reconnaissances for railroad rights-of-way are. With aerial photography half a dozen proposed routes can be photo-

*Photographs by courtesy of Fairchild Aerial Surveys Company, (of Canada) Limited.

graphed in less time than it would take to traverse one on the ground. The photographs can be rapidly mounted and examined, and the most feasible route chosen. The same applies to transmission lines, rights-of-way for telegraph and telephone lines and so forth. These can be photographed from the air without any ground work at all being done, and consequently no suspicion is aroused in the minds of property owners as to what is going on. In one actual case a complete survey of a wide stretch of property, through which a power line was to be built, was made and on the finished map fence lines and other property boundaries showed up clearly. A visit to the offices where titles were recorded showed the extent and ownership of each property. The location of the property was determined and the proprietors were approached and asked for options before anyone had the slightest inkling that any development was intended.

For all sorts of preliminary location work, and progress photographs, whether for town-planning, rights-of-way, plant locations or lumbering operations, aerial photomaps are quicker, cheaper, more easily understood and show all the detail which is on the ground. How often has an expensive and careful survey been made and when the map was finished some question came up about something which the man who made the map never thought about and there was no information. Often something is omitted on a map and the cost of going back to get it is prohibitive. The camera gets everything there is.

Method of Making Forest Surveys and Estimates

For many years the writer had dreamed of some way to avoid the toil and expense of making forest surveys and estimates. Some way in which the discomfort of handling instruments at 30 degrees below zero, or trying to operate a plane table when the air was so thick with black flies and mosquitoes that it was almost impossible to see them or to uncover one's hands long enough to make the necessary notes. The dream is now a reality.

Fig. No. 2. Aerial photograph of LaGabelle, St. Maurice River. Construction of hydro-electric development of St. Maurice Power Company, Limited, Spring 1923.

With the aerial photographs the whole country is spread out and can be examined at leisure.

A few words as to the method of making these surveys may be of interest. First of all the aerial photographs are taken of the area which is to be surveyed and estimated. This is made up into mosaics of convenient size for use with the plane table. A telescopic alidade fitted with stadia hairs and an arc is used, and the control necessary for adjusting the pictures is worked out directly on the mosaic. The photographs show every detail of the terrain so that it is possible to locate a traverse where the going is easiest. This is plotted directly on the photograph and a closure is made. Naturally this will not agree exactly with the mosaic, and the plane table sheet is brought into the office and the traverse adjusted. This traverse is then plotted to the scale desired for the finished map and the photos enlarged or reduced to fit it, making a final corrected mosaic. The timber types, which can be easily defined from the pictures, then have their boundaries drawn in on the photographs, and the different types are compared with standard photographs of the same general type which have already been carefully checked on the ground. A sample area, which seems to be a fair average, is laid out in each type, and on this area all the trees are counted and an estimate made of their height and the quantity of timber per acre, based on the standards already referred to. In cases where greater accuracy is desired these plots are actually checked on the ground.

Every one who has had any experience of timber cruising by the "strip" method knows that even where the cruise lines are located a half a mile apart, a swamp, lake, or burn which runs parallel to the cruise line, may be missed entirely. It is very difficult to sketch the boundaries of types as they merge into one another almost imperceptibly on the ground. From the air types are very easily seen and on the aerial photograph can be drawn with a surprising accuracy. Not only can different types of timber be distinguished on aerial pictures but individual trees of different kinds can be readily differentiated. Spruce cannot be distinguished from balsam-fir, but poplar, birch, larch, jack pine and white pine can be picked out.

Errors in Ground Cruising Eliminated in Aerial Works

By the old method of ground cruising the number of trees per acre could be determined with fair accuracy, although there are many sources of error. For instance, the strips are run with the compass, and usually their length is obtained by pacing. The width of the strip estimated is practically always determined by eye, so that here there is quite a chance of error. Where the areas of burns, swamps, blowdowns, and various types are determined by paced distances along cruise lines and by sketching, there is a great likelihood of error.

Fig. No. 3. Aerial photograph of LaGabelle, St. Maurice River. Progress of St. Maurice Power Company's development; dam, power house, coffer dam and temporary village.

With the aerial photographs the areas to which the average per acre is to be applied are almost absolutely accurate, and the number of trees per acre can be actually counted. This leaves to be determined on the ground the average height, the diameter, and the quality of the timber. Where trees have been killed by the bud-worm, the dead trees can be easily picked out on the photographs, so that we now have a much more rapid and inexpensive method of timber estimating.

Aerial Survey of a 450 square mile Timber Tract

An actual operation can be briefly described where it was necessary to obtain information in regard to the amount of timber on a tract of 450 square miles, together with the condition of a pulp mill located 12 miles from shipping point to which it was connected by rail. The country was not accessible by rail, but only by steamer, and then a drive of twelve to twenty miles was necessary to reach the property. The country was extremely broken, the hills rising to a height of a little over 4,000 feet, with deep valleys between them. The adjoining area of about 350 square miles had required eight months work on the ground with quite a large party. The first step was for the forester in charge of work to fly over the whole property using the existing government map for the purpose of sketching in the timber types, burns, and so forth, and making an ocular estimate of the timber. As there were no lakes large enough for landing it was necessary to fly between 7,000 and 7,500 feet, so as to have some chance of landing in case of accident.

The first thing that was discovered was that one chain of lakes, marked on the government map as draining into the river on the property, was seen to drain into an entirely different watershed, and a large lake at the other end of the property was also found to be marked on the map as going into the wrong river. The ocular estimate, from the air, of the timber gave twelve cords to the acre of spruce and fir, and the sample plots taken on the ground ran from 11.6 to 12.4 cords per acre. The main river draining the property was photographed, as was also a lake which could be dammed for the purpose of storing additional water. Photographs were also taken of the timber, of the dams for holding logs, and of the railroad and river connecting the mill and shipping point.

This work was completed, in spite of unfavourable weather, in about a week. A ground operating party was then made up and spent two weeks checking up the quality, size, and the amount per acre of the timber on plots which had been selected from the air as being averages for the tract, and the whole report was submitted to the owners within five weeks from the time of commencing operations. The whole cost was about $11.00 per square mile, including making of mosaics, drafting, and all office expenses. Other tracts varying in size from thirty to two hundred square miles have also been covered with the help of aerial photographs, but with these contracts complete mosaics have been prepared, and the estimates and type areas have been much more carefully worked out.

Reconnaissance Survey of Northern Ontario

Twelve thousand square miles were sketched from the air in northern Ontario during the past season, the government foresters flying over vast unexplored areas lying to the south and west of James bay. Here a very low degree of accuracy was required, and this work was only in the nature of reconnaissances to determine the relative amounts of burnt and timbered lands. There were no existing maps of this country, and no ground control was attempted, everything being located entirely by sketch. In no other way could the information about this area have been obtained in so short a time, or at so low a cost. The Ontario government are planning to cover an area of nearly 20,000 square miles during the approaching season, which will give it a very fair idea of the timber resources of this hitherto unexplored territory.

Comparative Costs of Ground and Aerial Cruising

Even where the work is carried to the point where ground control to the desired accuracy is made, either by surveyed base lines or by plane table traverses, the timber estimates made from the photographs carefully checked on the ground, and a complete drainage and type map prepared, the cost is lower than for work of far less accuracy carried out entirely on the ground. The cost naturally depends on how far it is necessary to fly to reach the land to be examined, and also the construction of a base at the point of operation. The average cost at present for a map and timber estimate made entirely on ground cruising runs from $60.00 to $75.00 per square mile. Where aerial photography is employed work carried on as outlined above can be done for $60.00 to $65.00 a square mile, and work of the same accuracy as that given by a 2 per cent ground cruise could be done for $40.00 a square mile, but the whole area would be covered by photographs and would amount to practically a 100 per cent cruise.

It is very easy for one unacquainted with this work to put forward theoretical objections to it, but the proof of the pudding is in the eating, and after four years' experience in this work the writer is willing to assert the entire practicability and commercial usefulness of aerial photography.

Fig. No. 4. Aerial photograph of the town of Grand Mere.

Irrigation Systems

Engineering features of operation and maintenance with particular reference to the Western Section Irrigation Project.

Robert S. Stockton, M.E.I.C.,

Superintendent of Operation and Maintenance, Western Section Irrigation Project, Canadian Pacific Railway.

Paper read before the Calgary Branch, of The Engineering Institute of Canada, February 12th, 1923.

The engineer responsible for the operating and maintaining of a large irrigation project is concerned with a variety of engineering work. This work has to do with the repairs and replacements required by existing structures, and betterments to such structures as well as new structures required to meet new conditions as they have developed, or new structures to take the place of old ones of temporary character, or where the design has not been adequate to meet actual conditions. Improvement in design and construction or arrangement is always possible, also the development in the use of water by the land owners, may require new structures, or the remodeling of old ones. For example, if the original deliveries of water are to 160 acre units and if after some years, most of the land is held in smaller units, it is evident that changes in the system and new structures are necessary. The operating engineer must have the irrigation system so that water can be delivered to the water users as required to produce crops and must therefore understand irrigation farming and have a staff organized to give reasonably efficient service. It would be too expensive to give perfect service so that it is a case of giving as good service as practicable and showing the water users that they are getting all they can expect. It is not easy to satisfy a large number of water users who realize keenly that their income depends on the water service rendered and who are inclined to look on good service to themselves as most important, rather than the best service to all the farmers on the project, which is the actual aim of the operating force. The problem of distributing water is somewhat analogous to running trains, in that something is delivered on schedule time over fixed routes. In most instances, water cannot be stopped like a train in case of trouble, but can only be diverted at some fixed or temporary spillway.

The maintenance engineer on an irrigation project must have all the canals and ditches and the flumes, drops, pipe lines and division gates so they will hold the water required, plus an overload due to sudden storms and all at the lowest cost consistent with the necessary degree of safety considering the interests at stake. For example, if there are 100,000 acres of land producing crops having a gross value of $30.00 per acre, it means that there is a $3,000,000 production more or less dependent on the water service and any interruption becomes an expensive matter.

The engineers responsible for operation and maintenance see the irrigation system in operation year after year and can observe the condition of different types of structures and soils under the action of water. This information is vital to the economic conduct of the enterprise and of the greatest value to construction engineers on future work. After observing the life of concrete, timber and metal structures of various types and designs, one should then go into the matter of cost on an actuarial basis as outlined by H. B. Muckleston, M.E.I.C., in his paper published in *The Engineering Journal* or April 1922.

The Western Section Irrigation project was started about 1903 and the main canal, Chestermere lake reservoir and the Secondary "A" canal to the Gleichen district were completed and water run through during the season of 1906, although no water was delivered to settlers until 1907. Nearly all the structures on this portion of the system were of timber and quite a number of the larger ones have been replaced after having served to failure, or as long as they were safe. Construction work on the project was continued until the end of 1910 when the whole was turned over to the operation and maintenance organization. The project therefore affords opportunities for the observation of a great variety of timber and concrete structures which have been in use from one to seventeen years. The engineers responsible for operating and maintaining the system have been constantly studying design of structures, field methods of handling repairs, replacements and new work and particularly that economic problem always assigned to engineers, namely, of doing well for one dollar what anyone could do for two. The operation and maintenance engineer has an annual amount of earth to move and timber to place and much of this work is in wet ground and in such small units and so widely scattered and so related to delivering water that it must largely be done as force account work. In other words, the maintenance engineer on irrigation work must act as the contractor and be capable of handling men and equipment in a practical way and on a very wide variety of work.

On the Western section, water is being carried in 360 miles of main canal and over 900 miles of distributary ditches, as well as about 200 miles of spillway channels. In connection with these canals and ditches, there are a large number of division gates, turnout gates, drops or falls, bridges, culverts, checks and flumes, besides a number of special structures such as the headworks and weir at Calgary, the Chestermere lake dam and the Crossfield siphon.

The Sector Gate of the Calgary Weir

A particularly interesting and unusual feature of the Calgary weir, is the sector gate which is a steel shell in the form of a sector 153 feet long and with a 15-foot radius from the hinge to the curved face. It is operated by hydraulic pressure so as to hold back water for any depth above the sill up to a maximum of 10 feet. This depth makes it always possible to fill the main canal to full supply or 10 feet in depth for a discharge of about 2,000 second-feet. This sector gate as originally designed and installed was very difficult to operate, owing to the ends getting out of line and binding, and owing to the rapid accumulation of silt in the sector pit. A study of this matter, covering several years was made by the writer and G. H. Patrick, A.M.E.I.C. This study enabled us to remodel the sector gate so that it now operates smoothly up and down; silt is accumulating very slowly, owing to a system of rubber belt sealers, and means for

Fig. No. 1. Dalroy Flume.

removing the silt have been provided by cutting manholes in the deck. The gate is operated by first placing stoplogs in the stoplog section of the weir which has 23 openings, 20 feet wide. This raises the water over the sector weir and provides a head of water. By opening the inlet valve, this head of water is made to act against the surface of the sector which rises and thus rapidly increases the available head. The sector is lowered by closing the inlet valve and opening a large outlet valve into the canal. The sector is held automatically at any desired point by running the outlet water through an annular weir which can be raised or lowered to adjust the head and when set tends to equalize any change in head, due to fluctuations in the Bow river, from which the main canal diverts.

Chestermere Lake Dam

The Chestermere Lake dam is about 40 feet high and 1,800 feet long and controls a lake or reservoir about 3 miles long and half a mile wide. The lake extends north and south and during high winds developes a rather heavy wave action on the dam. The rock rip-rap placed before 1911 had gradually slid down and the bank was washed in for a depth of several feet. The betterment work undertaken included building the inner bank out to a 2½ to 1 slope, which required 8,850 cubic yards of earth, covering the entire slope with one foot of gravel, requiring 2,570 cubic yards. Rip-rap was then placed by hand over the slope and required 2,637 cubic yards of which 1,870 cubic yards were taken from the old face. The final step was to place fine gravel over the face of the rip-rap so that it would fall into the crevices between the stones and wedge them solidly in place. Piles have been driven for a boom as an additional precaution, but owing to ice action early in the spring, this is of doubtful value. We have found everywhere that there must be a good layer of gravel under rip-rap in order that it may stay in place.

Crossfield Siphon

The Crossfield siphon was built in 1910 and finished and painted with creosote in the spring of 1911. The siphon is 53 inches in inside diameter, 1,680 feet long and operates under a head of 90 feet. There is a head of 8 feet allowed for an estimated capacity of 130 second-feet of water. The staves were 2-inch by 6-inch Douglas fir held by ½-inch rods spaced in proportion to the total head. The first trouble that developed in operating this siphon occurred due to lack of proper anchorage and chair supports, coupled with storm water running down the pipe trench and washing out the supports. This trouble occurred in the spring of 1911 and was at once remedied by diverting storm water, putting in bulk-heads and rock, and backfilling a portion of the pipe with bank-run sand and gravel. The porous backfilling was a mistake and resulted in early rotting of staves from the ground line downwards. In 1918 a few staves were rotted to a depth of ½ inch and repairs to the piers and rock-filled bulkheads were made and all exposed parts of the siphon painted with water gas and coal tar. At some points, particularly the north end, the backfilling was removed and the staves painted, but a considerable portion of the pipe remained covered with the porous backfilling.

About 11 p.m., on the night of July 16th, 1921, there was a break near the south end of this siphon which had been almost completely backfilled and where many of the staves were very rotten. A leak had previously developed and had been patched with the idea that it would last until the end of the season. The rush of the water rapidly eroded the supporting earth under the siphon and cut down into a bed of sand which melted away until a hole 100 feet long, 50 feet wide and 20 feet deep was formed. The pipe fell into the hole and was wrecked for a distance of 75 feet. The water from the break was diverted by one of the bulkheads or cutoff walls built to divert storm water and for an emergency such as occurred, to the drainage ditch running parallel to the siphon and this saved the remaining portion of the structure on the south hill. There was 25 second-feet running at the time of the break and the ditchrider discovered the trouble and turned off the water at 9 a.m., Sunday after it had run about ten hours. The siphon was built up again and water turned in, on the morning of July 30th. At the end of the season, the siphon was thoroughly repaired and repainted with water gas and coal tar. About 375 feet of new pipe was built and 34 patches put in which left the siphon in good shape again. The siphon is now all uncovered, except a few hundred feet on flat ground in the coulée where the filling apparently always remains wet. However, the staves in this section were in good condition after twelve years and were therefore not disturbed.

Heaving Action of Frost on Piles

One of the problems of interest in connection with maintenance work on the Western section, has to do with the heaving action of frost on piles. There is a total of a little less than 100,000 linear feet of piling used for bridge and flume bents and a considerable number of piles have been raised by frost action. The piles affected are usually in wet places and not driven over 10 or 12

Fig. No. 2. C.P.R. Excavator No. 2 on South Cluny Canal.

feet. A pile that once starts to heave never goes back and continues to rise although it may not go up every winter. Cases have been observed where the pile has lifted about a foot in one season. This condition has increased the cost of maintenance and decreased the life of some bridges and flumes. The present practice is to drive to refusal or secure a penetration of from 14 to 20 feet.

Removal of Silt and Vegitable Growth from Ditches

After an irrigation system has been in use for a few years, the ditches begin to grow up with weeds, grass, brush and willows. This growth, together with inequalities of grade, drifting soils, etc., tend to encourage the deposit of silt. These factors in varying proportions gradually reduce the carrying capacity, particularly of the smaller distributary ditches. Sometimes a small ditch may be drifted full of silt in one dust storm. It is estimated that on the average, these smaller ditches might have to be cleaned once in five years. The high labour rates and the limited time available when the ditch is empty and not frozen, made it extremely difficult to get the work done with teams and the cost of moving wet material held by the abundant growth of vegetation with its mass of roots and occasional brush, was high. This constituted the most serious problem that the staff had to solve and the conditions pointed to some kind of a power excavator.

After a study of all existing machines, the writer recommended the purchase of a machine made in California by C. H. Ruth, and called the Ruth dredger. One of these machines was obtained and tried out during the season of 1918 and proved that it was of the right type but was poorly designed and built, so that it would not stand up under the work. The Ruth dredger has since been greatly improved and the new models are in successful use now in the United States. Since this problem at that time was a very pressing one, it was arranged to re-design the Ruth dredger and have it built by the Riverside Iron Works in Calgary. The new machine was improved in every detail except the bucket line, which was the patented feature of the machine. A caterpillar traction was substituted for the old Bull wheel of the Ruth dredger and an Erd heavy duty four-cylinder engine substituted for the old single cylinder Titan which caused so much vibration on the old machines. The new machines are called D.N.R., excavators and have

Fig. No. 3. Fifteen-foot Timber Drop Crowfoot Spillway.

Fig. No. 4. Notch Drop No. 1, Main Canal.

been a great success. There are now six excavators in use on the Western section, nine on the Eastern section and one on the Lethbridge section. The credit for the design of the D.N.R., excavator, rests chiefly with Ben D. Fessenden, assistant canal superintendent in charge of mechanical equipment on the Western section and E. Dutcher, mechanical engineer for the Riverside Iron Works.

During 1922, the six excavators on the Western section cleaned out 273 miles of ditch at a total cost of $115.52 per mile. It is estimated that the saving this year over and above the cost of team work, will be around $50,000.00. The cost per yard of earth moved is about 12 to 15 cents, including interest and depreciation on the machines. The digging speed is about 5 feet per minute and about 13 to 15 buckets per minute are dumped. The buckets hold 2½ cubic feet when full, and from 600 to 1,000 cubic yards per mile is the estimated average for these machines as handled on the section.

A Total Fall of 700 feet throughout the System

A natural feature which has been of prime importance in the construction, operation and maintenance of the Western section, is the fall of the country over which the system is constructed. The headgate sill of the main canal at Calgary is at elevation 3,354 and the secondary "A" canal tails out in the Crowfoot creek at elevation 2,650, which corresponds to a total fall of about 700 feet. This feature has made necessary a large number of drops and inclined flumes to take up excess grade. There are twenty-three reinforced concrete drops and the Dalroy flume in the secondary canals and a 10-foot concrete drop in the main canal. The Dalroy flume, built in 1915 is of galvanized iron 10 feet 2 inches in diameter, 820 feet long and has a drop of 44 feet. It starts at a concrete division gate and empties into a concrete diffusion chamber of special design. The Hammerhill spillway flume is another inclined flume built in 1916, and is 1,696 feet long. It is built of galvanized iron, (Pedlar metal), graduating from a diameter of 7 feet 7⅝ inches down to 5 feet 1⅛ inche with a fall of 102.85 feet. There is a concrete inlet with one foot fall and a timber outlet with 5 feet fall. The timber outlet was selected because of very alkaline soil and consists of a large boxlike chamber with a baffle wall against which the high velocity of the water is dissipated. The Dalroy flume diffusion chamber, built of concrete, had to be covered in order to conform to the same principle. On account of wear, the use of metal flumes is not recommended except on low grades and with moderate velocities. Metal flumes are now all protected by painting with water gas and coal tar, as a general practice in maintenance.

Types of Drops

In addition to the concrete drops and metal flumes mentioned, there are now in use 74,333 feet of inclined flume of metal and timber, but largely of timber, and 8,608 timber drops of from 1 to 4 feet in height and 68 timber drops of from 5 to 15 feet in height. A standard one-foot drop has been developed for small ditches which is used largely and a more elaborate timber drop for falls of from 2 to 6 feet, both types being of a submerged water cushion type and based on the following empirical formula divised by the writer. Water cushion depth equals ⅓ the sum of the height of drop, plus depth of water, $C = \frac{d_1 + d_2}{3}$. Length of water cushion equals the height of drop, plus twice the depth of water $L = d_1 + 2d_2$. Larger drops have also been built following closely the lines of the standard drop for small ditches.

There has also been developed a drop used in both small and large ditches and particularly in spillway channels, which has a double or single water cushion according to size of drop, but always above grade and formed by baffle walls. A small standard drop has been designed, but the large ones have all been special structures but along similar lines. The following empiracal formula is suggested as it follows closely the results of field observations. Water cushion depth equals ¼ the height of drop, plus depth of water, and for larger drops, the second baffle is half the first one. $C_1 = \frac{d_1 + d_2}{4}$ and $C_2 = \frac{d_1 + d_2}{8}$ The length of the water cushion would be twice the height of drop, plus the depth of water under a maximum normal head. $L = 2d_1 + d_2$.

The reinforced concrete drops are built on several different general designs, but most of them are of the Indian type notch drop. The objections to this type are on account of extra form work, yardage and cost, and on account of troubles in operation due to weeds, brush or timbers catching in the notches and raising the water behind the drop to perhaps a dangerous degree. Our latest designs, as worked out by G. P. F. Boese, A.M.E.I.C., have a single notch designed to control velocity of approach and with a proper water cushion below to counteract the velocity of the fall. The below grade water cushion has a sloping outlet to allow for ice expansion if necessary.

There is nothing however, quite equal to a sufficiently deep and long water cushion below canal grade, but in wet ground as we always have in renewals after water has been running for years, the deeper excavation is often quite expensive. We favour a perfectly plain design with the tops of the walls finished with a chamfered edge. The cut-off and return walls are dimensioned according to soil conditions but cut-off walls are usually put below grade a number of feet corresponding to the normal maximum depth of water, and return walls are carried at least to the top of the inner slope of the bank, unless the canal is in thorough cut.

Fig. No. 6. Section A Canal near Strathmore, Alta. Drop No. 8A, Discharge 325 second-feet.

Another type of masonry drop has been used in a number of cases, where rock was available. This is called a rock drop and consists of an inclined rock chute with proper cut-off walls and with a water cushion or paved outlet. The structures built have baffle stones projecting 12 to 18 inches and at about 3½-foot intervals, staggered so as to break up the velocity of the water. The baffle stones are quite effective with a moderate discharge and reduce the velocity under a maximum head, but not sufficiently to obviate the necessity for a considerable length of rip-rap. These rock drops are simple in construction and do not require form work and are economical where plenty of rock is available at low cost. There is a foot of gravel under the rock and the rocks are carefully laid in a bed of cement mortar and all interstices are completely filled with 1:3 cement mortar.

The largest structure of this type we have built is called the McElroys weir and was completed in 1920. The structure is designed to discharge 1,500 second-feet of water at a depth of 3 feet over a crest 88 feet long. The chute is 100 feet long and has a 10-foot approach and 20-foot outlet section and drops the water 10 feet. The rock masonry averaged a little over one foot thick and 33.7 per cent of the masonry was mortar. One sack of cement was used to 8.56 square feet of masonry. A smaller rock drop is shown in the following pictures. This is drop *7A* and is designed to discharge a maximum of 600 second-feet over a raised crest and has a 2-foot water cushion, and a 10-foot fall.

Fig. No. 5. Rock Drop 7A, Secondary A Canal near Strathmore, Alta.

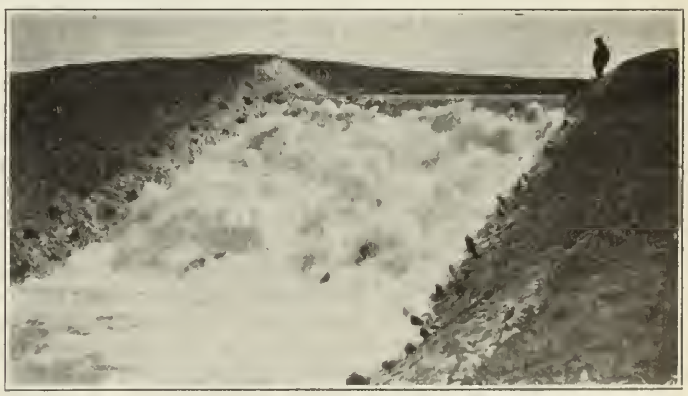

Fig. No. 7. Completed Rock Drop No. 7A, near Strathmore, Alta.

Proper use of Timber of Utmost Importance

Since most of the structures on the Western section are of timber, the proper use of this material is of the utmost importance. A survey of these structures shows over 11,000,000 feet B.M. of timber in place, which indicates that with repairs there would be around 1,500,000 feet B.M., required annually if renewals are based on a 10-year average life. Careful experiments with various classes of pressure treated and brush treated creosoted lumber are now being made. A study of results elsewhere and observation of brush treated telephone poles used here since 1911, and a consideration of costs, inclines the writer to believe that the maximum of economy under present conditions will result from giving such structures a brush treatment in the field as they are built. Pressure treated lumber will no doubt result in a longer life to the structure, but such lumber is difficult to handle and work, and costs more for creosoting, so that the final result may be more expensive considering the proper annual charge based on costs and probable life.

Many of the important drops and flumes are now being built with two thicknesses of 2-inch plank or one thickness of 2-inch plank and one thickness of inch material for the sides and floors. In many cases, a layer of tar paper is placed between the two layers of plank, as the results of this practice, as observed in some of the old structures, appears to have added to the life of the wood besides which the tar paper makes the wall or floor more nearly watertight. When a single layer of 2-inch plank is used in ditch structures, it is usually tongue-and-grooved. The policy has gradually leaned towards the heavy timber construction, due to the longer life of such structures. More than half the cost of the ditch structures in place is accounted for by carpenter work, excavation of wet material and backfilling. It therefore pays to put in more lumber and defer the time of renewal.

It is quite important that all ditch structures, that must carry water, shall be puddled in as backfilling progresses. A drop or gate backfilled with more or less dry material usually goes out sooner or later and must then be puddled in if anyone is there in time, but there is always a chance of damage to, or loss of the structure. Structures built in the fall should be partially backfilled and then puddled in when water is available in the spring.

There are other ditch structures that could be discussed, notably farmers turnout gates, division gates, canal bank gates and flumes. On the Western section during 1922, there was over 1,500,000 feet B.M., of lumber placed in ditch structures for maintenance and renewals at a field cost of about $75.00 per M feet B.M., including hauling, lumber, nails, excavation and backfilling.

This discussion, it is hoped, will give a general idea of the type and methods of maintenance and renewal of the ordinary structures used on an irrigation system. Other phases of operation work, such as duty of water in irrigation, water measurement and records, method of irrigation in general use, proper grades to prevent silt or scour, design of structures to handle Russian thistles and other weeds blown into the ditches, control of burrowing animals, prevention or removal of aquatic growth in the canals and many other things have more or less to do with the design, construction and maintenance of structures.

In closing it would be well to call attention to the great possibilities which lie in the complete development of the irrigation resources of Alberta. There is a possibility of developing 1,500,000 acres of irrigated land without counting another 1,000,000 acres or more that could be served from the North Saskatchewan and often referred to as the Wm. Pearce irrigation project. We can look forward to a time when this area will bring returns of perhaps $50,000,000 per year and will have caused a great growth of the cities and towns. The irrigated land lends itself to intensive development with small farm units. The increased farm and city population will foster industrial development which in turn increases population and affords markets for farm produce. The irrigated areas also supplement adjacent dryland and ranch production.

Recent Developments on The Temiskaming and Northern Ontario Railway

The Development of Northern Ontario and Its Natural Resources with the Extension of the Railway

S. B. Clement, M.E.I.C.,
Chief Engineer, The Temiskaming and Northern Ontario Railway.

Paper read before the Toronto Branch of The Engineering Institute of Canada, November 29th, 1923.

The history of the settlement and industrial development of Canada during the last seventy-five years is in large part the story of its railways. Nowhere has this relationship been more conspicious than in Northern Ontario, particularly in the districts of Temiskaming and Cochrane, during the last two decades. There the Temiskaming and Northern Ontario Railway was originally projected as a colonization railway and has been extended from time to time and has made possible the present settlement and industrial development of these districts.

Engineering science has played a pre-eminent part in the evolution of the modern railway and to-day is applied in its construction and operation to a greater extent than ever before. By reason of their vital importance in the every day economic life of the nation, the railways probably attract more widespread and intense public interest than other engineering undertakings. Recent developments on the Temiskaming and Northern Ontario Railway will be of interest to Ontario members of *The Institute* from an economic as well as an engineering standpoint, and, as the engineering problems encountered have not been of great novelty or magnitude, in this address possibly greater attention will be given to economic considerations than to details of engineering design and construction. In any discussion of the activities of the Temiskaming and Northern Ontario Railway, (T. and N. O. Ry.), the fact that it is essentially a development railway, should be borne in mind, although in this

Fig. No. 1. Abitibi Canyon, Abitibi River looking North.

respect only, it differs from other railways that have been built and operated primarily for the profits from operating revenues.

Colonization prior to Advent of Steam Railway

Before the advent of the steam railway, transportation by land was so costly and restricted that the settlement of what is now British North America was confined to comparatively narrow fringes along the Atlantic coast and the navigable rivers and lakes. During the long struggles for supremacy in North America, the French planted their colonies along the St. Lawrence and were in effective control of the St. Lawrence — Great Lakes waterway. At the same time, although the British controlled Hudson bay, a second great waterway into the heart of the continent, their efforts at colonization were confined to the colonies along the Atlantic coast. It is true that access to the Hudson bay was through Hudson strait, which was navigable for but three months each year, and the shores of Hudson bay and James bay were not as attractive for settlement as the Atlantic colonies, or even the shores of the St. Lawrence. But the reason that there was no British attempt at colonization on Hudson bay and tributary waterways, was that they were effectively closed to settlement and reserved exclusively for the fur trade by the granting of exclusive rights to the Hudson Bay Company in 1670. By the time these reservations were removed, the present trade routes from the seaboard to the head of the Great Lakes and to the great interior plain of North America, had become established. Notwithstanding, many and great climatic and physiographic disadvantages, Hudson bay and its tributary waterways, would have made a substantial contribution to the development of Canada, had they not been effectively closed during the period that the St. Lawrence route was developing to its present importance.

Settlement flows Westward leaving Northern Ontario Untouched

As the tide of settlement flowed westward, in the second half of last century, it left untouched the vast and unknown area stretching from these bays to the Great Lakes on the south and the prairies on the southwest. In time, forty years ago, a Canadian transcontinental railway became a political and economic necessity. So awed by this unexplored wilderness were the builders of the Canadian Pacific Railway, that, in their location, they clung to the north shore of lake Superior rather than venture back into the wilderness, through which their later competitors have found more favourable routes. The children in the Ontario schools, until recently, learned their geography from a wall map of the province showing that portion south of the French river and lake Nipissing on a large scale, while out in the middle of lake Huron was an inset on a very small scale of the northern and western portion of the province; the only details being a meandering line to represent the C.P.R., and such enlightening comments as "unexplored", "timber", "fur", "minerals". If one were to compare a school geography map of the year 1900 with maps dating back to the year 1700, the only difference would appear to be in the more accurate detail location of the principal water routes. These were all well known to the early British and French fue traders, and subsequent engineering and geologicar

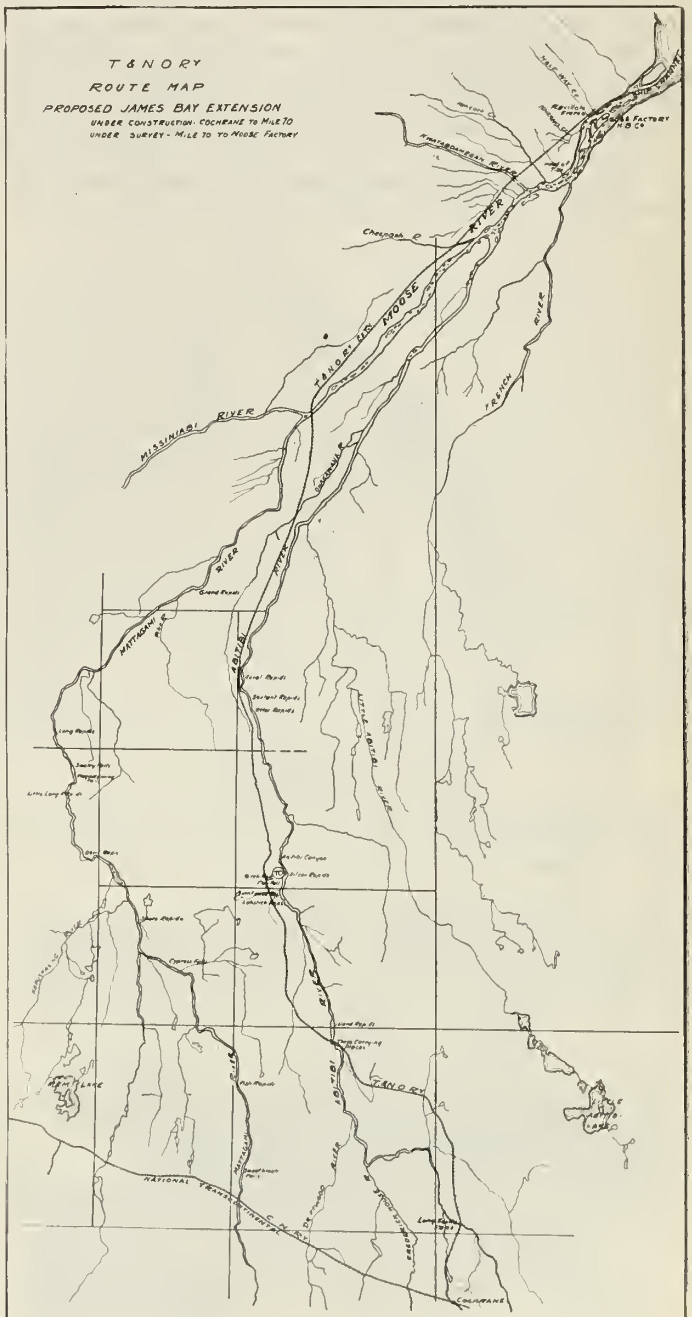

Fig. No. 2. Route Map of the proposed James Bay Extension, T. & N.O. Ry.

exploration had been confined to them, except of course areas quite close to the Great Lakes.

About twenty-five years ago, a number of hardy pioneers had established small and struggling settlements at Haileybury and New Liskeard, at the north end of lake Temiskaming where the Ontario government had then recently opened a few townships for settlement. Separated from the nearest railway in the province by over 100 miles of impassable rocks and forests, the only access was from Temiskaming, Quebec, at the south end of the lake. Notwithstanding the difficulties or transportation, it was soon shown that the soil was fertile and that with satisfactory transportation the settlement of these townships would be profitable and desirable.

Aggressive Development commenced in the Year 1900

The first aggressive steps toward the development of Northern Ontario began in the year 1900 when the legislature voted $40,000 for "surveys and exploration". When the data, collected the following summer by a number of survey parties, were compiled it was found that beyond the height of land, particularly in the drainage basin of the Abitibi and Metagami rivers and their tributaries, there was a large area of fertile clay land timbered mostly with spruce and poplar, and very similar to the clay land at the head of lake Temiskaming. This area, which was estimated to contain 16,000,000 acres, became known as the Northern Ontario Clay Belt. In 1902 the Legislature provided for the construction of the Temiskaming and Northern Ontario Railway "from a point at or near North Bay to a point on lake Temiskaming". The railway was in operation to New Liskeard in January, 1905, but in the meantime the Dominion government had undertaken the construction of the National Transcontinental Railway from Quebec to Winnipeg across the "clay belt" and the legislature had authorized the extension of the T. & N. O., to connect with the Transcontinental near the Abitibi river. The operation of the railway to the junction at Cochrane commenced on November 30th, 1908. Since then branch lines of the T. & N. O. Ry. have been built from Porquis Jct. to the Porcupine gold area and to the great paper mill of the Abitibi Power and Paper Company at Iroquois Falls. Two short branches have also been built through the farming lands in the Temiskaming district. The total mileage now operated by the T. & N. O. Ry., is 328, consisting of:

Main line — North Bay to Cochrane	252 miles
and Branch lines	76 miles

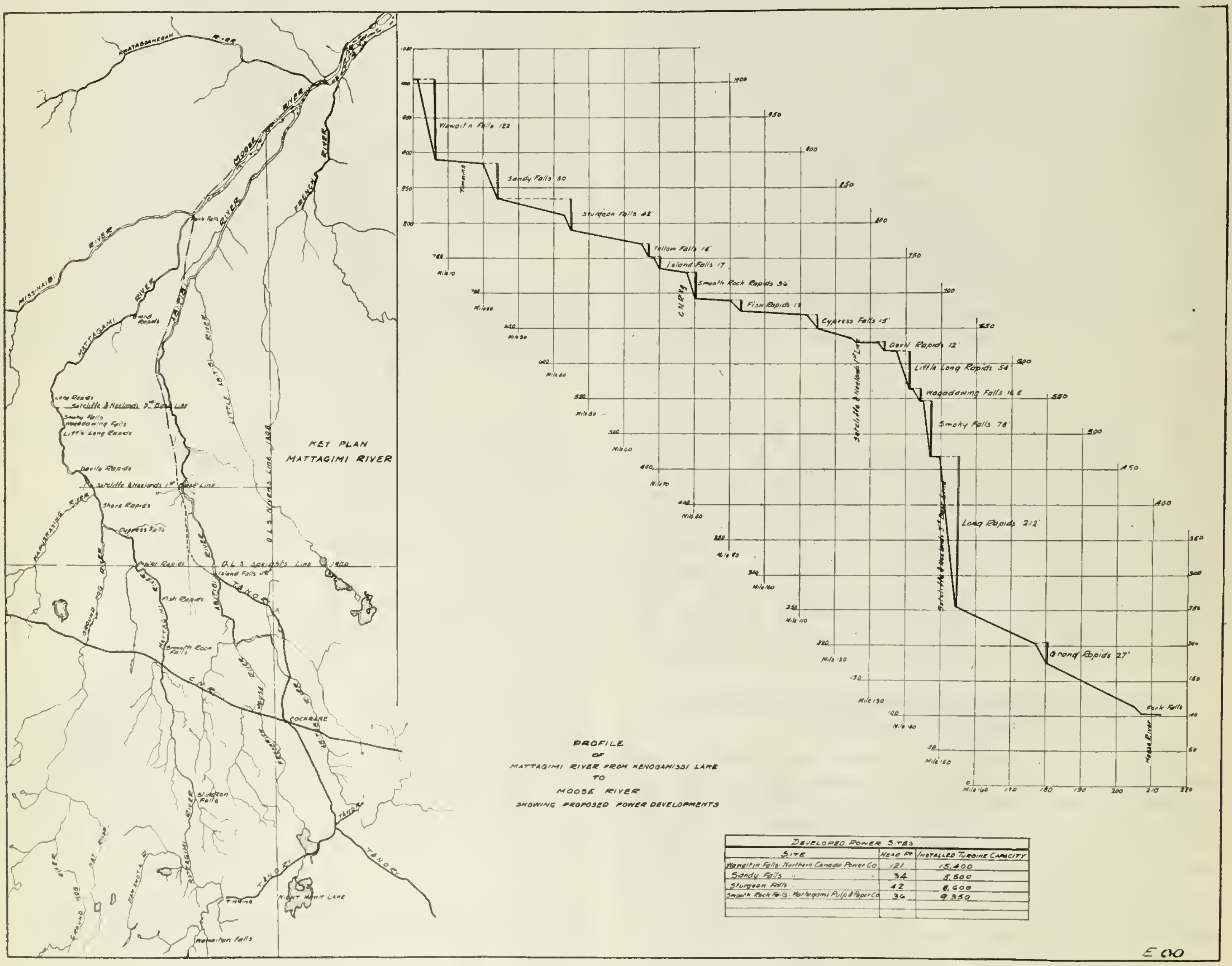

Fig. No. 3. Profile of Metagami River from Kenogamissi Lake to Moose River.

Fig. No. 4. Abitibi River Crossing, Mile 44.4 from Cochrane, T. & N.O. Ry.

Recent developments in gold and silver mining, in pulp and paper manufacturing and in agriculture in the districts of Temiskaming and Cochrane are well known and accepted as more than justifying the province in building the present lines of the T. & N. O. Ry. The value of the products of these industries annually exceeds the investment in the railway. The net operating profit during the past year was three per cent, but when the railways' contribution to the wealth and prosperity of the province and the additional indirect revenue derived by the province, are considered, the balance sheet will be found to be on the right side.

Investigations and Selection of Route North of Cochrane

Although originally projected to reach the clay lands at the head of lake Temiskaming, the conception of the possibilities of the railway grew and while the extension to the Transcontinental was under construction, legislature, in 1905, made a small appropriation for an exploratory survey of the Abitibi river to James bay, in anticipation of the ultimate extension to tide water.

In 1911 the systematic investigation of the topography and resources of the country north from Cochrane and the possibilities of harbours on James bay was commenced. These investigations from time to time have been made by S. C. Ells, M.E.I.C. and W. R. Maher, A.M.E.I.C. and Major Jas. McMillan, at present of the provincial department of mines. The results of these explorations have been included in the reports of the T. & N. O. Ry. Commission which, with the reports of other departments of the government, have made available considerable detailed information with reference to the Moose River basin.

In selecting a route for a further extension of the T. & N. O. Ry., for the purpose of developing the area between the Transcontinental Railway and James bay, an endeavor was made to locate it through or convenient to areas that appeared to have the best prospects of an early industrial development. It was found that the most desirable route would be obtained by following the Abitibi river. This route would be through the better drained areas most suitable for settlement, it would cross a number of large rivers at points where pulpwood and timber could be collected for manufacture or shipment and would be close to a number of large water powers, the development of which would lead to the establishment of pulp and paper or other industries.

It was also considered that any extension should be capable of being ultimately extended to a terminus on James bay. The most suitable harbour on the bay was found to be in the estuary of the Moose with a site for a railway terminal on the west bank near Revillon's Post.

The route shown on the map figure No. 2 has been located and meets these conditions. Comparatively light gradients, one-half of one per cent have been obtained with maximum curvature of four degrees. The grading is quite light except in the vicinity of Abitibi canyon, about 75 miles from Cochrane, where there will be four or five miles of heavy excavation mostly in sand. The numerous river crossings will require comparatively heavy bridging.

The usual difficulties accompanying railway location in northern Canada were met with. Supplies were largely taken down the Abitibi river, which was used as a base, by canoes in summer and dog teams in winter. Supplies for the last season's work on the Moose were sent in from Pagwa on the C.N.R. At this station the fur trading companies, each spring, float down large quantities of supplies on scows with the spring freshet. These go down the Pagwatchouan to the Kenogami river and thence to the Albany river. From Fort Albany they are taken to Moose Factory by schooner.

First Seventy Miles from Cochrane under Construction

Only the first seventy miles from Cochrane are at present under construction. A general contract for clearing, grading, culverts, bridge foundations, tracklaying and ballasting was awarded to Messrs. Grant Smith and Company, and McDonnell Limited of Vancouver, in January 1922. The steel bridges are being supplied and erected by the Hamilton Bridge Works Company of Hamilton. Grading having been practically completed for the entire 70 miles and track laid and ballasted to the bridge at the second crossing of the Abitibi river, 44.4 miles from Cochrane, it was recently found desirable to take the work out of the hands of the general contractor. This was done and since the first of November the commission has been operating a tri-weekly construction service from Cochrane to Island Falls Jct., at mileage 43, where connection is made with a spur line, three miles long, to the Hollinger power development now under construction at Island Portage, on the Abitibi river. Tracklaying and ballasting north of the second crossing will be completed by labour next season.

Grading Excavation

The grading on this seventy miles was comparatively light, averaging about 16,000 cubic yards per mile. There was no ledge rock excavation, except a few hundred yards

Fig. No. 5. Abitibi River Crossing, Mile 11.4 from Cochrane, T. & N.O. Ry.

Fig. No. 6. Moose River from Revillon's Post May 3rd, 1923.

in the bottom of two cuttings near the Sucker creek crossing at mile 20. The grading may be grouped under two types characteristic of the clay belt; the alternate cut and fill on the broken ground along the river and lakes and the long low fills from side borrow across the swamps and unbroken country.

All grading excavation was classified under three heads "solid rock", "loose rock", and "common excavation". These are defined in the specifications as follows:

> "*Solid Rock*" shall comprise all detached rock or boulders measuring more than one cubic yard, and all rock in place requiring blasting to remove it.
>
> *Lose Rock* shall comprise all detached rock or boulders measuring more than one cubic foot and less than one cubic yard, and shale, slate, and other rock which can be removed without blasting although blasting may be occasionally resorted to.
>
> *Common Excavation* shall include all materials of whatever nature that do not come under the classification of "solid rock" or loose rock".

The material in line cuttings with the exception of the solid rock previously referred to, was of glacial origin. It varied from extremely fine sands and clays to coarse boulders and from complex drift to clays and sands of marked stratification. The classification of these materials under this specification at times presents some difficulties, but it is doubtful that the problem is simplified by the use of a fourth or hardpan classification.

Embankments and Cuttings

Embankments are eighteen feet and cuttings twenty-four feet wide, and both were trimmed to slopes of 1½ to 1. The slopes of a number of the cuts were not stable at this angle and there has been some slipping and sloughing off but the yardage involved was not great. After track was laid, those cuts were ditched with a steam railway ditcher, loading into air dump cars, which is the cheapest and most economical method of removing surplus material from cuts. A slope of 1½ to 1 is too steep for much of the clay. It is impracticable in railway construction to determine in advance the proper slope for each cut and it is more economical to subsequently ditch the cuts where necessary by the above method than to excavate all of the cuts to an unnecessarily flat slope.

There were no serious land slides. The slips in the cuts already referred to merely filled the side ditches and did not cover the rails. In making fills across creek beds, there were some settlements of the heavier filling through the muck to a firm bearing, the displaced material rising on either side. In a few instances during ballasting operations there were settlements of muskeg embankments. It does not appear to be practicable to anticipate these settlements. Although the muskegs are deeper and softer where the timber is sparse and stunted, and wide crosslogging may be used under the embankments where considered necessary, generally this type of sink hole develops where least expected.

Rails, Ties and Ballast

Track, on the extension, is laid with 80 pound A.S.C.E., section rail and heat treated angle bars and

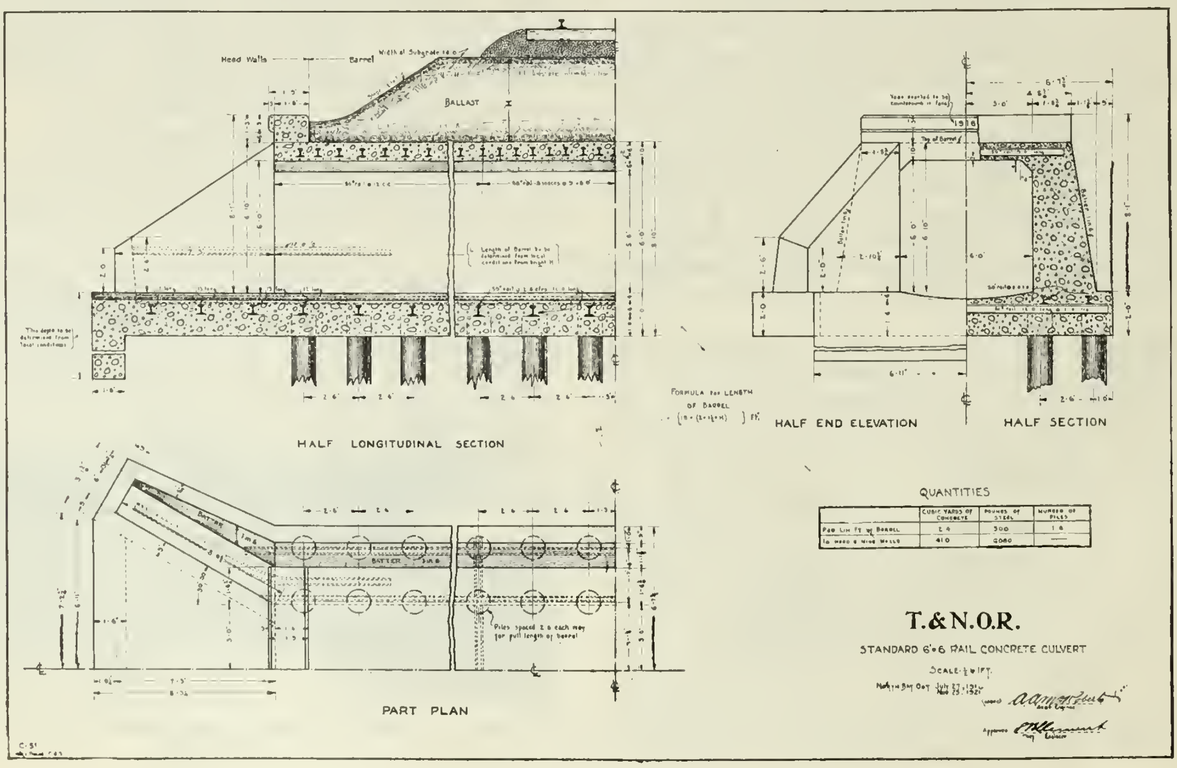

Fig. No. 7. Standard 6-foot by 6-foot Rail Concrete Culvert, T. & N.O. Ry.

bolts and all curves are fully tie plated. The ties are of untreated jack pine, 18 to 20 per 33-foot rail depending upon the size. Passing tracks are located at intervals of about 6 miles. In the switches of passing tracks No. 11 springs frogs and 22-foot switch points, are used. All other switches have No. 8 frogs and 15-foot switch points.

Sand or gravel suitable for ballast was not found in quantity along the line of the railway. Some difficulty even was encountered in finding material suitable for trestle filling. Except for a small quantity of selected material, obtained from the trainfill pits, the bulk of the ballast had to be hauled from a pit three miles south of Cochrane. The scarcity of gravel will also make it necessary to haul ballast long distances in the event of the further extension of the railway to James bay.

Construction in Advance of Tracking

By reason of the scarcity of material suitable for aggregate for concrete, only a very few structures could be built in advance of tracklaying, and, except at the two large bridges over the Abitibi river at mileages 11.4 and 44.4, track was carried over the streams on temporary structures.

The proportions of the concrete used were:

	Cement	Fine Aggregate	Coarse Aggregate
For reinforced concrete or concrete deposited under water	1	2	4
Mass concrete in forms	1	2½	5
Foundation concrete	1	3	6

The aggregate largely came from a gravel pit about one-half mile from the track and five miles north of Cochrane. Fine aggregate predominated in the pit gravel and, to obtain proper proportions, a sufficient amount of screened, coarse aggregate was added.

Reinforced concrete or corrugated iron pipes up to three feet in diameter were used for the smaller waterways, and as far as practicable were teamed in the winter and placed in advance of the grading. The reinforced concrete pipes are preferable but corrugated iron are

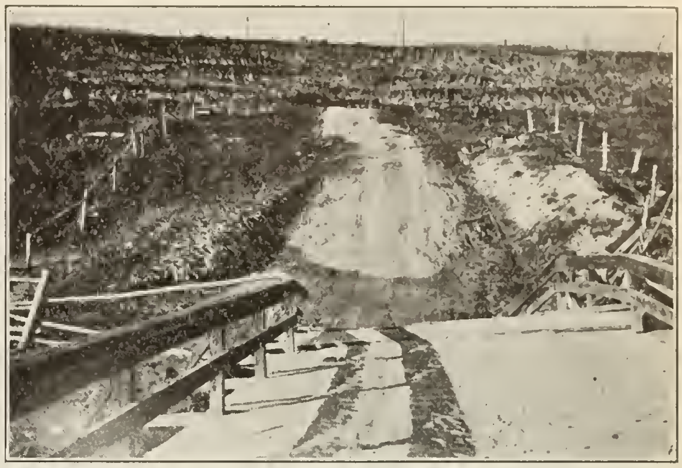

Fig. No. 8. Landslide in the Clay Belt, along the Route of the T. & N.O. Ry.

lighter and permit of easy handling and were used where the team haul was greatest.

Reinforced concrete flat top culverts were used where a greater opening was required than could be provided by a double 36-inch pipe culvert. Standard plans of concrete culverts are reproduced. Theoretically arch culverts are more economical in material, but a slight settlement of either bench wall results in serious cracks, if not in the complete failure of the arch. It is difficult to avoid settlement when built on the softer clays, even when piling is used, and to repair or rebuild a broken culvert under a high embankment and maintain traffic is a costly proceeding. Scrap rail reinforcing is used throughout in this type of culvert. It accumulates in large quantities on railways and costs per pound but a fraction of the cost per pound of reinforcing bars. In many cases sufficient rail is used in the tops to carry the load and the concrete merely serves as a protection.

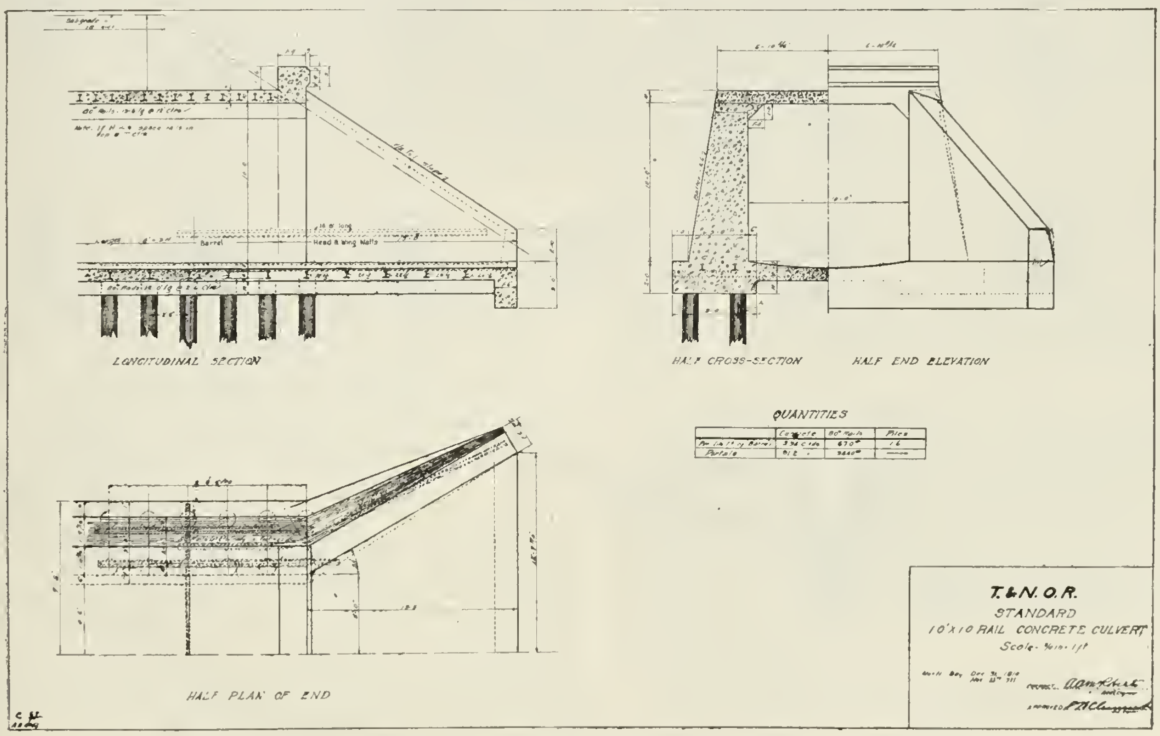

Fig. No. 9. Standard 10-foot by 10-foot Rail Concrete Culvert, T. & N.O. Ry.

Landslides along River in Clay Belt

Landslides along the banks of many of the rivers in the clay belt have been of frequent occurrence. A recent slide on the Blanche river in the fifth and sixth concession of Evanturel, is of sufficient interest to be briefly described. This slide effected the west bank of the river for almost one-half a mile and extended back, in places, for several hundred feet, and covered an area of about 50 acres. The original bed of the river was blocked and the water dammed back until it flowed over the narrow flood plain on the east side. At the lower end of the slide, the bed of the river rose vertically about forty feet, while at the upper end, the original river channel was filled by the movement of the west bank. The slide appears to have been due primarily to the flowing of an underlying stratum of very soft viscous clay. The overlying stratified clays broke along horizontal and vertical planes. The bridge abutment was moved about 200 feet horizontally and 40 feet vertically.

First Crossing Bridge on Abitibi River

In crossing the larger streams, the use of high bridge abutments was avoided where possible, particularly on unstable material or on steeply sloping banks. All bridges were designed for E-60 loading and in accordance with Canadian Engineering Standards Specification with B. C. fir decks. Where foundations are good as on solid or loose rock, and within certain limitations as to height, a reinforced concrete abutment with concrete slabs has been successfully used and is more economical than a U-type abutment.

The bridge of the first crossing of the Abitibi river, mile 11.3, consists of one 75-foot, two 110-foot and three 90-foot deck plate girder spans, supported on concrete piers and abutments. The footings in all cases were on hard pan. In the design of the bridge, provision was made for the raising of the level of the river which would follow the development of the Long Sault Rapids water power. A pool elevation at approximately the level of the tail race at the Iroquois Falls plant of the Abitibi Power and Paper Company was assumed, and in anticipation of navigation of this pool, a clearance of 14 feet was provided. Apart from this restriction longer deck truss spans in place of the 110-foot plate girders could have been used.

Satisfactory concrete gravel was found on each side of the river within teaming distance. Simple concrete mixing plants were installed on the top of each bank. The south abutment and piers Nos. 1 and 2 were poured from the south bank and the other piers from the north bank, all but pier No. 2, in advance of tracklaying.

In this structure there are 869,519 pounds of steel and 3,142.5 cubic yards of concrete.

An unexpected summer flood of unprecedented volume swept away the cofferdam for pier No. 2. The work on the other piers was well advanced and to avoid several months delay to tracklaying, temporary construction was used in place of the two 100-foot deck plate girders between piers No. 1 and No. 3. Three 55-foot deck plate girder spans already fabricated for one of the steel viaducts and a short length of timber trestle at each end were used to span the opening. Timber bents built on the cribs of the cofferdam supported the abutting ends of the girders, thus avoiding the placing of piling in the deep and swift channel. On the completion of the pier, the temporary work was removed and the 110-foot spans, t[illegible] place in permanent position. The timber in the temporary structure was used again elsewhere for false wor[illegible]

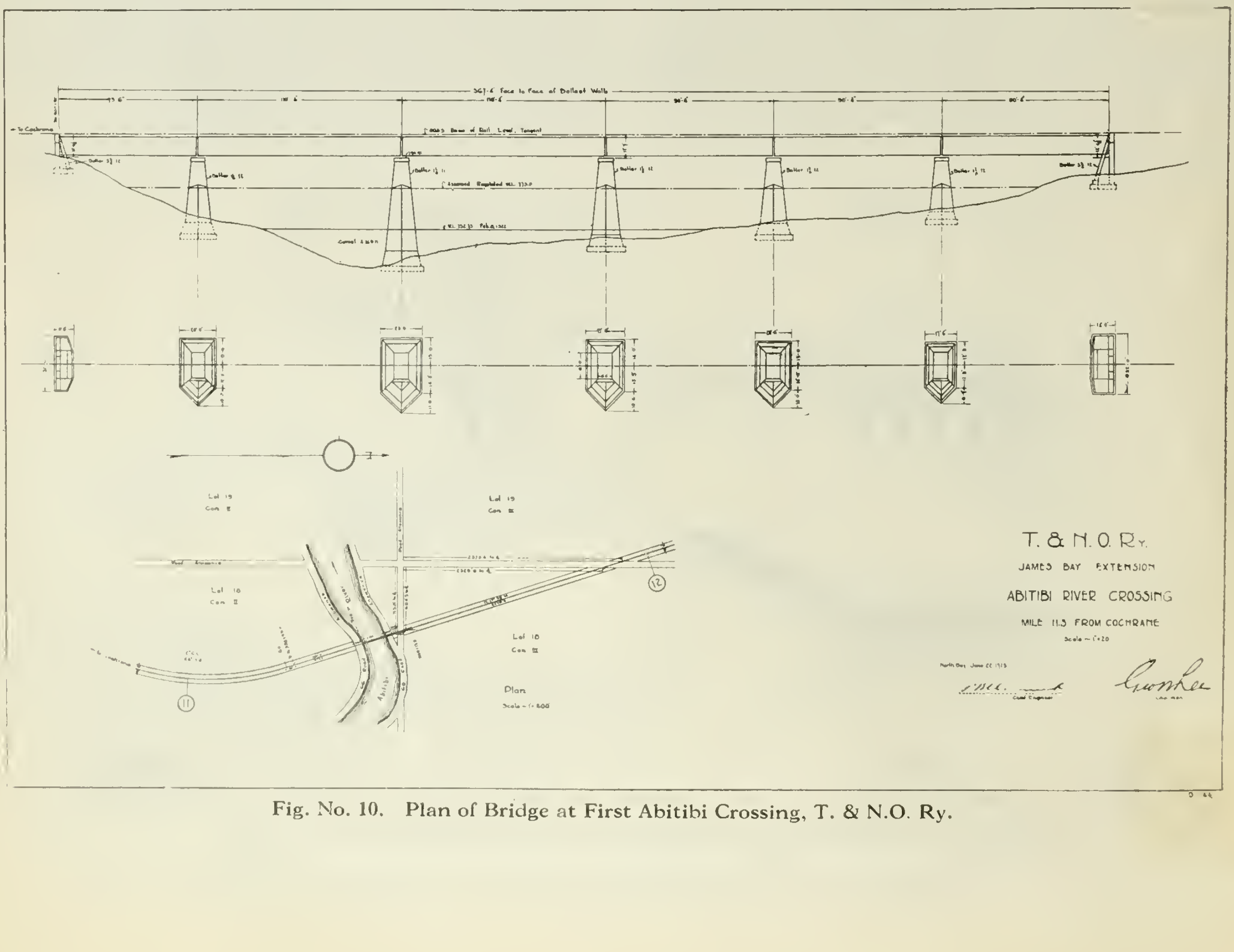

Fig. No. 10. Plan of Bridge at First Abitibi Crossing, T. & N.O. Ry.

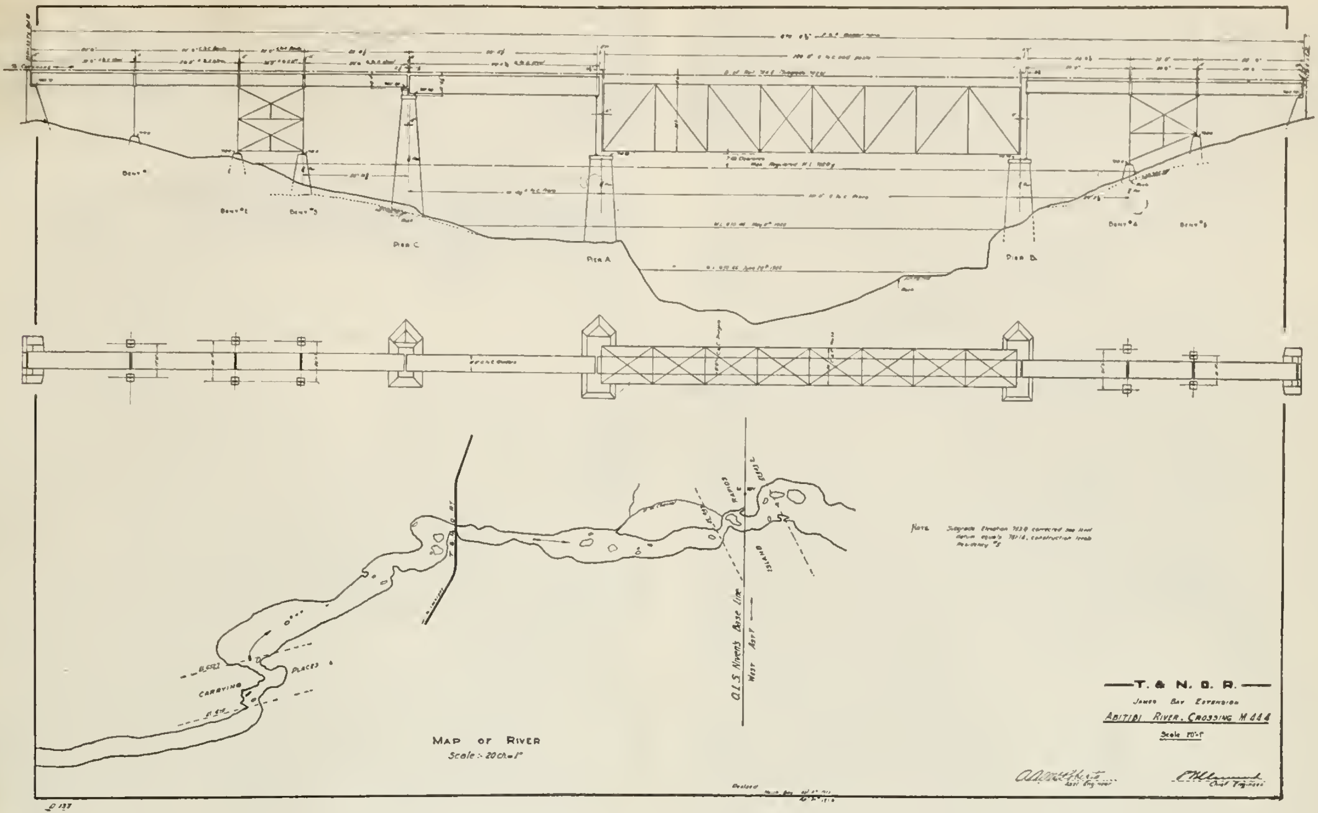

Fig. No. 11. Plan of Bridge Second Abitibi River Crossing, T. & N.O. Ry.

Abitibi River Second Crossing Bridge

The other crossing of the Abitibi river is at mile 44.4 midway between the Carrying Places and Island Portage. On the completion of the Hollinger power development at Island Portage, which is one and one-half miles below the bridge site, the level of the water will be raised to the foot of the Long Sault rapids. A 220-foot deck truss spans the present river channel and clears the regulated water level by 7½ feet. Deck plate girder approach spans provide additional clearance for navigation. The total length of the bridge, 670 feet, comprising five 55-foot, two 35-foot, and one 100 foot deck plate girder spans and one 220-foot deck truss span.

The steel work is carried on concrete piers and pedestals, all of which are on solid rock except the south abutment and adjacent pedestals, which are on hardpan. All concrete was mixed in a plant at the top of the south bank and was spouted to, and then elevated at piers *C* and *A*. Concrete for the north end was spouted to cars and trammed across a suspension bridge and then elevated and spouted to the forms. This suspension bridge was so adjusted that both loaded and empty cars crossed by gravity, except for the last few feet at each end where they required a little assistance.

The erection of the truss span involved the placing of false work under considerable difficulty. The current is very swift and deep and the bed of the river is bare rock. To hold the piles for the falsework, cables were stretched across the river between the main piers. Staging on these cables held the top of the piles while the bottom of each pile was held against the current by a long wire anchored to a projecting rock, a short distance above the bridge. On these piles, timber towers were built under the alternate panels.

In this structure there are 1,615,123 pounds of steel and 3,685.8 cubic yards of concrete.

Swastika-Larder Lake Branch

The Temiskaming and Northern Ontario Railway Commission also has under construction, a railway of quite a different type from that which has just been described. This branch extends from Swastika east through the Kirkland Lake gold area to Larder Lake, a distance of about twenty-four miles. A number of years ago the commission obtained all the capital stock of the Nipissing Central Railway Company, which operated an interurban electric railway between Cobalt and Haileybury but held a Dominion charter with rights to construct a number of additional lines in Northern Ontario and Quebec. As the route of one of these lines was well adapted to the purpose, it was utilized and the Swastika-Larder Lake branch is being built as a Nipissing Central line.

This branch is being built to serve a well established and important gold area with several producing mines at Kirkland Lake, five miles from Swastika, and other areas near Larder Lake. In the latter there is one producing mine and others on which very encouraging development work has been done. The geological belt in which these mineralized rocks occur extends from Larder Lake eastward across into Quebec and includes the Fortune Lake and Rouyn gold fields that are now attracting so much attention.

In the construction of this branch maximum grades of one and one-half per cent compensated for curvature and maximum curves of twelve degrees, are used. The country through which it is being built is the rugged pre-Cambrian country typical of the height of land where there is no general covering of clay as in the clay belt. Total grading quantities average about 12,000 yards per mile, about thirty per cent of which is solid rock. There are no structures of importance, the largest being small plate girders designed for Cooper's E50 loading. The general contractor is the Sinclair Construction Company, Toronto.

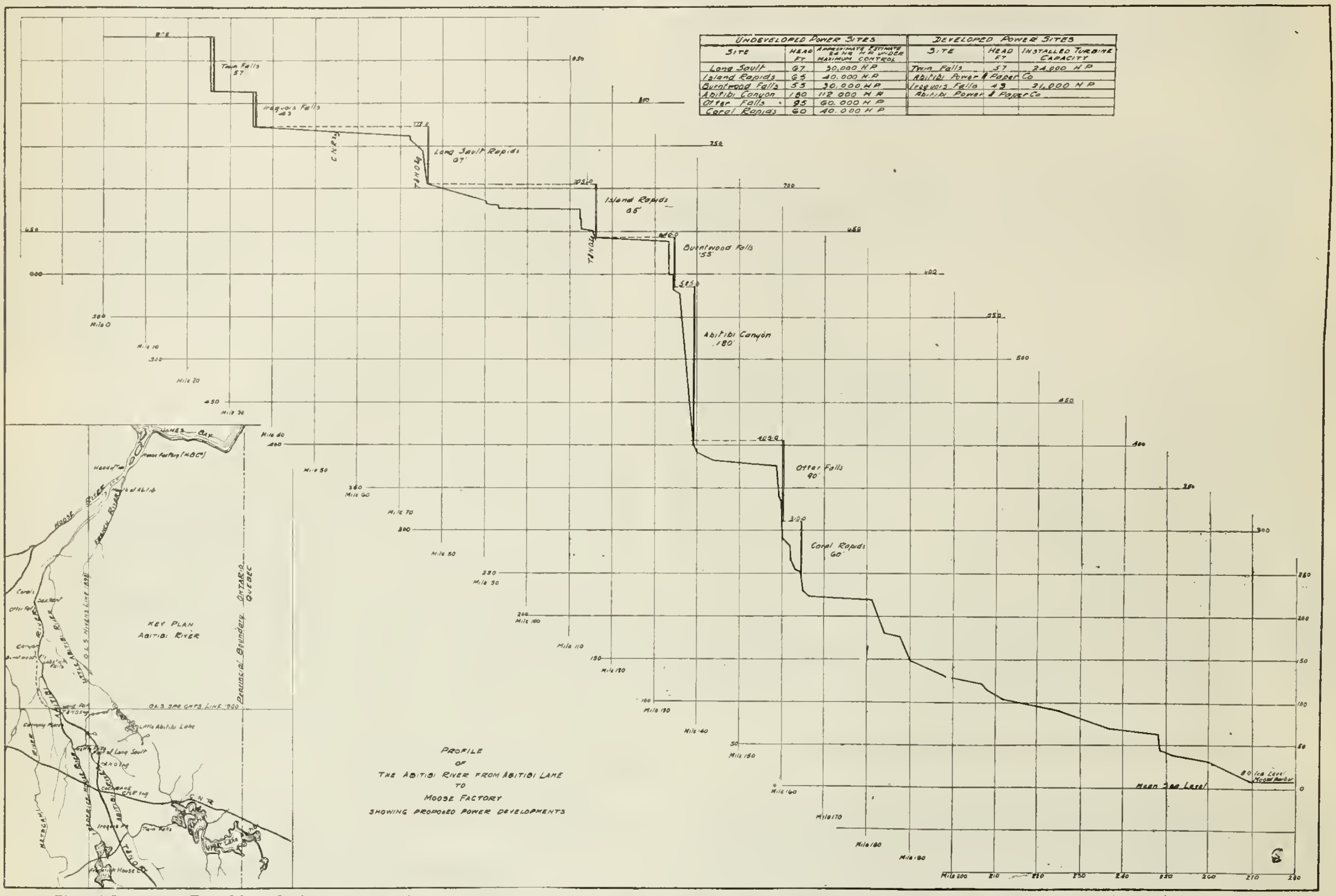

Fig. No. 12. Profile of the Abitibi River from Abitibi Lake to Moose Factory, showing proposed Power Developments.

A Method of Calculating a Fair Rate for the Transportation of Western Coal

Discussion on the paper presented by M. J. Butler, C.M.G., M.E.I.C., before the Toronto Branch of The Engineering Institute of Canada, November 7th, 1923

Professor W. M. Treadgold
University of Toronto

There are one or two points in connection with the proposed operation of heavy solid trains for the transportation of western coal that Mr. Butler did not allow for in his paper. The rated tractive power of the Mallet locomotive he suggests using is 101,250 pounds, but the available tractive power would not be much more than 65 per cent of this. There are several factors that would tend to reduce the tractive power exerted by the locomotive and which must be taken into consideration.

(1) Losses in transmitting steam from boiler to cylinder and in mechanical action of the engine.
(2) Engine resistance on grade.
(3) Locomotives are usually designed to exert their full tractive power at speeds less than 15 m.p.h., and at 15 m.p.h., the engine would not exert more than 75 per cent maximum cylinder tractive power.
(4) Average operation must be taken into account which means operation in winter as well as summer or in all kinds of weather. This country is subject to extremes in climate and it is well known that any locomotive cannot develop the same power in cold weather as under ideal summer conditions.

Hence when all these factors are taken into consideration a liberal estimate on the rated capacity of the engine would be 65 per cent of the rated tractive power and one would have to figure on $65/100 \times 101{,}250$ or 66,000 pounds. Again, in the operation of trains over this mileage it is unlikely that the train resistance would be as small as 16 pounds per ton. While in the west the ruling grade, (compensated), is 0.4 per cent, it is doubtful whether over the divisions in Ontario there would be less than 0.6 per cent grades and they may not be compensated for curvature. Also resistance in winter time is higher than in the summer. Allowing 6 pounds per ton as the average friction resistance and 12 pounds per ton for grade resistance one would allow the total train resistance as 18 pounds per ton.

Hence based on a maximum tractive power for rating at 66,000 pounds for a 2-8-8-2 Mallet locomotive and a train resistance of 18 pounds per ton you have the following:

Available tractive power for rating	= 66,000 pounds
Train resistance	= 18 pounds per ton
Gross load per train	= $\frac{66,000}{18}$ = 3,667 tons
Gross weight of 75-ton car loaded	= 107.5 tons
No. of cars per train	= 34
Tonnage of coal per train	= 34×75 = 2,550 tons.

Based on the assumption that it would be fair to figure on the average train mile earnings which at the present time are about $5.00 and on a distance of 2,200 miles to Toronto — or 4,400 train miles, the average price or cost of transportation would be around $8.60 per ton.

If one were figuring on Mikado engines and 50-ton car equipment, taking into account the same considerations as outlined above, the cost would be in the neighbourhood of $14.00 per ton.

Hence it would seem that the cost would be much more than that estimated by Mr. Butler without taking into account the tremendous outlay for special equipment necessary, and the capital outlay necessary to put the roadbed, bridges and terminals in physical condition, not to speak of grade revision, to take care of such heavy equipment.

Professor W. T. Jackman
University of Toronto

It is impossible for me to agree with the fundamenta unit of train-mile cost upon which Mr. Butler has built up his calculation of $5.75 rate on coal from Alberta to Toronto. The train-mile cost is such an unreliable element that it cannot be used with any degree of accuracy. It is too much of a hybrid to yield any scientifically pure results. It includes all trains in all directions, passenger, freight, mixed, branch line, main line, revenue and non-revenue, westbound empty trains as well as eastbound loaded trains. Such a composite figure applied to the movement of a single commodity in one direction could not furnish any adequate guidance as to the rate to be charged.

Moreover, the calculation which we have had placed before us does not take into account the westbound movement of empty cars, nor anything which should be charged for the maintenance of the equipment and the property. Nothing is added for terminal expenses nor for interest on the capital tied up in the rolling stock. No provision has been made for depreciation. Nothing in the way of fixed charges has been brought into the account and yet these constitute on the average ten to fifteen per cent of the total outlay of the Canadian railways. When it is remembered that, in 1922, for every loaded car moved 100 miles for the entire year's traffic an empty car was moved 45 miles; that in this coal movement the empty car movement would be practically 100 per cent of the loaded movement and that the loaded car movement should pay the high expense of the empty car movement; with these considerations in mind, it is manifest that the $5.75 rate per ton is very much too low. I should commend the system of computing this cost as established by the Canadian Pacific Railway and the Canadian National Railways as very much more scientific, in fact, as close as we can get to the actual cost of transportation, and when the former reaches a figure of $9.95 and the latter $9.03 we can see how wide a disparity there is between the estimates of these two railways based upon actual experience and the figure based upon train-mile costs. A much more accurate basis of computation, and to my mind the only proper basis, is the cost per loaded car mile, and against the loaded car movement, i.e., the revenue producing movement, there would have to be assessed the costs of transporting the empty cars westward.

Then, too, any theory based on starting a solid train of any given number of cars from the mines in Alberta, either at Lethbridge or Drumheller, to a destination in round numbers 2,000 miles distant is one upon which little reliance can be placed. Different gradients along the line alter the engine power. Different classes of engine power have to be assigned to different sections. For instance, a Canadian Pacific 210 per cent engine would haul 3,100 equivalent gross tons from Lethbridge to Dunmore, but from Dunmore to Swift Current only 2,709 tons. A 155 per cent engine would haul 2,116 tons from Moose Jaw to Broadview, but it would haul 2,685 tons from Brandon to Winnipeg, and from MacTier (Muskoka) to Toronto only 2,000 tons.

Reference has been made in the discussion upon this paper to the desirability of being freed from the coal supply of the United States and in, order to be freed from this economic dependence upon Pennsylvania anthracite, it has been suggested in all seriousness that if it is necessary, in order to secure this result, the National Railways should be required to carry Alberta coal to eastern Canada at less than cost. I should view with alarm any such attempts to obtain the carriage of coal at less than cost, for several reasons. In the first place, if the National Railways put down the rate below cost, the Canadian Pacific would have to follow suit and it is not difficult to see that this would mean disaster to the private company. In the second place, we are endeavouring to encourage the management of the National Railways to make the lines under their control a paying system; but nothing would more seriously undermine the initiative and enthusiasm of the management in their efforts than to be compelled to carry traffic at less than cost. In the third place, if the Canadian National Railways had to carry this coal to eastern Canada at less than cost, the deficit would have to be made up from the Dominion taxes and it would be injust to tax all parts of the country in order to provide a less-than-cost service to one particular part of the country.

Reply to Discussion

M. J. Butler, C.M.G., M.E.I.C.

The late Matthias N. Forney, M.E., once said, in discussing the frame of mind railway men usually show towards anything new, "We make for ourselves little puddles of prejudice and then we wallow in them".

I very much regret that I was unable to remain for the discussion on November 8th. Since that date I have travelled on the National Railways some 2,600 miles, and have so far as possible, noted how things seemed to be moving. All of the railway yards have been growing in size with the consequent opportunity of stowing away cars, great numbers of steel coal cars, refrigerators and foreign cars from nearly every railway in the United States. I particularly noted, Sydney, Truro, St. Lambert, Turcotte, Mimico, York, and Belleville. I would not care to estimate the number lying idle and so I expect it goes from one end of the system to the other.

In my opinion here is to be found the explanation of the poor showing of average mileage per car, in like manner in loading cars, the average load per car is the combination of lightly loaded cars, such as fruit, eggs, butter, meats, etc., as against heavy loads of stone, coal, etc. It has been said, "Figures are facts and facts can't lie," but mistakes may be easily made and figures may be manipulated to prove almost anything.

The attempt to meet the possibilities of what may be done, with a goodwill, a special equipment for the special business, by quoting so called statistics as to what is being done with an entirely different class of equipment and on the similar kind of movement is misleading and valueless.

Statistics relying on averages are notoriously dangerous and apt to mislead Mr. Henry's claim that the average on the National Railways train load is only 1,170 tons and that the Canadian Pacific is only 1,285 tons per train. So as to other railways he likewise shows a low average train load. It is quite possible that taking the entire business loaded and empties, etc., — he is quite right — but where the business warrants solid through trains loaded to capacity such train loads would be absurd. Take for instance the heavy trains moving the wheat crop from the west to Fort William, unless I am misinformed, the National and Canadian Pacific railways grain trains are about 4,000 tons. C. H. Mix, vice-president of the Virginian Railway in a letter states that the average train of coal on his railway is 8,500 tons. The Chesapeake and Ohio Railway also, as well as the Norfolk and Western, the Illinois Central and certain branch lines of the Santa Fe Railway, are hauling coal trains with from 5,000 to 10,000 tons per train. As all these cars, on the return journey are empties, the statistical average will be one half the actual loading. The standing idle, the empty movement, etc., are responsible for the misleading statistics as to car mileage and car loading.

With regard to a remark of Mr. Henry's as to the irregularity in ruling grades of certain divisions on the National Railways, i.e., I assume that the ruling grade does not vary, I regret I have no longer available the profile of the Grand Trunk Pacific and of the Transcontinental. I do know that the specification for both roads required that the maximum grade eastbound should not exceed 4/10 of 1 per cent—westbound 6/10 of 1 per cent.

The Canadian Northern contract with the government required the same grades. What effect velocity would have on such lines would require special study, the practical effect or virtual profile should approximate very closely to a level line. If there are any divisions where the above standard of construction has been deviated from it is high time the people of Canada should learn where it is and under what conditions the degradation of line took place. Under the terms of the contract and specifications under which the railways were constructed every division should be able to convey the same heavy train load.

The necessity for heavier rails, heavier bridges, longer turntables and longer roundhouses, etc., these are the usual concomitants of an improved railway and are gradually carried on as the business increases. All, of course, costs money and lots of it, but think of the National waste going on in sending out of Canada every year the huge sums to pay our fuel bills, estimated by competent authority at $300,000,000 per annum.

In taking an average speed of train of 15 miles per hour, I am following the advice of Sir George Bury, one of the ablest transportation men we have had in Canada. The American Engineer, April 1904, quoted Mr. (now Sir) George J. Bury, then general superintendent of the Canadian Pacific Railway as saying, "If freight trains average 15 miles an hour train and engine-drivers can make 5,000 miles per month while if the average be reduced to 8 miles per hour, the men cannot stand more than 3,000 miles per month. Sixty crews at 15 miles an hour will make 300,000 train miles per month while at an average of 8 miles it will take 40 more crews of 200 extra men to handle the business".

Also see page 170, "The Cost of Locomotive Operation," by Geo. R. Henderson, M.E., 1906, "The most important point to notice is that at 15 miles an hour running time (12.5 av.) we are able to produce the greatest amount of transportation per engine in service and this is also the schedule for minimum cost under the conditions that have been assumed, therefore if we run 15 miles per hour we not only do the work cheapest but get the most done".

Professor Jackman, of the University of Toronto, is undoubtedly an able man in his specialty. When he gives out an estimate of what, in his opinion, would be a fair and reasonable rate for the National and C. P. Ry., to charge for haulage of coal from Alberta to Toronto, it would have been more convincing if supported by the data on which he relied, and the detail of his calculation. If a railway makes an average earning of five dollars per train mile, on all classes of its business, it seems to me that, if such earning yields a profit — the conclusion must follow, that a profit will follow, by maintaining such an average earning.

The traffic returns show the origin of railway business to be about as follows:—

	Per Cent		Cents per 100 lbs, for an average haul of 450 miles
Manufacture and Miscellaneous	23	at	55
Products of Animals	04	at	28
" " Agriculture	29	at	07½
" " Forest	13	at	13
" " Mine	31	at	08½

The tonnage, mileage, etc., of the various items are available and it is an interesting problem to figure out the resulting gross earnings.

I must confess I am disappointed at not hearing from experts in the railway world, men with operating experience.

I would very much like to see an explanation of the special tariffs in force on the Canadian Pacific Railway from Vancouver to Montreal, New York, etc., for certain rather valuable products, such as tea, Japanese and Chinese products which do not net the railway one-half the rate per train mile I suggest for coal.

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THE

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Council's Message to the Members

Now that every member of The Institute in Canada is a member of some branch it is felt that there will be a quickening of interest in the profession even greater than heretofore, particularly by those formerly not associated with branch affairs. The general activity of The Institute this year has been eminently satisfactory. In thanking the officers and members of all the branches whose enthusiastic interest is one of the greatest assets of the profession, the Council extends hearty greetings of goodwill and sincere wishes for health and prosperity to every member.

Annual General and General Professional Meeting

The annual meeting is called for Tuesday, January twenty-second, for ten o'clock a.m., at the headquarters of *The Institute*, to be adjourned immediately after the appointment of scrutineers and auditors to the following morning at the Chateau Laurier, Ottawa, where the remainder of the business of the annual meeting will be conducted, and a professional meeting held which should attract members from all over Canada.

The Ottawa committees not only have their programme well arranged, but have concluded the details of most of the plans for the social engagements. In addition to the business of the first day, there will be two addresses, one by President Walter J. Francis at the noon luncheon, and the other by Doctor Charles Camsell, M.E.I.C., Deputy Minister of Mines, on the Fuel Problem. D. W. McLachlan, M.E.I.C., will be the principal speaker on the morning of January twenty-fourth, when he will discuss the St. Lawrence Waterways Problem. It is also anticipated that there will be a short paper on the new light-weight aeroplane by Lieut.-Col. E. W. Stedman, M.E.I.C., and at the luncheon on the second day it is expected to have a paper on the Centenary of the Rideau Canal, by Mr. Hamnett P. Hill. While few in number the papers are of outstanding importance and will attract considerable attention throughout the Dominion.

It is unnecessary to dilate on the social arrangements, as all who have had experience in being entertained by the Ottawa Branch know that as entertainers and hosts they are unsurpassed, so that all planning to go may look forward with confidence to a pleasant and profitable session. It is anticipated that there will be an unusually large gathering at this meeting, and all who can possibly arrange to be there are strongly urged to plan to attend.

Programme

Wednesday — January 23rd.

Morning: 9.00 a.m. Registration.
10.00 a.m. Reports of Committees.
Reports of Branches.

Noon: Luncheon—Chateau Laurier. His Excellency the Governor-General of Canada will be present.
Address by President Francis.

Afternoon: Unfinished business.
Report of Scrutineers.
Inauguration of newly elected President.
Address by Doctor Charles Camsell, M.E.I.C., Deputy Minister of Mines.

Evening: Banquet and Smoker.

Thursday — January 24th.

Morning: Professional Meeting.
The St. Lawrence Waterways Problem, by D. W. McLachlan, M.E.I.C.
The Baby Aeroplane, by Lieut.-Col. E. W. Stedman, M.E.I.C.

Noon: Luncheon.
The Centenary of the Rideau Canal. Biography of Colonel Bye, the engineer. Speaker: Mr. Hamnett P. Hill.

Afternoon: Visit to Deschenes.

Evening: Ball.

The Young Man in Engineering

Considerable discussion has arisen recently over the prospects of the young man now studying engineering in our various Canadian universities, and whether he would not be devoting his time to better advantage by taking some other course, in view of the crowded state of the engineering profession, and of the low average salaries of men engaged in engineering.

To get a proper perspective of the present situation it is necessary to go back to the first decade of the present century, when we find that there was an unprecedented development in this country, demanding more engineers than the few universities then giving engineering courses could turn out.

Railroad building absorbed many young men without engineering training who entered the engineering departments, many of these becoming qualified engineers. During this period of general expansion it was natural that there should be organized new schools and universities. Every province west of the lakes created a provincial university with an engineering department, all turning out engineering graduates. The first year of the second decade of this century saw a lull in expansion, the activity gradually decreasing until the War, when practically the only engineering work was that of munition making and which absorbed the technical men who were not overseas.

During that decade, however, there was added to the list of engineers in this country, a group of graduates from all over Canada much greater than the actual engineering requirements of the period.

During the past two years we have had what might be considered normal development, but yet during those years the country could not absorb as engineers the men being turned out from our engineering colleges.

The enrollment of the various engineering schools in Canada at the beginning of December of this year is as follows:—

University	1st Year	2nd Year	3rd Year	4th Year	5th Year	Post Grad.	Total Registration
Toronto	124	126	128	162	..	..	560
Queen's	71	52	46	69	..	6	244
N.S. Technical College	..	..	23	24	..	..	47
Dalhousie	First two years only.						60
Acadia	13	11	..	..	..	..	24
New Brunswick	17	14	9	18	..	..	58
Manitoba	44	49	25	35	..	..	153
Saskatchewan	29	14	18	9	..	..	70
Alberta	25	31	8	10	9	8	91
British Columbia	78	39	40	43	..	7	207
McGill	122	98	100	125	..	..	445
University of Montreal	(Approximately)			30	..	..	122
				546 (including postgrads.)			2081

The engineering training being given at our Canadian universities is the finest technical education that any man could receive. Due to its practical nature and its relation to the every day affairs of life it possesses attributes that go to make it a fitting education and a desirable one for any and every walk in life. The four years taken to make a man a B.Sc., do not make him an engineer, and therein lies the fallacy or failing of the present situation. We are training thousands of our finest young manhood, giving them as excellent an education as they could receive and inspiring in them the belief that they are engineers, when they merely have the foundation. The result is bitter disappointment to many who have set their hearts and minds on following an engineering career. Were we instead to train the young men to believe that the education they are receiving is not only the foundation of an engineering career, but that it is also the foundation — and an excellent one — for trade and commerce, for manufacturing, for finance, and, in general, for fitting a man to rise to a position of responsibility in any walk of life, we would have the technically trained man dominating many spheres of human activity and therein realizing his destiny in fuller fruition.

To-day, more than ever before, men with engineering training are needed. We need engineering training to offset visionary theorists, the ranting democrat, and the agitator. We need engineering training in business because after all the problem of business is to make the greatest use of the two factors, human work and stored up human work. Work being the energy of living people, and capital the stored-up energy of dead people, the problem is to manage these two forces of energy in a way to produce the most human welfare. Engineering training is needed in political life, and to a greater extent than even the average engineer realizes. Engineering is needed in teaching, for instead of dealing with theories of education the engineer would take the child as he is and try to make something out of him. The business world, every phase of it, dealing not only with industry, but finance and commerce, the political arena, the school room, and even the pulpit would all be the better if they had the benefit of the technical training our young men are now receiving.

Let us realize then that the young man to-day who is getting the benefit of the teaching of our engineering schools — a magnificent education — from institutions well equipped, with professors unrivalled in the world, and with the matriculation entrance of a high order, is on graduation endowed with an inheritance that should enable him to compete successfully in every walk of life. Let us realize further that on graduation from an engineering school the graduate is not an engineer, but has a magnificent foundation upon which to enter the profession, remembering that that same foundation may be used to even greater advantage by entering some sphere of activity other than the engineering profession itself. It should be forcibly impressed upon the graduating classes of our engineering schools that they are not engineers, and that they need not necessarily follow engineering to make the most of their engineering training.

It is not intended to suggest here what change should be made in the present training or what addition should be made to better qualify men to be engineers. The columns of *The Journal* are open for discussion, on this important matter, and it is anticipated that many members who are interested will take advantage and write and give their fellow members the benefit of their views.

The Work of the Institute's Fuel Committee

Only when the fuel problem of Canada shall have been permanently solved can the engineers of this country feel that they no longer have any concern with it. So long as the Dominion's policy on fuel is one of temporary expediency just so long must the engineers interest themselves in all those measures suggested to ameliorate in a permanent way the fuel conditions in Canada. The Council of *The Institute*, recognizing clearly this moral obligation on the part of their professional brethren, took upon themselves as a preliminary step the formation last spring of a Fuel Committee, the personnel of which appears on another page. This action was taken with the expectation that a report from such a committee would make possible a united pronouncement on the national fuel problem by the engineers. The obvious duty of such a committee appeared to be to collect and digest the various opinions of all their own members, and when so digested to attempt to draw up a composite opinion or symposium, that might be regarded as the attitude of the united mind of the profession toward a solution of this national problem.

F. A. Combe, M.E.I.C., the chairman, and the other members resident in Montreal set to work immediately and during the summer collected a large amount of valuable material for the committee. It is inevitable we suppose that much of the routine committee work of *The Institute* is done in a quiet and private atmosphere, and one of the problems that engineers as a class must face, is the relation of a thoughtful publicity for this unostentatious work in order that the public may come to a just appreciation of the accomplishments of our members. As a result, however, of the work dône to date, the local members of the general committee have just sent out a specially prepared digest on the coal situation in Canada, in order that their views on this matter may be submitted to the criticisms of the far western and eastern members of the committee. It is proposed that after this digest has been thrashed out by correspondence a meeting of representatives of the committee will be held in Montreal in order to formulate a policy which if approved by the Council will become the definite expression of opinion of the professional engineers of Canada on this critical question. The work now being done by the members of this important committee is but further evidence of the willingness and ability of the members of this *Institute* to serve in a quiet and unobtrusive way the broad interests of the Canadian people.

Contributed by Leslie R. Thomson, M.E.I.C.

First World Power Conference

The first meeting of the General Committee discusses plans made for Canadian participation, the programme approved assuring that Canada will be well represented.

Reference was made in the October *Journal* to the First World Power Conference to be held in London in July nineteen twenty-four, and information given as to the steps taken up to that time in order that Canadian participation in this conference might be well arranged. In order that the work of the Canadian and British committees might be more closely co-ordinated, J. B. Challies, M.E.I.C., who was chairman of the committee which was responsible for the preliminary work, took a trip to London with very satisfactory results.

The first meeting of the general committee was held at Ottawa on December 6th, at the invitation of the Minister of the Interior, the Honourable Charles Stewart, to advise regarding Canadian participation in the World Power Conference.

Address by the Minister

Following a luncheon in the Chateau Laurier, Hon. Charles Stewart, Minister of the Interior, addressed the gathering and stressed the importance of Canada being adequately represented at the World Power Conference. He declared his belief that the serious condition of affairs in Europe at present was but temporary and that Canada would again find herself facing keen competition from countries which could produce more cheaply because of lower standards of living. Power was going to play a tremendous part in cheap production and the development of power in Canada was one of the factors which would enable this country to compete successfully.

The Minister referred to the great water power resources of sections of the Dominion and said that in those parts where fuel was found water powers were lacking, while in other parts the conditions were reversed. He hope that the participation of this country in the World Power Conference would attract British capital to Canada. Capital, heretofore, had been largely secured from the United States. He stated that technical men would welcome the opportunity to visit the conference and learn about the features of power development in other parts of the world.

He stressed the fact that the function of the department which he administers was not to interfere with provincial prerogative in power development but to render appropriate and agreeable assistance to any power project which will add to the material prosperity of the Dominion.

At the request of the Minister, the Director of Water Power of his department sketched the steps which had led up to the calling of the World Power Conference, stating that the idea had originated in England in the year following the declaration of war, when it was realized that power was the basis of all production. The original intention had been to have a British Empire conference on water power but finally the British Electrical and Allied Manufacturers Association evolved the idea of a world conference to take place at the time of the British Empire Exhibition, and to comprehend both carbo and hydro power.

Address by Mr. Challies

Mr. Challies explained the preliminary steps which had been taken towards securing Canadian participation. A provincial committee was constituted early in the spring, comprising members of sufficient Dominion, provincial and corporate organizations to make it geographically representative of the whole Dominion. Two meetings were held, one in Ottawa in February 1923, and one in Montreal in May 1923, at which it was unanimously decided to participate in the conference. Arrangements were accordingly made for the preparation of five papers on the following subjects: — General National Review of Power Situation in Canada, by J. B. Challies, M.E.I.C.; Hydro Power Production, by H. G. Acres, M.E.I.C.; Power Transmission and Distribution, by Julian C. Smith, M.E.I.C.; Utilization of Power, by P. T. Davies; Carbo-Power Production, by B. F. Haanel, M.E.I.C. Each of those charged with the preparation of papers was to secure the collaboration of any who could render assistance in the proper presentation of the subjects.

In order to clear up certain misunderstandings as between the British committee and the various national committees regarding the scope of the conference and arrangements for its management, an international conference was called to meet in London and Paris in August. These meetings he attended as representing the Canadian committee. O. C. Merrill, executive engineering secretary of the Federal Power Commission at Washington represented the United States committee. As a result of the discussions in London and Paris, a standard method of presentation for the various participating countries to conform to was agreed upon. This has been since broadcasted by the British committee. Arrangements were also perfected for the setting up of an international committee to control and supervise the proceedings of the conference itself. Arrangements were initiated for three visitations after the conference in London: one to important steam producing plants, larger engineering works and coal areas of Great Britain; a second to the Scandinavian countries, Norway and Sweden; and a third to important hydro-electric points of interest in southern France, Switzerland and Italy. These three visitations will conclude with a two-day conference, under the aegis of the French National Committee at Paris.

When Mr. Challies was in London, tentative arrangements were also made for a Dominion luncheon at which all the delegates from the various participating countries would be present, the High Commissioner for Canada being in the chair. Through the courtesy of the Canadian Exhibition Commissioner a formal evening reception will be held in the Canadian Pavilion at the British Empire Exhibition, to which foreign delegates and those interested in the World Power Conference, as well as officialdom generally, will be invited by the High Commissioner for Canada.

Tentative arrangements were also made with the Commissioner General for Canada in Paris, Mr. Roy, for a Canadian reception to members of the French National Committee; delegates and officialdom generally, in the L'Union Internationale at Paris.

Mr. Challies stated that the original committee now felt that the purposes for which it had been formed had been accomplished and that the Canadian committee should be re-constituted and enlarged to be widely representative of the power interests throughout the Dominion and that the enlarged committee should meet and pass upon the work already done and decide on what further participation Canada should take in the conference, and appoint a permanent management committee to carry out its recommendations. The present meeting of the enlarged committee was the result.

Management Committee

As chairman of the original committee, Mr. Challies moved that the permanent management committee consist of the following:—

Chairman: Charles Camsell, B.Sc., LL.D., F.R.S.C., M.E.I.C., deputy minister, Deprtment of Mines, Ottawa.

Vice-Chairman: H. G. Acres, B.A.Sc., M.E.I.C., M.Am. Soc.C.E., chief hydraulic engineer, Hydro-Electric Power Commission of Ontario, Niagara Falls, Ont.

Arthur Amos, B.A.Sc., C.E., A.M.E.I.C., director of the hydraulic service, member of the Quebec Streams Commission, Parliament Buildings, Quebec.

John Murphy, B.A., M.E.I.C., F.A.I.E.E., consulting electrical engineer, Department of Railways and Canals; and Dominion Railway Commission, Ottawa, Ont.

Arthur Surveyer, B.A., B.A.Sc., C.E., M.E.I.C., consulting engineer, Drummond Building, Montreal, P.Q.

General-Secretary: J. B. Challies, C.E., M.E.I.C., M.Am. Soc.C.E., director Dominion Water Power Branch and Dominion Reclamation Service, Department of the Interior, Ottawa, Ont.

Members: A. A. Dion, M.E.I.C., F.A.I.E.E., general manager, Ottawa Electric Company and Ottawa Gas Company, Ottawa, Ont.

R. J. Durley, Ma.E.,M.Inst.C.E., M.E.I.C.,M.Am.Soc. M.E., secretary Canadian Engineering Standards Association, Ottawa, Ont.

J. G. Glassco, B.Sc., M.Sc., M.E.I.C., A.A.I.E.E., manager City of Winnipeg Hydro-Electric System, Winnipeg, Man.

F. R. Glover, chief executive assistant, British Columbia Electric Railway Company, Vancouver, B.C.

A. Monro Grier, K.C., president, Canadian Niagara Power Company, Ltd., Toronto, Ont.

B. F. Haanel, B.Sc., M.E.I.C., chief engineer, Division of Fuel and Fuel Testing, Department of Mines, Ottawa, Ont.

O. Higman, M.E.I.C., director, Electricity and Gas Inspection Branch, Department of Trade and Commerce, Ottawa, Ont.

Fraser S. Keith, B.Sc., M.E.I.C., secretary, The Engineering Institute of Canada, Montreal, P.Q.

O. O. Lefebvre, B.A.Sc., M.E.I.C., chief engineer, Quebec Streams Commission, Montreal, P.Q.

Brig.-Gen. C. H. Mitchell, C.B., C.M.G., C.E., LL.D., M.E.I.C., M.Am.Soc.C.E., dean, Faculty of Applied Science and Engineering, University of Toronto, Toronto, Ont.

Julian C. Smith, LL.D., M.E., M.E.I.C., M.Am.Soc. C.E., F.A.I.E.E., vice-president and general manager, Shawinigan Water and Power Co.; President, Quebec Power Company, Montreal, P.Q.

P. T. Davis, president, Canadian Electrical Association, Montreal, Que.

K. H. Smith, B. A. Sc., M.E.I.C., representing Nova Scotia Power Commission; and New Brunswick Electric Power Commission, Halifax, N. S.

Geo. C. Mackenzie, M.E.I.C., secretary, Canadian Institute of Mining and Metallurgy, Montreal, Que.

Mr. Glover of Vancouver, in seconding the motion, spoke briefly regarding the importance of the World Power Conference and the desirability of Canada being properly represented.

Discussion

Dr. Camsell, the chairman of the Management Committee, took the chair at 2.30 p.m., and requested the fullest co-operation of those present in carrying on the business of the meeting. He was glad to know that the government was in full accord with Canadian participation in the World Power Conference and judged that the conference was of great interest to others than those exclusively connected with the government by reason of the number who had come great distances to attend. He stressed the importance of world conferences based on his experience of the Geological Congress, both to the individual and the country represented. Careful and complete organization was necessary if Canada was to reap the full benefits of participation in this conference. He stated that conditions in Europe are ripe for us to take advantage of at the present time and the conference would provide an opportunity of advertising our country and attracting both capital and people.

The question of papers was then dealt with at some length, the major portion of the balance of the conference being devoted to this subject.

It was resolved to endeavour to secure additional funds in addition to the amount granted by the federal government.

At the close of the meeting a hearty vote of thanks and appreciation was tendered the Minister of the Interior for the opportunity afforded to the members of the committee to be present at the meeting.

At a meeting of the Management Committee held immediately after, it was decided that Division I of the classified programme — National Review of Power Resources — could best be covered in one paper with the author securing the co-operation of the proper authorities in each province with regard to the presentation of the outstanding features of the power situation peculiar to those provinces.

It was decided that Division II—"Power Production" — should be divided into three separate papers.

Section B — Water Power Production — by H. G. Acres, M.E.I.C.

Section C — Preparation of Fuels — by B. F. Haanel, M.E.I.C.

Section D, E, and F — Fuel Power Production — by B. F. Haanel, M.E.I.C.

It was decided that Division III — "Power Transmission and Distribution" — be covered in one paper to be prepared under the direction of Julian C. Smith, M.E.I.C.

It was decided that Division IV — "Power Utilization" — could best be covered by a series of individual papers on the uses of power in certain specific Canadian industries as already arranged by Mr. Davies.

It was decided that a paper on "Research, Standardization and Education," be secured from R. J. Durley, M.E.I.C.

THIS MONTH'S CONTRIBUTORS

Irrigation Systems

R. S. Stockton, M.E.I.C.

The development of irrigation is a matter of great interest to a wide area in western Canada. Irrigation stands for a great increase in the wealth that can be produced from lands which can be served with water for irrigation and which lie withint he region of limited rainfall. A considerable number of engineers in the west are directly concerned with the building and with the operation and maintenance of irrigation systems. An address on the engineering feature of operation and maintenance was given by Robert S. Stockton, M.E.I.C., superintendent of operation and maintenance for the Western Section Irrigation Project, Canadian Pacific Railway, Department of Natural Resources, before the Calgary Branch of *The Institute* on February 12th, 1923.

Mr. Stockton was born on June 5th, 1872, in the village of Oquawka, Illinois, which is on the banks of the Mississippi river and which was, in early days, the site of a Hudson Bay Company post. Mr. Stockton received the degree E.M., at the Colorado School of Mines in 1895 and was successively assistant, assistant professor and professor of mathematics and surveying at that institution until 1903.

In June 1903 Mr. Stockton received a temporary appointment in the United States Reclamation Service and soon after received an appointment as engineer from the secretary of the Interior. While in this service a reconnaissance survey and report was made on the proposed White River Irrigation Project in Colorado. In 1904 he had charge of the preliminary surveys and made a report on the irrigation projects of the Crow Reservation in Montana. This work was followed in 1905 by an appointment as project engineer in charge of the construction of the Huntley Irrigation Project in Montana. After completing the construction of this project and operating it the first year Mr. Stockton was transferred in 1908 to the Lower Yellowstone Irrigation Project in Montana and North Dakota and was in charge of the first two years operation on this project.

In 1907 Mr. Stockton had charge of the preliminary surveys and reports on the Flathead Irrigation Project in Montana.

In March 1911 Mr. Stockton resigned from the U.S. Reclamation Service and came to Alberta and took charge of the Western Section as superintendent of operation and maintenance and still holds this position.

Mr. Stockton was elected a member of *The Institute* on August 27th, 1918. He is also a member of the Association of Professional Engineers of Alberta, the American Society of Civil Engineers and the American Association for the Advancement of Science.

Recent Developments of the Temiskaming and Northern Ontario Railway.

S. B. Clement, M.E.I.C.

The recent extension on the Temiskaming and Northern Ontario Railway, which involved the construction of a section of seventy miles in length extending north from Cochrane, Ontario, is described in the paper by S. B. Clement, M.E.I.C., chief engineer of that railway, presented before the Toronto Branch of *The Engineering Institute of Canada,* on November 29th, 1923.

Mr. Clement has introduced his paper with an interesting discussion on the history of the settlement of the Northern Ontario district and, in addition to the details of the problems involved in the building of this extension, he has set forth the advantages to be gained and the factors which entered into and influenced the choice of the route.

Born at Stratford, Ontario, on May 29th, 1880, Mr. Clement attended the St. Thomas and London Collegiate Institutes and graduated from McGill University in civil engineering in 1901 with the degree of B.Sc. The next year he spent at the same university as demonstrator in civil engineering, receiving his degree of M.Sc., in 1902 for research work in hydraulics. Mr. Clement occupied various positions, during the following two years, on the staff of the Canadian Niagara Power Company, Niagara Falls, becoming resident engineer of the Guelph and Goderich Railway in August 1904, which position he held until July of the next year. At that time he took charge of a party on hydraulic and railway surveys for the Temiskaming and Northern Ontario Railway for two months. Mr. Clement was assistant engineer with the Hydro-Electric Power Commission of Ontario for one year previous to his appointment as assistant chief engineer of the Temiskaming and Northern Ontario Railway in 1906. The appointment to his present position as chief engineer of the latter company was April 1919.

The Use of Aeroplane in Surveying and Engineering

Ellwood Wilson, B.A. and B.Sc., M.E.I.C.

The use of the aeroplane in engineering work is only commencing to be appreciated and even at this stage the saving in time and labour, on certain classes of work, is readily apparent to even the casual observer. Aerial photography has many applications and in his paper entitled, "The Use of the Aeroplane in Surveying and Engineering", Ellwood Wilson, B.A., B.Sc., M.E.I.C., managing director, Fairchild Aerial Surveys Company (of Canada), Limited, and manager of Forestry Division Laurentide Company, Limited, has reviewed a number of its uses and has given at length some very enlightening information on its particular use in forest surveys.

Mr. Wilson was born in Philadelphia, Pa., February 16th, 1872, and received the degrees of B.A., and B.Sc., in chemistry, and certificates in civil engineering subjects from the University of the South, Sewanee, Tenn., in August 1893, later taking up postgraduate work at the University of Pennsylvania, from September 1894 to March 1896, spending the next seven months studying in Germany. He had charge of the construction of a plant for Walker-Gordon Laboratory Company, Limited, of London, England, and was manager for the company from 1897 to January 1900. In May 1901 Mr. Wilson entered private practice as civil engineer and surveyor at Saranac Lake, New York, holding the position of village engineer part of the time. In January 1905 he entered the employ of the Union Bag and Paper Company, Limited, and Laurentide Company, Limited, mapping timber limits, being on this work for two years. Since January 1907 Mr. Wilson has been manager, of the Forestry Division, Laurentide Company, Limited, Grand' Mere, Quebec, mapping and estimating timber limits, in charge of lands, reforestation, drainage, road building, etc. In this capacity he had charge of building the Grand' Mere-Three Rivers highway and other work. In July 1922, he also became managing director, of Fairchild Aerial Surveys Company (of Canada), Limited, the work with this company including aerial photographic mapping timber estimating, and surveying.

OBITUARIES

Lord Shaughnessy, K.C.V.O., Hon.M.E.I.C.

Canada's most distinguished citizen, Lord Shaughnessy, of Montreal, Canada, and of Ashford County, Limerick, Ireland, died at his home in Montreal, on Monday, December tenth, after an illness of only twenty-four hours, leaving a record of achievement behind him that has few parallels in industrial history. His fine courage, imagination, keen discernment and honourable purpose, blended with remarkable ability, made him great in purpose and successful in achievement.

No man ever had a higher conception of the responsibilities of his position than Lord Shaughnessy and few men ever discharged such great responsibilities with so little friction. To grasp the lever of a thousand phases of work with firmness and confidence, to guide the destinies of the greatest transportation system in the world, required long, practical and thorough experience, executive ability of a very high order, discrimination and tact in selecting and dealing with men.

That Lord Shaughnessy possessed these qualities no one who knew him will dispute. A tireless worker, he was throughout his life a man of indomitable energy, endowed with strong commonsense and natural faculties of a very high order, chief among these a prodigious memory, responsive to the needs of the moment — a surprise and sometimes a consternation to those who witnessed its operation.

In 1882 Thomas Shaughnessy was selected by President Van Horne for the position of general purchasing agent. He was then under thirty years of age. In his thirty-first year he was appointed to the position of assistant general manager of the road, which he held until 1889, being then appointed assistant to the president. So valuable did he make himself in that capacity that in June 1891 he was elected director of the company and made vice-president. Finally, on June 12th, 1898, when Sir William Van Horne retired, Mr. Shaughnessy became president of the Canadian Pacific Railway, and two years later became also chairman of the board of directors, which latter office he held to the time of his death, being succeeded in the presidency on October 10th, 1918, by President E. W. Beatty.

In addition he was a director of a number of other companies including the Bank of Montreal and the Royal Trust Company.

For his services to Canada and the Empire, he received the honour of knighthood (Knight Bachelor) from King Edward in 1901.

In 1907 Sir Thomas Shaughnessy was accorded the further distinction of Knight Commander of the Royal Victorian Order.

Finally, on New Year's Day, 1916, came the crowning honour of his life, when he was elevated to the peerage as a Baron of the United Kingdom by King George. He chose the title of Lord Shaughnessy, of Montreal, Canada, and Ashford County, Limerick, Ireland, and took his seat in the House of Lords on November 23rd, 1916.

LORD SHAUGHNESSY, K.C.V.O., Hon.M.E.I.C.

He became a member of the Order of the Sacred Treasure of Japan in 1901, and a Knight of Grace of St. John of Jerusalem in 1910.

Lord Shaughnessy was one of the outstanding figures in the world war. His advice was frequently asked and followed by the Canadian and Imperial governments. Upon the outbreak of hostilities he placed the whole resources of the Canadian people, ships and shops, at the disposal of the Allies, while he himself threw wholeheartedly into the work of recruiting in Montreal. His two sons, his heir and his second boy, A. T. Shaughnessy, went to the front and the latter was killed in France.

Lord Shaughnessy lived a quiet and unobstructive life in his handsome residence on Dorchester Street West. There he sometimes handled the cue on his well appointed billiard table and relaxed so far as to take a hand at bridge. He found in reading his only other recreation. The few holidays he took he loved to spend at "Fort Tipperary", his beautiful summer home at St. Andrew's-by-the-Sea, N.B.

Lord Shaughnessy was elected an Honorary Member of *The Institute* November 27th, 1917. He was a member of the Mount Royal Club, the St. James' Club, the Montreal Jockey Club, the Winter Club, the Forest and Stream Club, the Royal Montreal Golf Club, the Montreal Hunt Club; the Toronto Club, Toronto; the Rideau Club, Ottawa; the Union Club, Victoria, B.C.; the Vancouver Club, Vancouver, B.C.; the Garrison Club, Quebec, and the Manitou Club, Winnipeg.

Lady Shaughnessy came to Montreal with her husband from Milwaukee, where they were married in 1880. Before her marriage she was Miss Elizabeth Nagle. There are also surviving three daughters and one son, namely, the Hon. Mrs. H. Wyndham Beauclerk, the Hon. Mrs. Rene Redmond, the Hon. Marguerite Shaughnessy and the Hon. W. J. Shaughnessy, who is the heir to the barony. Another son, Captain the Hon. A. T. Shaughnessy, was killed in action in France, while serving with the 60th Battalion, in 1916.

Archibald Olin Powell, M.E.I.C.

Colonel Archibald O. Powell, M.E.I.C., of the firm of Powell and Jacobs, consulting engineers, Seattle, Washington, died suddenly at his home in that city, on November 18th, 1923.

Colonel Powell was born in Milwaukee, Wisconsin, on August 31st, 1859, and graduated from the College of Engineering, University of Wisconsin in 1880, receiving the degree of B.C.E., and from which he later received the honorary degree of C.E., He was for many years attached to the United States engineers office with headquarters in St. Paul. In 1906, he moved to Seattle to take charge of the original Lake Washington canal project and upon completion of that engagement entered private practice as a consulting engineer, specializing in river and harbour work.

He served as captain of engineers in the Spanish-American war and as Lieut.-Col. of engineers in the World War.

On January 11th, 1913, Colonel Powell was elected a Member of *The Engineering Institute of Canada.* He is a past president of the Pacific Northwest Society of Engineers and of the Seattle section of The American Society of Civil Engineers. He was also a member of the American Association for the Advancement of Science.

George Louis Rainboth, A.M.E.I.C.

The sad death of George L. Rainboth, A.M.E.I.C., who was accidentally killed at Ottawa on December first, nineteen twenty-three, came as a great shock to his many friends and fellow engineers. The accident which resulted in his death, occurred when he was attempting to catch a street car and was struck by an automobile. The late Mr. Rainboth was thirty-nine years of age and was geodetic engineer with the International Boundary Commission.

He was born at Aylmer, Que., on August seventeenth, 1884, and commenced his engineering work in 1903, when he was assistant on Dominion and Provincial land survey subdivision contracts in Saskatchewan. Since that time, Mr. Rainboth has consistently followed the surveying branch of engineering, having been engaged on boundary survey work in various parts of eastern Canada. At the time of his death, he resided at 16 Glen Avenue, Ottawa, although for a number of years his work has taken him into the field for the greater part of each year. On July 9th, 1923, Mr. Rainboth was elected an Associate Member of *The Engineering Institute of Canada.*

PERSONALS

Gordon McKindsey, S.E.I.C., has accepted a position with the Canadian Bridge Company, Limited, at Walkerville, Ontario, as structural detailer.

B. C. Bordessa, A.M.E.I.C., has accepted a position with the Southern Pacific Railroad of Mexico on construction work, where his address is Tepic, Nay, Mexico.

Thomas H. Winter, S.E.I.C., formerly of Halifax, N.S., has accepted a position with the Sir W. G. Armstrong, Whitworth and Company, Limited, Deer Lake, Newfoundland.

J. C. Brodeur, S.E.I.C., who graduated in mining engineering from McGill University with the class of '23 is at present in Paris, France, taking a special course in mines engineering.

Thos. C. Connell, A.M.E.I.C., has been transferred by the Southern Canada Power Company, Limited, from their head office in Montreal to the construction staff at Drummondville, Que.

R. D. Keenleyside, S.E.I.C., formerly of London, Ontario, has been appointed to the staff of the Ingersoll Rand Company, of Phillipsburg, N.J., where he will be engaged in time study work.

Norman I. Edwards, A.M.E.I.C., formerly special hazards inspector for the Canadian Underwriters Association, Montreal, has accepted a position with the Franklin Railway Supply Company of Canada, Montreal.

D. A. Evans, M.E.I.C., for the past six years manager for the St. Maurice River Boom and Driving Company is now associated with the Newfoundland Power and Paper Company, Limited, Deer Lake, Newfoundland.

G. H. Carson, Jr.E.I.C., formerly field engineer with the St. Lawrence Paper Mills, Three Rivers, Que., is now associated with the Newfoundland Power and Paper Company, Limited, and is located at Shawinigan Falls.

J. E. Pringle, A.M.E.I.C., is now associated with the W. H. Yates Construction Company of Hamilton on the construction of a new foundry for the Canadian Westinghouse Company. Mr. Pringle is a graduate of the University of Toronto of the class of 1916.

E. McL. Benedict, A.M.E.I.C., has been transferred by the Dominion Radiator Company, Toronto, to the Buffalo office of the American Radiator Company. Mr. Benedict received his engineering education from McGill University, graduating in mechanical engineering in 1907.

Patrick Philip, M.E.I.C., chief engineer of the Public Works Department, Victoria, B.C., was elected vice-president of the Association of Professional Engineers of British Columbia, at the annual convention held in Vancouver on December 1st.

J. A. Loy, Jr.E.I.C., is at present on the eastern division construction staff of the Bell Telephone Company of Canada. Mr. Loy received the degree of B.Sc., in civil engineering from McGill University in 1921 and was for a time inspector for the department of Public Highways of Ontario.

Victor L. Gladman, A.M.E.I.C., engineer for Sproatt and Rolph, architects, Toronto, has resigned to form a partnership under the name of Gladman Construction Company, Limited, with offices at Port Hope, Ont. Mr. Gladman graduated with the class of 1910 from McGill University.

F. H. Palmer, A.M.E.I.C., has been appointed the Canadian Government Trade Commissioner in the Netherlands, with offices in Rotterdam, Holland. Mr. Palmer was formerly connected with the same department in New York, and was for a time with the Nova Scotia Highways Commission.

E. P. Bowman, A.M.E.I.C., has resigned from the Topographical Surveys Branch, Department of the Interior, Ottawa, with which he was in charge of a survey party, and has entered private practice in surveying and engineering at Guelph, Ontario, where he has taken over the practice of the late D. A. Niven, O.L.S.

J. B. McClure, S.E.I.C., a graduate of the class of '23 of Queen's University, who was with the Canadian Crocker Wheeler Company, St. Catharines, Ont., is employed with the General Electric Company, Lynn, Mass., in the work of testing and calibrating polyphase induction watt-hour meters for the United States Navy.

H. L. Currie, A.M.E.I.C., is at present in St. Catharines, Ontario, acting in the capacity of inspector for a new terminal station. Previous to coming to St. Catharines Mr. Currie had charge of the construction of the building in connection with a new yard at Neebing, Ont. Mr. Currie is an assistant engineer with the Canadian National Railways.

C. Miles Burpee, S.E.I.C., has resigned his position as resident highway construction engineer with the Department of Public Works of the province of New Brunswick to accept the position of instructor and head of the department of drawing and descriptive geometry of the Engineering College of Marquette University, Milwaukee, Wis.

W. Dicker Stroud, S.E.I.C., who has been a member of the Laurentide Company's staff, has joined the staff of the F. C. Huyck and Sons, manufacturers of felts. Mr. Stroud will go to Albany for the present where he will enter the sales engineering department of the company. Mr. Stroud has been in the employ of the Laurentide Company since his graduation from McGill University in 1921.

E. L. Miles, M.E.I.C., at present county road superintendent and county engineer for Victoria, Ontario, residence Lindsay, was elected a Fellow of the Royal Society of Arts, London, Eng., on November 7th, 1923. This society was founded in 1754 and incorporated by Royal Charter in 1847 with the Royal consort H.R.H. Prince Albert of Saxe Coburg and Gotha as its first president. At the present time H.R.H., the Duke of Connaught and Strathearn, K.G., is president of the society, and Lord Asquith, K.C.B., K.C., D.C.L., chairman of the council.

G. H. Wood, A.M.E.I.C., formerly on the field staff of the Reclamation Service, Ottawa, has been transferred to the Ontario division of the Dominion Water Power Branch with headquarters at Niagara Falls, Ontario. Mr. Woods' first connection with the Dominion Water Power Branch dates back to 1914 when he was a junior assistant on a survey party, except for two years when he was on active service in the Canadian Engineers. On his return he again joined the department as junior power development engineer and in 1920 he was transferred as assistant hydraulic engineer with the Reclamation Service.

Dr. Waddell, M.E.I.C., addresses Chinese Students' Alliance

Doctor J. A. L. Waddell, M.E.I.C., consulting engineer of New York City, delivered two addresses on September 11th, and 14th, 1923 to the Chinese Students' Alliance in the U.S.A. at its nineteenth annual conference, held at Brown University in Providence, R.I.

The first address was on "Some Observations on the Regeneration of China and the Engineering Work involved Therein" while the second address dealt with "The Functions of Both Pure and Applied Science in the Future Development of China."

Dr. Waddell's addresses were based on a large amount of first hand information secured during a period of seven months in China. While in China, Dr. Waddell was made Honorary Member of the two leading Chinese engineering societies and also of the Chinese Railway Association and, after his departure, the Chinese Government conferred upon him the Second Class Order of Chia Ho.

Chosen President of Kiwanis Club at Vancouver, B.C.

A. E. FOREMAN, M.E.I.C.

A. E. Foreman, M.E.I.C., was recently unanimously chosen president of the Kiwanis Club of Vancouver. Mr. Foreman has for the past year been president of the Association of Professional Engineers of British Columbia. Last year Mr. Foreman was re-elected a member of the executive of the Convocation of the University of British Columbia for a term of three years.

E. E. Brydone-Jack, M.E.I.C., President of B.C., Professional Engineers.

At the annual convention of the Association of Professional Engineers of British Columbia, held in Vancouver on December first, E. E. Brydone-Jack, M.E.I.C., was elected president of the association for the coming year, succeeding A. E. Foreman, M.E.I.C.

Mr. Brydone-Jack is a native of Fredericton, N.B., and in 1891 received his degree of B.A., from the University of New Brunswick, and three years later his C.E., from the Rensselaer Polytechnic Institute. His earlier work was in connection with railway construction and maintenance while later he was engaged principally in bridge work. For four years, he was dean of the Engineering School of the University of New Brunswick, Fredericton, N.B. During this time he was also city engineer for that city. In September 1905 he was appointed professor of civil engineering at Dalhousie University, Halifax, N.S. He was later professor of civil engineering of the University of Manitoba, Winnipeg, Man. While in Winnipeg, Mr. Brydone-Jack was for several years attached to the Public Works Department of the federal government, with which department he is now employed as supervising district engineer, western Canada, at Victoria, B.C.

Institute Member Receives Promotion

The Under-Feed Stoker Company of Canada, Limited, announce the following change in their personnel:

W. T. Brickenden, B.A.Sc.,(Honours), Jr.E.I.C., has been appointed chief engineer for the company vice D. F. Grahame, who has been transferred to the head office of the Sanford Riley Stoker Company, at Worcester, Mass., U.S.A.

W. T. BRICKENDEN, B.A.Sc., Jr.E.I.C.

Mr. Brickenden, who is a graduate of the University of Toronto in mechanical engineering has been with the company as assistant to chief engineer since 1920 and has been engaged in research and installation work during the ensuing period.

V. L. Havens, M.E.I.C., opens Office in New York

V. L. Havens, M.E.I.C., has opened an office at 185 Madison Avenue, New York, as a consulting engineer. For the past three years Mr. Havens has occupied the position of editor and director of "Ingenieria Internacional", a publication issued in Spanish covering the civil, electrical, mechanical and mining engineering of South America. Mr. Havens' experience dates back to 1898 when he was on railway location and survey work, and in 1902 was appointed assistant engineer on the Union Pacific Railway, being engaged on the construction of a fifty-mile line in the vicinity of Verne and Leroy, Wyoming. A year later he was associated with the Mexican Central Railroad as division engineer in charge of heavy mountain construction. Moving to Omaha, Nebraska, in 1904, he was assistant engineer on streets and boulevards, and was appointed chief engineer for the Tri-State Land Company of Nebraska, where he had charge of the construction of an irrigation system for over a hundred thousand acres. He again returned to Mexico where he received the appointment of assistant engineer for the Mexican Light and Power Company, and later was appointed chief engineer. He also held the same position with the Mexico Steel and Chemical Company and the Pachuca Irrigation and Power Company. In 1913 he was engaged in general consultation work and in 1915 was commercial attache to the American Embassy at Santiago, Chile. He again entered the consulting work on technical and commercial problems principally for public utility corporations in Brazil, Mexico and Spain.

World Power Conference General Committee

The general committee appointed to advise regarding Canadian participation in the World Power Conference to be held in London in July nineteen twenty-four, is as follows:

H. G. Acres, B.A.Sc., M.E.I.C., M.Am.Soc.C.E., chief hydraulic engineer, Ontario Hydro-Electric Power Commission, Niagara Falls, Ontario.

F. D. Adams, Ph.D., D.Sc., LL.D., F.R.S., Hon.M.E.I.C., vice-principal of McGill University; and dean, Engineering Faculty, McGill University, Montreal, Que.

Col. C. W. Allen, B.A.Sc., M.E.I.C., Royal Securities Corporation, 164 St. James St., Montreal, Que.

Arthur Amos, A.M.E.I.C., chief engineer, Hydraulic Service, Parliament Buildings, Quebec.

Adrien Beaudry, K.C., president, the Quebec Public Service Commission, 9 St. James St., Montreal, Que.

Edward Beck, secretary, Canadian Pulp and Paper Association, 511 St. Catherine St. West, Montreal, Que.

G. E. Bell, B.Sc., M.E.I.C., assistant to the president, Dominion Engineering Works, Montreal.

W. A. Bowden, B.A.Sc., M.E.I.C., chief engineer, Department of Railways and Canals, Ottawa, Ont.

W. A. Bucke, Esq., B.A.Sc., M.E.I.C., manager, Apparatus Sales Department, Canadian General Electric Company, Toronto, Ont.

Charles Camsell, B.Sc., LL.D., F.R.S.C., M.E.I.C., deputy minister of mines; and chairman, Dominion Fuel Board, Ottawa, Ont.

Walter Carr, M.A., Ph.D., editor, "Electrical News", 347 Adelaide St. West, Toronto, Ont.

J. B. Challies, C.E., M.E.I.C., M.Am.Soc.C.E., director, Dominion Water Power Branch; and Dominion Reclamation Service, Department of the Interior, Ottawa, Ont.

A. L. Clark, B.Sc., Ph.D., F.R.S.C., Hon.M.E.I.C., dean, Faculty of Applied Science, Queen's University, Kingston, Ont.

E. A. Cleveland, M.E.I.C., comptroller of water rights, and consulting engineer, Department of Lands, Victoria, B.C.

F. A. Combe, M.E.I.C., consulting combustion and steam engineer, Southam Building, Montreal, Que.

P. T. Davis, president, Canadian Electrical Association, 330 Coristine Bldg., Montreal, Que.

Colonel J. S. Dennis, C.M.G., M.E.I.C., chief commissioner, Department of Colonization and Development, Canadian Pacific Railway Company, Montreal, Que.

A. A. Dion, M.E.I.C., F.A.I.E.E., general manager, Ottawa Electric Company, Ottawa, Ont.

V. M. Drury, president, Calgary Power Company, Limited, 164 St. James St., Montreal, Que.

E. A. Dunlop, president, Pembroke Electric Light Co. Ltd., Pembroke, Ont.

R. J. Durley, Ma.E., M.Inst.C.E., M.Am.Soc.M.E., M.E.I.C., secretary, Canadian Engineering Standards Association, Jackson Building, Ottawa, Ont.

Walter J. Francis, C.E., M.E.I.C., M.Am.Soc.C.E., consulting engineer, 260 St. James St., Montreal, Que.

J. G. Glassco, B.Sc., M.Sc., M.E.I.C., A.A.I.E.E., manager, City of Winnipeg Hydro-Electric System, Winnipeg, Man.

F. R. Glover, chief executive assistant, British Columbia Electric Railway Company, Vancouver, B.C.

P. S. Gregory, B.A., B.Sc., A.M.E.I.C., A.A.I.E.E., assistant to vice-president, Shawinigan Water and Power Company, Montreal, Que.

A. Monroe Grier, K.C., president, Canadian Niagara Power Company, Dominion Bank Building, Toronto, Ont.

B. F. Haanel, B.Sc., M.E.I.C., chief engineer, Division of Fuels and Fuel Testing, Department of Mines, Ottawa, Ont.

O. Higman, M.E.I.C., director, Electricity and Gas Inspection Branch, Department of Trade and Commerce, Ottawa, Ont.

F. T. Kaelin, M.E., M.E.I.C., chief engineer, Shawinigan Water and Power Company, Montreal, Que.

Fraser S. Keith, B.Sc., M.E.I.C., editor, *The Engineering Journal*, 176 Mansfield St., Montreal, Que.

J. G. G. Kerry, M.Sc., M.E.I.C., M.Am.Soc.C.E., consulting engineer, Confederation Life Building, Toronto, Ont.

R. S. Lea, Ma.E., M.E.I.C., M.Am.Soc.C.E., consulting engineer, 340 University St., Montreal, Que.

O. O. Lefebvre, B.A.Sc., M.E.I.C., chief engineer, Quebec Streams Commission, Montreal, Que.

Geo. C. Mackenzie, M.E.I.C., secretary, Canadian Institute of Mining and Metallurgy, Montreal, Que.

C. A. Magrath, M.E.I.C., chairman, Canadian Section, International Joint Commission, Ottawa, Ont.

J. B. McRae, B.A.Sc., M.E.I.C., M.Am.Soc.C.E., consulting engineer, Jackson Building, Ottawa, Ont.

Brig.-General C. H. Mitchell, C.B., C.M.G., C.E., LL.D., M.E.I.C., M.Am.Soc.C.E., dean, Faculty of Applied Science and Engineering, University of Toronto, Toronto, Ont.

A. W. McLimont, general manager, Winnipeg Electric Railway Company, Winnipeg, Man.

John Murphy, B.A., M.E.I.C., F.A.I.E.E., consulting electrical engineer, Department of Railways and Canals; and Dominion Railway Commission, Ottawa, Ont.

A. J. Nesbitt, Messrs. Nesbitt and Thomson, 145 St. James St., Montreal, Que.

Mgr. J. A. V. Piette, P.D., rector, Université de Montréal, Montreal, Que.

J. Rocchetti, M.E., E.E., M.E.I.C., A.A.I.E.E., acting commissioner, Manitoba Power Commission, Winnipeg, Man.

L. V. Rorke, O.L.S., director of surveys, Department of Lands and Forests, Toronto, Ont.

R. A. Ross, D.Sc., E.E., M.E.I.C., consulting engineer, Marcil Trust Building, Montreal, Que.

J. J. Salmond, Affiliate E.I.C., president and general manager, "Canadian Engineer," 62 Church St., Toronto, Ont.

Julian C. Smith, LL.D., M.E., M.E.I.C., M.Am.Soc.C.E., F.A.I.E.E., consulting engineer, president, Quebec Power Company, etc., Montreal, Que.

K. H. Smith, B.A.Sc., M.E.I.C., representing Nova Scotia Power Commission; and New Brunswick Electric Power Commission, Halifax, N.S.

W. J. Stewart, M.E.I.C., chief hydrographer, Department of Marine and Fisheries, Ottawa, Ont.

Arthur Surveyer, B.A., B.A.Sc., C.E., M.E.I.C., consulting engineer, Drummond Building, Montreal, Que.

R. O. Sweezey, B.Sc., M.E.I.C., Newman, Sweezey and Company, 136 St. James St., Montreal, Que.

Sir Henry Thornton, K.B.E., president, Canadian National Railways, Ottawa, Ont.

K. B. Thornton, M.E.I.C., M.A.I.E.E., general manager and chief engineer, Quebec-New England Hydro-Electric Corporation, 263 St. James St., Montreal, Que.

H. M. Tory, M.A., D.Sc., F.R.S.C., LL.D., F.R.H.S., chairman, Research Council of Canada, Ottawa, Ont.

Annual Meeting of the Association of Professional Engineers of B.C.

The fourth annual meeting of the Association of Professional Engineers of the Province of British Columbia was held in Vancouver, December 1st, 1923.

E. E. Brydone-Jack, B.A., C.E., M.Inst.C.E., M.E.I.C., M.Am.Soc.C.E., M.Am.Inst.Cons.E., supervising district engineer, Western Canada, Dominion Public Works, (civil), was elected president. Patrick Philip, M.E.I.C., chief engineer, provincial Public Works, (civil), was elected vice-president, and H. Rindal, C.E., (civil), G. S. Eldridge, B.Sc., (chemical), A. G. Langley, B.Sc., M.I.C.M.M., (mining), and Frank Sawford, (electrical and mechanical), were elected members of the council.

The most successful meeting in the history of the association was held. Nearly 300 members took part during the course of the day. This amounts to nearly 40 per cent of the total membership of the association, and the presence of so many out of town visitors was extremely gratifying to the council.

ELECTIONS AND TRANSFERS

At a meeting of Council held on December 18th, 1923, the following election and transfers were effected:—

Members

WALL, Edward Walter, Sc. B. in C.E. (Brown Univ.), gen. supt. in charge of all constrn. work. Atlas Construction Company. Montreal.

WOOTTON, Allen Shakespeare, Assoc. in Arts (Oxford Univ.), chief engr. to Board of Park Commissioners, Vancouver, B.C.

Associate Members

HEWARD, Francis Stephen Beverley, B.Sc. (McGill Univ.), director and works manager, James Howden Co. Ltd., and director, Combustion Engrg. Corpn. Ltd., Montreal.

LEGRIS, Charles Ernest, B.Sc. (McGill Univ.), engr., Quebec Development Company, St. Joseph d'Alma, Que.

RIDDELL, John Morrison, B.A.Sc. (Univ. of Tor.), junior geodetic engr., Geodetic Survey of Canada, Ottawa.

SHARON, Maurice William, chief architect, Dept. of Public Works, Prov. of Sask., Regina, Sask.

STEVENS, Frederick, checker, Canadian Bridge Co. Ltd., Walkerville, Ont.

THOMAS, Edward Arnold, asst. in charge of the Courtenay bay staff, under the engr. public works, St. John Harbour, St. John, N.B.

WALSH, Steven Nicholas, prov. examiner of electricians of Quebec, Montreal, Que.

Juniors

CAMPBELL, Robert Arthur, transitman, mtce. work, C.P.R., Brandon, Man.

HAGERMAN, Bernard Harrison, B.Sc. (Univ. of N.B.), instr'man and asst. to res. engr. on highway work in prov. of N.B., Fredericton, N.B.

MUNRO, William Cauldwell, B.Sc. (McGill Univ.), asst, engr., Ontario Paper Co. Ltd., Thorold, Ont.

Affiliate

KEMPTON, John, asst. gen. mgr. of coal sales, British Empire Steel Corpn., Montreal, Que.

Transferred from the class of Junior to that of Associate Member

NEILSON, Stanley Alexander, B.Sc. (McGill Univ.), asst. engr., on hydro-elec. power development surveys, etc., Walter J. Francis & Co. consltg. engrs., Montreal.

Transferred from the class of Student to that Associate Member

KIRBY, Guy Hurlston, B.Sc. (McGill Univ.), charge of high voltage transmission line constrn., supt. of transmission line dept., Price Bros. & Co. Ltd., Kenogami. Que.

Transferred from the class of Student to that of Junior.

ROBINSON, Denis Owen, B.Sc. (Queen's Univ.), foreman on Michigan Central R.R. yard extension in St. Thomas, for Dominion Construction Co., St. Thomas, Ont.

The following students were admitted:—

ARNOTT, Clarence, 1639 Comox Street, Vancouver, B.C.
BEAVERS, George Robert, dftsman., Canadian Blower and Forge Company, Kitchener, Ont.
CAMPBELL, John Middleton, 4120 Etna Street, Vancouver, B.C.
COFFIN, Frederick Winfield, 2425 Pine Street, Vancouver, B.C.
DONOHUE, Edward William Burgess, 85 St. Famille Street, Montreal.
EVJEN, Ralph Walter, 1362 — 22nd Avenue East, Vancouver, B.C
FERGUSON, Boyden Hamilton, 1782 First Avenue East, Vancouver, B.C.
FULTON, Fraser Fowler, St. John, N.B.
GALE, Stanley Cuthbert, 589 Burrard Street, Vancouver B.C.
GIBSON, Ernest Sydney, 44-14th Avenue West, Vancouver, B.C.
HICKS, Kenneth W., 128 Fifth Avenue West, Vancouver, B.C.
KIDD, George Stuart, 3007 Denbigh Street, Burnaby, B.C.
LANE, Cecil Taverner, 905 St. Urbain Street, Montreal.
LAZENBY, Frederick Arthur, Port Hammond, B.C.
MacQUARRIE, John Douglas, 236 Robert Street, Toronto, Ont.
MacREA, Donald Alexander Gregory, 217 St. John Street, Fredericton, N.B.

MATSON, Bruce Cook, 444 Gladstone Avenue, Toronto, Ont.
MORGAN, Frederick Stewart, 1609 Nelson Street, Vancouver, B.C.
MORRIS, Max, Sydney, N.S.
MORTON, Ralph McKenzie, 3148 Second Avenue West, Vancouver, B.C.
PEARSON, Harold James P. St. George's, Bermuda.
PRESTON, Frederick Henry, 80 Park Street, Niagara Falls, Ont.
PRUDHAM, William Merrill, 756 University Street, Montreal.
REES, Arthur Fred. 3114 Neville Street, New Westminister, B.C.
ROWAT, Geoffrey Holms, 83 Spring Street, Moore Park, Toronto, Ont.
STEWART, William Franklin, 806 Shuter Street, Montreal.
STROYAN, Philip Bateman, 4312 Dundas Street, Vancouver, B.C.
THOMPSON, William Lennox, Toronto. Ont.
TIMLECK, Curtis James, 814 Fifth Avenue, New Westminster, B.C.
WELCH, William Hamlyn, 2835 Spruce Street, Vancouver, B.C.
WOLVERTON, Jasper Matthews, 137-11th Avenue West, Vancouver, B.C.

Contracts Open to Canadian Firms for Large Modern Buildings in Japan

In a letter from A. E. Bryan, Canadian Trade Commissioner, Kobe, Japan, to H. R. Pousette, Director, Commercial Intelligence Service, Ottawa, Mr. Bryan states "There is a good opening out here for any good Canadian engineering firm able to contract on large modern buildings. If you know of any firm that would be interested in looking into the matter further, line them up and I will go into it with them when I come home".

Tungsten Lamp Specification

The Canadian Engineering Standards Association has just issued a standard specification for regular tungsten incandescent lamps, copies of which are available either through the office of the secretary of the Association, 630 Jackson Building, Ottawa, or from the secretary of the Institute, for twenty-five cents.

The specification is designed to:—

(a) Detail the standards and definitions pertaining to tungsten incandescent lamps, the physical and electrical characteristics that constitute good lamps, and the tolerances permissable in their inspection and testing.

(b) Provide a scientific and authoritative method of determining tungsten lamp quality with respect to mechanical characteristics, lumen maintenance, and life performance.

(c) Provide tables of the dimensions and electrical characteristics of the regular classes of tungsten lamps.

(d) And thus to afford a technical basis for contracts governing the sale and purchase of tungsten incandescent lamps that will adequately protect both the purchaser and the manufacturer.

A marked change in the method of rating the light-output of incandescent lamps is introduced, that of expressing it in lumens instead of in candle power. The lumen is a measure of total light emitted and therefore applicable to any type of light-giving source which can be used in all cases. The lumens has a further advantage of providing a more logical expression for efficiency, namely, lumens per watt.

The special committee on incandescent lamps responsible for producing this specification was under the chairmanship of John Murphy, M.E.I.C., electrical engineer, Department of Railways and Canals, Ottawa.

"Canada—Natural Resources and Commerce"

In a small compact volume well illustrated with photographs and containing two maps showing the main physiographic divisions, transportation routes, industrial areas and the distribution of resources of the country, the Natural Resources Intelligence Service, Department of the Interior, has made available in a most convenient form a wealth of information on Canada's natural resources, development of industries and commercial growth.

This is not a government blue-book but an attractive publication compiled especially for the business man. It gives a condensed but thorough survey of Canada's varied resources and of the broad features they impart to the commerce of the Dominion by their limitations as well as by their diversity and abundance. It gives, in short, a bird's-eye view of Canada's physical assets, developed and latent.

Separate chapters of this volume are devoted to the industries and trade that have been built up around each form of natural resource, farm lands, forests, minerals, waterpowers, fisheries, and fur-bearing wild life. Special attention is also paid to Canada's advance in manufacturing and to her position in international trade.

Copies may be obtained free of charge upon application to F. C. C. Lynch, Affiliate, E.I.C., superintendent, Natural Resources Intelligence Service, Department of the Interior, Ottawa, Ont.

EMPLOYMENT BUREAU

Situation Vacant

Electrical Draughtsman

A power company in Montreal requires the services of a first-class electrical draughtsman. Must be experienced in design and layout. Apply Box No. 60-V.

Structural Engineer

Structural engineer wanted, experienced in designing of steel buildings and bridges, with knowledge of costs. Good opening in executive capacity. Apply Box No. 61-V.

Industrial Officer

There is an opening with a Federal institution for an engineer with three or four years practical experience in masonry work. The position is that of industrial officer and the salary range is from $1640 to $1860 with bonus. Apply Box No. 62-V.

Draughtsman

A large pulp and paper company near Montreal requires the services of a first class draughtsman for layout and improvements work. Must be able to produce neat and accurate drawings. Apply Box No. 65-V.

Mechanical Engineer

Industrial firm manufacturing machanical equipment requires the services of a recent graduate in mechanical engineering to work through their organization with a view to learning the manufacture and instalation of heating plant equipment. Applicant must be able to talk French and English. Apply Box No. 66-V.

Structural Engineer

A firm of construction engineers in Montreal have an opening for a young engineer, on design and layout of buildings. Apply Box No. 67-V.

Chemical Engineer

A company engaged in a large power development scheme in Quebec wish to secure a recent chemical engineering graduate, whose immediate work would be the testing of borings and other tests in connection with construction work. Apply Box No. 68-V.

Mining Engineer

A mining engineer of from thirty to forty years of age required for a partnership in a gold and arsenic proposition in Nova Scotia. Apply Box No. 69-V.

Combustion Engineer

A pulp and paper company in Quebec have an opening for an engineering graduate who has had experience in combustion engineering, to be in charge of their boiler house control. Salary $175. Apply Box No. 70-V.

Mechanical Engineer

A young mechanical engineer required in the capacity of efficiency engineer for mill repair and supply room, by a pulp and paper company. Apply Box No. 71-V.

Recent Graduates in Mechanical and Chemical Engineering

A firm in Toronto have one or two openings for recent graduates with either chemical or mechanical training. Apply Box No. 72-V.

Situation Wanted

Civil Engineer

Civil engineer, A.M.E.I.C., 30 years of age, desires position with firm of contractors or engineers. Location immaterial. Three years railroad construction, three years river improvement work, two years engineer officer overseas, one year building construction, etc. At present employed in China. Apply Box No. 131-W.

Electrical Engineer

Technical graduate, A.M.E.I.C., member American Institute of Electrical Engineers, professional engineer B.C. Experience covers construction and maintenance of power and industrial and hydro-electric plants and substations. At present employed, but desires change. Location preferred Western Canada. Apply Box No. 132-W.

BRANCH NEWS

St. John Branch

W. J. Johnston, A.M.E.I.C., Secretary-Treasurer.

A paper on "Telephone Transmission" was delivered by A. A. Turnbull, Jr.E.I.C., Assoc. A.I.E.E., to the members of the St. John Branch, on November 23rd, in the N.B. Telephone Company's building.

Telephone Transmission

In introducing this subject the speaker mentioned the important use of the telephone in community life, and, with the recent success in long-range communication, its growing importance in national life. The technical problems met with in telephone engineering and the underlying principles of transmission of sound were explained in detail by charts.

Telephone transmission is fundamentally dependent on the use of electricity, and involves the theory of alternating currents and of sound. In a telephone conversation sound waves are received, converted into electrical waves which are transmitted varying distances, where they are received and changed to sound waves. The telephone requires a camparatively small amount of electricity; to carry on a conversation up to a distance of 300 miles would require energy only of millionths of a watt.

The volume and range of the human voice has a wide range of acoustic properties, and the frequency of the voice currents is between 200 and 2,200 cycles per second. The speed of the voice over the wires ranges between 80,000 and 150,000 miles per second. A maximum of 186,000 miles per second has been attained in wireless.

Open wires and cables each have their respective fields of usefulness in telephone operation. On open wires it is possible to talk a limited distance and transmission over greater distances is effected by loading and the use of repeaters, with modern practice favouring repeaters. Loading is the deliberate addition of inductance. Loading in open wires is not as successful as in cables which are much improved by loading. Repeaters are either the mechanical or vacuum-tube type, the latter are more important and involve the amplifying principle demonstrated in radio. By the use of loading and repeaters a telephone conversation was recently carried on over the record distance of 3,400 miles between New York and San Francisco. This feat is simplified in a country such as the United States (or Canada), and would be practically impossible in a country such as Europe with its several languages and the lack of co-operation between the telephone systems of the different nations. The voice has been heard through cables a maximum distance of about 125 miles.

The increased capacity of the lines resulted in the carrier system which is the super-imposing of a band of higher frequencies on the telephone circuit. An additional circuit referred to as a phantom circuit is obtained from two physical circuits by the use of repeating coils resulting in three circuits where originally there were two.

The linking of telephone lines with wireless was mentioned as a recent development, an experimental but not a commercial success. After reading this paper a general discussion on telephone matters was engaged in by the members present.

Future Meeting in Fredericton

At this meeting a committee was appointed to arrange for holding a branch meeting in Fredericton during the coming winter. This proposed meeting will give *The Institute* members resident in Fredericton and vicinity, and now members of this branch, an opportunity to attend a branch meeting. This meeting will be held with the Engineering Society at the University of New Brunswick.

London Branch

E. A. Gray, Jr. E.I.C., Secretary-Treasurer.

R. I. Olmsted, A.M.E.I.C., Branch News Editor.

The regular monthly meeting of the London Branch was held on November 28th, in the board room of the Public Utilities Commission. In the absence of the chairman, Major W. J. Forbes-Mitchell, D.S.O. M.E.I.C., due to illness, H. B. R. Craig, M.E.I.C., occupied the chair.

The papers presented consisted of "The Springbank Dam", by E. V. Buchanan, M.E.I.C., and an informal talk on Sewage Disposal", by W. P. Near, M.E.I.C.

A resolution was passed, expressing the regret of the members of the branch, at the enforced absence of the chairman, due to illness, and best wishes for a complete recovery.

At the conclusion of the meeting, a light supper was served by the entertainment committee of which J. R. Rostron, A.M.E.I.C., is chairman.

Lethbridge Branch

Geo. S. Brown, A.M.E.I.C., Secretary-Treasurer.

The winter meetings of the Lethbridge Branch have got away to a splendid start. The enthusiasm of the members and affiliates shows no sign of abating and under the able chairmanship of Colin D. Mackintosh, M.E.I.C., his branch bids fair to be in for a series of splendid meetings.

The first meeting took place on November 3rd and the one following on the 17th and it is the intention to hold a meeting on the Saturday of every second week throughout the winter.

This branch has been fortunate enough to make arrangements with the Ladies' Auxiliary of the Y.M.C.A., for catering and we have Sam Porter, M.E.I.Ç., to rely upon to lead the community singing; the social side of affairs is not by any means overlooked. The engineers here seem to stand pretty well in the community and we are never short of good friends to entertain us with songs, etc. Then we have an orchestra that is made up entirely of our own members which we are not a little proud of.

The first meeting brought out an attendance of around forty and the next meeting was attended even better. The chairmen of the various committees reported as to their past and proposed activities at the meeting on November 3rd, and their reports indicate that the affairs of the branch are being well looked after.

At the meeting on November 3rd, a valuable and instructive paper was read on "The Formation of the Coal Areas and General Statistics on the Coal Situation in Alberta". The paper was prepared by Messrs. R. Livingstone, M.E.I.C., general manager of the C.P.R., mines at Lethbridge and Wm. Meldrum, mine surveyor of the said mines. The paper was the result of much experience of coal mining here as well as a vast amount of general research.

At the meeting on November 17th, the principal item was a paper by T. Lees, M.E.I.C., on Boiler Waters with reference to those available in Western Canada.

Border Cities Branch

J. Clark Keith, A.M.E.I.C., Secretary-Treasurer.

The opening fall meeting of the Border Cities Branch was held at the Prince Edward hotel, Friday, October 12th, at seven o'clock.

In order that the members might be aware of the activities of the Detroit branch of the American Society of Civil Engineers, the secretary was requested to make this information available on the regular notices covering our own meetings.

M. E. Brian, A.M.E.I.C., extended an invitation to the branch to visit the municipal asphalt plant of the city of Windsor at a date to be later decided upon.

The chivalrous spirit of the engineer was in evidence at this meeting when means were discussed for providing entertainment for the wives or near wives who stay at home while we are otherwise enjoying ourselves.

Sewage Problem on Both Sides of Detroit River

The speaker of the evening was C. W. Hubbell, former city engineer of Detroit. Mr. Hubbell stated that the sewage problem on both sides of the Detroit river might be considered under two main heads:—(1) The obligation to live up to International agreements. (2) The necessity of maintaining standards of common decency.

By means of slides the pollution of the Detroit river at various points was shown. This was greatest at the shore, diminishing toward midstream with the lower section of the Detroit river grossly polluted from shore to shore. The prevalence of B. Coli was subject to seasonal variation of winds and temperature.

On both the American and Canadian shore the B. Coli count is above 500 per 100 c.c. This is in excess of the accepted standard for water, reasonably amenable to purification. Under certain conditions of high and prolonged winds the water flow in the Detroit river has been reversed and it is a matter of record that the level at Fort Wayne has been higher than at either end.

The drainage system of Detroit, both present and proposed, was interestingly dealt with. The difficulties of construction owing to the level nature of the ground and to subsurface conditions was a feature of the address.

At the conclusion of Mr. Hubbell's address, a general discussion was indulged in on the sewerage problems of the Border as compared with those of Detroit.

Visit to the Ford Motor Company construction works

At the special meeting on October 20th, the members visited the Ford Motor plant at the invitation of J. E. Porter, A.M.E.I.C., and were first conducted over the new Ford docks where 100,000 tons of coal can be stored with ample accommodation as well for thousands of feet of lumber on its way to the dry kilns for the building of motor bodies. The next point of interest was the new power house. Immediately adjoining this are situated the coke ovens for the coking of coal and the recovery of by-products.

The members then visited the new machine shop of one storey construction and covering approximately 14 acres. The next point was the new heat-treat building. From here they descended into the tunnel and were conducted back to the wharf by the underground route: first, through the power tunnel, 11 feet by 12 feet in cross-section, then through the coal conveyor tunnel by which the coal will be brought from storage on the wharf to the coking ovens.

About thirty members thoroughly enjoyed the outing. W. R. McGie, plant engineer, and J. E. Porter, A.M.E.I.C., were very efficient guides and had a ready answer for all questions, wise or otherwise, which were forthcoming.

Low Temperature Distillation of Coal

The regular meeting of the Border Cities Branch was held in the Prince Edward Hotel, November 9th. The address of the evening was given by W. R. McGie, of the Ford Motor Company on "The Low Temperature Distillation of Coal".

In his introductory remarks Mr. McGie stated that any comments he might make were his personal opinions and that he might be open to contradiction. He paid a very high tribute to the technical ability as well as to the modesty of Mr. Piron, the inventor of the system now being installed by the Ford Motor Company.

From the viewpoint of experiment the process is old, from the practical standpoint it is new. All the basic industries, steel, power, lumbering and the home are dependent upon fuel for their operation and anything relating to the fuel problem is of value to the engineer for thereon his living largely depends. The low temperature distillation of coal will probably have a greater influence on the fuel problem than any other single factor which is in evidence at the present time. In America 1¼ billion tons of coal are consumed annually and of this about ¼ billion tons are coked. If the low temperature process becomes universal, coal will not be used as it is to-day and a new problem will be created, the disposal of the by-products. It is vital to us living in America due to the large quantities of high volatile coal which we possess, in distinction to the low volatile fuels of the Old Country. The high volatile coals give this county the opportunity to be pioneers in the process. Prior to the present time, all coke has been produced by high temperatures but with low temperatures new products are obtained with a wonderful field to be developed. Eight or ten different processes have been tried in an attempt to produce coke by this means with an invested capital of 100 million dollars. Coal is an insulator and it is difficult to force heat through it at low temperatures.

Japan has great quantities of bituminous coal but, with little or no oil, she is dependent on other nations for this supply so this new process would make her independent in that respect. A Jap is generally to be found wherever any work of this nature is under way.

This is the first process which has seemed commercially sound. The Ford Motor Company is trying to make it practical insofar as it relates to power but Mr. Ford is interested in burning the coal twice. The great departure from standard practice is in choosing molten lead as the medium of heat transmission. This simple idea has swept away the previous difficulties. The problem had always been to secure a material which would stand up indefinitely at 1,200 degrees. Lead melts at a low temperature, boils at high temperature, has a high specific gravity and is unaffected by anything but an oxidizing atmosphere. Molten lead is to be the medium for floating the pans on which the coal will be deposited.

The coal is roughly crushed between rollers to ⅛ inch in diameter and is carried on cast iron pans in ¼-inch to 1-inch layers on a conveyor, floating on the molten lead. From three to nine minutes is required for these pans to travel across the lead. Passing over the conveyor wheel the pans are brought into contact with a similar set on a companion conveyor below. These two pans rub together and loosen the coke so that it is readily discharged into a hopper when the belt drops down over the sprocket wheel. When passing over the lead, the products which are distilled at that time are drawn off by an exhauster.

One ton of coal is about 35 per cent volatile. From it would be produced 1,500 pounds of coke, 20 gallons of light oil and 10 gallons of ammonium sulphate. After using enough gas to drive off the distillate there will be a surplus of 4,000 cubic feet of gas per ton with a heat valve of 500 to 600 B.t.u.'s. The by-products from one ton of coal have a present market value of $10.44 which would mean that power could be developed without cost.

There is a variety of possibilities from the standpoint of power. The coke is obtained in a form resembling black char. This is pulverized and injected under the boilers by air and burned. It gives an overload rating impossible with underfeed stokers. Under test it has proved superior to any coal ever used at the River Rouge plant of the Ford Motor Company due to the incombustible elements such as moisture, low temperature, hydrocarbons and ammonia having already been removed.

A new field will be open to the Diesel engine to utilize the by-products should the market become glutted. If coal were $5.00 a ton and oil 5 cents a gallon there would be double the efficiency in an oil engine that there would be in a steam turbine. If tar oils glut the market the plant could be swung over to an oil fuel and the coke marketed. Much coal is burned in hauling coal, while slack at the mine heads would be readily convertible into gas, tar, oils, etc. Coal will at a later time be distilled on low temperature basis and central power stations will come into existence at many points. With the low temperature process a success, it would seem to be akin to crime to burn coal direct.

Toronto Branch

J. A. Knight, A.M.E.I.C., Secretary-Treasurer.
L. W. Wynne-Roberts, A.M.E.I.C., Branch News Editor.

Four very successful meetings of the Toronto Branch have been held during the past month, the members showing much interest in sustaining a good attendance, and the papers read and discussions thereon, having been of a very high character.

Patents

On November 22nd, Herbert J. Dennison, patent attorney, addressed the branch on the subject of "Patents" making particular reference to the relation of patents to progress in the engineering and industrial fields. The speaker referred to the general idea that patents are the conception of a dream, and declared this to be a mistaken viewpoint, as patents in most cases were things which had come slowly and only at the expense of much thought and time. Mr. Dennison showed the difference between discovery and invention. The discoverer, such as Newton, deals with the laws of known phenomena, and investigates and delves into them. The wonderful advance of radio was cited as an example of the work of discovery. The Royal Society was founded in the reign of Charles II, and included many famous men, such as Lord Kelvin, Sir Humphrey Daly, Lister, Crookes, but few of these were inventors.

The scientist discovers laws, but does not accomplish results. The inventor uses the knowledge of science, and brings it into practical form, so that some of the laws may be commercialized. Michael Faraday, Smeaton, Bunsen, Watt, were mentioned as men whose inventive genius turned toward different lines of engineering. It took thirty-seven years to produce a commercially operating magneto machine. The speaker stated that the inventor's mind must travel ahead of known laws. The first internal combustion engine was made in 1680 by using gunpowder in the cylinder. In 1794 inflammable vapour was employed, but it was not until 1876 that the first commercial combustion engine was produced.

The field of invention was endless said Mr. Dennison, and he recommended all engineers to make use of the patent office records library which was open to all, to keep in close touch with developments in their particular branch of engineering science.

Tracing the history of the patent law, the speaker said it was started in Great Britain during the reign of James I, when the crown granted monopolies to its friends. The importance of granting patents was first realized by Thomas Jefferson in the States, and all examinations of patents in those days were personally superintended by himself. The government grants patents for a limited period because it believes that the party who has invented something, has given something to the public and should be rewarded in some way. The speaker claimed that industrial life could not exist without patents, as patented devices are used on almost every machine employed in the industrial world. Without patent laws and the protection these laws give to the patentee, few men would make public their valuable ideas and inventions. The speaker stated that 90 per cent of the patents are good, but that on searching through the records it was found that in 50 per cent of the cases, other patents had previously been taken on similar devices.

Mr. Dennison described the patent laws of various countries, stating that those of Canada and the United States are now practically identical. Many changes were made in the Patent Act this year, and the time limit in which the inventor must now manufacture his invention has been extended from two to three years, and at the end of the three years, if the invention is not commercialized, anyone may apply for a license to use the invention on a royalty basis. Canada is now a member of the International Union comprising 56 states, and the inventor enjoys the right of priority of claim in the other countries, in any of which he is allowed twelve months to take out his patents.

In the discussion which followed and which brought to light other interesting points, the following took part: Professor C. R. Young, M.E.I.C., R. O. Wynne-Roberts, M.E.I.C., J. M. Oxley, M.E.I.C., J. A, Knight, A.M.E.I.C., and Professor Cockburn, M.E.I.C.

Recent Developments on the T. & N.O. Railway

S. B. Clement, M.E.I.C., chief engineer of the Temiskaming and Northern Ontario Railway, addressed the meeting on November 29th, on "Some recent Developments of the T. & N.O. Railway", and after describing the work in connection with the 70-mile extension which is now in course of construction, explained to a very interested audience the possibilities of Northern Ontario, such as forest products, good agricultural land, the available water powers, and probable mineral wealth. Mr. Clement's paper is published elsewhere in this issue of *The Journal.*

Inspection of Materials

A comprehensive address on "Inspection of Materials" was delivered at the regular meeting on December 6th, by R. J. Marshall, M.E.I.C., president of the Canadian Inspection and Testing Company, in which he capitulated the standard specifications for a variety of materials, and the standard methods of test and analysis, and discussed from the ethical point of view the interdependence of vendor, contractor, inspector and engineer on construction work.

Mr. Marshall stated that engineering may be divided into a number of sections, such as chemical, electrical, mining, civil, mechanical, architectural, etc., and each of these may be subdivided into its specialist branches. Engineers could not be expert in every branch and therefore specialized. One of such specialist branches was that of inspection engineering.

An inspector depended very largely upon specifications, said the speaker, to determine what tests he was to carry out on any material, and vague or badly written specifications were a source of much anxiety to the inspection companies. Valuable work was being done by the American Society for Testing Materials, and the Canadian Engineering Standards Association in preparing standard specifications. He referred to the fact that the A.S.T.M., had no less than forty-eight specifications for ferrous metals. The Canadian Engineering Standard Association had prepared some seven or eight standard specifications among which were steel Railway Bridges, Portland Cement, Highway Bridges and Wire Rope, and other specifications for Reinforced Concrete and Structural Steel for buildings were now in course of preparation. He explained the numerous standard methods of test and analysis, and indicated how the contractor, inspector, engineer and manufacturer as vendor depended one upon the other. Specifications are the working tools of Inspectors, Mr. Marshall said, and in writing, these should be clearly worded, in order that the inspector may know just what is called for when testing and inspecting the materials. Specifications must set forth in detail the limits which govern strength and other quantities in the material to be purchased. Such phrases as "to the approval of the engineer", "in a workmanlike manner," should be avoided.

Inspection itself was divided into three processes, visual inspection, actual external inspection and internal inspection. In testing a material three analyses were performed: physical, chemical and microscopic.

In the open discussion after the address, Professor C. R. Young, M.E.I.C., who presided, referred to the valuable services rendered by the inspection companies. G. A. McCarthy, M.E.I.C., in referring to a remark of Mr. Marshall, that an engineer should give a contractor all information, considered that a contractor should find out certain things for himself. The relation between a contractor and municipal corporations or a government was somewhat different to that between a contractor and an individual, and in the former case he believed that the contractor should ascertain information such as the kind of bearing, etc., from his own observations. R. J. Dalzell, M.E.I.C., was of a similar opinion, and in referring to the manufacture of sewer pipes, considered that only trained inspectors should pass on such material, as the process of manufacture was difficult. Up to the present time engineers had not demanded a standard specification for clay products, and the manufacturers were prepared to let the matter stand. Professor O. W. Ellis, A.M.E.I.C., described some interesting experiences in the inspection of munition materials during the war. He remarked that the sulphur and phosphorous content in steel had been increased 100 per cent without any ill effects. He described "season cracking" of certain brass rods which failed after careful examination, and also the extrusion defects of brass tubes, in which a second tube had formed inside the outer shell, and was capable of moving up and down.

Professor Peter Gillespie, M.E.I.C., spoke on the interpretations of specifications and cited certain cases wherein the engineer had insisted upon the strict observance, resulting in serious loss to the contractor. Others who spoke were G. W. Winckler, M.E.I.C., J. M. Oxley, M.E.I.C., and F. G. Engholm, A.M.E.I.C.

Following the reading of the minutes, N. D. Wilson, M.E.I.C., explained the proposed changes in the Branch by-laws in order to make them conform to those of *The Institute* and moved their adoption. R. O. Wynne-Roberts, M.E.I.C., seconded the motion.

Heating

"Heating" was the subject of a very informative address given by F. R. Ewart, M.E.I.C., to the branch on December 13th. Much interest was evinced by the large number of members present, and the discussion which followed proved to be one of the best this season.

In his opening remarks Mr. Ewart said he proposed to make a general review of present day 'Art of Heating' and its form of application. He outlined the progress from the fires kindled by prehistoric man in his cave to the fires burnt in individual grates and furnaces, which were provided with chimneys and flues to take away the burning gases. Due to climatic conditions, possibly greater headway has been made on this continent than abroad, inasmuch as our system for heating provided for a furnace and radiators connected thereto, whilst in most other countries the individual fire grate for heating rooms was still predominant.

By means of a blackboard and chalk the speaker illustrated his various remarks relative to the methods in calculating and obtaining the heat required. The basic consideration is why, and how much heat is required. In the first place it is desirably to keep the house at a temperature of 68° to 75°. (68° for men and 75° for ladies.) The temperature range for Toronto was considerably less than most people believed, and to illustrate this fact the speaker cited the average mean temperatures for five years, as follows: — January 20.7°; February 24.4°; July 70.4°. For the heating season which is usually accepted as October 15th to April 30th, say 6½ months, the average mean aemperature was 32.7°; for the non-heating season of 5½ months the tverage was 63.4°, the difference in range being 30.7°.

In determining the heat required for a building, the method used is to ascertain the amount of heating required for each room individually. In the speaker's opinion, a system carefully designed for zero weather is rarely found to be inadequate. The range for computation purposes may therefore be taken as from zero to 70°.

The heating required for any room is obtained by making a careful mensuration of the wall area, window area, etc., multiplying each by its respective transmission factor, summating these products, which represent heat loss, and adding thereto the quantity of heat required to raise the volume of air contained in the room to a given temperature. The transmission factor represents the B.t.u. per square foot of surface per degree of temperature.

This factor varies for different ranges of temperature, but is not proportional. For instance, if the factor is assumed to be 20 per cent with a difference of temperature of 70°, its value when the range is 50° is 66 per cent of 20, instead of 50/70 of 20, and when the range is 90°, the relation is 138 per cent as against an anticipated increase to 129 per cent.

The speaker said that with a 13-inch brick wall, plain inside and out, 22 B.t.u. per square foot per hour at a 70° range were lost by transmission. The same wall furred and plastered lost 15 B.t.u.; glass, wood sash, lost 75 B.t.u., and glass, steel sash, lost 90 B.t.u.

It was customary to make an exposure allowance in addition, and this is satisfactory for the average house and the older fashioned buildings, but was not suitable for the modern designed structures. This allowance varied from 25 per cent to 30 per cent, for a north exposure; 20 to 25 per cent for west; 15 per cent for east, and 10 per cent for south.

Instead of exposure allowance it is safer to make a leakage allowance for each room for windows and sashes and this would be dependent upon the strength of the wind and the condition of the sash. If there were a 5 m.p.h., wind and the fittings were good, the leakage would be 31 B.t.u.; with a 20 m.p.h., wind and poor fittings the leakage would be 351 B.t.u.

One B.t.u. will heat 55.2 cubic feet of air through one degree, and the heating required therefore to heat any quantity of air supplied, say, for ventilation through a given range of temperature is easily calculated.

Heat is conveyed by means of three media, steam and hot water, which are direct radiation systems, and air which is an indirect radiation system. Radiation is supplied either from pipe coils largely used in factories, and cast iron radiators, which are usually preferred owing to their compactness and neatness. Mr. Ewart explained that radiators gave radiant heat from the ends and convected heat by air circulating through the columns, the convected portion usually being from 58 per cent to 73 per cent of the total. He also stated that a 3 or 4 column radiator emits less heat per square foot than the more simple 2 or single column type, citing the example of a 4-column, 45-inch radiator emitting 205 B.t.u. per square foot, and a 1-column, 23-inch giving 279 B.t.u. per square foot. Wall radiators were very satisfactory, the emission of heat ranging from 295 to 323 B.t.u. per square foot and pipe coils gave as much as 319 to 360 B.t.u. per square foot. The pipe coils gave off so much heat owing to a much larger surface area being exposed to the room.

The speaker explained the three systems of heating, describing the advantages of each. He considered the steam heat to be advantageous for factories, offices, etc., as it will heat up a building fairly fast and is somewhat cheaper. The hot water system has the advantage that it can be used at lower temperatures, and is subject to better regulation. It provides less radiant heat and is therefore more comfortable for residences, hospitals, etc. Hot air heating was an advantage when the building had much glass area and particularly skylight glass, as the system appeared to be more suitable to combat the down drafts of cold air.

In concluding his address, Mr. Ewart expressed the hope that in large centres with a fair density of population, the day will soon come when central heating will be employed, and the benefits of modern science and engineering may be employed. The obstacles to such a system are not engineering or financial, but those of promotion. Heat can be distributed over large areas economically. The plant would have to be co-operative and would supply heat at cost.

Replying to a question put to him, Mr. Ewart stated that the treatment of recirculated air consists of two processes, the first to remove dirt and dust and the second of bringing out a definite degree of purity of carbon dioxide. Fresh air consists of two or three parts of CO_2 per million, and when circulated air has 6 or 7 parts it must be diluted with fresh air to bring it to 4 or 5 parts. The dirt removal can be done through air washers or can be trapped in filters. Mr. Staunton, a visitor to the meeting, spoke with reference to the dehumidification of air which was required for the purposes of making and drying wall paper. He stated that air was received from the duct at a temperature of 130°, with a room temperature of 95°, yet the paper came off the rack wet. R. O. Wynne-Roberts, M.E.I.C., questioned the speaker as to what was the best method of humidifying the air in a room and also explained the central heating in use in Regina. A. G. Dalzell, M.E.I.C., expressed a view and quoted the example where careful insulation of a house had a very appreciative effect upon the coal bill. Considerable discussion arose over the question of central heating and Col. A. D. LePan, A.M.E.I.C., described the system of central heating used at the Toronto University. He stated that in spite of increased coal costs and labour the cost of central heating was only in slight excess of the cost of anthracite heating before the system was installed. G. A. McCarthy, M.E.I.C.; G. M. Winckler, M.E.I.C.; Professor. J. R. Cockburn, M.E.I.C.; J. M. Oxley, M.E.I.C., and J. M. Duncan also took part in the discussion.

Peterborough Branch

R. C. Flitton, A.M.E.I.C., Secretary.

The Fuel Problem

A meeting of the branch, held on October 11th, was addressed by F. A. Combe, M.E.I.C., chairman of the Fuel Committee of *The Institute* and chairman of the Montreal branch of this committee, the subject being "The Fuel Problem".

Mr. Combe has made an extensive study of the question and opened his address with a general review of the sources of coal, discussing the possibilities of each kind with a possible leaning toward the use of bituminous through coking. Various suggestions were advanced by the speaker such as the use of Nova Scotia coal by the province of Quebec, whose demands it would be sufficient to supply, thus releasing an equal quantity of United States coal. A supply of bituminous coal in the United States, practically inexhaustible, could be drawn upon for use in Ontario by means of coking. Economy in the use of coal was advocated, the utilization of water power being recommended wherever available.

The speaker described anthracite as the luxury fuel. Those who felt the burden of the coal bill must look elsewhere for a source of fuel supply. In this connection he spoke of briquettes, bituminous coal, peat, coke and Alberta coal as possible substitutes for anthracite. In concluding his address Mr. Combe suggested that tests be made by *Institute* members to ascertain the relative merits of such substitutes. This meeting was well attended. Chairman Ross L. Dobbin, M.E.I.C., who presided over the meeting welcomed new members.

Electric Arc Welding

An interesting paper on the "Application of Electric Arc Welding" was presented before the branch on October 25th, by J. B. Minns, B.A.Sc., of the Canadian General Electric Company, Toronto. The speaker described various types of equipment for arc welding, showing a number of excellent lantern views of the most modern apparatus. Mr. Minns explained the uses of the automatic, semi-automatic and hand welding apparatus giving the comparative speeds of operation of the different types, their limitations and their possibilities. There are many advantages which the electric arc method possesses over gas welding, cheapness being one of the greatest. A moving picture showing the electric arc apparatus in operation was shown. The meeting was presided over by E. R. Shirley, M.E.I.C.

Annual Banquet

The annual banquet of the branch was held on the evening of November 20th, at the Empress hotel, and was the most largely attended function that has ever been held by this branch.

Among the guests of honour were Walter J. Francis, M.E.I.C., president of *The Institute*, Fraser S. Keith, M.E.I.C., general secretary, D. W. McLachlan, M.E.I.C., chief engineer of the St. Lawrence Ship Canal, de Gaspé Beaubien, M.E.I.C., representing Montreal Branch, J. M. Oxley, M.E.I.C., representing Toronto Branch, J. L. Rannie, M.E.I.C., representing Ottawa Branch, F. S. Lazier, M.E.I.C., representing Niagara Peninsula Branch, T. H. Hogg, A.M.E.I.C., of the Hydro-Electric Power Commission of Ontario, Frederick B. Brown, M.E.I.C., consulting engineer, of Montreal, J. L. Busfield, M.E.I.C., consulting engineer of Montreal, G. N. Gordon, M.P., deputy speaker of the House of Commons, also representatives of the sister professions.

The programme, which was arranged by a committee in charge of E. R. Shirley, M.E.I.C., was run on a time schedule, commencing at 7.30 p.m., with the singing of "O Canada". Branch Chairman, R. L. Dobbin, M.E.I.C., who presided, gave an address of welcome and made a roll call of the guests.

President Walter J. Francis, M.E.I.C., in a short address, congratulated the branch on the reputation it holds throughout Canada. He traced the history of *The Institute* from its origin as the Canadian Society of Civil Engineers to its present position of importance, reminding the members of its objects, which, he trusted, every member of the twenty-four branches was endeavouring to carry out.

General Secretary Fraser S. Keith, M.E.I.C., remarked that it was five years since the first annual dinner was held and during this time the Peterborough Branch has been growing in strength and usefulness. Other branches have been heartened, he said, by the work of the Peterborough members, who have made the most of their opportunities.

J. A. G. Goulet, M.E.I.C., speaking in French, introduced de Gaspé Beaubien of Montreal, repeating his introduction in English.

De Gaspé Beaubien, representing Montreal Branch, replied in French, thanking the chairman for the privilege of being present. Continuing in English, he said he knew from previous experience in Peterborough of the wide-awake branch he would find. Representing the Montreal Branch, with 700 members, he congratulated Peterborough on its achievements in engineering, electrical, hydraulic and mechanical.

D. W. McLachlan, M.E.I.C., was next called upon, and, in the short time at his disposal, proceeded to take his audience from end to end of the proposed improvements on the St. Lawrence waterway, illustrating his address by means of large charts and maps displayed on the wall.

He outlined the scheme in general as it exists to-day, giving estimated costs on the various projects envolved. He also spoke briefly on the opinion of the United States engineers with regard to the best solution of the problem.

T. H. Hogg, A.M.E.I.C., in commenting on the address of the previous speaker, said that the development of the St. Lawrence was of intense interest to the province of Ontario at the present time on account of the urgent need for power. He advocated the development of power at Morrisburg, as being a more expedient means of solving the power problem.

J. M. Oxley, M.E.I.C., conveyed the felicitations of the Toronto Branch. J. L. Rannie, M.E.I.C., brought the greetings of the Ottawa Branch and congratulated the Peterborough Branch on the excellent work done here. F. S. Lazier, M.E.I.C., conveyed the good wishes of the Niagara Peninsula Branch and praised Chairman Ross Dobbin on the splendid speakers he had secured for the occasion.

G. N. Gordon, M.P., voiced his pleasure in the statements made by some of the visitors that so many prominent engineers were either born in Peterborough or received their training here. It is the concensus of opinion in Ontario, he thought, that a solution of the problems affecting the development of the St. Lawrence should be reached as quickly as possible, so that a supply of power to meet the growing needs of the province may be assured. "On both sides of the House," he said, "there is complete unanimity that an early decision should be reached".

The branch sextette was in its usual good form, and entertained the guests with several original numbers, from the pen of W. E. Ross, Jr.E.I.C. The arrangements for the musical part of the entertainment were in the able hands of Paul Manning, A.M.E.I.C., who, in addition to leading the sextette, rendered a solo. "Fred." Brown of Montreal, in his own inimitable way, led in the singing of "Allouette" by the entire assemblage.

The proceedings of the evening closed on schedule time, (11.10 p.m.), with the singing of the National Anthem and Auld Lang Syne.

Ottawa Branch

F. C. C. Lynch, Affiliate E.I.C., Secretary-Treasurer.

At the luncheon held in the Chateau Laurier December 12th under the auspices of the Ottawa Branch of *The Engineering Institute of Canada*, the speaker of the day was Mr. Harold Fisher, K.C., M.L.A. His subject was "Expert Evidence".

Expert Evidence

"Had I known as much about the subject when I was asked to discuss it as I do now," said Mr. Fisher, "I might have hesitated". Had he done so, the engineers would have missed a very enjoyable and educational paper, generously punctuated with humor.

Mr. Fisher protested at the beginning of the address that he had been led to believe that he was to speak to a gathering of engineers. He found himself faced by many of the leading lights in the legal world. He felt that it would be a presumption on his part to offer advice to the engineers on practical points which concerned them in their profession, and to express opinions on legal points to the distinguished justices present. Consequently any remarks he might make on engineering matters would be addressed to the lawyers, and any comments on points of law would be for the ears of the engineers in his audience.

The sum-total of his advice to engineers who might be called upon to act in the capacity of expert witnesses was that given long ago by "Punch" to those about to be married: "Don't." "If it is quite unavoidable, then either stick rigidly to the truth or lie boldly."

"All men are liars," said the Psalmist in his wrath. A lay expert, long after this pronouncement of the Psalmist had said: "There are liars, d— liars — and expert witnesses". Moreover, although the Psalmist had spoken in wrath, the lay expert had uttered his statement after mature deliberation. The same thing had been said over and over again, in language, if not so strong, yet equally positive. In 1843 Lord Campbell had said: "The statements of experts are of slight value". In 1849 Lord Cottenham, the Lord Chancellor of England, had said: "There is no difficulty in procuring professional opinions upon either side. Upon any subject of doubt, any person seeking for pecuniary advantage, to obtain an object by managing, conducting and obtaining the favourable report of professional men, will find no difficulty in procuring such favourable opinions". The difference between expert evidence and that given by the ordinary witness was that the latter was only allowed to say what he had actually seen. His opinion was not accepted as testimony. But the expert evidence consisted, almost entirely of opinions of men, whose profession or studies had placed them in the position to obtain specific knowledge on certain points. Therein lay the reason for the fact that their testimony was often discredited.

Firstly, evidence was given under oath. If a witness as to fact made a false statement, he was liable to prosecution for perjury. An expert witness could not be similarly indicted. He was expressing an opinion only, and as to whether or not he was really giving his honest convictions it was impossible for any human being, even a judge, to decide. He was immune from legal penalty.

This is not all. Expert evidence is sometimes that of persons who live by their business, and in all cases are remunerated for their evidence. It is, then, natural that his mind, however honest, should be biased in favour of the person employing him.

"Many suggestions have been made," said Mr. Fisher, "for the improvement of the situation. Of these the one which has met with most approval is that the court shall call persons selected by the judge, these persons chosen being in addition to any the parties chose to bring themselves. In the Ontario rules of practice there is a provision that the court may obtain the assistance of merchants, engineers, accountants, actuaries or scientific persons in such ways as it thinks fit. There is no similar provision in the Exchequer Court. This plan opens out possibilities, and I am quite satisfied that something along this line will have to be provided in the Exchequer Court in regard to patent legislation."

To the engineer who contemplated becoming an expert witness, he would say "Don't". At all events he would strongly advise the engineer not to become a professional witness. There were too many pitfalls. He quoted from the reminiscences of Baron Brampton, who was once conducting a case in which an expert on handwriting was representing the other party.

An English wag had remarked that "the truth will out — even in an affidavit". His advice to young engineers was that the rules of the game were the same as in other relationships. You were expected to tell the truth. The fact that one is under oath does not lessen one's obligation to tell the truth.

One great essential, before giving expert evidence, was to know upon what subject you were to be examined, said Mr. Fisher. Then you should know what your answers would be, and should see to it that counsel also knew beforehand what your answers would be. If they would prove satisfactory to him, well and good. If not, then he could get someone else. Above all don't place yourself in the position in which you are compelled to hold back something. This will lead to a crisis in which you will find yourself either compelled to leap the fence and lie — or else give evidence that will be injurious to your client's case.

In conclusion Mr. Fisher warned engineers who might be called upon to give expert testimony that their evidence to be of value must be heard. It must be given clearly. Moreover it must be in language that was intelligible to all concerned, particularly to the judge. Finally make your arguments persuasive and do not ruin your clients' case by pretending that you know everything.

"Some cross-examiners," said Mr. Fisher, as he sat down, "win their case by making the witness talk until he hangs himself — even as I have talked to you to-day."

Calgary Branch

J. A. Spreckley, A.M.E.I.C., Secretary.
W. St. J. Miller, A.M.E.I.C., Branch News Editor.

Financial Difficulties in Irrigation Development

On November 26th, D. W. Hays, M.E.I.C., presented to the branch one of the most interesting papers it has been our pleasure to listen to for a considerable time. The paper entitled "Financial Difficulties in Irrigation Development" came at a most opportune time, when it is considered that we are undoubtedly entering upon an era of considerable advance in irrigation problems.

Some sixty members and invited guests were present on this occasion, and an interesting discussion followed at which it was agreed that very definite steps should be taken by way of safeguarding the farmers on irrigation projects against what appears to be an unwarranted hardship suffered under existing legislation regarding the tax sale of lands as noted in the paper.

Much favourable comment has since been expressed respecting the clear presentation by Mr. Hays of the financial difficulties and problems confronting irrigation districts, and it is to be sincerely hoped that steps will be taken as a result to improve the present legislation along the lines suggested.

Water for Boiler Purposes

A regular meeting of the branch was held at the Board of Trade rooms on Monday, December 10th, 1923, when Thos. Lees, A.M.E.I.C., district engineer of the C.P.R., for Alberta, read a paper on the effect of Western Canada water on locomotive boilers. The lecturer dealt exhaustively with the question from the chemical and operating standpoints and much interest was shown in the technical details of boiler design and means taken to obviate the difficulties of scaling and corrosion.

The discussion was led by J. F. McCall, who gave details of his own experience at the Calgary Power Station, and Messrs. R. M. Dingwall, A.M.E.I.C., A. H. Willson, B. L. Thorne, M.E.I.C., and M. H. Marshall, M.E.I.C., contributed to an interesting discussion.

Hamilton Branch

W. F. McLaren, M.E.I.C., Secretary-Treasurer.

A meeting of the Hamilton branch was held on Friday, December 14th, 1923, in the Westinghouse Auditorium.

Much sympathy was expressed for E. R. Gray, A.M.E.I.C., who is seriously ill at his home.

Asbestos Production

J. W. Tyrrell, M.E.I.C., the chairman of the branch, introduced Mr. Bradley, representative of the Johns-Manville Company, who gave a non-technical address on asbestos production, illustrated with moving pictures. Mr. Bradley pointed out that this lecture was not given with any commercial idea. Before the lecture commenced, samples of Canadian asbestos were passed around.

Asbestos is a valuable and unique material and its main qualities arise from the fact that it is both a rock and a fiber. As a rock it has the following characteristics: It has a very high resistance to heat, it is non-inflammable, it is a non-conductor of heat and of electricity, is chemically inert and is very resistant to weather. As a fibrous material it may be spun into thread, woven into cloth, made up into paper, and so forth, and when so treated it still retains its valuable ock characteristics.

The geology of asbestos is somewhat indefinite; it is wrapped in romance and myth. Probably the most satisfactory explanation is that it was deposited by pre-historic volcanic eruption, and fiberized by subsequent heating and cooling.

Asbestos was first mined by the Romans from deposits in the Alps, and was used by them for cremation cloth. It is related that Charlemagne had an asbestos table cloth, and used to entertain his guests by throwing it into the fire.

From this early beginning, the uses of asbestos have grown enormously. Some of the uses of asbestos are as follows: — Paper for roofing, packing, etc., cloth for clothing for fire fighters and theatre curtains. When made into cloth, it is woven as other materials on the same machinery, but usually requires some additional matter for strength, such as cotton. On some theatre curtains, a wire insertion is used.

Eighty-five per cent of the world's asbestos is found in Canada, in vast deposits in the Eastern Townships of Quebec. The limits of these deposits have not yet been determined. Another large asbestos deposit is in Arizona. The Arizona asbestos is very valuable on account of its long fibers, about 2 inches in length, but is very difficult to mine. The Canadian fiber is finer, but very much shorter, averaging from ¼ to ½ inch in length, and with a small proportion of long fiber. In the manufacture of asbestos products, it is necessary to add a certain proportion of the Arizona fiber to the Canadian fiber on account of strength.

Chrysotile is in the heart of the mountains and is 65 miles from the nearest railroad. All the materials used at the mines must be transported this 65 miles by motor truck and burros. Burros are very sure footed animals which hardly ever tumble, and if they do tumble, they roll up into a ball and roll down hill, and so they are practically never hurt. At times in the pictures, it looked as though the burro had walked off the edge of the path. A burro can take a 300-pound load.

On account of the inaccessibility of the Arizona deposits, crude methods of mining are used. It is necessary to drive tunnels into the side of the mountain to recover the asbestos. This fiber is separated from the crushed rock by screening at the mines. The Canadian deposits are of the open-pit type. They use the open-pit mining method and follow up-to-date mining procedure.

It was announced that the next meeting of the Hamilton branch will be held in Brantford in about a month's time. The speaker and subject will be announced later.

Power and Irrigation Schemes in Spain

An ambitious plan for the extended utilization of the water power of the river Ticino and lake Maggiore has been under study for several months. The region affected is one of the richest and most populous in Italy, from both the agricultural and industrial points of view.

A long canal would be constructed to irrigate about 24,000 acres at present untouched, and give a greater water supply to another 36,000 acres now sparsely irrigated. On the Milan bank over 52,000 acres would be brought under irrigation, the water being raised from the bed of the Ticino, which is on the average about 30 metres lower than the land, by means of two water-raising plants, for the working of which 20,000 h.p. would be necessary. It is estimated that the new scheme would yield 55,000 h.p., giving roughly 280,000,000 kw. hours, which would be produced partly by an electric station to be constructed by the side of the barrage, and partly by the enlargement of a station already in existence. The work is estimated to cost 160,000,000 lire.

Public Works in Spanish Morocco

The Military Directory has approved a large programme of public works to be carried out in the Spanish Protectorate zone in Morocco. The total cost of the works is at present estimated at 54,000,000 pesetas (about £1,800,000 at the current rate of exchange) the expenditure of which will be spread over a period of six years. Advances will be made to the government of the Protectorate by the Home Government.

The works in connection with harbours, railways, water supply and drainage will be put up for tender in the Madrid *Gazette* and in the *Official Bulletin* of the Protectorate. Tenders will be solicited for rolling-stock in the same manner. The High Commissioner is authorized to execute the other works by contract or direct administration.

Bangor, Me., Company plans 30,000-Kw., Hydro-Electric Station

Expansion of generating plant facilities by the Bangor, Me., Railway and Electric Company is slated for the near future, according to a statement last week by E. M. Graham, president of the company. Studies have been made for a new thirty thousand kilowatt hydro-electric station and by the early part of January it is expected that the full benefit of dam reconstruction above the present Ellsworth water-power station will be again enjoyed.

Contract for Port Colborne Elevator

The contract for the addition to the government elevator at Port Colborne has been awarded to the E. G. M. Cape Construction Company, Montreal. The capacity of the elevator will be increased by 1,000,000 bushels. Work on the foundations will commence immediately. Lake Erie gravel is being supplied by the National Sand and Material Company, Limited.

Publication

The Federal Department of Health has just issued a brochure on "Sanitation" dealing with the subject of sewage treatment for isolated houses and small institutions where municipal sewage system is not available. The publication is generously illustrated, emphasizing the application of the advice given, and can be obtained free on request from the Deputy Minister, Department of Health, Ottawa.

Well Known Bridge Erector Dies

The death occurred in Vancouver, B. C. of one of the best known bridge erectors in Canada, in the person of James Finley, formerly of Lachine and Vancouver, B. C. He began his long and praiseworthy career with the Hamilton Bridge Company, when he erected for them the Stoney Creek arch in the Rocky mountains. Later on, he associated himself with the Dominion Bridge Company Limited at Lachine, and became their chief erection foreman.

In 1899, he was erector in charge of the interprovincial cantilever bridge at Nepean Point, Ottawa, and afterwards became erection superintendent of the Dominion Bridge Company Limited. Among the notable bridges erected by the Dominion Bridge Company Limited at this time, were those over the St. Lawrence river at Coteau for the Grand Trunk Railway System, and at Lachine for the Canadian Pacific Railway Company, both of which structures presented some very difficult erection problems.

The majority of bridges on the Transcontinental system, including some of the highest steel viaducts in Canada, were erected under his supervision, and five years ago, he left the Dominion Bridge Company to make his home in Vancouver. When he arrived there, he was frequently consulted about erection work and carried on business for the Canadian railways in an independent way. He was engaged by the Canadian Pacific Railway Company, in the erection work of their bridge at Towley, Alberta and it was on this structure that he was seized with what proved to be his fatal illness. C. F. Draper, engineer in charge, took care of him and hoped that by removing him comfortably to his home in Vancouver, his recovery would be assured, but he never rallied, and died on December 11th, a few days after his active and effective work on the bridge.

The late Mr. Finley leaves an enviable and distinguished record in his own particular line, especially in his methods of erection by the floating system. The launching of the large spans of the Lachine bridge, (C.P.R.), in 1913, confronted him with a most difficult problem, but its erection took place on scheduled time and without loss of prestige to the erector who was warmly congratulated by the engineers in charge. He was well known to all engineers throughout Canada, and not only held their admiration and respect, but also enjoyed the affectionate friendliness always extended by those who worked with him, and who knew him as "Reliable Jim".

Canadian Trade Index

The 1923-1924 issue of the Canadian Trade Index, compiled and published by the Canadian Manufacturers' Association, is now available. This volume is issued in four parts. Part one is devoted to an alphabetical list of manufacturers with addresses, branches, export representatives, trade marks and branches. Part two is a directory of the manufacturers of Canada, classified according to articles made, the exporters being distinguished by an asterisk. Part three is a directory of agricultural products and allied lines, giving a list of forwarding agents and export merchants. Part four contains an alphabetical list in French of the headings in part two with parallel English, and in Spanish. A review of the Canadian Manufacturers' Association organization and services is also included, and a list giving figures showing the value of Canadian materials and products, classified under forty headings for 1920. The gross value of goods made in Canada for that year amounted to over four billion dollars.

The primary object of the publishers of this index has been to provide all buyers of manufactured goods with a dependable list of the articles made in Canada and the names of the manufacturers making them. This issue contains approximately twelve hundred new headings, and the names of over two thousand new manufacturing firms, a total of ten thousand five hundred.

The information contained in this volume is a real asset to the people of Canada, and of particular value to the business realm. The Canadian Manufacturers Association is to be congratulated on the excellence of this publication.

Harbour Construction in South-West Africa

The work of constructing a harbour at Walvis Bay is now well in hand, and it is anticipated that by the end of 1923 two or three ships will be accommodated alongside the wharf. A deep channel has been dredged, and the expenditure on the development of the port is expected to amount to three-quarters of a million.

This sum includes the provision of a water supply. The pipe-line has been surveyed and will be about 20 miles long, and will cost approximately £50,000. The only water available at present is condensed sea water, involves an annual expenditure to the South-West African Administration of between £12,000 and £14,000. The present supply is approximately 10,000 gallons a day, but under the new scheme the town will be supplied with 500,000 gallons daily.

Provincial Road Statistics

In a recent statement the Canadian Good Roads Association published the following statistics relative to the expenditures on highways in the various provinces.

Province of Manitoba

The amounts expended by the province of Manitoba for road work performed under the operations of the Good Roads Act of the province, as compiled by A. McGillivray, A.M.E.I.C., highway commissioner, are as follows:

Year	New Construction	Maintenance
1920	$2,452,694.00	$15,600.00
1921	2,514,464.82	22,500.00
1922	1,682,205.16	28,218.00
1923	883,320.00	45,000.00

Total road mileage	74,000 miles
Mileage open for traffic, approximately	25,600 miles
Mileage improved to end of season 1922 under the Good Roads Act of the province	3,050 miles

NOTE: — The above expenditures represent the amount spent on roads improved by the province and the various municipalities under the provisions of the Good Roads Act, only. No record is available in the provincial department of the amount spent for construction or maintenance annually, by the rural municipalities on other roads.

The expenditures above given for maintenance represent the amount spent in improving such roads that have been designated as provincial highways and towards which the province assumes two-thirds of the cost of maintenance.

Expenditures for 1923 are to August 31st.

Province of Ontario

G. C. Parker, A.M.E.I.C., departmental secretary of the Department of Public Highways of Ontario, supplies the following information regarding expenditures on roads in that province:

County roads.	1920	1921	1922
Counties' share	$3,443,137.35	$4,581,270.22	$3,666,935.34
Provincial grants	2,295,424.90	3,054,180.25	2,444,623.50
Total	5,738,562.25	7,635,450.47	6,111,558.84
Provincial county roads.			
Counties' share	887,345.27	1,377,135.18	1,269,187.12
Provincial grants	1,331,017.90	2,065,702.74	1,903,780.64
Total	2,218,363.17	3,442,837.92	3,172,967.76
Township roads.			
Townships' share	1,327,190.34	2,757,363.42	2,780,776.02
Provincial grant	340,973.38	708,486.91	722,813.24
Total	1,668,163.72	3,465,850.33	3,503,589.26
Provincial highways.			
Counties' share	990,753.88	2,000,228.70	2,447,198.95
Province's share	3,963,016.23	8,000,914.78	9,788,795.83
Total	4,953,770.11	10,001,143.48	12,235,994.78

Summary for 1920, 1921 and 1922.

Total expenditure	$64,148,252.09
Counties and townships	27,528,521.79
Province	36,619,730.30

The mileage of travelled roads in the southern portion the province, i.e. the part covered by county and township organization, is 49,875.7. The total mileage of improved roads up to the end of 1922 was approximately 28,000, or 56 per cent of the total road mileage".

Province of Quebec

J. L. Boulanger, deputy minister of highways for the province of Quebec, forwards the following succinct statement showing in round figures the total amounts expended by the province for road work in the years given:

Year	New Construction	Renewals	Maintenance	Total
1919-20	$ 3,700,000	$ 100,000	$1,000,000	$ 4,800,000
1920-21	5,350,000	200,000	1,000,000	6,550,000
1921-22	5,300,000	165,000	875,000	6,340,000
1922-23	5,800,000	1,600,000	1,100,000	8,500,000
1923-24 (anticipated)	5,600,000	1,900,000	1,300,000	8,800,000
Total	$25,750,000	$3,965,000	$5,275,000	$34,990,000

Total road mileage, province of Quebec.... 45,000 miles

Total road mileage improved in the province of Quebec up to 1922:

Earth roads	15,000 miles
Gravel, macadam, concrete, etc	4,660 miles

Province of Alberta

J. D. Robertson, A.M.E.I.C., deputy minister of roads for the province of Alberta, supplied the following information:—

Year	Construction	Maintenance	Total
Roads			
1920	$ 651,615.22	$313,992.53	$ 965,607.75
1921	1,294,883.78	115,842.83	1,410,726.61
1922	569,747.90	57,395.43	627,143.33
1923 (estimated)	250,000.00	130,000.00	380,000.00
Bridges			
1920	518,196.65	....	518,196.65
1921	602,048.58	76,017.73	678,066.11
1922	501,899.52	52,724.63	554,624.15
1923 (estimated)	310,000.00	45,000.00	355,000.00
Ferry service			
1920	22,673.18	64,336.53	87,009.71
1921	69,495.24	22,177.66	91,672.90
1922	7,085.07	60,507.50	67,592.57
1923 (estimated)	12,500.00	62,500.00	75,000.00

Miles of continuously graded road	16,000
Miles of road improved and opened for traffic but not continuously graded throughout	28,500
Miles of prairie trail	15,500
Miles of legal road allowance in the settled portions of the province not yet opened for traffic	80,000
Total mileage in the settled portions of the province only	140,000

Province of Nova Scotia

R. W. McColough, chief engineer of the provincial Highway Board, reports as follows on highway construction in the province of Nova Scotia:

Year	Expenditure on roads reconstructed to Dominion aid standard	Expenditure on roads reconstructed solely with provincial funds	Maintenance	Totals
1920	$ 888,737.26	$1,300,620.15	$ 748,504.61	$2,937,862.02
1921	1,387,234.79	724,572.71	591,517.11	2,703,324.61
1922	1,534,578.08	529,697.97	530,437.67	2,594,713.72
1923	1,300,000.00	360,000.00	1,350,000.00	3,010,000.00
Grand total				$11,245,900.35

NOTE: — The above amounts do not include monies expended for construction and maintenance of bridges and culverts.

Total mileage of D. A. roads constructed and under construction at Dec. 31st, 1922	467.67 miles
Approximate mileage 1923 programme	200.00 "
Total mileage Dominion aid roads	667.67 "
Provincial loan mileage constructed (1920)	1,318 miles
" " " " (1921)	500 "
" " " " (1922)	633 "
" " " proposed (1923)	300 "
" " total mileage (reconstructed)	2,751 "
Total mileage of all roads, province of Nova Scotia	15,000 miles

Province of Prince Edward Island

H. H. Shaw, A.M.E.I.C., chief engineer, forwards the following report on the total amount expended by the province of Prince Edward Island for road work:

Year	New Construction	Renewals	Maintenance	Total
1920	$ 105,527.12	$ 44,423.48	$ 85,363.96	$ 235,314.56
1921	288,479.55	39,742.43	88,301.85	416,523.83
1922	289,656.15	18,258.42	78,979.25	386,893.82
1923 (anticipt'd)	250,000.00	20,000.00	92,000.00	362.000,00
Total road mileage				3,650 miles
Total road mileage improved				300 miles

Province of British Columbia

The total amount expended by the Province of British Columbia for road work, as reported by J. Philip, public works engineer, is given hereunder:

Year	New Construction	Renewals and Maintenance	Total
1920-21	$1,487,624.57	$1,494,473.57	$2,982,097.14
1921-22	1,620,018.73	1,273,682.70	2,893,701.43
1922-23	1,875,495.40	1,407,589.59	3,283,084.99
1923-24 (anticipated)	2,015,000.00	1,326,500.00	3,341,500.00
Total road mileage province of British Columbia			15,969.31 miles

Province of New Brunswick

B. M. Hill, M.E.I.C., provincial road engineer for New Brunswick, furnishes these figures showing the total amounts expended by the province of New Brunswick for road work:

1920	New Construction	Maintenance	Total
Roads	$1,340,000	$ 407,000	$1,747,000
Bridges	550,000	322,000	872,000
1921			
Roads	1,220,000	410,000	1,630,000
Bridges	730,000	370,000	1,100,000
1922			
Roads	860,000	290,000	1,150,000
Bridges	400,000	265,000	665,000
1923	Not compiled.		

Total mileage province of New Brunswick	15,000 miles
Trunk roads	3,600 "
Byroads	11,400 "
Total road mileage improved, prov. of N. B.	5,000 "
Trunk roads	2,000 "
Byroads	3,000 "

Province of Saskatchewan

H. S. Carpenter, M.E.I.C., deputy minister of highways for the province of Saskatchewan, supplied the following information of the expenditure of the Department of Highways for the years 1920, 1921 and 1922, and the estimated expenditure for the year 1923. These expenditures include the construction, renewal and maintenance of roads and bridges and the ferry system, and also cover the surveying of new and old roads:

1920	$1,689,780.00
1921	2,389,018.00
1922	2,098,000.00
1923 (estimated)	2,118,000.00

With regard to expenditure upon maintenance; from the above sums it may be said that the Department expends $400,000 per annum on maintenance of roads, bridges and ferries.

ROAD MILEAGE

Provincial highway system	7,000 miles
Main market roads	25,000 miles
Lateral and feeder roads	170,000 miles

The estimated total of the provincial highway system completed by the end of 1923 was 1,075 miles. Practically the whole of the main market road mileage is improved.

Canadian Engineering Standard Association

Meeting of Main Committee

A meeting of the Main Committee of the Canadian Engineering Standards Association was held in Ottawa on November 5th, under the chairmanship of H. H. Vaughan, M.E.I.C.

The committee unanimously approved of the formation of a sub-committee to prepare specifications for steel structures for buildings, the members of which are being nominated by *The Engineering Institute of Canada*, the Royal Architectural Institute of Canada, the steel fabricating companies, and other bodies interested. It will be the duty of this sub-committee to prepare specifications similar in scope to the C.E.S.A., specifications for railway and highway bridges, but dealing with steel structures for buildings, and it is hoped that such specifications, if agreed upon by all concerned, may eventually be adopted by public and municipal bodies engaged in the formulation of building codes in Canada. Arrangements are being made to provide for this sub-committee as full information as possible concerning the activities of the bodies now engaged in similar work in the United States.

A report of the proceedings of the conference called by the Minister of Trade and Commerce, held in Ottawa in May, on which representatives from the various provinces sat to consider the best method of procedure looking to the eventual formation of a Canadian Electrical Code governing the manufacture and installation of electrical fittings and appliances, was presented. After discussion, the report was approved, and in accordance with its recommendations, it was decided to proceed at once with the formation of a C.E.S.A., committee on Canadian Electrical Code, on which the various provincial governments will be asked to name representatives, this Committee being empowered to arrange for the formation of the necessary provincial or local sub-committees to deal with the situation as it exists in the various provinces and cities of the Dominion.

Attention was drawn to the forthcoming World Power Conference, which is to be held in London in 1924, and the committee expressed its hearty support of this project, and directed the Secretary to assist as far as possible in the formation of the National Committee for the Dominion of Canada, which is being organized under the direction of the deputy minister of the Interior.

Announcement of Meeting

Further information may be secured from the Secretaries of the various branches, whose addresses will be found under "Officers of Branches" on page 2 of *The Journal.*

Peterborough Branch:—

Secretary, R. C. Flitton, A.M.E.I.C.

Jan. 10th. Address on "Town Planning", by H. L. Seymour, M.E.I.C., Town Planning Engineer, Toronto, Ont.

Jan. 24th. Lecture on some subject in connection with steam boilers, by T. H. Fenner, A.M.E.I.C., chief engineer, General Accident Assurance Company, Toronto, Ont.

Feb. 6th. Address on "Asphalt and its Uses in Highway Construction", by G. C. Graham, district engineer of the Asphalt Association.

Feb. 28th. Address on "The Testing and Inspection Work of the Hydro-Electric Power Commission of Ontario", by W. P. Dobson, M.E.I.C., laboratory engineer, H.E.P.C., Toronto.

Winnipeg Branch:—

Secretary-Treasurer, P. Burke-Gaffney, A.M.E.I.C.

Jan. 3rd. Address on "The Composition of Matter", by Rev. Father Morton.

Jan. 17th. Annual Meeting — Association of Professional Engineers.

Feb. 7th. Address on "Electric Steam Boilers", by Mr. De Kermor.

Feb. 21st. Address on "Mechanical Equipment of Packing Houses", by W. J. Cummings.

Saskatchewan Branch:—

Secretary-Treasurer, D. A. R. McCannel, A.M.E.I.C.

Jan. 10th. Address on "The Hudson Bay Route", by J. A. Campbell, Commissioner Northern Manitoba.

Jan. 24th. Joint Meeting with Engineering Society of University of Saskatchewan by telephone. Address to be delivered in Saskatoon.

Feb. 7th. Address on "The Coal Fields of Saskatchewan, the Advantages and Disadvantages of Generating Power at Pit Head", by J. B. Hamilton, A.M.E.I.C., town engineer, Estevan, Sask.

Feb. 21st. Short addresses by several members.

Toronto Branch:—

Secretary, J. A. Knight, A.M.E.I.C.

Jan. 3rd. No meeting.

Jan. 10th. Address on "Public Health Machinery of Canada", by Dr. J. A. Amyot, Deputy Minister of Health, Canada.

Jan. 17th. Address on "Public Speaking for Engineers", by Professor W. H. Greaves, Victoria College. Professor Greaves instructs students in Victoria College and in the Faculty of Applied Science and Engineering of the University of Toronto, in the art of public speaking.

Jan. 24th. Address on "Recent Northern Expeditions", by John D. Craig, M.E.I.C., officer in charge of Arctic Expeditions, Department of the Interior, Canada. Illustrated by moving pictures

Jan. 31st. Address on "The Great Lakes and a Few of the Structures Thereon", by Lt.-Col. H. J. Lamb, D.S.O., M.E.I.C., supervising engineer for the province of Ontario, Department of Public Works of Canada. Illustrated.

Niagara Peninsula Branch:—

Secretary, R. W. Downie, A.M.E.I.C.

Jan. 9th. Dinner meeting at the Hotel Reeta, Welland. "A Series of papers on Electrical Subjects."

Feb. 1st. Annual Dance at Niagara Falls.

Feb. 12th. Dinner meeting at the Welland Inn, St. Catherines, "Asphalt Paving," by Germain P. Graham, of the Asphalt Association.

Investigation Commission on Compensation in Labour Accidents

The Government of the Province of Quebec, under the authority of the Act 13 George V, chapter 38, has recently created a Commission charged with the duty of inquiring into the conditions of labour in this Province with regard to compensation in labour accidents.

The Commissioners have begun their investigation, and has invited all persons, syndicates, associations, companies, or organizations whatsoever to communicate by writing the suggestions and remarks which they might deem opportune in order to render the legislation on this matter as perfect as possible. With this end in view the commission has addressed a letter and a questionnaire to a large number of persons and associations.

There is a possibility of the commission not reaching all those desirous of being heard. It would be happy to receive communications even from those who have not been specially invited to give any.

Copies of the letter and questionnaire may be secured on application to the secretary, Alf. Crowe, 415 St. Paul Street, Quebec.

RECENT PUBLICATIONS

Transactions, Proceedings, Etc.

Presented by the Societies.

Proceedings of the American Society of Civil Engineers, Volume XLIX, No. 10, December 1923.

Transactions of the American Society of Civil Engineers, Volume LXXXVI, 1923.

Proceedings of the Engineers' Society of Western Pennsylvania, Volume 39, No. 8, November 1923.

Transactions of the Institution of Engineers and Shipbuilders in Scotland, Volume LXVI, 1922-1923.

Transactions of the Engineering Association of Malaya, Volume II, 1922.

Scientific Proceedings of the Royal Dublin Society, December 1922, Nos. 11-13, February 1923, Nos. 14-19, June 1923, Nos. 20-24 and August 1923, Nos. 25-31.

Reports

Presented by British Cast Iron Research Association.

Bureau Bulletin of the British Cast Iron Research Association, Volume 1, No. 2, April 1923.

Presented by Natural Resources Intelligence Service, Department of the Interior, Canada.

Canada. Natural Resources and Commerce.

Presented by Dominion Bureau of Statistics, Canada.

Statistics of Steam Railways of Canada, for the year ended December 31, 1922.

Presented by Department of Public Works, Province of British Columbia.

Report of the Minister of Public Works of the Province of British Columbia for the fiscal year 1922-1923.

Presented by la Sociedad Cubana de Ingenieros, Cuba.

Census of the Republic of Cuba, 1919.

Presented by United States Geological Survey, Dept. of the Interior.

Outline of Ground-Water Hydrology with definitions. Water-Supply paper 494.

Reports for 1922 on clay; talc and soapstone; tin; platinum and allied metals; potash; phosphate rock; gypsum; silver, copper, lead and zinc in the Central States, and for coal in 1919, 1920 and 1921.

Presented by Bureau of Standards, Department of Commerce, Washington, D.C.

United States Government specification for water-resisting red enamel, specification No. 66, and for leather belting, specification No. 37.

Sources of Elementary Radio Information, circular No. 122, September 12, 1923.

A Study of Radio Signal Fading, scientific paper No. 476, September 25, 1923.

Tests of Heavily Reinforced Concrete Slab Beams: Effect of Direction of Reinforcement on Strength and Deformation, technologic paper No. 233.

Some Compressive Tests of Hollow-Tile Walls, technologic paper No. 238.

Tests of Caustic Magnesia Made From Magnesite from Several Sources, technologic paper No. 239.

Detector for Water Vapor in Closed Pipes, technologic paper No. 242.

Visibility of Radiant Energy, scientific paper No. 475.

Presented by Bureau of Mines, Department of the Interior, Washington, D.C.

The Electrothermic Metallurgy of Zinc, by B. M. O'Harra, bulletin No. 208.

Bibliography of Petroleum and Allied Substances, 1921, by E. H. Burroughs, bulletin No. 220.

Manual for Oil and Gas Operations, by T. E. Swigart and C. E. Beecher, bulletin No. 232.

Smoke Abatement, technical paper No. 273.

Water-Gas Tar Emulsions, technical paper No. 304.

Leaching Nonsulphide Copper Ores with Sulphur Dioxide, technical paper No. 312.

Tests of a Powdered-Coal Plant, technical paper No. 316.

Technical Books.

Presented by Chapman & Hall, Limited.

Engineering Science, by Arthur G. Robson, A.M.I. Mech. E.

Presented by John Wiley & Sons, Incorporated.

Kent's Mechanical Engineers' Handbook, by the late Wm. Kent, M.E., Sc.D., tenth edition, re-written by Robert Thurston Kent, M.E., editor-in-chief and a staff of specialists.

Elementary Steam Power Engineering, by Edgar MacNaughton, M.E.

Technical Writing, by T. A. Rickard, 2nd edition, re-written and enlarged.

Elementary Surveying, by Charles B. Breed and George L. Hosmer, volume 1, fifth edition.

Elements of Engineering Thermodynamics, by James A. Moyer, James P. Calderwood and Andrey A. Potter, 2nd edition revised.

Machine Design Drawing Room Problems, by C. D. Albert, M.E.

Elements of Machine Design (Second edition)

By Dexter S. Kimball and John H. Barr.

Reviewed by Arthur H. Roberts, M.Sc., A.M.E.I.C.

This book is the outcome of the teaching experience of the authors who are acknowledged authorities on the subject of machine design.

The book is primarily a text-book intended for the use of students and teachers, noteworthy features being the stress laid upon the fundamental principles of design, the discussions by the authors of practical considerations in design and the free use of illustrative examples worked out in the text.

While it is assumed that the reader has a knowledge of the mechanics of materials and machines, the first two chapters following the introduction are devoted to these subjects and the last chapter, which occupies but eight pages, deals with the elements of balancing. The emain sixteeꝫuın chapters are devoted to machine design, the topics ncluding friction and bearings, shafts, springs, pipes, fastenings, toothed gearing, belts, ropes, chains, flywheels, rotating disks, and machine frames.

In the revision of the first edition the authors have made few additions or changes with the exception of the adoption of a more logical arrangement of the subject matter.

The book is published by John Wiley & Sons, Inc., New York.

Automatic Sprinkler Protection

By Gorham Dana, S.B.

Reviewed by Donald Ross-Ross, A.M.E.I.C.

The library of the Institute has been presented by the publishers, John Wiley and Sons Inc., with a copy of the third edition of "Automatic Sprinkler Protection" by Gorham Dana.

The book, which is of especial interest to engineers as well as those men associated with fire insurance, gives an historical sketch of the progress of sprinkler protection from the perforated pipe system up to the present day highly efficient head. Mr. Dana gives a brief description of the multitude of heads that have been patented, pointing out the best features and defects of each. The various insurance regulations regarding installations and testing of heads are thoroughly gone into, and suitable layouts for various building conditions pointed out. Other important features of fire protection and detection, alarm valves, dry valves, supervisory systems, are fully described.

Some of the most interesting sections in the book are those containing statistical comparisons between fires in buildings with sprinkler protection and those without.

Mr. Dana is manager of the Underwriters' Bureau of New England and writes from a vast amount of experience. His book, which appeared in its first edition in 1914, was revised in 1919 and finally brought up to date in this third edition, is exceedingly interesting throughout and would well repay anyone his time to read it.

Trade Publications

Link-Belt Limited has issued a new book, No. 660, on chain and chain application which should be of particular interest to pulp and paper and saw mill operators. It is well illustrated and in its 128 pages is to be found useful information describing the various types and classes of chains used in this industry. In addition it covers, briefly, such equipment as the electric hoist, locomotive and crawler cranes, belt conveyors, coal handling equipment, log stackers, sprockets, clutches, etc. Copies may be secured from the Link-Belt Company, 910 S. Michigan Ave., Chicago.

Fulton Iron Works Company Inc., St. Louis, Mo., have recently issued a new catalogue, No. 805, describing Fulton-Diesel engines. This catalogue has been prepared in a very attractive form with a considerable number of large illustrations and diagrams.

"Wave Transmission of Power."

A reprint of an article published in The Engineer, London, England, describing the wave transmission of power has been prepared for circulation. Copies of the same may be secured upon application to Mr. Walter Haddon, c/o John Haddon & Company, Salisbury Square, Fleet Street, London, E.C. 4.

CORRESPONDENCE

Employment Service Appreciated

The Engineering Journal.

Dear Sir:—

We wish to thank you for your co-operation in assisting us to obtain some mechanical men through your engineering Journal. We were able to employ one man through this medium and have found his services very satisfactory.

We believe that engineering firms in Canada should use your Journal more frequently and hope that you may be able to develop this phase of your work.

Thanking you again for your courtesy in this regard, we are,

Yours very truly,
Dominion Bridge Company Limited,
(Signed) ALEXANDER PEDEN,
Chief Draughtsman.

Measurement of Flow of Water in Closed Conduits.

An interesting article by Norman R. Gibson, M.E.I.C., hydraulic engineer, the Niagara Falls Power Company, describing the Gibson method and apparatus for measuring the flow of water in closed conduits, appears in the December issue of Mechanical Engineering.

The purpose of the paper is to elucidate a new method of determining the rate of discharge or quantity of water flowing in a pipe or other closed conduit, and to describe the apparatus used for the practical application of this method in testing the efficiencies of water wheels in hydro-electric plants. The procedure in the field is explained, as well as the manner of recording, delineating, and measuring the pressure-time diagram from which the discharge is calculated.

Prince Rupert, B. C. to have new Pulp Mill

The Emerson timber limits and saw-mill in the vicinity of Prince Rupert, B.C., has been taken over by the Prince Rupert Sulphite Fibre Company, Limited, which was organized recently for this purpose. The company has had plans prepared for a ninety-ton bleached sulphite pulp mill and the machinery for the plant has been ordered. It is expected that it will be seven or eight months before the machinery will arrive, and in the meantime the work of constructing eight reinforced concrete buildings to house the plant will go ahead, so that they may be ready for the machinery when it arrives.

Power Development on Rivière du Loup

A possible power development in the near future is that on the Rivière du Loup, county of Maskinonge, about seventy miles north east of Montreal. The site is located near St. Paulin, in the county of Maskinonge, and involves the construction of dam and power house to produce 21,000 horse power, which could be considerably augmented by later extensions.

Power Company changes Name

The name of the Central Quebec Power Company is being changed by supplementary letters patent to the Algonquin Power Company. This change follows the recent announcement in the Quebec Official Gazette to the effect that the capital of the company had been increased from one million to two million dollars.

Island Portage Transmission Line Tenders Called

The Hollinger Consolidated Gold Mines have called for tenders for construction on their Timmins sub-station. Tenders are also wanted on the erection of the steel tower transmission line from Island Portage to Timmins. The work on the Hollinger power development at Island Falls has been greatly facilitated by the lateness of the cold weather, and it is reported that the dam will be completed in ample time to permit of the installation of equipment before the end of nineteen twenty-four.

Construction of Section 8, Welland Ship Canal

Tenders are being called for the construction of Section 8, Welland Ship Canal, by the Department of Railways and Canals, and will be received until January 15th, 1924. Plans, specifications and form of contract to be entered into can be seen at the office of the chief engineer of the Department of Railways and Canals, Ottawa, and at the office of the engineer in charge, Welland Ship Canal, St. Catharines, Ont.

Canadian Highway Association

The Canadian Highway Association, an active body of good roads supporters, has the custody of a gold medal to be presented to the first motorist who makes the journey from Halifax to Victoria, B. C., on the Canadian side of the international line. It has been presented by Alderman A. E. Todd, of Victoria, a pioneer in the world of horseless traction, who was the pathfinder of the Pacific Highway, that wonderful paved road over 1,680 miles long which stretches from Vancouver, B. C., through the States of Washington, Oregon and California, to the state line at Tia Juana in lower California. That great enterprise took 13 years to complete. It may be that the motorist will yet be able to travel from Halifax to the Pacific Coast without touching American territory, by plain and forest, stream and mountain to claim this award.

With the anticipated construction of the last link in the trans-provincial highway in British Columbia, either through the Hope mountains 100 miles east of Vancouver, which form a spur of the Coast range, or by way of the historic Fraser canyon, communication will be established with Winnipeg by road. As the Winnipeg-Kenora work is steadily progressing, and efforts are being made to connect with Fort William, only the great loop along the North of Lake Superior will remain to be constructed.

Jetty Construction at Vancouver

Contracts for the construction of grain-carrying jetty for No. 1 elevator, at Vancouver, B.C., have been awarded to Northwest Dredging Company for dredging and the Pacific Construction Company for substructure. The construction work will commence at once. The cost of the jetty will be in the neighbourhood of six hundred thousand dollars.

The county of Peterborough have called for tenders for the construction of a concrete arch bridge at Lakefield, Ontario. The bridge is to consist of two open spandrel arch spans of 109 feet and 84 feet with 20-foot roadway and one 6-foot sidewalk, the total estimated quantity of concrete being 658.3 cubic yards.

Construction Costs from Wentworth County, Ontario

At the meeting of the Wentworth County Council on the 11th inst., Major Hugh Lumsden, M.E.I.C., county engineer, presented his first annual report. He surprised the councillors by furnishing each with a copy, complete with maps and pictures artistically arranged. Costs were very favourable, some of the items being: — Concrete at $2.32 per square yard, stone $1.60 to $1.85 per ton, gravel 50 cents to $1.90 per cubic yard, according to haulage, concrete in place in bridges and culverts $10.50 to $16.50 per cubic yard. The engineer's automobile cost 8 cents per mile, and travelled 12,300 miles.

A traffic census taken in October showed that in one day 701 vehicles drove over the Stoney Creek road, 440 over Barton street, 124 on the Greensville road, 443 on the Guelph road detour, and 176 on the Tapleytown road.

Construction of Water Purification Plant

The Essex Border Utilities Commission, of which J. Clark Keith A.M.E.I.C., is chief engineer, has called for tenders for the construction of a water purification plant in Ford City, Ont. The contracts for which these tenders have been called are:—

(a) Construction of reinforced concrete filters, coagulating basins, pure water reservoir, office building, etc.
(b) Supplying 42″ diameter steel pipe.
(c) Supplying cast iron pipe and specials.
(d) Supplying valves and sluice gates.
(e) Supplying rate controllers and operating tables.

Canada's Position in Power Development

An interesting comparison of water power and fuel power developed, and the use of electricity per capita, in Canada and the United States, has been published by the Department of the Interior, Ottawa, quoting statistics recently published in the United States with the exception that the Canadian figures are slightly modified to correspond with the final figures of the last Census of Population and the final figures of the last Census of Central Stations.

	Canada	United States
Total electric output in kilowatt-hours per head of population	683	472
Dwellers in electric lighted abodes in per cent of total population	37.1	36.8
Water power developed in horse-power per 1000 of population	338	90
Hydro-electric *v.* fuel plants:—		
Water power, per cent of total	88.1	23.7
Fuel power, per cent of total	11.9	76.3

The output of electric energy in kilowatt hours per capita for the countries leading in this respect stands as follows: Switzerland, 700; Canada, 683; Norway, 493; United States, 472; Sweden, 364.

Ile Perrot-Vaudreuil Second Bridge

Tenders will be called soon for the construction of a second bridge between Ile Perrot and Vaudreuil.

The second bridge will be larger than the first, which has just been completed, and will measure some fourteen hundred feet in length.

Rebuilding Great Western Railway Station at Swansea

The rebuilding of the Great Western Railway High-street Station at Swansea, estimated to cost about £350,000, is to be started immediately. The rebuilding will require about three years, and a number of other extension and improvements, which will cost £150,000 to to £200,000 more, are included in the scheme. One contract, representing about £67,500, has already been placed, and others will be let early next year.

Water Power Schemes in Northern Wales

Interest is given to the schemes for water power in northern Wales by the announcement that the government is prepared to give guarantees under the Trade Facilities Act in connection with the raising of the capital required, amounting to £1,600,000. It is believed that the schemes for the great dam at Trawsfynydd, Merionethshire, and other works will give employment to about 2,000 men for three years at least. The water is to be utilized to generate electricity, and, in addition to the generating plant, the scheme involves the construction of some 600 miles of transmission lines to supply the whole of North Wales and part of Cheshire. One line will be about 100 miles long, and will carry current as far as Crewe.

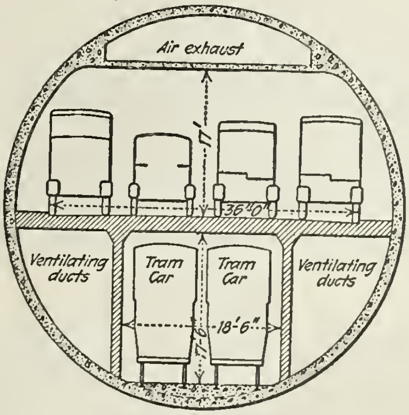
Dawson Valley Irrigation Project in Australia

The Queensland Parliament has approved of the Dawson Valley irrigation undertaking, estimated to cost approximately £1,968,000.

The scheme comprises a main storage dam, starting in the Dawson river at Nathan Gorge, which will impound 2,480,000 acre-feet of water. The water will be carried from the dam by gravitation along the natural bed of the river to Delusion creek, 27 miles from the dam site, where the irrigable land begins. From a weir at Delusion creek the water will ve diverted by main and lateral channels over the whole area. In connection with the dam it is proposed to establish an hydroelectric plant to be operated by the water as it comes from the sluices.

Tunnel to Connect Liverpool and Birkenhead, England

The consulting engineers in connection with the project for a highway tunnel under the river Mersey to connect the cities of Liverpool and Birkenhead, England, are Sir Maurice Fitzmaurice, M.E.I.C., Basil Mott and John Brodie. The projected tunnel provides for a single bore forty-four feet inside diameter. It would be located a little downstream from the Mersey Railway tunnel, and would have a river length of about four thousand feet with long approaches or grades of five per cent for light traffic and street cars and three per cent for a lateral approach carrying heavy traffic of the docks district. At the centerline of the tunnel section would be a thirty-six-foot deck wide enough for four lines of vehicles and two narrow sidewalks. Two supporting walls for this deck would form a central section for street cars and two side sections for ventilating ducts. About seventeen feet above the upper deck would be a flat roof or ceiling forming an air exhaust duct along the top of the tunnel. It is proposed to have a cast-iron shell with interior concrete lining and with grout pumped to fill all exterior voids. The total cost is estimated at thirty-two million dollars.



PROPOSED MERSEY RIVER TUBE

Report of the Oxygen Research Committee

The Department of Scientific and Industrial Research, Westminster, London, S.W.1, have issued a report describing certain aspects of the work of the Oxygen Research Committee since its appointment in 1919. The subject matter of the report is arranged under the following principal headings: — Part 1, The Storage of Liquefied Gases; Part 2, The Manufacture of Metal Vacuum Vessels for Liquefied Gases; Part 3, Vacuum Vessels in Use; Part 4, The Transport of Liquefied Gases and Compressed Gases; Appendix; Index.

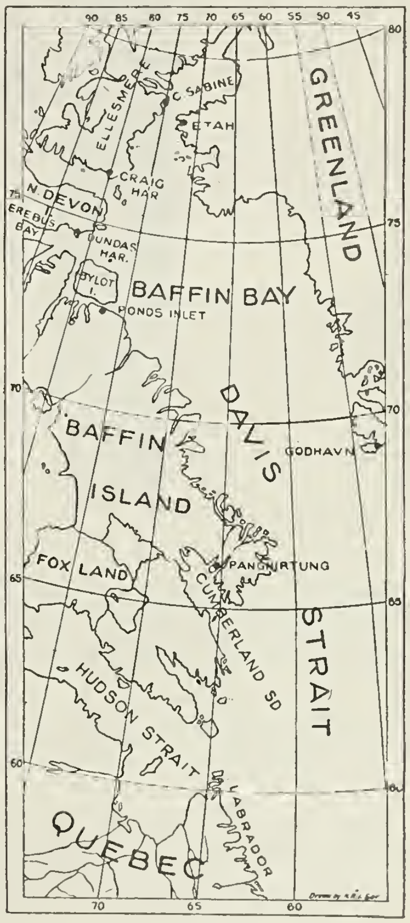
C. G. S. Arctic Returns from Annual Cruise

The 1923 expedition to the Canadian Arctic archipelago, organized by the Department of the Interior through its North West Territories and Yukon Branch, has returned, and J. D. Craig, D.L.S., M.E.I.C., officer in charge, reports that with one exception the several objects with which the party set out were accomplished and the expedition was very successful. Ice conditions prevented the making of a landing at the site of the proposed post at cape Sabine, Ellesmere island, and next year's expedition along with its other work will probably again attempt the establishment of this post.

The work accomplished by this expedition, which made the voyage on board the famous old steamer, *Arctic*, included the establishment of a Royal Canadian Mounted Police post at Pangnirtung, on Cumberland sound, Baffin island; the transporting of relief police parties and supplies to Craig Harbour, and Ponds Inlet; the conviction and sentence of two of the three Eskimos charged with the murder in March, 1920, of the Newfoundland trader, Robert S. Janes; visits to Godhaven and Etah, on the west coast of Greenland; together with the completion of numerous surveys and comparisons of previous observations.

The men at the posts were found to be in excellent health and spirits, and several members of the police detachments volunteered for a year in addition to their regular two-year service period in the north.

The expedition covered about 7,250 miles during its three months absence and in that time it reached a point 78 degrees, 47 minutes north latitude, which is some 250 miles farther north than was attained by last year's expedition.



C. G. S. Arctic 1923 Cruise.

Addresses Wanted

Any information regarding the addresses of members on the list printed below will be greatly appreciated by the Secretary.

Members
Aitken, F. X.
Allison, J. L.
Canniff, C. M.
Fellows, A. C.
George, F. J.
Macdonald, Chas.
Macpherson, O. C.
Ord, L. R.
Press, W. J.
Welch, Arch.

Associate Members
Adam, Wm. A.
Avery, Chas. R.
Bell, Chas. B.
Bene, E. M.
*Bishop, Reg. W.
Borland, V. J.
*Bowie, Jas.
*Butler, G. A.
Butler, J. K.
*Caddell, W. P.
Campbell, Neil
Chown, R. C. F.
Clarke, Frederick
Clarson, A. S.
Collingwood, Cuthbert
Coltman, Walter J.
Dale, W. P.
Davis, F. M.
de Lestang, Paul L. G.
*Donaldson, J. M.
Earl, E. A.
Flood, J. G.
Gorrie, D. F.
Graham, D. A.
Habben, L. E.
Hamilton, G. M.
Harries, J. F.
Hay, N. K.
Hay, Wm. W.
Hebert, H. F.
Herren, P. H.
*Hodgson, H. M. T.
Jamieson, W. T.
Laniel, J. A.
Lepage, J. S.
Lillico, R. S. B.
Lockhart, W. S.
Macdonald, C. A.
Macdonald, John
*Mackenzie, John A.
*MacLachlan, J. B.
*MacLennan, A. L.
Martin, L. A.
McDonald, N. G.
McDiarmid, S. S.
McKenzie, Jas. E.
McLean, J. R.
Mercieca, A. L.
Milne, J. E.
Moody, J. A.
*Muirhead, Thos.
Mulock, R. H.
*Murphy, P. F.
Newton, C. A.
Nowlan, A.
*Oborn, S. M.
O'Connor, J. F.
*O'Leary, H. Gordon
*Patrick, K. S.
Peck, O. K.
*Pickering, F. A.
Pinch, H. H.
*Reynolds, Geo.
Riddall, J. B.
*Roberts, J. R.
Rodd, B. T.
*Rowley, H. G.
Saunders, W. L.
Scarnegie, D. A.
Schuster, K. R.
*Simpson, R.
*Smith, A. Parker
Smith, H. E. B.
*Sohier, Raymond
Somers, N. L.
Sprenger, H.
*Stavert, W. D.
*Stewart, A. M.
Suttie, Jas. P.
*Walker, T. M.
Wallis, Newton J.
*Watts, A. D.
Whittaker, F. J.
Wilkins, S.
Zverina, J.

Juniors
Betournay, J. N.
*Booth, Chas. D. G.
Boulton, C. A.
*Brown, H. L.
Bryant, E.
Burton, E. C.
*Campbell, W. I. H.
*Clark, C. R.
*Clendinning, Jas.
*Dansereau, J. A.
*DeCardaillac, G.
*Draper, W. H.
Dustan, E. B.
*Fairn, A. S.
Ferris, C. B.
Greening, E. O.
Hughes, H. C.
Igoe, F. J.
*Jones, J. H.
*Junkin, R. L.
*Keefer, J. A.
Lacroix, P. A.
Lamb, G. J.
Mackenzie, Norman
Mackenzie, R. G.
Mayes, F. L.
*McNeil, O. M.
*Mitchell, J. Cameron
Penney, Edgar
*Richardson, C. E.
Roberts, H. A.
Roscoe, H. M.
Shepard, H. W. R.
Tempest, Frank
*Wetmore, F. W. C.
Wilson, J. K.

Students
*Anderson, A. C.
Baker, A. J.
Barnes, F. H.
Bickell, W. A.
Blackall, J. F. W.
*Bremner, F. E. A.
Brow, J. B.
Brown, E. C.
Brown, L. B.
Buckingham, E. J.
Cameron, G. D. W.
*Cameron, J. R.
Cassidy, I. B.
Circle, J.
Clark, W. J.
Cockfield, A. E.
Cousineau, C. A.
Cromwell, H. R.
*Cumming, C. H.
Dawson, J. K.
Deamude, F. V.
dePaul, M. J.
Deschamps, A.
Desmaisons, O.
*Dickson, W. J.
Dunn, R. G.
Durham, J. B.
Eaton, H. T.
Farnham, D. M.
*Farrow, J.
Ferguson, G. H.
*Fessenden, C. V.
Filteau, J. N. L.
Foster, M. G.
Fraser, J. A.
*Gagnier, O. J.
*Gagnon, E.
Gannon, L. J.
Garrett, A. R.
*Glanville, J. C.
Glave, R. B.
*Graham, D. S.
Grant, W. R.
Guenther, W. F.
Haley, J. P.
*Hammer-Schou, J.
*Harris, R. W.
*Hayman, L. T.
Hendershot, R. W.
Henderson, D. A.
Heurtley, E. S.
Hovey, L. M.
Hunter, W. H.
*Jaffary, J. H. E.
Kennedy, C. L.
Laurin, J. E.
*Macheras, J. P.
MacLeod, C. H.
*Macpherson, H. E.
Martin, B. E.
McCallum, F. L.
*McDonald, J. N.
*McInnes, W. A.
*McIntosh, W. L.
*Mignault, L.
Murphy, A. E.
Murray, Jas.
Noonan, W. H.
Pearse, H. A.
*Peterkin, S. M.
*Plant, W. A.
*Pym, J. S.
Reeve, C. L.
Rowan, J. C.
Rumble, G. R.
Rundle, W. L.
*Ryan, C. C.
Scovil, J. L.
*Seymour, E. R. W.
*Shannon, R. E.
*Sime, A. W.
Simons, J. J.
Simpson, R. L.
*Spears, D. C.
Spence, W. A.
*Staples, G. J.
*Stewart, A. E.
Stewart, M. G.
Stewart, V.
*Sutherland, D. M.
Tansley, W.
Taylor, F. H.
Townsend, J. H.
Vanier, Geo.
Webster, R. C. P.
Whitlock, W. H.
Williams, A. S.
*Williscroft, G. M.
Wilson, F. E.
*Wood, H. A.
*Woollatt, D. H.
Wyman, M. B.

*Indicates members from whom *The Institute* has had no definite word and no address since the war.

Publications

Electrical Equipment of the Motor Car; by David Penn Moreton and Darwin S. Hatch; published by the U.P.C. Book Company, Inc. of New York. A complete textbook of four hundred and eighty-four pages of reading matter, together with two hundred and fifty-six blue-prints of wiring diagrams, has recently been published by this company and provides a general working guide on the installation, care and repair of the starting, lighting and ignition systems of all cars. The book is bound in the form of the regular engineering handbook and contains a large number of diagrams together with photographic reproductions of parts of well known motor cars.

"*Burning Liquid Fuel*", by William N. Best, published by the U.P.C. Book Company, Incorporated, is a practical treaties on the perfect combustion of oils and tars, giving analyses, calorific values and heating temperatures of various gravities with information on the design and proper installation of equipment for all classes of service. The volume contains three hundred and thirty-six pages and is very completely illustrated and it should prove valuable in view of the current interest in this subject.

Heat Transmission through Walls, Concretes and Plasters.—This report has been prepared for the Building Research Board of the Department of Scientific and Industrial Research, London, England, by Dr. Ezer Griffiths, of the National Physical Laboratory, and consists of a description of experiments for the determination of the thermal conductivities of representative wall materials, plasters and concretes. A brief account of heat transmission experiments which have recently been carried out on the continent is given in appendices to the report.

Trade Publication

Power — Is Application from the 17th, Dynasty to the 20th Century. This interesting booklet, which is a reprint of the address by F. L. Morse, president of the Morse Chain Company, at the 26th annual convention of the American Mining Congress, Milwaukee, September 27th, 1923, will be forwarded to members of *the Institute* on application to Messrs. Jones and Glassco, Registered, St. Nicolas Building, Montreal. The booklet traces the evolution of mechanical devices and power transmission from the early ages and is well illustrated throughout.

Preliminary Notice

of Applications for Admission and for Transfer

December 17th, 1923.

The By-laws now provide that the Council of the Institute shall approve, classify and elect candidates to membership and transfer from one grade of membership to a higher.

It is also provided that there shall be issued to all corporate members a list of the new applicants for admission and for transfer, containing a concise statement of the record of each applicant and the names of his references.

In order that the Council may determine justly the eligibility of each candidate, every member is asked to read carefully the list submitted herewith and to report promptly to the Secretary any facts which may affect the classification and election of any of the candidates. In cases where the professional career of an applicant is known to any member, such member is specially invited to make a definite recommendation as to the proper classification of the candidate.*

If to your knowledge facts exist which are derogatory to the personal reputation of any applicant, should be promptly communicated.

Communications relating to applicants are considered by the Council as strictly confidential.

The Council will consider the applications herein described in January, 1924.

FRASER S. KEITH, Secretary.

*The professional requirements are as follows:—

A **Member** shall be at least thirty-five years of age, and shall have been engaged in some branch of engineering for at least twelve years, which period may include apprenticeship or pupilage in a qualified engineer's office, or a term of instruction in a school of engineering recognized by the council. The term of twelve years may, at the discretion of the council, be reduced to ten years in the case of a candidate for election who has graduated from a school of engineering recognized by the council. In every case the candidate shall have held a position in which he had responsible charge for at least five years as an engineer qualified to design, direct or report on engineering projects. The occupancy of a chair as a professor in a faculty of applied science or engineering, after the candidate has attained the age of thirty years, shall be considered as responsible charge.

An **Associate Member** shall be at least twenty-seven years of age, and shall have been engaged in some branch of engineering for at least six years, which period may include apprenticeship or pupilage in a qualified engineer's office or a term of instruction in a school of engineering recognized by the council. In every case a candidate for election shall have held a position of professional responsibility, in charge of work as principal or assistant, for at least two years. The occupancy of a chair as an assistant professor or associate professor in a faculty of applied science of engineering, after the candidate has attained the age of twenty-seven years, shall be considered as professional responsibility.

Every candidate who has not graduated from a school of engineering recognized by the council, shall be required to pass an examination before a board of examiners appointed by the council. The candidate shall be examined on the theory and practice of engineering with special reference to the branch of engineering in which he has been engaged. This examination may be waived at the discretion of the council if the candidate has held a position of professional responsibility for five or more years.

A **Junior** shall be at least twenty-one years of age, and shall have been engaged in some branch of engineering for at least four years. This period may be reduced to one year, at the discretion of the council, if the candidate for election has graduated from a school of engineering recognized by the council. He shall not remain in the class of Junior after he has attained the age of thirty-three years.

Every candidate who has not graduated from a school of engineering recognized by the council, or has not passed the examinations of the first year in such a course, shall be required to pass an examination in the following subjects: geography, history (that of Canada in particular), arithmetic, geometry, euclid (books I, IV and VI), trigonometry, algebra up to and including quadratic equations.

A **Student** shall be at least seventeen years of age, and shall present a certificate of having passed successfully an examination equivalent to the final examination of a high school or the matriculation of an arts or science course. He shall either be pursuing a course of instruction in a school of engineering recognized by the council, in which case he shall not remain in the class of student for more than two years after graduation; or he shall be receiving a practical training in the profession, in which case he shall pass an examination equal to that prescribed for admission to the grade of Junior in the foregoing section and he shall not remain in the class of Student after he has attained the age of twenty-seven years.

An **Affiliate** shall be one who is not an engineer by profession but whose pursuits, scientific attainments or practical experience, qualify him to co-operate with engineers in the advancement of professional knowledge.

The fact that candidates give the names of certain members as references does not necessarily mean that their applications are endorsed by such members.

FOR ADMISSION

ANDRUS—DONALD ALLAN, of St. Catharines, Ont. Born at Southfleet, Kent, England, Oct. 6th, 1870; Educ., Crystal Palace School of Practical Engineering, London, England, 1889; 1890-94, instr'man., dftsman., and gen. rly. mtce. work, Ottoman Rly. Co. (Smyrna-Arden), Asia Minor. (English Co. head office, London); 1894-1895, res. engr. on Sokia branch of above rly. and from 1895-1900, continuously engaged in charge of location work and surveys for extension of this rly. through Central Asia Minor to Konia, on the line of the proposed Baghdad rly.; 1901-03, engr. in charge for J. W. Williamson & Co., contractors, Cairo, Egypt, on contract for widening Suez Canal between Ismailish and Suez; 1903-11, engaged on contracts secured in own name from Egyptian govt. for constrn. and mtce. of irrig. works in upper and lower Egypt; 1913-17, chief engr. for Messrs. Baldry, Yerburgh & Hutchinson Ltd., of London, England, on contract for constrn. of section No. 2, Welland Ship Canal; 1918-20, gen. mgr. and chief engr., St. Lawrence Dock & Shipbldg. Co., Levis, Que.; At present, gen. mgr. and engr. in Canada to Sir Wm. Arrol & Co. Ltd., of Glasgow, Scotland.

References: P. B. Motley, A. J. Grant, C. F. Draper, H. M. Scott, F. S. Lazier.

BEATTIE—WILLIAM CAVEN, of 66 Craig Street, Ottawa, Ont. Born at Gobles, Ont. May 12th, 1886; Educ., Toronto Tech. School. Passed exam. held at S.P.S. on struct'l. engrg. under Ont. Assn. of Arch'ts.; engrg. work for Darling & Pearson, John M. Lyle and Chapman & McGiffen; asst. to heating engr., Gurney Foundry Co., Toronto; 1912-15, mgr. of contracts, steam insulation and refrigeration, Johns-Mansville Co. Toronto; 1915-19, heating and ventilating engr., Ottawa office, C. A. Dunham Co. Ltd.; 1919 to date, architect and supt. of bldgs., City of Ottawa, Public School Board, Ottawa.

References: J. A. Ewart, E. B. Jost, R. Henham, T. E. McGrail, W. H. C. Flay, A. K. Hay, H. E. Maple, A. E. Smaill, J. W. Anderson, T. S. Nash, R. C. Berry, R. F. Uniacke.

BROSSEAU—JOSEPH CHARLES, of Verdun, Que. Born at Montreal, Que., Dec. 17th, 1896; Educ., Grad. Montreal Tech. School, 1919; 1914-16, general survey work with J. P. B. Casgrain and M. D. Barclay; 1919, transitman and gen. engrg. work, Montreal Tramways Co.; 1920, mech. dfting., Morgan & Wright, Detroit Mich., and Wayagamack Pulp & Paper Co. Three Rivers, Que.; 1921 to date, asst. to H. Hadley, A.M.E.I.C., city engr. of Verdun, Que.

References: H. Hadley, M. D. Barclay, A. L. Ghysens, P. Bailey, B. Vernon, J. P. B. Casgrain, T. P. Hamel.

BRYDONE-JACK—HERBERT DISKROW, of Glacier, B. C. Born at Sandbach, Cheshire, England, Oct. 31st, 1888; Educ., B.Sc. McGill Univ. 1911; 1907-09 (summers), rodman, C.P.R.; 1910 (summer), leveller, C.P.R.; 1911 (May-Dec.), transitman, C.P.R. constrn,; 1912 (Jan.-Sept.), asst. engr., constrn., prelim. and location surveys, C.P.R.; 1912-14, asst. engr., double track constrn., C.P.R.; 1914-19, overseas; 1920 (Mar.-Dec.) asst. engr. in charge of lining Connaught tunnel, C.P.R.; Jan. 1921 to date, supt. for the Sydney E. Junkins Co. Ltd., engrs. and constructors, at Glacier, B.C., lining Connaught tunnel.

References: J. M. R. Fairbairn, E. E. Brydone-Jack, G. E. Bell, F. Lee, T. C. Macnabb, T. Lees, H. R. Younger, T. E. Price, L. L. Brown.

CARMICHAEL—FREDERICK NORMAN DUBOURDIEN, of Toronto, Ont. Born at Toronto, April 28th, 1895; Educ., B.A.Sc. Univ. of Tor. 1915: 1912 (summer), harbour work, Toronto; 1913 (summer), engr. in charge of dredging operations, Bruce Mines, Ont.; 1914-15 (summers), harbour surveys and dredging, Sault Ste Marie and Windsor, Ont.; 1915-16, munition inspection; 1916-19, Lieut. Royal Naval Volunteer Reserve, England, Egypt, Italy, Greece, etc.; 1921 (Jan.-July), traffic study, Toronto Transportation Commn.; 1921 (Aug.-Sept.), surveying in connection with Toronto Street Railway arbitration; 1921-22, res. engr. on constrn. work, Toronto Transportation Commn.; April 1922 to date, engr., plan examination branch, city arch't's dept., city hall, Toronto, Ont.

References: A. L. Mudge, H. W. Tate, H. W. McAll, P. M. Thompson, G. Rankin.

CONNOR—GEORGE TUPPER, of 143 High Street West, Moose Jaw, Sask. Born at Alma, N.B., Feb. 2nd, 1890; I.C.S. steam engrg. and steam electric course. Night classes in mech. drawing; 1905-07. machine shop work, Portland Iron & Steel Co.; 1907-11, stationary steam engr., Portland Iron & Steel Co.; 1911-20, chief engr. for Moose Jaw Electric Rly Co., in charge of generating plant including erection of 1000 h.p. diesel engines; 1920 to date, supt. of Moose Jaw Electric Rly. Co. Ltd., Moose Jaw, Sask.

References: A. A. Dion H. A. McLean, J. B. McRae, G. D. Mackie, J. D. Peters, W. H. Greene, J. R. C. Macredie, M. Sinclair.

DAVIS — FRANK LESLIE, of 54-A St-Laurent Road, Cartierville, Que. Born at Gloucester, England, Nov. 20th, 1890; Educ., 3 years Newport Tech. School. Cert. for maths., mechanics, prac. geom., and bldg. constrn., South Kensington (London), 3 years articled pupil and 1 year asst. to Messrs. Kirby Son & Co. Civil Engrs., Newport, England; 1911-13, leveller and dftsman, mtce. of way, dist. No. 3, eastern divn., C.P.R.; 1913 (6 mos.), dftsman. on constrn., Pacific Great Eastern Rly., Vancouver; 1914 (5 mos.), asst. to city engr., Westmount, Que.; 1914-19, overseas, C.F.A., Lieut.; 1919-20, engr., North American Magnesite Producing Co. Ltd., Calumet, Que.; 1921-23, engr. in charge of constrn. on various works for J. A. Grant & Co. Ltd., engrs. and contractors, St. John, N.B.; 1923 (Apr.-Nov.), asst. engr. on constrn. of grain elevator "B" and elevator No. 3 for Harbour Commissioners of Montreal for The John S. Metcalfe Co. Ltd.; At present asst. engr. on staff of above firm.

References: C. C. Kirby, J. A. Grant, H. Rolph, P. E. Jarman, T. W. Harvie, L. C. Hill.

DAW—JOSEPH, of 86 Maisonneuve Avenue, Quebec, Que. Born at London, England, November 8th 1867; Educ., Dulwich College. School of Military Engrg., Chatham, England; 1892-98, constructional dftsman. to instructor in workshops, S.M. E., Chatham; 1900-01, rly. constrn. and bridging, South Africa (Boer War); 1901-02, in charge of constructional work, Salisbury Plain; 1903-04, machine shop, Algoma Iron Works; 1905-14, practising as architect and factory engr., St. Catharines, Ont.; 1915, R.C.E. Headquarters, Ottawa; 1916, asst. camp engr., Camp Borden; 1917, asst. camp engr., Valcartier; 1919-20, preparing record plans and surveys militia property, Quebec; 1920 to date, engr., engrg. dept., Brown Corporation, Quebec Que.

References: J. B. Cochrane, D. Barry, P. deL. D. Passy, D. O. Gallagher, S. L. deCarteret.

DONKIN—ROBERT PERCY, of Halifax, N. S. Born at Mulgrave, N. S., July 4th, 1888; Educ., B.Sc. (Mech.), N. S. Tech. Coll. 1914, Engrg. cert. from Acadia Univ.; 1905-08, ap'prentice and journeyman from machine shops of Dominion Coal Co. Ltd., Glace Bay, N.S.; 1915-16, dftsman., Starr Mfg. Co. Ltd., Dartmouth, N.S.; 1916-17, chief dftsman., W. E. Barrett, consltg. engr., New York, on new bldgs. and equipment for N.S. Tramways and Power Co. Halifax; 1917, asst. to Gen. Supt. P.A. Freeman, N. S. Tramways and Power Co. Halifax; 1918-19, instructor in machine tool operation, at N.S. Tech. Coll. for D.S.C.R.; 1919 to date, asst. professor of mech. engr., N. S. Tech. Coll., Halifax, N. S. (Also — 1920, special investigation and design of skinning machines for National Fish Co. Ltd., Halifax; 1921, investigation and report on central heating and power plant for Mount St. Vincent Academy, Rockingham, N. S.; 1921-23, consltg. engr., Parsons Ocean Power Co. Ltd., Halifax.

References: K. L. Dawson, F. R. Faulkner, C. E. W. Dodwell, P. A. Freeman, W. F. McKnight, D. W. Munn, W. G. Hardy, J. F. Lunsden, C. A. D. Fowler.

DUNSMORE—ROBERT LIONEL, of Calgary, Alta. Born at Seaforth, Ont., Sept. 2nd. 1893, Educ., B.Sc. Queen's Univ. 1915; 1912, recorder on precise levelling, Geodetic Survey of Canada; 1913, asst. engr., public works dept., of Canada, Fort William; instr'ment work in charge of sounding party; 1914, as above, res. engr. on Mission River harbour improvements; 1914-19, overseas. Major, Can. Engrs.; 1919, asst. city engr., Sarnia, Ont.: 1919 to date with Imperial Oil Company, 1919-20, engrg. dept., Sarnia, estimating and designing for docks, power plants, etc., 1920-22, asst. master mechanic, Sarnia, and from 1922 to date, engr. in charge of constrn. of refinery at Calgary.
References: G. W. Craig, W. L. Malcolm, C. D. Dean, T. Montgomery, J. V. Dillabough, H. T. Hughes, V. A. Newhall.

FREEMAN—CORRELL HUNTER, of 7 Ralph Street, Ottawa, Ont. Born at Newboro, Ont. Nov. 18th, 1887, Educ., B.Sc. Queen's Univ. 1913; 1911-13 (summers), with topog'l. divn., Geol. Survey, Ottawa, 1914 (summer), in charge of sub-party, and 1915-20 in charge of parties; At present, mineral technologist, (Grade 1) Mines Branch, Dept. of Mines, Ottawa.
References: L. H. Cole, F. V. Seibert, A. E. MacRae, J. M. Wardle, A. U. Meikle, R. C. Purser, L. C. Prittie.

LOW—DAVID DUNCAN, of Regina, Sask. Born at Regina, Sask., July 26th, 1897; Educ., B. Sc. Univ. of Sask. 1923; Aug. 1921 to July 1923, rodman, and at present instr'man., C.N.R., Regina, Sask.
References: A. M. Macgillivray, C. J. Mackenzie, D. A. R. McCannel, R. A. Spencer, P. C. Perry.

MACKINTOSH—WILLIAM JOHN, of Oxbow, Sask. Born at Inverness, Scotland, Sept. 16th, 1893; Educ., final exam. Inst. of C. E., London, England, 1915. 1912-15, pupil with Messrs. Black & Manners, civil engrs., Inverness; 1915-18, engrg. asst. Liverpool Corporation, Gen. municipal work constrn. of bldgs. etc.; 1918-19, in Imperial Army; 1919-20, asst. engr., Port of London. (authority on constrn. Royal Albert Dock extension); 1920-21, asst. engr., dept. of public highways, Ontario; 1921 to date, asst. engr., dept. of Highways, Saskatchewan, Regina, Sask.
References: H. S. Carpenter, H. R. MacKenzie, C. C. Cronk, W. E. Denley, C. S. Cameron.

ROGERS—ALVAH BURPHEE, of 339 Hingston Avenue, Montreal Que. Born at Stellarton, N. S. April 24th, 1880; Educ., 3 years elect'l. McGill Univ. (1904-05, 1913-15); 1906-13, dfting. and design, apparatus dept., Northern Electric Co., Montreal, 1915-18, dfting and design, engrg. dept., Shawinigan Water & Power Co.; and 1918-19, asst. engr. on design aud supervision of install'n. of elect'l. layouts for industrial plants; 1919 to date, asst. engr., Shawinigan Engineering Co. Ltd. Montreal, Que.
References: J. C. Smith, F. T. Kaelin, S. Svenningson, J. A. McCrory, E. Brown, H. M. MacKay, C. V. Christie.

SEARS—JOHN JOSEPH, of 87 Birmingham Street, Halifax, N. S. Born at Antigonish, N. S., March 23rd, 1891; Educ., B. A. St. Francois Xavier College, 1911. B. Sc. (C. E.), N. S. Tech. Coll. 1916; 1912-15, student engr., dept. of public works, Antigonish, N. S.; 1916-18, dftsman, shipbldg, dept., N. S. Steel & Coal Co., New Glasgow; 1918-21, chief engrg. dftsman., Halifax Shipyards Limited; 1921-22, estimator, inspector and field engr., C. A. Fowler & Co., Engrs. and Arch'ts.; June 1922 to date, field engr., N. S. Tramways & Power Co., Halifax, N. S.
References: K. L. Dawson, F. R. Faulkner, I. P. MacNab, H. W. L. Doane, C. A. D. Fowler, J. B. Hayes, D. E. O'Brien.

SCHIPPEL—WALTER HERBERT, of 573 Durocher Avenue, Montreal, Que. Born at Montreal, May 26th, 1900. Educ., B.Sc. McGill Univ. 1920; 1920 (7 mos.), testing of elec. machinery, Can, Gen. Elec. Co.; 1921-23, asst. designer on elec. layout of power plants, substations. power transmission and distribution, with Messrs, L. A. Herdt and E. Godfrey Burr, consltg. engrs.; Also 1921-23, senior demonstrator in elec. engr., McGill Univ. Montreal, and asst. designer of electrical installations.
References: C. V. Christie, L. A. Herdt., E. G. Burr, C. M. McKergow H. M. MacKay.

VATCHER—ALLAN, of 134 Hamilton Street, St. John's, Nfld. Born at Freshwater, Bay de Verde, Nfld.; April 2nd, 1881; Educ., B. A. Sc. Univ. of Toronto 1910; 1910-11, instr'man on rly. location for Reid Newfoundland Co.; 1911-15, res. engr. on rly. constrn. and chief of party on location for the above company; 1915-23, engr. in charge of field surveys and constrn. of an Hydro-Elec. development for the Union Electric Co., Port Union, capacity 850 H. P., the Public Service Electric Co., capacity 3000 H. P. in charge of field surveys and prelim. layout of hydro-electric developments for the Newfoundland Products Corpn. (now the Newfoundland Power & Paper Co.), having a combined capacity of 120,000 H.P., all in Newfoundland; At present asst. chief engr., Reid Newfoundland Co., St. John's, Nfld.
References: H. G. Acres, T. H. Hogg, P. Gillespie, C. R. Young, J. R. Montague, J. J. Traill.

WILSON—ALFRED WILLIAM GUNNING, of Ottawa, Ont. Born at Cobourg Ont., Feb. 6th, 1873; B.A. Univ. of Tor. 1893, A. M. Harvard Univ. 1899. Ph. D. Harvard Univ. 1901. Special student in industrial chemist, assaying, geology, S.P.S. Univ. of Tor. 1893, mining and metallurgy, Columbia School of Mines, 1902 and at McGill Univ. 1902-04; engrg. geology and topography for G.T.R. at intervals 1903-09, under J. G. G. Kerry. Similar work for private clients during same period; 1902-96, demonstrator in geology, McGill Univ.; 1901, 1902, 1908 (summers), in charge of field mapping and geol. exploration, Geol. Survey; 1904, selection of Elk River coal lands for C. P. R. including report on location of development rly.; 1905, engrg. geol. and topographer attached to James Bay exploration party of Temiskaming and Nor. Ont. Rly. Commn.; 1906, in charge of exploration on Northern Quebec, possibilities of industrial development, including rly. location, mineral and timber exploration etc.; 1907, prospecting in Northern Ontario, in charge of two parties; 1909-10, mining engr., Mines Branch, Copper resources of Canada; 1910-20, chief engr., Metalliferous Mines Division, Mines Branch. (Also — 1915-16, special commissioner under the Minister of Militia to advise on the securing of home supplies of copper and zinc; 1916-17, supt. of plant for Wilson munitions, mfg. steel clad shrapnel ball; 1918-20. technical adviser to the War Trade Board.); 1920 to date, chief engineer, Mineral Resources Division, Mines Branch, Dept. of Mines, Ottawa.
References: J. G. G. Kerry, C. V. Corless, J. F. Robertson, R. L. Peek, L. H. Cole,

FOR TRANSFER FROM CLASS OF JUNIOR TO HIGHER GRADE

GAUTHIER—HENRI, of Ottawa, Ont. Born at Montreal, April 9th 1890; Educ., B.A.Sc. Polytech., Laval Univ. 1915. Post graduate work, two winter seasons, Columbia University, New York; 1910-15 (summers). land surveying with, J. E. A. McConville, M. D. Barclay and Eug. Desaulniers; 1915-20, with Dept. of Mines, Ottawa as asst. engr. (road material investigations), in Road Materials Divn. In charge of field party since 1916. Carried individual work in investigation of road material since 1917 (memoir 114, geol. survey-road materials in the city and district of Montreal, by H. Gauthier, 1917), and since 1920 has acted as road materials engr. (senior asst.), Road Materials and Ceramics Divn., Mines Branch, Dept. of Mines, Ottawa (in charge of road materials divn.)
References: L. H. Co.e, J. McLeish, H. S. Spence, J. M. Wardle, A. Frigon, J. H. Landry, E. Viens.

FOR TRANSFER FROM CLASS OF STUDENT TO HIGHER GRADE

BULMER—CLARENCE EDWARD, of 39 East Avenue North, Hamilton, Ont. Born at Cobden, Ont., August 10th, 1900; Educ., B. Sc. Queen's Univ. 1922; 1917 (summer) tool maker apprentice, Renfrew Machinery Co.; 1920 (summer), special apprentice, Angus Loco. Works, Montreal; May 1922-July 1923, on engrg. staff, General Motors of Canada, Oshawa, as engr. in charge of production of Oakland and Cadillac cars; Sept. 1923, to date, instructor to apprentices in dfting., machine design, shop maths. and electricity, Hamilton Technical School, Hamilton, Ont.
Reference: L. T. Rutledge, L. M. Arkley, L. W. Gill, W. P. Wilgar, A. Macphail, E. D. W. Courtice.

ROSS—JAMES HARGRAVE DRUMMOND, of Antofagasta, Chile. Born at Dundas, Ont. April 2nd, 1897; Educ., B. Sc. McGill Univ. 1922; R. M. C. 1913-15; 1915-19, overseas. Capt. R. F. A.; 1920-21 (summers), worked in plants of Standard Chemical Co.; 1922 (summer), Dominion Textile Co. Magog; Sept. 1922 to date, with Guggenhein Bros., New York, on experimental nitrate work, Antofasgata, Chile.
References: Sir Alex. Bertram, C. M. McKergow, H. M. MacKay, E. Brown.

WILLIAMS—ARTHUR SAMUEL, of 610 Ontario Street, Toronto, Ont. Born at Winnipeg, Man., March 27th, 1895; Educ., B. Sc. Univ. of Manitoba, 1921; 1920 (summer), mtce. work and operating, Winnipeg Electric Railway Co.; 1921 (summer), test dept., C. G. E., Peterborough; 1921-22, demonstrator in physics, Univ. of Man.; 1922-23, test. dept., C. G. E., Peterborough and Toronto; June 1923, to date, dftsman. on station electrical layouts, H. E. P. C. of Ontario, Toronto, Ont.
References: E. P. Fetherstonhaugh, H. V. Armstrong, J. N. Finlayson, A. B. Gates, N. D. Seaton, W. M. Cruthers, V. S. Foster.

FOR TRANSFER FROM CLASS OF AFFILIATE TO HIGHER GRADE

LYNCH—FRANCIS CHRISTOPHER CHISHOLM, of 305 Stewart Street, Ottawa, Ont. Born at Ottawa, May 11th, 1884; Educ., undergrad. McGill Univ. Seasons 1904, 1905, and part of 1906; 1902-05 (summers), field work, Carillon and Greenville Canal; 1906-11, technical clerk, rly. lands branch, Dept. of the Interior, in charge, mapping division and B. C. Dom Rly. Belt Lands Divn.; 1911-12, asst. supt., Rly. Lands Branch, and 1912-17, supt., Rly. Lands Branch, Dept. of the Interior; 1917 to date, supt., Natural Resources Intelligence Branch, Department of the Interior, Ottawa, Ont
References: O. S. Finnie, J. L. Rannie, C. P. Edwards, J. B. Challies, C. M. Pitts.

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A

AERONAUTICAL INSTRUMENTS

Meteorographs. A New Airplane Meteorograph (Ein neuer Flugzeug-Meteorograph), Albert Wigand and Heinrich Koppe. Zeit. für Flugtechnik u. Motorluftschiffahrt, vol. 14, nos. 13-14, July 26, 1923, pp. 106-108, 3 figs. Details of new meteorograph and desiderata upon which design is based; describes how it should be attached to airplane.

Types. Measuring Instruments for Aeroplanes, E. Everling and H. Koppe. Eng. Progress, vol. 4, no. 6, June 1923, pp. 111-115, 17 figs. Service requirements; pressure meters; statoscopes; temperature; speed; climbing; turning.

AIR COMPRESSORS

Turbo-Compressors. Modern Types of Large Compressors in Mining Practice (Neuzeitliche Grosskompressoren im Bergwerksbetrieb), Ernst Blau. Fördertechnik u. Frachtverkehr, vol. 16, no. 15, Aug. 3, 1923, pp. 171-173. Describes design and use of turbo-compressors and electrically driven compressors in mines.

AIR COOLING

Buildings. Cooling Systems for Buildings, A. M. Feldman. Am. Architect & Architectural Rev., vol. 124, no. 2431, Oct. 24, 1923, pp. 379-384, 10 figs. Describes cooling equipment installed at banking offices of Kuhn, Loeb & Co., New York City, Mt. Sinai Hospital, New York City, and country residence of Paul M. Warburg at Hartsdale, N.Y.

AIR FURNACES

Oil-Fired. Burning Oil in the Air Furnace, A. V. Landschoot. Foundry, vol. 51, no. 21, Nov. 1, 1923, pp. 862-867, 4 figs. Successful adaptation to melting malleable iron requires proper combustion, close control of heat and attention to charge time element.

AIRPLANE ENGINES

Calculations. Aero-Engine Calculations. Practical Engr., vol. 68, no. 1907, Sept. 13, 1923, pp. 143-154. Formulas giving horsepower required to propel an airplane; calculation for power to drive gear-driven compressor; exhaust-gas turbo-compressor calculations; etc.

Distribution in Multi-Cylinder. The Arithmetic of Distribution in Multi-Cylinder Engines, Stanwood W. Sparrow. Nat. Advisory Committee for Aeronautics—Tech. Notes, no. 162, Oct. 1923, 23 pp., 15 figs. Consideration of effect on engine performance of known inequality of distribution.

AIRPLANES

Airfoils. Note on the Experimental Aspect of One of the Assumptions of Prandtl's Aerofoil Theory, N. A. V. Piercy. Roy Aeronautical Soc.—Jl., vol. 27, no. 154, Oct. 1923, pp. 501-511, 3 figs. Note is confined to assumption whereby vorticity in strictly limited region is in effect substituted for part of general action of viscosity; it is shown that viscosity as such is of fundamental importance in determining system of flow.

On the Vortex Pair Quickly Formed by Some Aerofoils, N. A. V. Piercy. Roy. Aeronautical Soc.—Jl., vol. 27, no. 154, Oct. 1923, pp. 488-500, 3 figs. Results of tests carried out in 4-ft. wind tunnel of aeronautical laboratory of East London College; author seeks to show that wing tip vortices are amenable to accurate investigation; deals with structure of vortex well on into turbulent flow.

The Supporting Vortex Surface as an Aid in the Treatment of Plane Problem of the Airfoil Theory (Die tragende Wirbelfläche als Hilfsmittel zur Behandlung des ebenen Problems der Tragflügeltheorie), W. Birnbaum. Zeit. für angewandte Mathematik u. Mechanik, vol. 3, no. 4, Aug. 1923, pp. 290-297, 3 figs. It is shown how Prandtl's theory of "supporting vortex" can be used to include distribution of lift according to depth of airfoil in calculation, and to find dependence of this distribution on form of profile.

Theoretical Relationships for the Lift and Drag of an Aerofoil Structure, H. Glauert. Roy. Aeronautical Soc.—Jl., vol. 27, no. 154, Oct. 1923, pp. 512-518. Aerodynamic problems; cyclic flow; two-dimensional and three-dimensional problem.

Angular Velocity in Pitch. A Study of Controlability, Angular Velocity and Dynamic Stability of an Airplane About the Axis of Pitch, Leslie MacDill. Air Service Information Circular, vol. 5, no. 418, Apr. 1, 1923, 14 pp., 7 figs. Analysis of problem involving variations in longitudinal and vertical velocity, and angular velocity in pitch; study of steady motion and of small oscillations.

Design. Aeroplane Design, H. P. Folland. Instn. Aeronautical Engrs.—Proc., no. 3, 1922, pp. 3-19, and (discussion) 19-38, 27 figs. Author goes over preliminary design and gives rough approximations; draws attention to importance of detail design and points which go toward reliability, efficiency and engineering structure.

Model Tests Without Wind Tunnel. Experimental Data Without a Wind Channel, O. T. Gnosspelius. Instn. Aeronautical Engrs.—Proc., no. 5, 1923, pp. 3-10 and (discussion) 11-17, 3 figs. Description of testing method, its advantages and disadvantages; mathematical analysis of lift and drag forces from pendulum observations.

Seaplanes. *See Seaplanes.*

Speed Calculation. Graphic Method for Calculating the Speed and Climbing Ability of Airplanes, Adolf Rohrbach and Edwin Lupberger. Nat. Advisory Committee for Aeronautics—Tech. Notes, no. 163, Oct. 1923, 10 pp., 4 figs. Method by means of which, starting from actual power developed by engine, it is possible to determine all factors which together constitute what are known as flight performances for any combination of engine and airplane, from single graphic diagram given herewith.

ALLOYS

Aluminum. *See Aluminum Alloys.*

Brass. *See Brass.*

Contraction. High Shrinkage Alloys. Brass World, vol. 19, no. 10, Oct. 1923, pp. 341-343. Results of investigation to determine linear contraction of a series of brass and bronze alloys used generally in foundry work. Abstract of paper by R. J. Anderson and E. J. Fahlman.

Modifications of the Law of Volumetric Shape and Contraction of Metals and Alloys (Ueber die Gesetzmässigkeiten der Volumengestaltung und Schwindung von Metallen und Legierungen), F. Sauerwald. Giesserei-Zeitung, vol. 20, no. 20, Sept. 15, 1923, pp. 391-393, 5 figs. Deals with binary alloys in liquid and solid state and during interval of solidification.

Copper-Zinc. Cold Rolling and Annealing of Some Copper-Zinc Alloys, Pendleton Powell. Brass World, vol. 19, nos. 9 and 10, Sept. and Oct., 1923, pp. 281-284 and 335-338, 42 figs. Results of experiments on influence of cold rolling upon annealed alloys and influence of heat treatment upon cold-rolled alloys. Abstract of report made to Technische Hoch-Schule.

Molybdenum in. Molybdenum as an Alloy Component (Molybdän als Legierungsbestandteil), W. Guertler. Zeit. für Metallkunde, vol. 15, nos. 6 and 9, June and Sept., 1923, pp. 151-154 and 251-256, 17 figs. For alloys with molybdenum as main component, following additions can be used: carbon, silicon, titanium, zirconium, tungsten, tantalum and metals of the iron group which melt at high temperature, including vanadium; as addition molybdenum can be used only for such alloys in which iron, cobalt and nickel, or tungsten, tantalum and palladium constitute the main component.

ALUMINUM ALLOYS

Duralumin. *See Duralumin.*

Uses. The Use of Non-Ferrous Alloys in Place of Iron and Steel, John L. Haughton. Beama, vol. 13, no. 67, Nov. 1923, pp. 293-297, 2 figs. Consideration of aluminum alloys.

Working Qualities. The Workability of Aluminum-Casting Alloys with Special Regard to Solumin (Bearbeitbarkeit von Aluminiumgusslegierungen unter besonderer Berücksichtigung von Silumin), G. Welter. Werkstattstechnik, vol. 17, no. 18, Sept. 15, 1923, pp. 545-549, 7 figs. Results of tests with German and American alloys, and with silumin; behavior of different alloys in case of sawing, turning, milling, drilling, or thread-cutting; influence of lubrication.

AMMONIA CONDENSERS

Design. Ammonia Condenser Design, Oscar A. Anderson. Refrig. Eng., vol. 10, no. 4, Oct. 1923, pp. 115-117 and (discussion) 117 and 119-120. Characteristics of different types of condensers.

AUTOMOBILES

Brakes. Some Notes on Brake Design and Construction, H. M. Crane. Soc. Automotive Engrs.—Jl., vol. 13, no. 5, Nov. 1923, pp. 395-398, 1 fig. Braking functions; desirable features of brake design; power available for operating brake; brake-operating mechanisms; design and construction of brake mechanism; types of brake drum and band or shoe design; brake materials.

The Four-Wheel Brake Question. Autocar, vol. 51, no. 1461, Oct. 19, 1923, pp. 701-703. Views of section of manufacturers who prefer to continue experiments before adopting them.

Transmissions. New Sliding Change Speed Gearsets Announced in Europe. Automotive Industries, vol. 49, no. 17, Oct. 25, 1923, pp. 830-833, 6 figs. Lavaud automatic transmission brought out in France; Constantinesco torque converter developed in England.

Revolutionary Transmission. Autocar, vol. 51, no. 1460, Oct. 12, 1923, pp. 647-650, 10 figs. Three modern mechanisms which may greatly influence automobile practice, namely, the De Lavaud system; Healey variable-speed gear box; and Constantinesco variable gear.

Variable Transmission, G. Constantinesco. Automobile Engr., vol. 13, no. 182, Nov. 1923, pp. 332-335, 2 figs. Deals with transmission gear developed by author, which he calls converter, as viewed from automobile standpoint, and compares its behavior with previous attempts to solve problem of transmission for automobiles.

AVIATION

Aerial Transportation. Tbe Development of Airship Transport. Aeroplane, vol. 25, no. 11, Sept. 12, 1923, pp. 273-274. Points out that the smaller and slower types of airship have distinct commercial possibilities; transport and development.

Transporting Ore by Airplane, Adrian Van Muffling. Eng. & Min. Jl.-Press, vol. 116, no. 19, Nov. 10, 1923, pp. 797-802, 5 figs. Problem of substituting airplanes for present means of transportation in carrying ore from outlying mines situated far from a railway. Factors to be considered in making analysis of given locality and in preparing a financial estimate, including landing fields, character of ore, flying equipment, etc.

B

BALANCING

Weights, Dimensions of. The Dimensions of Balance Weights. Mach. (Lond.), vol. 23, no. 577, Oct. 18, 1923, pp. 72-73, 3 figs. Consideration of dimensions of weights required to balance equivalent unbalanced mass at crankpin.

BALANCING MACHINES

Lawaczeck-Hevmann. The Balancing of Rotating Machine Parts (Das Auswuehten rotierender Maschinenteile), Ernst Lehr. Förderteebnik u. Frachtverkehr, vol. 16, no. 14, July 18, 1923, pp. 160-162, 3 figs. Describes Lawaczeck-Heymann balancing machine which works on so-called double-pendulum principle.

Static-Dynamic. Some Developments in Balanceing Machines, C. Norman Fletcher. Machy. (Lond.), vol. 23, no. 576, Oct. 11, 1923, pp. 52-53, 4 figs. Describes improvements made in Olsen-Carwen static-dynamic balancing machines.

BAROMETERS

Types and Use. The Meaning of Atmospheric Pressure, T. M. Gunn. Power, vol. 58, no. 21, Nov. 20, 1923, pp. 811-813, 3 figs. Types and principle of barometers for measuring atmospheric pressure, and their use; presents charts for finding barometrical pressure above sea level, and correction for latitude and temperature.

BEARINGS, BALL

Roller and. Some Developments in Ball and Roller Bearing Work, with Particular Reference to Steel Rolling Mill Plant, A. W. Macaulay. West of Scotland Iron & Steel Inst.—Jl., vol. 30, parts 5-7, Feb.-Mar.-Apr., 1923, pp. 58-68 and (discussion) 69-73, 34 figs. on supp. plates. Deals with steel used in production of ball bearings and refers to recent developments regarding their application to steel works.

The Question of Ball and Roller Bearings in Street Railway Operation (Zur Frage der Kugel- und Rollenlager im Strassenbahnbetrieb), H. Tobias. Verkehrstechnik, vol. 40, no. 38, Sept. 21, 1923, pp. 347-350. Results of investigations show that correctly designed ball and roller armature bearings are superior to journal bearings from viewpoint of safety in operation, saving in use of lubricating oil and in care and maintenance of motors.

BEAMS

Reinforced-Concrete Slab. Tests of Heavily Reinforced Concrete Slab Beams; Effect of Direction of Reinforcement on Strength and Deformation, Willis A. Slater and Fred B. Seely. U. S. Bur. Standards—Technologic Papers, no. 233, Mar. 20, 1923, 344 pp., 32 figs. Results of tests made as part of investigational work of concrete ship section of Emergency Fleet Corp. for purpose of determining relative economy of using as reinforcement for shell of ship bars placed at right angles to frames which support shell, bars placed at some other angle with frames, and expanded metal.

BLAST-FURNACE GAS

Dry Cleaning. Filtering Dirty Gas Through Flue Dust, George B. Cramp. Iron Age, vol. 112, no. 17, Oct. 25, 1923, pp. 1111-1114, 2 figs. Dry cleaning of blast-furnace gas, based on tests at Monessen plant of Pittsburgh Steel Co.; calculation of areas required.

BOILER FEEDWATER

Air Separator. The Hickman Air Separator. Pac. Mar. Rev., vol. 20, no. 11, Nov. 1923, pp. 528-529, 2 figs. Simple device for mechanical separation of entrained air from feedwater in steam plant, practically eliminating interior corrosion.

BOILER FURNACES

Design. Furnace Design (With Special Reference to Welsh Coal Burning), David Wilson. South Wales Inst. Engrs.—Proc., vol. 38, no. 8, Sept. 26, 1923, pp. 723-738 and (discussion) 738-755, 9 figs. Function of fire grate and of combustion chamber; advantages of mechanical stokers, including saving in labor, high thermal efficiency, and large grate area.

Forced Draft. Forced Draft (Unterwind), H. Bergmann. Archiv. für Wärmewirtschaft, vol. 4, no. 8, Aug. 1923, pp. 151-152, 1 fig. Describes new type of grate which is departure from all previous designs and is said to fulfill all requirements for use of forced draft.

Improvements. New Furnaces (Neue Feuerungsanlagen), H. Pradel. Feuerungstechnik, vol. 11, nos. 20 and 21, July 15 and Aug. 1, 1923, pp. 204-205 and 211-213, 9 figs. Extension furnaces for travelling grates; low-temperature tar recovery in boiler furnaces; auxiliary oil furnaces; etc.

Pulverized Coal Plant. A New Coal Dust Fuel Plant, G. Petri. Eng. Progress, vol. 4, no. 6, June 1923, pp. 119-121, 4 figs. Describes combined coal-dust fuel and chain-grate plant, main object of which is economical combustion of fuels which are difficult to ignite; principal fields of application.

Steam-Jet. The Modern Steam-Jet Furnace. Gas Jl., vol. 163, no. 3149, Sept. 19, 1923, pp. 870-872, 5 figs. Scientific principles involved in design of an efficient forced-draught steam-jet furnace, as exemplified by latest developments in "turbine furnace".

Temperature Control. New Apparatus Successfully Controls Temperature. Fuels & Furnaces, vol. 1, no. 6, Oct. 1923, pp. 437-439, 4 figs. Describes automatic control devised by H. G. Geissinger, of Detroit, Mich., for fuel-fired furnaces; electricity used as motive force, and safety against overheating is assured if power supply fails.

BOILER PLANTS

Efficiency, Increasing. Prospects for Increasing the Efficiency of Boiler Plants (Die Leistungserhöhung der Dampfkesselanlagen und ihre Aussichten), August Loschge. Zeit. des Bayerischen Revisions-Vereins, vol. 27, nos. 15, 16 and 17, Aug. 15, 31 and Sept. 15, 1923, pp. 113-115, 121-123 and 130-132, 15 figs. Methods of enlarging or strengthening boiler plants and difficulties involved; other methods of increasing efficiency, such as alterations in superstructure, use of maximum-pressure boilers and utilization of heat-accumulator effect.

Efficiency Meter. The Gilson Efficiency Meter. Engineering, vol. 116, no. 3018, Nov. 2, 1923, pp. 558-559, 4 figs. Device for indicating continuously number of pounds of coal being burnt per kw-hr. in power station.

Problems. Power Problems of Vital Interest to Executives, James T. Beard, 2nd. Indus. Management (N. Y.), vol. 66, no. 5, Nov. 1923, pp. 302-307, 5 figs. Maintenance and repairs.

Steam-Production Costs Reduction. How Steam Production Costs Were Reduced in a Hand-Fired Return-Tubular Boiler Plant, A. R. Mumford. Southern Engr., vol. 40, no. 3, Nov. 1923, pp. 38-42, 1 fig. Original fuel cost to produce 1,000 lb. steam was $0.5287; simple changes reduced this cost to $0.354 per 1,000 lb. of steam, a saving of over 30 per cent in fuel cost.

BOILERS

Gas-Fired. Town-Gas Fired Boilers. Gas Jl. (Supp.), vol. 163, no. 3150, Sept. 26, 1923, pp. 164-166, 3 figs. Describes Spencer-Bonecourt systems, with automatic action; comparison of costs and results obtained of solid fuel and town gas for boilers.

Heat-Storage Problems. The Heat Storage Problem with Special Regard to Elastic Efficiency of Boilers (Das Wärmespeicberproblem unter besonderer Berücksichtigung der Leistungselastizität von Dampfkesseln), Robert Jurenka and H. E. Witz. Archiv für Wärmewirtschaft, vol. 4, no. 1, Oct. 1923, pp. 187-192, 17 figs. Under elastic efficiency is meant fluctuations which a boiler can sustain without noticeably affecting its efficiency; greatest possible elastic efficiency is obtained by use of hot-water storage, and combining hot-water and steam accumulators.

Waste-Heat. Why Not Harness the Engine Exhaust, L. H. Morrison. Power, vol. 58, no. 20, Nov. 13, 1923, pp. 765-767, 4 figs. Value of heat now wasted in exhaust of internal-combustion engines is pointed out, and types of waste-heat boilers in use and installation costs are outlined.

BOILERS, WATER-TUBE

Developments. Water-Tube Boiler and Crane Construction, James H. R. Kemnal. Instn. Mech. Engrs.—Proc., no. 4, June 1923, pp. 579-594 and (discussion) 594-608, 9 figs. History of development of water-tube boilers; air heaters vs. economizers. Description of electric jib crane fitted with luffing gear, and its use for luffing of jibs, shears and boats' davits.

BRASS

Constitution. The Constitution of Brass (Zur Konstitution des Messings), Georg Masing. Wissenschaftliche Veröffentlichungen aus dem Siemens-Konzern, vol. 3, no. 1, May 15, 1923, pp. 240-242, 3 figs. It is shown that beta-crystals under 470 deg. (cent.) develop in brass through diffusion and therefore contrary to prevailing assumption, are likewise constant in lower temperatures.

BREATHING APPARATUS

Types. Gas Masks and Other Respiratory Apparatus. Safety Eng., vol. 46, nos. 2 and 3, Aug. and Sept. 1923, pp. 74-75 and 130-132. Four types of gas masks suitable for different gases; comparison with hose masks and oxygen breathing apparatus.

BRIDGE PIERS

Delaware-River Bridge. The Main Piers of the Bridge over the Delaware River, Between Philadelphia and Camden, Franklin Inst.—Jl., vol. 196, no. 5, Nov. 1923, pp. 593-625, 23 figs. Piers are of massive granite masonry; Details of design, by Clement E. Chase; Construction details, by Montgomery B. Case.

BRIDGES

Girder, Specifications. British Standard Specification for Girder Bridges. British Eng. Standards Assn., No. 153, Aug. 1923, 25 pp. Specifications covering loads and stresses, details of construction, and erection. Appendixes giving schedule of unit loadings for railway and road bridges, and table of standard dimensions of clevises and turnbuckles

BRIDGES, CONCRETE

Arch. Old Steel Arch Utilized in New Reinforced Concrete Structure, Charles F. Bornefeld. Concrete, vol. 23, no. 3, Sept. 1923, pp. 102-106, 9 figs. Old steel arch ribs have been incorporated into new concrete ribs of new Salmon-River bridge at Pulaski, N.Y.

BRIDGES, HIGHWAY

Standardization. Standardizing the Design of Highway Bridges, C. A. Melick. Can. Engr., vol. 45, no. 14, Oct. 2, 1923, pp. 369-373. Practice followed in state of Michigan; fundamental and secondary factors governing design of bridges; advantages of through concrete girder type of bridge described in paper read at high conference, Univ. of Mich.

Steel. Tentative Specifications for Steel Highway Bridge Superstructure. Am. Soc. Civil Engrs.—Proc., vol. 49, no. 7, Sept. 1923, pp. 1377-1403. Progress report of special committee. Specifications for design of fixed span bridges, covering loads and stresses, unit stresses, workmanship, full-size eye-bar tests, weighing and shipping, structural steel for bridges, and structural nickel steel.

BRIDGES, RAILWAY

Hurricanes, for Withstanding. Rigolets Bridge Built to Stand Hurricanes: L. & N. R.R., (La.). Eng. News-Rec., vol. 91, no. 16, Oct. 18, 1923, pp. 626-630, 7 figs. Each pier a concrete cylinder sunk 80 to 113 ft. below sea level on Gulf Coast; steel shells sank and concreted; truss spans and draw; construction equipment floating or on piles.

Steel. General Specifications for the Erection of Steel Railway Bridges (For Fixed Spans Less Than 300 Feet in Length). Am. Ry. Eng. Assn.—Bul., vol. 25, no. 257, July 1923, pp. 67-73.

BUILDINGS

Moving. A 7,500-Ton Office Building is Moved 85 Feet. Ry. Age, vol. 75, no. 19, Nov. 10, 1923, pp. 867-868, 3 figs. Preparation for terminal improvements at Chicago required shifting of 7-story structure, 81 ft. wide by 131 ft. long, for distance of 85 feet.

C

CABLES, ELECTRIC

Steel-Aluminum. Report upon Tests on Steel-Cored Aluminum Cables for Overhead Transmission Lines. Instn. Elec. Engrs.—Jl., vol. 61, no. 322, Sept. 1923, pp. 1041-1043. Tensile tests; limit of proportionality; modulus of elasticity. Report received from Brit. Elec. and Allied Industries Research Assn.

CABLEWAYS

Curve Guides. Automatic Curve-Guide for Rope Haulage Plant, G. Ryba. Indus. Management (Lond.), vol. 10, no. 8, Oct. 18, 1923, pp. 229-230, 2 figs. Describes self-acting guides designed by A. Krahl, chief surveyor of Himmelfürst Pit, Hammer (Czecho-Slovakia), with which arrangement it is stated that tubs run easily round curves, jockeys do not require such accurate adjustment, tubs can be loaded above level of body, there is no lateral tension on rope, and latter cannot slip off guides. From Montanische Rundschau.

ELECTRIC SUSPENSION. An Improvement in Suspension Railways (Eine Neuerung im Hängebahnwesen), G. A. Geipel. Fördertechnik u. Frachtverkehr, vol. 16, no. 15, Aug. 3, 1923, pp. 169-170, 6 figs. Describes so-called fixed-tongue switch and points out its advantages; control of driver's stand crab, of front and rear car; construction data for fixed-tongue crab.

CANALS

CONCRETE LINING. Economy of Concrete for Irrigation Canal Linings, R. C. E. Weber. Concrete, vol. 23, no. 4, Oct. 1923, pp. 158-159, 4 figs. Comparative costs of maintaining earth and concrete-lined sections covering season's work of cleaning 66 mi. of former and 31 mi. of latter, from which is obtained cost of $55.70 per mi. for earth and $19.50 for concrete-lined sections.

CAR DUMPERS

RAILWAY, SEMI-AUTOMATIC. Semi-Automatic Railroad Car Dumper. Iron Age, vol. 112, no. 20, Nov. 15, 1923, pp. 1324-1326, 3 figs. All motions except revolving are automatic; car held by clamps rigidly against blocking; only one motor.

CAR LIGHTING

ELECTRIC. Car Lighting Maintenance on the Illinois Central. Ry. Elec. Engr., vol. 14, no. 10, Oct. 1923, pp. 309-310, 3 figs. 32-volt axle-lighting, system with a battery on each car is standard; nickel-alkaline storage batteries used; overhauling done as car goes through shop every 16 months.

CAR WHEELS

ROLLED STEEL. The Manufacture of Rolled Steel Wheels, G. A. Richardson. St. Louis Ry. Club—Proc., vol. 28, no. 3, July 13, 1923, pp. 60-63. It is shown how standardization has immeasurably simplified problems of buying and selling.

CARS

WHEEL, GEAR AND AXLE PRACTICE. Wheel, Gear and Axle Practice. Elec. Ry. Jl., vol. 62, nos. 7 and 17, Aug. 18 and Oct. 27, 1923, pp. 245-250 and 729-736, 25 figs. Findings resulting from survey of 60 electric railways; mileage obtained and costs resulting from operation of cast iron and steel wheels; conditions limiting life obtained from wheels and expedients used to increase mileage of wheels in service; methods, equipment and shop arrangement used in maintaining wheels and axles.

CARS, COAL

COMPOSITE HOPPER. Composite Hoppers for the Nickel Plate. Ry. Mech. Engr., vol. 97, no. 11, Nov. 1923, pp. 754-756, 6 figs., also Ry. Age, vol. 75, no. 16, Oct. 20, 1923, pp. 703-704, 3 figs. Wooden sides and flooring are found to be more economical than all steel in cost of building and maintenance.

PLANNED REPETITIVE MANUFACTURE. Planned Repetitive Manufacture of Heavy Equipment—Steel Coal Cars, William B. Ferguson. Management & Administration, vol. 6, no. 5, Nov. 1923, pp. 585-592, 11 figs. Deals with manufacturing to order or on contract small number of articles of same design; example selected is that of order of 1,500 steel coal cars, hopper type of 57½-tons cap., manufacture for Chesapeake & Ohio R.R.

CARS, PASSENGER

SLEEPERS. New Sleeping Cars, Buenos Ayres Great Southern Railway, Ry. Gaz., vol. 39, no. 18, Nov. 2, 1923, p. 553, 2 figs. There are two compartments of four berths each, and remainder are two-berth compartments; coach is divided into two portions by a central entrance, compartments being in blocks of 16 and 14 berths respectively, in positions diagonally opposite; length over buffers 81 ft.; width over side matching 10 ft. 6 in.; weight 43 tons.

CAST IRON

MARINE-ENGINE CASTINGS. A Note upon Cast Iron for Marine Engine Castings from the Metallurgical and Engineering Points of View, H. J. Young and E. Wood. Inst. Mar. Engrs.—Trans., vol. 11, no. 5, Oct. 1923, pp. 209-221, 8 figs. Deals with more common difficulties of work, as met by engineer and chemist working in co-operation.

CASTINGS

DEFECTS. Defective Ferrous and Non-Ferrous Castings, Wallace Dent Williams. Can. Foundryman, vol. 14, nos. 9 and 10, Sept. and Oct. 1923, pp. 18-19 and 21, and 18-19, 7 figs. Reviews defects and considers some specially manufactured pieces and expresses his opinion as to best method of manufacturing such pieces.

CATALYSIS

PROMOTION OF REACTIONS. Promotion of Catalytic Reactions, Samuel Medsforth. Chem. Soc.—Jl., vol. 123-124, no. 728, June 1923, pp. 1452-1469, 1 fig. Action of hydrogen upon oxides of carbon; theoretical discussion on action of promoters in methane synthesis; details of experiments; application of dehydration or hydration hypothesis; action of carbon monoxide on steam; the incandescent mantle; selective catalysis.

CEMENT

ALUMINA. Ciment Fondu, J. C. P. Tosh. Roy. Engrs. Jl., vol. 37, no. 3, Sept. 1923, pp. 419-429, 3 figs. Advantages over Portland cement; tests on concrete.

CEMENT, PORTLAND

SETTING. The Setting of Portland Cement, W. Laurence Gadd. Concrete, (Cement Mill Section), vol. 23, no. 3, Sept. 1923, pp. 115-116. Results of investigation by Brit. Portland Cement Research Assn. (Abstract.)

CENTRAL STATIONS

GAS-ENGINE-DRIVEN. Gas Driven Alternators for South Africa. S. African Min. & Eng. Jl., vol. 34, no. 1663, Aug. 11, 1923, pp. 677-678. Describes power plant of Salisbury central station, at Rhodesia, to consist of two Browett-Lindley 4-cylinder vertical 4-stroke-cycle gas engines, each direct coupled to a 300-kw. alternator with exciter, and four 300-hp. double-draft gas producers; description of gas producers, gas engines and alternator.

INTERCONNECTION. Interconnection in New York State. Elec. World, vol. 82, no. 20, Nov. 17, 1923, pp. 1013-1016, 1 map on supp. plate. Study of proposed inter-company network designed to give largest power pool in America; itemization of savings, operating procedure and control; recommendation for immediate development. Present situation with reference to interconnection in New York and neighbouring states is shown in map.

CHAIN DRIVE

TYPES. Points to Consider in Using Various Types and Kinds of Chain Drives, Frank E. Gooding. Indus. Engr., vol. 81, nos. 7, 8 and 9, July, Aug. and Sept. 1923, pp. 335-339 and 373-373, 379-382, and 432-437 and 470, 28 figs. Salient characteristics and considerations which govern selection of different types of chain drives for various purposes; information regarding service conditions which should be known and used as basis for specifying proper chain for given drive; practical details of specific installations.

CHARTS

SEMI-LOGARITHMIC. The Semi-Logarithmic Chart, Allan C. Haskell. Indus. Management (N. Y.), vol. 66, no. 5, Nov. 1923, pp. 300-301, 5 figs. Use of semi-logarithmic charts to measure relative on percentage variations; their value for showing percentage variations.

THERMOTECHNICAL CALCULATIONS. Nomographical Method for the Solution of Thermotechnical and Mathematically Related Problems (Nomographisches Verfahren zur Lösung wärmetechnischer Probleme sowie mathematisch verwandter Aufgaben), Felix Wolf. Wissenschaftliche Veröffentlichungen aus dem Siemens-Konzern, vol. 3, no. 1, May 15, 1923, pp. 77-93, 19 figs. Presents differential equation which is integrated and exemplifies its application to physical phenomena.

CHIMNEYS

HEAT LOSSES IN. Analysis of Heat Losses in Chimneys According to the CO_2 Content of the Exhaust Gases (Zur Beurteilung der Wärmeverluste im Schornstein nach dem CO_2-Gehalt der Abgase), L. Litinsky. Feuerungstechnik, vol. 11, no. 22, Aug. 15, 1923, pp. 217-219. Chimney losses when firing with solid fuels; losses in connection with excess air with gaseous fuels; necessity of analysis of fuels.

STEEL. Steel Chimneys. Indian & Eastern Engr., vol. 52, no. 1, July 1923, pp. 14-16a, 8 figs. Necessity for support; details of design; venturi type of stack; advantages of steel over brick chimneys.

TALL. Tall Chimneys, W. Wallace Christie. Combustion, vol. 9, no. 5, Nov. 1923, pp. 368-374 and 383, 16 figs. Discusses chimney bases, shafts, lightning protection, masonry, steel chimneys, venturi type, concrete stacks, and describes various types, including some exceptionally tall chimneys.

CHROME-VANADIUM STEEL

ANALYSIS. The Analysis of Chrome-Vanadium Steel. G. E. F. Lundell, J. I. Hoffman and H. A. Bright. Indus. & Eng. Chem., vol. 15, no. 10, Oct. 1923, pp. 1064-1069. Particular emphasis is paid to determinations which are troublesome in analysis of chrome-vanadium steel, namely, chromium, vanadium, and manganese.

CIRCUIT BREAKERS

ELECTRICALLY OPERATED. Some features of Importance in Circuit Breaker Design, E. K. Read. Elec. Jl., vol. 20, no. 11, Nov. 1923, pp. 408-410, 3 figs. Describes electrically operated oil circuit breaker designed for heavy power-house service.

OIL-TYPE. British Standard Specification for Oil Immersed Switches and Circuit Breakers for Alternating Current Circuits. British Eng. Standards Assn., No. 116, Aug. 1923, 24 pp., 2 figs. Specification covering: definitions; rating, sizes and marking; design and construction; and tests. Appendixes giving notes on selection of oil immersed circuit breakers, and methods for calculating kva. to be broken.

CLUTCHES

CENTRIFUGAL. Centrifugal Clutches Practical Eng., vol. 68, nos. 1903 and 1904, Aug. 16 and 23, pp. 87-90 and 102-104, 17 figs. Advantages of various types of clutches; details of design and application.

FRICTION. A Review of Power Transmission Machinery. Belting, vol. 23, no. 3, Sept. 1923, pp. 36, 38 and 40, 13 figs. Description of Johnson, Lawton, Farrel, O.K. Hanson and Mule-Pull types of friction clutches.

COAL

CARBONIZATION. Carbonizing Coal at Low Temperature in the Fusion Retort, C.H. S. Tupholme. Chem. & Met. Eng., vol. 29, no. 17, Oct. 22, 1923, pp. 752-755, 3 figs. Process which gives high yield of oils and little gas, can be used for shales and cannels as well as for coals.

ILLINOIS, ANALYSIS OF. Analyses of Illinois Coals. G. W. Hawley. Satte of Ill. Dept. Registration and Education, Division of State Geol. Survey, Bul. no. 27, 1923, 68 pp., 1 fig. Analytical data of study of chemical character of Illinois coals based on new face samples collected in 1921 from approximately 100 mines in various parts of the state with a view to extending knowledge of chemical properties, heating quality, and special adaptability of Illinois coals.

COAL BREAKERS

FIRE-PREVENTION EQUIPMENT. Destruction of Anthracite Breakers Proves Need for Fire-Prevention and Fire-Fighting Equipment, Hadyn Hammond. Coal Age, vol. 24, no. 20, Nov. 15, 1923, pp. 729-731, 3 figs. Use of steel and concrete is said to materially reduce fire hazard; describes spray system in coal breaker.

COAL HANDLING

CONVEYORS. Mechanical Equipment Cuts Cost of Handling Coal, Russell B. Williams Contract Rec. & Eng. Rev., vol. 37, no. 42, Oct. 17, 1923, pp. 992-993, 3 figs. Describes portable belt conveyor which piled coal at a cost of 15 cents per ton as against 40 cents by hand.

FLOATING PLANTS. Floating Coal-Handling Plants for Seaports (Schwimmende Kohlenverladeanlagen für Seehäfen), E. Krahnen Fördertechnick u. Frachtverkehr, vol. 16, no. 16, Aug. 18, 1923, pp. 181-183, 5 figs. Floating steam slewing cranes, for discharging coal from steamers; coat hoists for unloading coal steamers; coal hoist designed as coal ships for coaling steamers.

PIERS. Immense Coal Pier of Virginian Railway Under Construction at Norfolk. Mfrs. Rec., vol, 84, no. 18, Nov. 1, 1923, pp. 97-99, 5 figs. Structure with 7200-ton-per-hr. capacity, features of which are car dumpers, elevator, 130-ton conveying cars, travelling towers with mechanical trimmers, all electrically operated

COAL MINES

EQUIPMENT RECORDS. How Permanent Records of Mechanical and Electrical Equipment May Be Kept, J. H. Edwards. Coal Age, vol. 24, no. 16, Oct. 18, 1923, pp. 586-589, 8 figs. Advantages of equipment records and co-operation needed to maintain them; how different types of machinery are classified; permanent inventory made possible; records as guide for purchasing new equipment.

VENTILATION. How Mines Can Be Moistened Without Use of a Big Force Fan or Obstruction of Haulage Roads, Thomas Chester. Coal Age, vol. 24, no. 18, Nov. 1, 1923, pp. 663-664, 1 fig. By using disk force fan in subsidiary intake conditioned air is delivered to main airway, ventilation of which is by suction, air being motionless in mine portal.

COAL MINING

MACHINE LOADING. Machine Loading Reduces Mine Cost 30 Per Cent. Coal Age, vol. 24, no. 20, Nov. 15, 1923, pp. 733-738, 3 figs. U. S. Coal Commssision investigator finds machine loading 45 tons per hr.,even though idle 40 per cent of time; compares machine and hand loading in same mine.

COFFERDAMS

DEMOLITION. Demolition of Cofferdams below Great Falls Power Development on Winnipeg River. Eng. Jl., vol. 6, no. 11, Nov. 1923, p. 513, 4 figs. Removal of upper and lower cofferdams used in construction of channel at Whitemud Falls.

COKE HANDLING

LOADING AND TRANSPORTATION. Coke Loading and Transportation (Kokslöschung und Kokstransport) L. Rodde. Gas- u. Wasserfach, vol. 66, nos. 35, 36, 38, 40 and 42, Sept. 1, 8, 22, Oct. 6 and 20, 1923, pp. 521-524, 543-545, 568-570, 593-596 and 618-623, 11 figs. Discusses following aspects: Loading, transporting and storing; conditions which influence appearance of coke; therm-technical and gas-technical considerations; simplicity of system; economical results; hygiene.

COLD STORAGE

WAREHOUSE. Cold Storage Warehouse Has Unusual, Design, Stewart T. Smith. Eng. News-Rec., vol. 91, no. 16, Oct. 18, 1923, pp. 633-635, 5 figs. Insulation requirements complicate design; railway track enters at third floor level; asphalt and plaster wall coating put on with spray and cement gun.

CONCRETE

BALL TEST ON. Ball Test applied to Cement Mortar and Concrete, R. B. Crepps and R. E. Mills. Purdue University — Bul., vol. 7, no. 6, May 1923, 30 pp., 17 figs. Investigation conducted for purpose of establishing simple method of determining mechanical properties of cement mortar and concrete; study relative to effect of tire loads upon hardness or surface strength of these materials.

AGGREGATES. Grading of Aggregates and Strength of Concrete. Can. Eng., vol. 45, no. 17, Oct. 23, 1923, pp. 427-430, 2 figs. Fineness modulus has been developed to indicate size and grading of aggregates and their value for use in concrete explains fineness modulus; proper porportioning may double strength of concrete From Concrete Data for Engineers and Architects.

MATERIALS TESTING. Testing Materials for Concrete, Duff Abrams. Can. Eng., vol. 45, no. 15, Oct. 9, 1923, pp. 392-393. Report on methods of testing materials used in cement concrete pavements presented at Int. Road Congress, Seville, Spain.

PROPORTIONING. Rich Mix Strengthens Concrete. Can. Engr., vol. 45, no. 14, Oct. 2, 1923, pp. 367-368. Effect of quantity of cement on strength of concrete; using more cement and less water inproves quality. From Concrete Data for Engrs. & Architects.

STRENGTH. The Strength of Concrete; Its Relation to the Cement Aggregates and water, Arthur N. Talbot and Frank E. Richart. Univ. of Ill. Bul., No. 137, Oct. 1923, 116, pp., 46 figs. Methods for studying concrete-making properties of fine and coarse aggregates and for comparison and acceptance of aggregates; means for designing concrete mixtures for different densities and strengths when voids in mortars made up with a given cement and fine aggregate have heen determined by laboratory tests; suggests means for estimating effect upon strength and density of concrete that accompanies an increase in amount of mixing water beyond that which would give minimum volume to concrete; results of tests of mortars and concretes made up with a variety of fine aggregates, and discussion of methods used.

CONCRETE BLOCKS

NEL-STONE PRECAST. Nel-Stone Construction, a Precast Monolithic System, William B. Eastwood. Concrete Products, vol. 20, no. 3, Sept. 1923, pp. 25-28, 6 figs. Consists of precast block 12 by 12 by 4 in., or smaller. block being edged with grove into which suitable reinforcing rods are introduced, space left in groove filled with Portland cement grout.

PRE-CAST. New Type of Pre-Cast Concrete Blocks, F. M. McCullough. Can. Engr., vol. 45, no. 19, Nov. 6, 1923, pp. 467-469, 4 figs. Results of tests carried out in materials laboratory of Carnegie Inst. Technology on concrete Universal building blocks developed by Henderson Corp., Pittsburgh, Pa.; can be used for a variety of structures.

CONCRETING

COLD-WEATHER. How to Use Concrete in Winter Time. Contract Rec., vol. 37, no. 44, Oct. 31, 1923, pp. 1034-1037, 3 figs. Practical pointers; fundamentals of cold-weather concreting; methods of winter work; heating forms; protective coverings; use of salt or calcium chloride; application of load.

COLOR

OSTWALD MEASUREMENT METHOD. Color Measurement by the Ostwald Method. Ismar Ginsberg. Textile World, vol. 64, no. 11, Sept. 15, 1923, pp. 53, 55 and 73, 1 fig. Principles of Ostwald theory and how practical use is made of them; apparatus employed in analyzing colors; sample analysis; importance of method for designating colors, determining their purity and defining fastness in exact terms.

CONCRETE CONSTRUCTION

BELT CONVEYORS, USE OF. Concrete Construction With the Aid of Belt Conveyors, F. W. Kennedy. Eng. World, vol. 23, no. 4. Oct. 1923, pp. 215-218, 8 figs. Describes construction methods in connection with Laurel Road Dam, near New Canaan, Conn, for Stamford Water Co , which presents interesting plant layout and an effective and unique use of belt conveyors for handling materials and for lateral distrib ution of concrete itself.

CONDENSERS, STEAM

STEAM INJECTORS AND WATER-JET PUMPS. Steam Injectors and Water-Jet Pumps in Condenser Plants (Dampfstrahlpumpe und Wasserstrahlpumpe hei Kondensationsanlagen), L. Heuser and K. Finzel. Schiffbau, vol. 24, no. 51-52, Sept. 19-26, 1923, pp. 785-791, 5 figs. Comparative tests show superiority of steam injectors over water-jet pumps.

SURFACE, AIR PUMPS FOR. The Selection of Air Pumps for Surface Condensers. Shipbldg. & Shipg. Rec., vol. 22, no. 15, Oct. 11, 1923, p. 1923, p. 452. Air capacity under working conditions; air in pump.

TUBES. Contributions to the Study of Corrosion of Condenser Tubes (Beiträge zur Kenntnis der Korrosion an Kondensatorrohren), E. Maas and E. Liebreich. Zeit. für Metallkunde, vol. 15, no. 9, Sept. 1923, pp. 245-250, 6 figs. Account of tests carried out at Chem-Tech. State Inst., Berlin; recommendations for treatment of surface of condenser tubes; increased protection of zinc-rich brass against local corrosion.

Determining the Economical Interval Between Cleanings of Condenser Tubes, C. E. Colborn. Power, vol. 28, no. 21, Nov. 20, 1923, pp. 803-805, 4 figs. Most economical period between tube cleanings depends upon how fast sediment is deposited, cost of vacuum loss which varies with relative load to large extent, and cost of cleaning tubes.

CONVEYORS

ASSEMBLING. Speeding Up Transmission Assembling. Am. Mach., vol. 59, no. 17, Oct. 25, 1923, pp. 617-618, 5 figs. Installation of simple assembling conveyor increases output of same crew over 50 per cent.

AUTOMOBILE MANUFACTURING PLANTS. The Application of Conveyor Equipment to a Small Production Plant, H. P. Harrison. Soc. Automotive Engrs.—Jl., vol. 13, no. 5, Nov. 1923, pp. 357-365, 25 figs. Conditions that determined whether power-driven or gravity-actuated conveyors should be used; various types required for handling raw stock, for machining operations, sub-assemhling and finished assemblies; conveyors for handling cylinder castings; handling parts between department and machines; assembling transmissions, engines and axles; handling finished cars through final-inspection and touch-up operation etc.

CO-OPERATIVE SOCIETIES

DEVELOPMENTS. Co-operation. Monthly. Labor Rev., vol. 17, no. 4, Oct. 1923, pp. 184-195. Comparative study of co-operation in various countries; development of various types of co-operative societies; consumers' societies; court decision as to contract with co-operative marketing association, Kansas; development of building and loan associations in United States; strike of employees of English co-operative wholesale Society.

COPPER MINES

ELECTRIFICATION. Electrified Copper Mine, J. B. Johnson and C. L. Gerhardt. Elec. World, vol. 82, no. 18, Nov. 3, 1923, pp. 903-909, 8 figs. Describes installation of United Verde Copper Co. at Jerome, Ariz.; underground hoisting stations used; flexibility and economy of electrification; unusual ore-bin selector.

CORROSION

TESTS. The Control of Motion and Aeration in Corrosion Tests, J. F. Thompson and R. J. McKay. Indus. & Eng. Chem., vol. 15, no. 11, Nov. 1923, pp. 1114-1118, 4 figs. Discusses mechanism by which variation in aeration and rate of motion affects corrosion rate; gives test method of control sufficiently accurate to reproduce results within about 5 per cent; results obtained in connection with series of 2000 tests on acid-resisting metals in 2 to 10 per cent sulphuric acid, duplicating conditions found in picking steel sheets.

COST ACCOUNTING

FACTORY. Linking Accounting to Production, Ernst Just. Management & Administration, vol. 6, no. 4, Oct. 1923, pp. 491-493. Development of New Germany system of factory accounting called "energetic" method principles and applications of which are explained; how assets at rest, consumed, newly produced and total assets are dealt with.

Precalculation and Economic Production (Vorkalkulation und wirtschaftliche Fertigung), C. Riedrich. Werkstattstechnik, vol. 17, no. 20, Oct. 15, 1923, pp. 599-600, 2 figs. Points out importance of modern factory organization with special regard to functions of cost finding and its difficulties when organization is not up-to-date.

METHODS. "Is Our Investment in Cost Accounting Profitable"? Thomas W. Howard. Factory, vol. 31, nos. 2, 3, 4 and 5, Aug., Sept. Oct. and Nov. 1923, pp. 172-174, 216 and 218; 318-321; 466-467, 512, 514, 516 and 518, 3 figs. and 605-607, 1 fig. Consideration of questions in effective cost accounting from viewpoint of executive. Aug.: Common leaks and ways to stop them. Sept.: What the difference cost methods are. Oct.: Job-cost method and where it works best. Nov. specification costs and how they compare with job costs.

CRANES

CABLEWAY. Calculation of Ropes for Cableway Cranes (Zur Berechnung der Tragseile von Kabelkranen), V. Hirschhaut. Fördertechnik u. Frachtverkehr, vol. vol. 16, no. 14, July 18, 1923, pp. 162-163. Simplified method of calculation.

ELECTRIC. Electric Cranes, Daniel Adamson. Elec. Rev., vol. 93, no. 2395, Oct. 19, 1923, pp. 567-568. Methods of electric control; crane protective panels; contractor panels.

Electrically Operated 25ft. Goliath Crane at the Goods Station at Zurich, W. Druey. Int. Ry. Congress—Bul. vol, 5, no. 10, Oct. 1923, pp. 961-962, 1 fig. Describes crane designed for loading and unloading furniture vans; also provided with auxiliary crabs for handling all types of goods. From Bul. Technique de la Suisse Romande.

PORTABLE BATTERY. Three-Motor Portable Battery Crane. Engineering, vol. 116, no. 3018, Nov. 2, 1923, p. 558, 4 figs. Especially designed for handling freight on platforms; battery is Exide Ironclad type and has capacity of 258 ampere-hr. on 5-hr. rating.

CRUSHERS

STONE. A recent Development in stone Crushing Machinery, Ernest W. Roland. Good Roads, vol. 65, no. 14, Oct. 3, 1923, pp. 111-112, 2 figs. Describes special Duplex synchronous motor attached to Kennedy-Van Saun crusher, with which crusher can quite probably be started when fully loaded.

CULVERTS

CONCRETE, PRE-CAST. Pre-Cast Concrete Culverts. Ry. Rev., vol. 73, no. 16, Oct. 20, 1923, pp. 572-574, 3 figs. Extracts from committee report before Am. Ry. Bridge & Bldg. Assn. General considerations in determining openings of culvert pipe for railroad embankment.

SELECTION OF MATERIAL. The Relative Merits of Concrete, Cast-Iron and Corrugated Metal Pipe Culverts. Ry. Age vol. 75, no. 16, Oct. 20, 1923, pp. 710-711. Committee report on various considerations affecting selection of materials most commonly used in pipe culverts. (Abstract.) Report before Am. Ry. Bridge & Bldg. Assn.

CUPOLAS

HEAT BALANCE. The Heat Balance of Cupolas (Die Wärmebilanz des Kupolofens). Giesserei-Zeitung, vol. 20, nos. 21 and 22, Oct. 1 and 15 1923, pp. 412-415 and 429-431, 4 figs. Comparison of different analyses; probable values in ordinary practice; elements of heat balance; remarks on changes of separate expressions in heat balance; tests with re-dressed coke; heating cupola with pulverized coal or with heavy oil; use of hot air in cupolas for cast iron.

WASTE-HEAT UTILIZATION. Utilizing the Waste Heat from the Cupola, G. Ernest Booker. Iron & Steel of Canada, vol. 6, no. 10, Oct. 1923, pp. 211-212, 4 figs. Ways in which heat of fuel consumed in operation of a foundry cupola can be used profitably.

D

DAMS

STORAGE. Hollow Dam with Notable Design Features, Frank W. Chappell and E. M. Urban. Eng. News-Rec., vol. 91, no. 18, Nov. 1, 1923, pp. 706-710, 11 figs. Storage dam at Cisco. Tex., has cut-off wall integral with deck; corrugated footing resists sliding; 4-mi. railways constructed; forms for deck used thirty times.

DIELECTRICS

SOLID, CONTACT ELECTRICITY OF. The Contact Electricity of Solid Dielectrics, Harold F. Richards. Physical Rev., vol. 22, no. 2, Aug. 1923, pp. 122-133. Electric charges produced by wringing optically flat surface together were measured in order to determine whether or not there is possibility of formulating single-contact theory which will include both metals and dielectrics; determination of electric effect of compressing amorphous dielectrics, and of collision of solid insulator and metal.

DIESEL ENGINES

DEUTZ COMPRESSORLESS. Horizontal Diesel Motor Without Compressor. Eng. Progress, vol. 4, no. 9, Sept. 1923, pp. 181-184, 15 figs. Particulars of Deutz engines. Diesel engines without compressor and economic fuel consumption.

McIntosh & Seymour's New Big Diesel. Motorship, vol. 8, no. 11, Nov. 1923, pp. 772, and 775, 1 fig. American-designed marine engine of 2250 hp. which has completed successful trials.

DREDGES

ELECTRIC SAND-AND-GRAVEL. Electric Equipment of Sand and Gravel Dredges, J. E. Borland. Elec. Jl., vol. 20, no. 11, Nov. 1923, pp. 390-395, 14 figs. Describes two electrically operated dredges for sand and gravel service and their operation.

DRILLING MACHINES

RADIAL. Improved Radial Drilling Machines. Eng. Production, vol. 6, no. 134, Nov. 1923, p. 451, 1 fig. Describes 6-ft. machine constructed by George Swift & Sons Ltd., Halifax, for operation upon girder and structural work, boiler and tank plates, etc.

ROTARY INDEXING TABLE. A New Drilling Device. Eng. Production, vol. 6, no. 134, Nov. 1923, p. 447, 3 figs. Describes device developed by Leyland Motors, Ltd., Leyland, Lancashire, Eng., to eliminate marking out in connection with drilling of circles of holes, comprising a rotary work table capable of being indexed radially.

DRYING

PROCESS CHART. Graphic Presentation of Processes of Drying (Einiges aus dem Bilderhuch über Troekniungsvorgänge), Karl Reyscher. Gesundheits-Ingenieur, vol. 46, no. 42, Oct. 20, 1923, pp. 414-416, 3 figs. Describes simplified method hy use of which diagram is obtained visnalizing complicated phenomena of drying.

DURALUMIN

TENSION TESTS. Tests on Riveted Joints in Sheet Duralumin, H. F. Rettew and G. Thumin. Nat. Advisory Committee for Aeronautics—Tech. Notes, no. 165, Nov. 1923, 7 pp., 3 figs. Results of tension tests on various forms of single-riveted lap joints, Abstracted and revised from thesis presented to Dept. of Mech. Eng. of Mass. Inst. of Technology.

E

EDUCATION, ENGINEERING

FUNDAMENTAL STUDIES. Education for the Functional Divisions of Engineering, Edward Bennett. Am. Inst. Elec. Engrs.—Jl., vol. 42, no. 11, Nov. 1923, pp. 1145-1152. Presents for consideration course of study in which fundamental studies of first two years are not identically same in all courses, hut are avowedly different hoth in content and in aim; each course is intended to provide foundation for what is designated as one of hasic types of engineering work or as one of functional divisions of engineering, these divisions being listed as engineering research, design, supervision, management, and sales.

ELECTRIC ARC

MERCURY. Positive Ion Currents in the Positive Column of the Mercury Arc, Irving Langmuir. Gen. Elec. Rev., vol. 26, no. 11, Nov. 1923, pp. 731-735. Negatively charged electrodes in path of mercury arc take up current which is found to be independent of impressed voltages; starting with this phenomen, author arrives at theory which not only explains this fact but which also gives new conception of nature of mereury arc.

ELECTRIC CURRENTS

SHORT-CIRCUITS. The Short-Circuits Current of an A. C. Generator (Der Kurzschlusstrom eines Wechselstromgenerators), A. Mandl. Elektrotechnik u. Maschinenhau, vol. 41, no. 42, Oct. 21, 1923, pp. 609-614, 11 figs. Author seeks to explain in physical terms and without any calculation the phenomena of sudden short eireuits.

ELECTRIC DRIVE

WORKSHOPS. Electric Drive for Engineering Workshops, J. Scoular. Commonwaelth Engr., vol. 10, nos. 11 and 12, June I and July 1, 1923, pp. 408-409 and 446-451, 8 figs. Application and advantages of electric drive for operation of machine tools and other machinery employed in workshops; principles of efficient operations.

ELECTRIC FURNACES

CATHODE RADIATION. A Cathode Radiation Furance (Ein Kathodenstrahlofen), Hans Gerdien and Hans Riegger, Wissenschaftliche Veröffentlichungen aus dem Siemens-Konzern, vol. 3, no. 1, May 15, 1923, pp. 226-230, 3 figs. Consists of a ball-shaped vessel, from wall of which the cathode radiations run radially toward preparation to be heated which is located in middle of vessel.

ELECTRODES. Automatic Hydraulic Regulation of Furnace Electrodes. Electricity, vol. 37, no. 1679, Jan. 12, 1923, pp. 13-14, 1 fig. Describes hydraulic system of electrode control, developed by Brown, Boveri & Co., providing a direct-acting mechanism which requires no sensitive relays, is free from delay in operation, and has no blacklash or overshooting.

SIZE AND COSTS. Size of Furnace Affects Costs, Larry J. Baton. Iron Trade Rev., vol. 73, no. 19, Nov. 8, 1923, pp. 1309-1310. Conditions which govern selection of size of furnace and operating costs for large and small installations based upon output; little difference is found in costs per ton.

ELECTRIC GENERATORS

AMBIENT TEMPERATURE TESTS. Amhient Temperature Observations, H. T. Lange. Am. Inst. Elec. Engrs.—Jl., vol. 42, no. 11, Nov. 1923, pp. 1168-1170, 2 figs. Shows that actual temperature of small machine is of slight importance in its effect on amhient temperature; size of unit is more important factor; different between ambient and room temperatures on 6-kw. motor generator set is 0.5 deg. cent.

ELECTRIC GENERATORS, A.C.

WAVE SHAPE, IMPROVING. Improving the Shape of Alternator Voltage Waves, E. W. Marchant and T. H. Turney. Elecn., vol. 91, no. 2368, Oct. 5, 1923, pp. 362-363, 4 figs. It is shown that under normal circumstances correction of wave shape may be affected by described arrangement without altering design of alternator or decreasing its rating to any appreciable extent. (Abstract.) Paper read before Brit. Assn.

ELECTRIC LOCOMOTIVES

BALDWIN-WESTINGHOUSE. Baldwin-Westinghouse Electric Locomotives for Trunk Line Service, Paul T. Warner. Baldwin Locomotives. Baldwin Locomotives, vol. 2, no. 2, Oet. 1923, pp. 28-39, 12 figs. Describes different types of Baldwin-Westinghouse locomotives in use on different railways.

Transmission hy Connecting Rods. New Type of Transmission by Coupling Rods for Electric Locomotives. Int. Ry. Congress—Bul., vol. 5, no. 10, Oct. 1923, pp. 963-965, 2 figs. Extract article by Joseph Bianchi published in Revue Générale des Chemins de Fer, Feh. 1923.

ELECTRIC MEASURING INSTRUMENTS

BOILER PLANTS. Electric Measuring Instruments in Steam Plants (Elektrische Messgeräte für Dampfhetriebe), G. Quaink. Dinglers Polytechnisches Journal, vol. 338, nos. 13-14, July 14, 1923, pp. 141-145, 13 figs. Describes different types of CO and CO_2 indicators, thermometers, thermo elements, filament pyrometers, etc., and their application.

LONG-DISTANCE. New Electrical Recording System As Used in Pulp and Paper Mills, L. G. Bean. Paper Trade Jl., vol. 77, no. 19, Nov. 8, 1923, pp. 45-36, 2 figs. Describes instrument designed and distributed by Bristol Co., of Boston, Mass., which enables a measurement of perssure, temperature, liquid level, flow, motion or other qualities, to he made at a distance up to several miles from point at which actual condition takes place.

ELECTRIC MOTORS

INSTALLATION AND OPERATION. Installation and Care of Motors and Generators. Indus. Engr., vol. 81, no. 11, Nov. 1923, pp. 540-544 and 563-564, 2 figs. Recommendations of Electric Power Club for handling, installation and operation, from standpoint of those in charge of their operation and maintenance.

ELECTRIC MOTORS, A.C.

REACTION SYNCHRONOUS. Polyphase Reaction Synchronous Motors, J. K. Kostko. Am. Inst. Elec. Engrs.—Jl., vol. 42, no. 11, Nov. 1923, pp. 1162-1168, 11 figs. Develops theory of reaction motor, showing that its inferiority is mainly due to faulty form of rotor; analyses construction whose performance can he made comparable to that of any standard type of a.c. motors.

SECONDARY WINDINGS OF INDUCTION. Induction Motor Secondary Windings, C. W. Kincaid. Elec. Jl., vol. 20, no. 11, Nov. 1923, pp. 410-419, 17 figs. Squirrel-cage rotors; mechanical construction of squirrel-cage windings; wound rotors; winding connections: modified wave winding.

SQUIRREL-CAGE. A Squirrel-cage Induction Motor with High Starting Torque and Low Starting Current in the Line, T. F. Wall. Elec. Rev., vol. 93, no. 2393, Oct. 5, 1923, pp. 514-518, 12 figs. Describes new type developed by author. Paper read before Brit. Assn.

STARTING. The Starting of Polyphase Squirrel-Cage Motors, Benjamin F. Bailey. Am. Inst. Elec. Engrs.—Jl., vol. 42, no. 11, Nov. 1923, pp. 1172-1181, 8 figs. Reviews different methods of starting polyphase induction motors and considers speed torque eurves obtained with various types; effect of starting current upon line voltages, upon motor and upon connected apparatus; energy required with various methods.

ELECTRIC SWITCHES

OIL, TRIPLING DEVICE FOR. Sensitive Tripping Mechanism for Oil Switches. Engineering, vol. 116, no. 3017, Oct. 26, 1923, pp. 522-524, 14 figs. Describes device which forms part of oil switch-operating gear and does not necessitate use of any independent relays or tripping circuits.

ELECTRIC TRANSMISSION LINES

CALCULATION. Electric Line Calculations: Their Practical Application to Transmission and Distrihution Problems, W. T. J. Atkins. Instn. Elec. Engrs.—Jl., vol. 61, no. 332, Sept. 1923, pp. 1044-1048, 3 figs. Fundamental principles of type of network feeding scattered loads and having complicated layout; describes calculating methods based on principle of superposition enabling problems of any degree of complexity to he solved by successive approximation; calculation of short-circuit currents and their heating effect.

CONSTANTS, TABLES OF. Tables of Transmission Line Contants, D. D. Ewing. Purdue University—Bul., vol. 7, no. 8, Sept. 1923, 31 pp., 3 figs. Presents tahles of certain line constants which are of assistance in application of exact formulas to solution of electric transmission-line prohlems.

DESIGN. Mechanical Electrical Construction of Modern Power Transmission Lines—Insulators for High-Voltage Lines, C. B. Carlson and W. R. Battey. Am. Inst. Elec. Engrs.—Jl., vol. 42, no. 11, Nov. 1923, pp. 1126-1128, 4 figs. Deals with investigations for economics followed by design assumptions based on economical findings; limitations hy electrical clearances; testing of structures; design assumptions of cahle attachments; extensions required by nature of country traversed; erection problems.

FROZEN FOG FORMATION. Transmission Line Construction in Crossing Mountain Ranges, M. T. Crawford. Am. Inst. Elec. Engrs.—Jl., vol. 42, no. 11, Nov. 1923, pp. 1121-1125, 12 figs. Discusses failures occurring in Pacific Northwest under severe climatic conditions; outlines conditions in extreme loading area and makes assumption that most severe stresses were largely of intermittent nature; subsequent modifications in construction.

ICE LEAD. The Behavior of Overhead Lines with Additional Ice Lead (Das Verhalten der Freileitungen bei zusätzlicher Eishelastung), H. Kallir. Elektrotechnik u. Maschinenbau. vol. 41, no. 41, Oct. 14, 1923, pp. 593-602, 5 figs. Specifications for additional loads in Austria and Germany. Czecho-Slovakia, France, Switzerland, England, Sweden and United States; behavior of line when additional load is greater than that based on calculation; influence of electric condition of conductor on development of ice load addition.

TOWERS, DESIGN AND LOCATION. Special Features in the Design of Transmission Tower Lines as Imposed hy Electrical Conditions, W. Dreyer. Am. Inst. Elec. Engrs.—Jl., vol. 42, no. 11, Nov. 1923, pp. 1117-1120, 5 figs. Deals with factors which effect structural and mechanical phases of transmission-line design, namely, factors affecting design of towers and features involving location of towers.

TRANSIENTS. Transmission Line Transients, V. Bush. Am. Inst. Elec. Engrs.—Jl., vol. 42, no. 11, Nov. 1923, pp. 1155-1158, 13 figs. Results of investigation on transients recently performed in Mass. Inst. of Tech., in order to check experimentally part of theory of transients on transmission lines and cables, and to investigate qualitatively certain phenomena of reflection and wave form. (Ahridgement.).

ELECTRICAL MACHINERY

DESIGN CONSTANTS. Design Constants and Measuring Units, Lawrence E. Widmark. Am. Inst. Elec. Engrs.—Jl., vol. 42, no. 11, Nov. 1923, pp. 1153-1154, 3 figs. Presents generalization of method describes in previous paper hy author entitled an Arangement of the Circle Diagram, published in Sept 1922 Journal; outlines unit parabola diagram" for d.c. machine, "unit circle" arrangement of Behrend eircle diagram, and cross-section unit reference system where length dimensions take place of ordinary electric units in recording electrical data of machine.

LARGE CAPACITY OF. Electrical Machinery of Large Capacity. (Ausndem Grossmaschinenhan), K. Sache. Elektrotechnik u. Maschinenhau, vol. 41, no. 35, Sept. 2, 1923, pp. 505-521, 19 figs. Resume of accomplishemnts in design of large generators and motors during last ten years, with particular attention to problems of insulation and heating; deserihes methods which enahle modern designer to huild generators with windings withstanding safely dangerous glow dischanges of high voltages up to about 12,000; cooling and ventilating prohlems of turho-generators; frequent mention is made of American-made apparatus.

LOCUS DIAGRAMS. The Use of the Scalar Product of Vectors in Locus Diagrams of Electrical Machinery, Vladimir Karapetoff. Am. Inst. Elec. Engrs.—Jl., vol. 42, no. 11, Nov. 1923, pp. 1181-1183, 5 figs. Shows advantages of branch of mathematics known as vector analysis in deduction of locus diagram, over usual method involving plane geometry and trigonometry.

ELECTRIC WELDING, ARC

A. C. MACHINE. A Pacific Coast Alternating Current Arc Welder. West Machy. World, vol. 14, no. 10. Oct. 1923, pp. 324-325, 5 figs. Describes a. c. are-welding equipment of simple construction and operation, developed and manufactured hy Welding Service & Supply Co., San Francisco, Cal.

CAST IRON. Welding Cast Iron With a Special Nickel Copper Alloy Welding Wire, Alexander Churchward. Am. Welding Soc.—Jl., vol. 2, no. 9, Sept. 1923, pp. 17-19, 3 figs. Describes successful method of welding cast iron involving new principle of absorbing carhon contained in cast iron, forming thereby at juncture of weld a new alloy which not only insures strength equal to that of original casting, but also permits ready machining; accomplished without pre-heating, annealing or use of studs.

EFFICIENCY. Efficiency of Arc Welding, R. D. Reed. Welding Engr., vol. 8, no. 10, Oct. 1923, pp. 28-29, 3 figs. Choosing machine for work; selection of electrodes and adjusting welding current.

STEEL SHIP MASTS. The Manufacture of Welded Steel Masts, A. G. Bissell. Mar. News, vol. 10, no. 6, Nov. 1923, p. 75. Describes construction of fourteen steel masts for seven seagoing tugs at U. S. Navy Yard at Puget Sound, parts of which were entirely assemhled by arc welding.

ELECTRIC WELDING, RESISTANCE

SHEET METAL. Resistance Welding of Sheet Metal, H. W. Tobey. Am. Welding Soc.—Jl., vol. 2, no. 9, Sept. 1923, pp. 24-28, 28 figs. Results of tests made on various forms of sheet metal.

ELEVATORS

CABLES, USED, STRENGTH OF. Chart for Determining the Strength of Used Elevator Cables, C. W. Willetts. Power, vol. 58, no. 20, Nov. 13, 1923, pp. 762-764, 2 figs Gives formula which is based on tests made on used cables and wires described in same journal (Sept, 18), and chart which was worked out to accomplish calculations that formula is intended to perform.

GOVERNORS. Operation of Over-Speed Governors on Electric Elevators, Howard B. Cook, Power, vol. 58, no. 17, Oct. 23, 1923, pp. 651-652, 2 figs. Comparison of different types of elevator governors and advantages and disadvantages of each.

HYDRAULIC VS. ELECTRIC. Electric and Hydraulic Elevators in Modern Buildings, James A. McHollan. Architectural Forum, vol. 39, no. 4, Oct. 1923, pp. 169-174, 4 figs. Some of the latest improvements in electric elevator equipment, together with operating records from existing plants; comparative cost figures of electric and hydraulic-elevators.

EMPLOYEES REPRESENTATION

DISCIPLINE AND. Employee Representation and Discipline, Elisha Lee. Ry. Age, vol. 75, no. 19, Nov. 10, 1923, pp. 855-857. Experience on Pennsylvania indicates that disciplinary control has been strengthened.

EMPLOYMENT MANAGEMENT

PENSION COSTS. Pension Costs and the Labor Turnover Factor, Joseph H. Woodward. Management & Administration, vol. 6, no. 4, Oct. 1923, pp. 483-486, 1 fig. Method of determining cost as percentage of payroll.

ENGINEERING

AUTOMOBILE. Automobile Engineering as a Profession, H. G. Burford. Automobile Eng., vol. 13, no. 181, Oct. 1923, pp. 316-319. Notes on standardization; roads and their relation to transport; legislation; education and training of automobile engineer; part to be played by Institution.

ENGINEERS

ACHIEVEMENTS OF. The Rise of The Engineer, C. R. Young. Eng. Jl., vol. 6, no. 11, Nov. 1923, pp. 508-512. Review of what engineers have achieved; early status of engineer; growth of confidence in engineer; influence of engineering societies; profession vs. business future of engineering.

RELATION TO PUBLIC. The Relations of the Engineer to the Public, A. N. Johnson. Univ. of Va. Jl., Eng., vol. 3, no. 5 Jan. 1923, pp. 93 and 102. Points out that engineers collectively and individually, should take more active part in public affairs, in order that they may be intrusted with greater responsibility in management of public affairs.

ENGINEHOUSES

LIGHTING. Enginehouse Lighting on the Great Northern. Ry Elec. Engr., vol. 14, no. 10, Oct. 1923, pp. 299-300, 4 figs. Describes method of wiring enginehouses which has advantages of low first cost, overhead lights and durability; 32-volt extension circuits are a feature.

EXHAUST STEAM

TOTAL HEAT, CALCULATION OF. Figuring the Total Heat of Exhaust Steam, A. G. Christie. Power vol. 58, no. 18, Oct. 30, 1923, pp. 685-686, 1 fig. Methods by which total heat may be computed for turbines.

EXPLOSIVES

TRINITROTOLUENE. Strength and Sensitiveness of TNT as Determined by the Laboratory "Sand-Test" Bomb. C. A. Taylor and R. D. Leitch. U. S. Bur. of Mines—Reports of Investigations, no. 2526, Sept. 1923, 5 pp. Method and results of tests.

F

FANS

AIR MEASUREMENT. Air Measurement Methods for Experimental Work on Fan-Pipe Installations, G. E. McElroy and A. S. Richardson. U. S. Bur. of Mines—Reports of Investigations no. 2527, Sept. 1923, 2 pp. Results of experiments in Butte mine to determine friction factors for different types and sizes of fan piping.

FEED-WATER HEATERS

LOCOMOTIVE. A New Feed-heater for Small Locomotives. Engineer, vol. 136, no. 3537, Oct. 12, 1923, p. 404, 1 fig. Also Ry. Mech. Engr., vol. 97, no. 11, Nov. 1923, p. 749 1 fig. Describes smokebox feed heater for new type of locomotive designed by A. Borsig, Berlin-Tegel; hot gases enter heater through circular perforated cylinder and are entertained by annular series of steam jets placed below vertical smoke tubes of heater. Abstract from Verkehrstechnik.

FLIGHT

CONTROL AT LOW SPEED. Control of Aeroplanes at Low Speeds, Melvill Jones. Roy. Aeronautical Soc.—Jl., vol. 27, no. 154, Oct. 1923, pp. 473-485 and (discussion) 485-487, 3 figs. Deals with control of airplane when stalled.

FLOOD CONTROL

PROJECTS AND THEIR APPLICATION. Relief From Floods, Chas. B. Burdick. West. Soc. Engrs.—Jl., vol. 28, no. 10, Oct. 1923, pp. 451-467 and (discussion) 467-471, 10 figs. Reviews subject of great floods, points out various remedies therefor, and illustrates few of more important applications.

TIDAL STREAMS. Flood Control in Tidal Streams, W. J. Roberts. Eng. World, vol. 23, no. 4, Oct. 1923, pp. 213-214. Factors which make a tidal stream a menace to its harbor; constructed channels; causes of flooding of a stream and remedies.

FLOORS

COMPOSITION FLOORING. Composition Flooring, Raymond R. Butler. Chem. & Industry, vol. 42, no. 41, Oct. 12, 1923, pp. 980-982. Deals with Portland cement, magnesite cements, bitumen rubber, calcium-sulphate cements, miscellaneous cements. Patent literature.

FLOW OF FLUIDS

CALCULATION. Simplifying the Solution of Problems of Fluid Flow, Barnett F. Dodge. Chem. & Met. Eng., vol. 29, no. 19, Nov. 5, 1923, pp. 844-846, 3 figs. Methods of calculation which eliminate procedure of trial and error heretofore in vogue.

FLUE-GAS ANALYSIS

CO METERS. At Last: A CO Meter. Fuels & Furnaces, vol. 1, no. 6, Oct. 1923, pp. 471-474, 4 figs. Describes simple electrical apparatus which gives percentage of CO almost instantly in general indications of combustible gases by this instrument are accurate within a few tenths of one per cent.

CO_2 METERS. An Electrical CO_2 Meter. Gas Age-Rec., vol. 52, no. 19, Nov. 10, 1923, pp. 587-588, 4 figs. Describes meter operating on principle different from usual chemical meter; utilizing physical property of heat conduction of gases.

FLYWHEELS

ENERGY EFFECT. Energy Effect of a Flywhell on Rotating Mass. Robert Johnson. Machy (Lond,), vol. 23, no. 578, Oct. 25, 1923, pp. 102-103, 4 figs. Use of chart designed by author, by means of which the "m" of wheel or number of ft.-lb. of kinetic energy stored at 1 r.p.m., can be read off by counting number of rectangles enclosed by section of flywheel.

FORGING

LOCOMOTIVE FRAMES. Notable Economies in Forging Locomotive Frames. Ry. Rev., vol. 73, no. 19, Nov. 10, 1923, pp. 687-689, 7 figs. Beech Grove Ind., shops of Big Four forge front end in one piece from scrap material.

FOUNDRIES

CLEANING-ROOM COSTS. Determining Cleaning Room Costs, B. K. Price. Abrasive Industry, vol. 4, no. 11, Nov. 1923, pp. 311-313, 4 figs. Describes cost system at plant of Lebanon Steel Foundry, Lebanon, Pa., said to be unique in steel-foundry industry; wheel performance is based on amount of material removed in pounds with total cost expressed in terms of cents per pound removed.

MACHINE-TOOL CASTINGS. Makes Machine Tool Castings, Pat Dwyer. Foundry, vol. 51, no. 21, Nov. 1, 1923, pp. 853-857, 5 figs. Describes plant and equipment of Pratt & Whitney Co., Hartford, Conn., in which molding, melting and cleaning facilities are particularly adapted to production of high-class castings.

OVERHEAD CARRYING SYSTEM. Overhead Carrying System for Modern Foundry, F. H. Bell. Can. Foundryman, vol. 14, no. 10, Oct. 1923, pp. 13-16, 10 figs. Describes overhead system for conveying molten metal and other meterial in foundry; saves time and labor, increases production and makes life easier for workmen.

STEEL. Adopts Melting Units to Meet Varied Needs, B. K. Price. Foundry, vol. 51, no. 21, Nov. 1, 1923, pp. 868-872 and 883. Plant of Eastern Steel Castings Co., Newark N. J., which is largest jobbing foundry in New York metropolitan district and one of few in country producing both electric and open-hearth steel castings.

FREIGHT HANDLING

CONTAINERS, ROAD-RAILWAY. Interchangeable Road-Railway Containers? Motor Transport (Lond.), vol. 37, nos. 969, 970, and 975, Sept. 24, Oct. 1 and Nov. 5, 1923, pp. 384-387, 420-422, 565-566, 38 figs. Discusses question of whether goods containers or bins interchangeable between road and railway vehicles can be standardized, making calculations.

TRACTOR-TRAILER SYSTEM. Developing Lower Costs for Handling Freight. Ry. Age, vol. 75, no. 17, Oct. 27, 1923, pp. 757-760, 8 figs. Southern Ry. pays for tractor-trailer installation at Pinners Point, Va., out of savings produced.

FUELS

See Coal; Oil Fuel; Peat; Pulverized Coal.

FURNACES, HEAT-TREATING

HARDENING. The New "Ley" Hardening Furnaces, (Der neue "Ley" Härteofen), Engel. Motorwagen, vol. 26, no. 25, Sept. 10 1923, pp. 374-376, 5 figs. Describes construction and operation of new furnace, consisting of number of muffles of different temperature requirement combined in one unit.

TYPES. A Day at the Ford Plant, W. Trinks. Fuels & Furnace, vol. 1, no. 6, Oct. 1923, pp. 411-414, 460, 462, 464 and 466-468, 7 figs. Discusses salient features of the various types of furnaces in operation at Highland Park plant; producer gas is main fuel; describes Smith gas producers used.

G

GAGES

HOLES, LOCATING. The Positioning of Holes for Gauge or Jig Work, E. W. Eager. Mech. World, vol. 74, nos. 1918 and 1919, Oct. 5 and 19, 1923, pp. 206-208 and 238-239, 6 figs. Describes methods for locating holes an a flat surface.

GALVANIZING

ANGLO PROCESS. Anglo Process of Galvanizing. Iron & Coal Trades Rev., vol. 107, no. 2904, Oct. 26, 1923, p. 623. Hot process methods of galvanizing; describes Anglo process, a new cold process of galvanizing iron and steel, which appears definitely to solve problem of galvanization by giving iron and steel surfaces a thoroughly efficient coating of zinc.

GALVANNEALING METHOD. A New Process of Coating Metals. Sheet Metal Worker, vol. 14, no. 20, Oct. 26, 1923, p. 760, 4 figs. Describes galvannealing method which gives longer protection against rust.

GARBAGE DISPOSAL

ST. LOUIS. Garbage Disposal in St. Louis. Pub. Works, vol. 54, no. 9, Sept. 1923, pp. 289-291, 2 figs. Garbage disposal during past 84 years; describes incinerator built in 1922.

GAS ENGINES

WINKLER-KLEIN. Double Piston Two-Stroke Gas Engine, Type Winkler-Klein. Eng. Progress, vol. 4, no. 9, Sept. 1923, pp. 195-196, 2 figs. Describes engine designed by Maschinenbau A.-G. vorm. Gbr. Klein of Dahlbruch, which operates according to Körting principle, i.e., double effective two-stroke method.

GAS MANUFACTURE

VERTICAL RETORTS. Official Inauguration of the "Dempster-Toogood" Vertical-Retort Installation and Reconstructed Gas-Works at Great Hardwood. Gas Jl., vol. 163, no. 3149, Sept. 19, 1923, pp. 847-853, 8 figs. Describes reconstructed works at Great Harwood, Eng., including coal handling, carbonizing plant, wagon tippers, coal breaker, elevator, gravity-bucket conveyor, hoist, coke screening and storage plant purification plant, sulphate plant, etc., Description of Dempster-Toogood system of (steamed) continuous vertical retorting.

GAS PRODUCERS

CENTRAL TYPE. Performance and Grate Tests on Inclined-Retort Batteries Heated with Central Producer Gas (Leistungs- und Unterfeuerungsversuche an fremdgasbeheizten Schrägofenbatterien), E. Schumacher. Gas- u. Wasserfach, vol. 66, no. 35, Sept. 1, 1923, pp. 524-526. Results of tests in Frankfurt gas works on two new installations of highly refractory material with gas heating supplied from a central producer plant; coke and coal analysis; advantages of central-type producers.

GEAR CUTTING

BEVEL GEARS. Straight Bevel Gear Generator Is Designed for Mass Production. Automotive Industries, vol. 49, no. 19, Nov. 8, 1923, pp. 958-959, 1 fig. Single-purpose machine brought out by Gleason Works increase speed of manufacture.

HOBBING MACHINE. New Gear Hobbing Machine. Iron Age, vol. 112, no. 17, Oct. 25, 1923, pp. 1115-1116, 5 fig. Machine for accurate hobbing of spur and spiral gears developed by Brown & Sharpe Mfg. Co.

GEARS

BEVEL. Spiral Bevel Gears Which Can Be Hobbed, Nikola Trbojevich. Am. Mach., vol. 59, no. 18, Nov. 1, 1923, pp. 647-652, 8 figs. New Theory of bevel gearing; how tapered hob can be employed; method of determining action of gearing.

GRINDING

CYLINDRICAL PRODUCTION. Development in Production Grinding in the Automotive Industry, Oscar A. Knight. Soc. Automotive Engrs.—Jl., vol. 13, no. 5, Nov. 1923, pp. 387-392, 15 figs. Details of new attachments, mechanisms and grinding machines; author points out importance of quality product to serve needs of automotive industry adequately.

STEEL CASTINGS. Steel Casting Grinding Practice, Herbert R. Simonds. Abrasive Industry, vol. 4, no. 11, Nov. 1923, pp. 318-320, 4 figs. Selection of wheels; use of goggles and wheel guards; correct wheel speeds essential.

GRINDING MACHINES

SPUR-GEAR. Spur-Gear Grinding and Testing, A. J. Ott and C. L. Ott. Soc. Automotive Engrs.—Jl., vol. 13, no. 5, Nov. 1923, pp. 401-406, 19 figs. Grinding machine for finishing spur gears which, it is claimed will grind transmission gears on production bases after they have been heat treated, will produce correct tooth contour, smooth finish, and accurate tooth spacing; also describes machine for testing gears that have been ground.

H

HACK-SAWING MACHINES

DEVELOPMENTS. Developments in Power Hacksaw Blades and Machines. Machy. (Lond.), vol. 23, no. 577, Oct. 18, 1923, pp. 65-69, 9 figs. Describes new type of saw blade with specially set tooth patented by A. H Evans; sharpening machine for reconditioning blades, and sawing machine suitably adapted to run at high speeds under more severe conditions required to obtain maximum advantages from new blades.

HANDLING MATERIALS

FOUNDRIES. A Cost Comparison in Handling Materials, Shellman B. Brown. Management & Administration, vol. 6, no. 5, Nov. 1923, pp. 611-616, 6 figs. Mechanical equipment contrasted with hand labor at Warren Foundry & Pipe Co.

HARBOR IMPROVEMENT

TORONTO, CANADA. Plans for Toronto Harbor Development, R. Home Smith. Can. Engr., vol. 45, no. 19, Nov. 6, 1923, pp. 475-477. Commissioners' proposals include refinancing, sale of lands, tanks at Sunnyside, completion of driveways, bridges across harbor entrances, and preservation of Scarboro bluffs and eastern beaches; factors affecting industrial growth.

HARDNESS

BALL HARDNESS TESTING. Brinell Hardness Tests, Practical Engr., vol. 68, nos. 1909 and 1910, Sept. 27 and Oct. 4, 1923, pp. 175-176, and 185-187, 3 figs. Ball-indentation principle of comparing hardness of metals. Formulas and calculations.

SCLEROSCOPE, APPLICATION OF. The Standardization of Methods of Applying the Scleroscope, A. F. Shore. Soc. Automotive Engrs.—Jl., vol. 13, no. 5, Nov. 1923, pp. 409-416, 16 figs. Statement of nine items suggested by Iron and Steel Division of Society for consideration with reference to securing greater uniformity in practice when making precision hardness tests with scleroscope; comparison between Brinell and scleroscope hardness testing.

TESTERS. Hardness Tester on the Rebound Principle H. Degen. Eng. Progress, vol. 4, no. 9, Sept. 1923, pp. 193-194, 7 figs. Design and performance; Shore's hardness index; examples of application of hardness tester on rebound principle.

HEALTH

SUPERVISION IN INDUSTRY. The Economics of Health Supervision in Industry, Bernard Langdon Wyatt. Am. Jl. Pub. Health, vol. 13, no. 11, Nov. 1923, pp. 914-919. Factors which determine degree of success, stability and permanence of such supervision; question of returns.

HEAT TRANSMISSION

CYLINDERS. Heat Migration in Cylinders from Homogeneous Heat Conductors (Wawmewanderung in Zylindern aus homogenen Wärmeleitern), Ernst Oelschläger. Wissenschaftliche Veröffentlichungen aus dem Siemens-Konzern, vol. 3, no. 1, May 15, 1923, pp. 29-40, 5 figs. Describes approximate method for calculation of temperature in relation to time in long cylindrical bodies, when these are heated internally or externally.

HEATING, ELECTRIC

DWELLINGS. Facts About Electric Heating, M. P. Whelen. Elec. News, vol. 32, no. 18, Sept. 15 1923, pp. 78-80, 3 figs. Results of special research on application of electrical heating systems to dwellings; sizes of units; energy required; cost of installation; limiting factors.

HEATING, GAS

EXPERIMENTS. The Denber Residence Gas-Heating Experiment, T. M. Foulk and T. G. Storey. Heat. & Vent. Mag., vol. 20, no. 10, Oct. 1923, pp. 37-43, 11 figs. Detailed report of conditions under which this program inaugurated by Denver Gas & Elec. Light Co., is being conducted, methods and experience relative to installations, and economics results obtained.

INDUSTRIAL. Industrial Gas Heating (Ausgewählte Kapitel aus dem Gebiete der gewerblichen Gasfeuer), H. Albrecht. Gas- u. Wasserfach, vol. 66, no. 24, June 16, 1923, pp. 346-353, 9 figs. Deals with following problems; Fixing price of gas to compete with price of coal firing; low-pressure gas, compressed air, and compressed gas; removal of exhaust gases; heat losses, their prevention and recovery.

HEATING, STEAM

CENTRAL-STATION. Analysis of Some Central Station Heating Plant Problems. Mun. & Country Eng., vol. 65, no. 3, Sept. 1923, pp. 101-107. Growth of central-station heating; advantages to consumer; advantages of steam; factors affecting success; location of plant relative to water and coal supply; design and equipment of plant; data on Minnesota plants.

The New Central Heating Plant of Queen's University and Kingston General Hospital, L. M. Arkley and W. P. Wilgar. Eng. Jl., vol. 6, no. 11, Nov. 1923; pp. 475-483, 12 figs. Design and equipment of plant in which existing equipment was used wherever practicable.

COMMUNITY OR GROUP. Facts and Figures on Community or Group Heating, H. C. Kimbrough, Mun. & County Eng., vol. 65, no. 4, Oct. 1923, pp. 146-148. Investigation of engineering and commercial factors. Data on cost of construction and operation of single unit, or block plant, consisting of 42 residences, 4 apartment buildings, 1 club and 9 garages.

COUNTER-FLOWING CONDENSATE. Critical Velocity of Steam with Counter-Flowing Condensate, William A. Pearl and Eri B. Parker. Heat. & Vent. Mag., vol. 20, no. 10, Oct. 1923, pp. 46-49, 3 figs. Practical data secured through recent tests for solving problems where flow of condensation is counter to steam flow. From Eng. Bul. No. 13 issued by State College of Wash. Experiment Station.

HIGHWAYS

PAVEMENT DESIGN. What is the Correct Design for a Highway Pavement? Elmer G. Hooper. Good Roads, vol. 65, no. 14, Oct. 3, 1923, pp. 105-106. Most important obstacle to determine design in author's opinion is lack of permanency of supports for road structure.

HYDRANTS

STREET AND FIRE. Modern Street and Fire Hydrants (Moderne Strassen-und Feuerlösch-Hydranten), W. Heubeling. Gas- u. Wasserfach, vol. 38, no. 39, Sept, 29, 1923, pp. 582-583. Describes various. types.

HYDRAULIC TURBINES

DRAFT TUBES. Comparative Tests on Experimental Draft-Tubes, C. M. Allen and I. A. Winter. Am. Soc. Civ. Engrs.—Proc., vol. 49, no. 9, Nov. 1923, pp. 1813-1845, 29 figs. Results of tests made at Alden Hydraulic Laborarory on 12 model draft tubes, to determine relative efficiencies of draft tubes of different types under hydraulic conditions existing at 120,000-hp. hydro-electric power plant under construction.

ECONOMIC OPERATION. Economical Operation of Hydraulic Turbines, Amory R. Haynes. Elec. Light & Power, vol. 1, no. 10, Oct. 1923, pp. 19-21, 50-52, an 54-55, 6 figs. Discussion of economical use of water in a station, and features of system operation affecting best internal economy; test data.

FLUME CALCULATION. Hydraulic Calculation of Flumes (Hydraulisk beräkning av flottningsrännor), Frederick Jonson. Teknisk Tidskrift, vol. 53, no. 17, Apr. 28, 1923, pp. (Vägoch Vattenbyggnadskonst) 37-41, 4 figs. Formulas and calculations for flumes of turbines of hydro-electric plants, and examples of application.

KAPLAN HIGH-SPEED. European Development in High-Speed Hydraulic Turbines, Elov Englesson. Power, vol. 58, no. 20, Nov. 13, 1923, pp. 758-760, 10 figs. Kaplan-type turbines designed with movable blades to be adjusted for different load conditions, which improve part-load efficiencies; 11,200-hp. turbine of this type under construction in Sweden to operate under 21.25 ft. head and run at 62.5 r.p.m.; runner is 19 ft. in diam. and weights 62.5 tons.

RACING. Protection Against the Racing of Hydraulic Turbines (Schutz gegen das Durchgehen von Wassertubinen C. Reindl. Elektrotechnik u. Maschinenbau, vol. 41, nos. 39 and 40, Sept. 30 and Oct. 7, 1923, pp. 566-571 and 582-586, 10 figs. Investigation of influence of different protective arrangements, influence of flywheel moment, and water content of turbine chamber and pipe pipe on increase in speed.

REACTION IN. A Study of Irregularity of Reaction in Francis Turbines, Roy Wilkins. Am. Inst. Elec. Engrs.—Jl., vol. 42, no. 11, Nov. 1923, pp. 1141-1144, 14 figs. Describes successful method of study of such phenomena as vibration caused by irregularity of reaction manifesting itself in several impulses per second.

HYDRO-ELECTRIC DEVELOPMENTS

AUGUSTA, GA., PROJECT. Proposed Electrification of the Augusta, Georgia, Power Canal, Nisbet Wingfield. Mun. & County Eng., vol. 65, no. 3, Sept. 1923, pp. 121-126. Present sources of power; how additional power can be obtained; possible sites for hydro-electric development; proposed development.

HYDRO-ELECTRIC PLANTS

CALIFORNIA. Recent Hydro-electric Developments of Southern California Edison Company, H. L. Doolittle. Am. Inst. Elec. Engrs.—Jl., vol. 42, no. 11, Nov. 1923, pp. 1132-1133. Details of Kern River and Big Creek power plants; installation of venturi meters; draft tubes; impulse wheels; and rubber seal rings.

CANADA. Hydro Development at Chute Des Galets, Hector Cimon, Can. Engr., vol. 45, no. 14, Oct. 2, 1923, pp. 361-362, 4 figs. Describes hydro-electric plant on Shipshaw river built to supply power to paper mill at Kenogami, Que.; concrete dam and power house; two vertical turbines direct-connected to 8000-kva. generators.

SPOKANE, WASH. Upper Falls Development of The Washington Water Power Company in Spokane, Wash., L. J. Pospisil. Am. Inst. Elec. Engrs.—Jl., vol. 42, no. 11, Nov. 1923, pp. 1133-1140, 6 figs. Describes hydro-electric development in centre of city having single vertical-shaft generator and delivering its output to busses of existing distribution substation 350 ft. distant, excitation and load control of new generator being from substation.

I

ICE PLANTS

ELECTRICALLY OPERATED. Electrically-Driven Ice-Making Plant. Ice & Cold Storage, vol. 26, no. 306, Sept. 1923, pp. 211-212, 4 figs. Details of installation consisting of two separate and independent units, each capable of producing 75 tons of ice per day.

SPRAY-COOLING EQUIPMENT. Spray-Cooling Equipment for Ice Plants, B. R. Sausen. Rerfig. Eng., vol. 10, no. 3, Sept. 1923, pp. 94-95 and (discussion) 95-96. Type design, size and arrangement of nozzles; type of spray; type and function of louvre; etc. This method has low initial and operating cost, practically no maintenance cost and satisfactory cooling effect.

INDUSTRIAL MANAGEMENT

BUDGETARY CONTROL. The Monthly Financial Budget, Joseph H. Barber. Management & Administration, vol. 6, no. 4, Oct. 1923, pp. 453-457, 1 fig. Budgetary procedure adopted by Walworth Mfg. Co.

CONTROL SYSTEM. The "Tell-Tale" Control Board, Chester B. Lord. Management & Administration, vol. 6, no. 4, Oct. 1923, pp. 467-472, 7 figs. Describes simple self-contained, kinetic chart capable of indicating simultaneously any or all factors of industrial operation in terms of sommon denominator, and of indicating selective responsibility in measure that condition of any item demands.

COST CONTROL. Interpreting Operation to the Directors, Geoffrey C. Brown. Management & Administration vol. 6, no. 5, Nov. 1924, pp. 593-598, 6 figs. Describes methods employed in New York mirror factory for purpose of presenting data in such a way that picture of month's activity is constantly before management, and easily accessible to board of directors; tables and graphs prepared by planning office in closing the month.

FINANCIAL CONTROL. Finance and Common Sense, C. L. Eiermann. Management & Administration, vol. 6, no. 4, Oct. 1923, pp. 487-490. Practical suggestions for proper handling of financial matters, emphasizing particularly necessity of co-ordinating financial program with sales and production programs.

PLANNING SYSTEM. A Workable Planning System for the Moderate Sized Plant, A. F. Erikson. Factory, vol. no. 5, Nov. 1923, pp. 611-612, 4 figs. Basis of system is large planning board provided with horizontal angle pockets for each machine; planning slip used in connection with board is ruled along one side to indicate hours and fractions of hours.

INDUSTRIAL ORGANIZATION

VERTICAL COMBINATION. The "Vertical Combination" and How it Reduces Distribution Costs, William R. Basset and Johnson Heywood. Indus. Management (N. Y.), vol. 66, no. 5, Nov. 1923, pp. 278-280, 1 fig. Shows why vertical combination—a combination of links in chain from raw material to distributed product—is inevitable development of near future, and outlines possibilities of such combinations.

INDUSTRIAL PLANTS

GENERAL ELECTRIC CO., SCHENECTADY. Extreme Variety Versus Standardization, John H. Van Deventer. Indus. Management (N. Y.), vol. 66, no. 5, Nov. 1923, pp. 253-264, 19 figs. partly on supp. plate, Production problems of Gen. Elec. Co. The Schenectady works.

INTERNAL-COMBUSTION ENGINES

Friction Losses. Influence of Speed and Temperature on Friction Losses in Internal-Combustion Engines (Influence de la vitesse et de la température sur les pertes par frottements dans les moteurs à explosions), Andre Planiol. Académie des Sciences—Comptes Rendus des Séances, vol. 176, no. 16, Apr. 16, 1923, pp. 1044-1047, 2 figs. Results and deductions from experiments made on a single-cylinder 4-stroke gas engine, 30 hp., 200 r.p.m., 290-mm. bore, 430-mm. stroke, on town gas with volumetric compression 7.0.

Heat Transmission in. Heat Transmission in Internal-Combustion Engines (Der Wärmeübergang in der Verbrennungskraftmaschine), Wilhelm Nusselt. Zeit. des Vereines deutscher Ingenieure, vol. 67, nos. 28 and 29, July 14 and 21, pp. 692-695 and 708-711, 6 figs. Study of cooling of hot combustion gases, based on explosion tests in spherical bombs; formulas for heat-transmission coefficients; equation for calculation of heat exchange between gas and wall in internal combustion engine.

See also Airplane Engines; Diesel Engines; Gas Engines; Oil Engines; Semi-Diesel Engines

IRON CASTINGS

Separation under Solidification. Separation Phenomena in Castings (Entmischungserscheinungen an Gussstücken), Reinh. Kühnel. Giesserei-Zeitung, vol. 20, no. 21, Oct. 1, 1923, pp. 407-411, 6 figs. Mixture of layers; mixture of zones; causes of zone separation; influence of contraction; practical examples; experimental results.

IRON FOUNDING

Casting-On to Metal. Casting-On to Metal, etc., in Foundry Work, Walter J. May., English Mechanics & World of Sci., vol. 118, no. 3056, Oct. 19 1923, pp. 162-163, 4 figs. Informative account of, modern foundry methods.

IRON, PIG

Mixers. Temperature Changes in Thomas Pig Iron on the Way from Blast Furnace to Converter (Die Temperaturveränderungen des Thomasroheisens auf dem Wege von Hochofen zur Birne), E. Septzler. Stahl u. Eisen, vol. 43, no. 42, Oct. 18, 1923, pp. 1315-1321 and (discussion) 1321-1322, 6 figs. Describes mixer plant in steel works at Rheinhause, Germany; temperature losses of pig iron for blast-furnace tapping to converter; reduction of heat losses of mixer through insulation; tests with one-mixer and two-mixer practice and results.

IRRIGATION

Turlock District, California. The Don Pedro Project of the Turlock Irrigation District, R. W. Shoemaker. Gen Elec. Rev., vol. 26, no. 11, Nov. 1923, pp. 736-740, 7 figs. Construction details, with special reference to electrical equipment.

Water, Use of. Theory and Tests on Duty of Irrigation Water, Eng. News-Rec., vol. 91, no. 16, Oct. 17, 1923, pp. 642-645. Discussion of article on Economical Use of Irrigation Water Based on Tests by W. Gardenr, M. Clyde and O. W. Israelsen, published in previous issue of journal.

L

LABOUR

Wages and Hours. Wages and Hours of Labor. Monthly Labor Rev., vol. 17, no. 4, Oct. 1923, pp. 59-69. Wages and hours of labor in foundries and machine shops, 1923; schedule of wages for civil employees under naval establishment; English factory hours and two-shift system for women; etc.

Wages, Hours and Employment in American Manufacturing, July, 1914—July, 1923. Nat. Indus. Conference Board—Research Report, no. 62, 1923, 154 pp., 8 tables, 10 charts. Report portrays important features of movement of hourly and weekly earnings, hours of plant operation and worker hours, as well as number employed, during 9 years since pre-war period, treating in detail trends in past 3 years.

LABORATORIES

Foundry. Designing and Equipping a Foundry Laboratory, H. H. Shepherd. Foundry Trade Jl., vol. 28, nos. 373, 374 and 375, Oct. 11, 18 and 25, 1923, pp. 305-307, 334-337 and 352-353, 16 figs. Status of laboratory; site; building; furnishing; balance room; chemical laboratory; titrating bench; fume cupboards; physical laboratory; microscope and dark room; bench considerations; lighting, heating and ventilation; estimated cost.

LATHES

Turret. Modern Turret Lathe Refinements, E. W. Field. British Machine Tool Eng., vol. 2, no. 23, Sept.-Oct. 1923, pp. 688-691 and 712, 6 figs. Describes developments.

LIGHTING

Progress 1922-1923. The Year's Progress in Illumination 1922-1923. Illuminating Eng. Soc. — Trans., vol. 18, no. 7, Sept. 1923, pp. 583-678. Report of committee on progress. Deals with gas. incandescent electric lamps, arc and vapor tube lamps, lamps for projection purposes, street lighting and other exterior illuination, interior illumination, luminaires, photometry, physics, physiology, illuminating engineering. Bibliography.

Railway. Report of Committee (Assn. Ry. Elec. Engrs.) on Illumination. Ry. Elec. Engr., vol. 14, no. 11, Nov. 1923, pp. 361-367, 5 figs. Review of development in incandescent lamp and illumination fields that are of interest to railway electrical engineers; changes in industrial lighting codes; diversity of opinion as to how flood lighting should be applied.

Street. Street Lighting — An Undeveloped Source of Revenue, G. E. Miller. Elec. World, vol. 82, no. 17, Oct. 27, 1923, pp. 859-862, 4 figs. Describes plan worked out in East Cleveland whereby city installed at its own expense poles, brackets and lamps, while Cleveland Elec. Illuminating Co. provided necessary overhead and underground distribution to lamps transformers, etc.

LOCOMOTIVES

Diesel-Engined. A New Diesel Locomotive, George Held and M. Kuljinski. Verkehrstechnik, vol. 40, no. 40, Oct. 5, 1923, pp. 361-363. Disadvantages of present-day steam locomotives and advantages of Diesel locomotives are pointed out; design of new Diesel locomotive and its useful possibilities.

How the Sulzer-Diesel Locomotive Operated. Oil Engine Power, vol. 1, nos. 7 and 8, July and Aug., 1923, pp. 337-339, and 401-406, 7 figs. Detailed description of Diesel engine which developed over 1600 b.hp. in a locomotive that weighed 95 tons and which represented greatest departure ever made from standard Diesel practice.

Electric. *See Electric Locomotives.*

Half-Stroke Cut-off. Possibilities of Half Stroke Cut-off Locomotive, W. F. Kiesel, Jr. Ry. Age, vol. 75, no. 20, Nov. 17, 1923, pp. 903-906, 3 figs. Advantages of compound and three-cylinder types combined with simplicity of two-cylinder types combined with simplicity of two-cylinder type. (Abstract.) Paper read before New York R. R. Club.

Headlights. Report of Committee (Assn. Ry. Elec. Engrs.) on Locomotive Headlights. Ry. Elec. Engr., vol. 14, no. 11, Nov. 1923, pp. 354-359, 4 figs. Status of marker and classification lights with regard to operating rules; photometry tests for headlight reflectors recommended.

Heat Economy in. Heat Economy in Steam Locomotives (Wärmewritschaft bei Dampflokomotiven), L. Schneider. Archiv fur Wärmewirtschaft, vol. 4, no. 8, Aug. 1923, pp. 145-149, 9 figs. Notes on firing, boiler, preheater, superheater, engine and valve gear, etc.

Lubricated Area. A New Language for the Steam Locomotive. Ry. & Locomotive Eng., vol. 36, no. 11, Nov. 1923, pp. 346-348, 3 figs. Sets forth wide range of difference in lubricated areas engines in same class of service.

Steam-Turbine. Ramsay Turbo-Electric Condensing Engine. Ry. Mech. Engr., vol. 97, no. 11, Nov. 1923, pp. 746-749, 6 figs. Experimental locomotive developed by Armstrong, Whitworth & Co.; details of latest modified design; results of tests.

Three-Cylinder. New York Central Three-Cylinder Locomotive. Ry. Mech. Engr., vol. 97, no. 11, Nov. 1923, pp. 743-744, 1 fig., also Ry. Age. vol. 75, no. 18, Nov. 3, 1923, pp. 821-822, 1 fig. 4-8-2 type for freight service, with booster, develops 75,700 lb. tractive force; adhesion factor 3.73.

Wheel Guidance in Track. The Guidance and Running of Locomotive Wheels on the Track (Führung und Lauf des Lokomotivrades im Geleise), J. Buchli. Schweizerische Bauzeitung, vol. 82, no. 10, Sept. 8, 1923, pp. 119-125, 14 figs. Results of model test for investigation of lateral holding power of a wheel on rail under widely differing operating conditions.

LUBRICANTS

Cutting Tools. Tool Engineering, Albert A. Dowd and Frank W. Curtis. Am. Mach., vol. 59, no. 17, Oct. 25, 1923, pp. 613-615, 1 fig. Cutting lubricants and their application; principles of coolants; suitability to material being cut; factors such as power consumption and removal of chips.

LUBRICATING OILS

Reclamation of. Reclaiming Power Plant Lubricants, Allen F. Brewer. Elec. Light & Power, vol. 1, no. 10, Oct. 1923, pp. 13-16 and 64-65, 8 figs. Describes methods of purification and reclamation systems.

Storage and Handling. Lubricating Oil Storage and Handling Methods, Allen F. Brewer. Elec. Light & Power, vol. 1, no. 9, Sept. 1923, pp. 13-16, 76-77 and 79, 7 figs. Deals with type of shipping container that is to be handled, construction of oil house, equipement installed for handling shipping containers, storage tanks and their appurtanances, manner of delivery to the various parts of plant, and means for measuring oil so delivered.

LUBRICATION

Power Plants. What the Lubrication Engineer Has Done for Power Plant Maintenance, Allen F. Brewer. Indus. Management (N. T.), vol. 66, no. 5, Nov. 1923, pp. 281-289, 10 figs. Discusses various lubricants and their characteristics and shows how modern science of lubrication makes it possible to keep it under control.

M

MAGNESIUM

Foundry Uses. Magnesium in the Foundry, H. J. Maybrey. Metal Industry (Lond. vol. 23, nos. 14 and 15, Oct. 5 and 12, 1923, pp. 292, and 315-318, 4 figs. Uses of magnesium; objection to chloride flux; procedure of magnesium melting and pouring; casting in chill molds; casting in sand molds; affinity for water; moulding sand; casting design.

MAGNETISM

Theory. The Modern Theory of Magnetism (La teoria del magnetismo di ampere secondo le viste moderne), Luigi Donati. Elettrotecnica, vol. 10, no. 15, May 25, 1923, pp. 325-327. Explains theory of magnetism according to modern views on electrons; known differences between magnetic and electric circuits with regard to mechanical work explained.

MAPPING

Aerial Photography. Topographic Surveying from the Air, J. W. Bagley, L. B. Roberts and Eric. Haquinius. Military Engr., vol. 15, no. 64, Nov.-Dec. 1923, pp. 505-507, 2 figs. Equipment for taking aerial photographs; method of obtaiuing planimetric detail from photographs; interpretation of information shown on photograph, and use of stereoscope in this connection.

MARINE STEAM TURBINES

German Construction. Marine Turbines of the German General Electric Co. Berlin (Der Schiffsturbinenbau der AEG-Berlin), E. A. Kraft. Zeit. des Vereines deutscher Ingenieure, vol. 67, no. 43, Oct. 27, 1923, pp. 1002-1007, 25 figs. Describes turbines, transmission gear thrust bearings and condensers constructed by A. E. G.

MEASURING INSTRUMENTS

Out-of-Roundness Measurement. Factors Governing "Out-of-Roundness" Measurement, A. H. Frauenthal. Soc. Automotive Engrs.—Jl., vol. 13, no. 5, Nov. 1923, pp. 370-374, 7 figs. Types of out-of-roundness and those peculiar to certain machines; three-point measuring system; errors of V-block method; use of V-block for elliptical objects; other methods of checking elliptical forms and indicator-reading correction; three items for instrument improvement are suggested.

METALS

Cleaning. Metal Cleaning F. H. Guernsey. Machy. (N. Y.), vol. no. 3, Nov. 1923, pp. 185-186. Deals with factors involved in effective cleaning, namely, condition of water, type of equipment, temperature of cleaner, and time allowed for cleaning.

Cold Working. The Cold Working of Metals, Machy. (Lond.), vol. 23, no. 575, Oct. 4, 1923, pp. 17-20, 5 figs. Relative effects of cold and hot working; bright drawn steel bar; cold-drawn tubing; wire drawing; cold-working effects on non-ferrous metals.

Internal Strains. The Heyn Theory of the Stiffening of Metals Due to Hidden Elastic Stresses (Zur Heyn'schen Theorie der Verfestigung der Metalle durch verborgen elastische Spannungen), George Masing. Wissenschaftliche Veröffentlichungen aus dem Siemens-Konzern, vol. 3, no. 1, May 15, 1923, pp. 231-239, 4 figs. Confirmation of Heyn's theory that stiffening phenomena are partially due to internal strains.

Overstrain. Overstrain in Metals, Joseph Kaye Wood. Am. Inst. Mon. & Met. Engrs.—Trans., no. 1278-S, Nov. 1923, 13 pp., 12 figs.; also (abstract) in Min. & Metallurgy, vol. 4, no. 203, Nov. 1923, pp. 575-577, 1 fig. Overstrain depends on partial elastic action occurring above elastic limit; amount depends on amount of "hyper" elastic energy expended, which energy corresponds to partial elastic action; this energy depends furthermore on elastic and plastic constants of metal; with aid of these principles shape of stress-strain diagram is explained.

Testing, Value of Energy Relation in. The Value of the Energy Relation in the Testing of Ferrous Metals at Varying Ranges of Stress and at Intermediate and High Temperatures, T. M. Jasper. Lond., Edinburgh, & Dublin Philosophical Mag. & Jl., Sci., vol. 46, no. 274, Oct. 1923, pp. 609-627, 10 figs. Development of energy equation with reference to testing; testing materials at various temperatures; application of use of energy relation to static testing of ferrous materials at various temperatures. Conclusions based on fatigue experiments.

MICROMETERS

Ocular. A New Ocular Micrometer, Hermann Kellner. Optical Soc. Am.—Jl., vol. 7, no. 10, Oct. 1923, pp. 889-891, 4 figs. Describes micrometer employing sliding measuring wedge in place of micrometer screw.

MINERAL RESOURCES

CANADA. Mineral Resources along Hudson Bay Railway and round Hudson Bay. Can. Min. Jl., vol. 44, nos. 42 and 43, Oct. 19 and 26, 1923, pp. 831-823 and 843-845. Brief synopsis of important available information by Natural Resources Intelligence Service, Ottawa, concerning resources of that portion of country lying adjacent to Hudson Bay, and Hudson Bay railway in particular.

MINES

REPORTS. An Analytical Method of Summarizing Mining Reports, Frederick C. Fearing. Eng. & Min. Jl.—Press, vol. 116, no. 17, Oct. 27, 1923, pp. 713-718, 6 figs. Use of a "critical value" of ore a factor significant in condensing and presenting results of an engineer's examination of a mine. Suggests certain broad principles in use of estimates and illustrates them by specific examples.

TIMBERING. Timbering of Metal Mines, E. A. Holbrook, Richard V. Ageton and Harry E. Tufft. U. S. Bur. Mines, Bul. 215, 1923, 70 pp., 77 figs. Necessity for timber in mining; principles of mine timbering; structure of wood; behavior of wood under pressure; kinds of timber employed in mining; methods of timbering tunnels, drifts, crosscuts, inclined shafts and winzes, and vertical shaft; combination of vertical and inclined shafts; safety in mine timbering; effect of ventilation; preservation of mine timbers.

VALUATION. Valuation of Metal Mines, Orr R. Hamilton. Min. & Metallurgy, vol. 4, no. 203, Nov. 1923, pp. 568-571. Various bases of valuation; method of "present worth"; factors determining present worth; selection of suitable discount rate.

MOTOR BUSES

IMPROVEMENTS. Low Frames, Air-Brakes and 6-Cylinder Engines Features New Buses, Herbert Chase. Automotive Industries, vol. 49, no. 16, Oct. 18, 1923, pp. 779-784, 8 figs. Federal, International, Yellow, Pierce-Arrow and Acme show new models at exhibit in Atlantic City; changes in Mack, White and F.A.C.

SIX-WHEEL. A Six-Wheel Stage Is Developed in California. Bus Transportation, vol. 2, no. 6, June 1923, pp. 265-267, 6 figs. Describes vehicle with a 4-wheel rear end in service on Cal. Transit Co.'s system, having seating capacity of 26; 26 ft. long from front to rear bumpers; better braking, no skidding wider tread, more tire mileage and easier tiding are advantages claimed for it.

MOTOR TRUCKS

A. E. C. An A. E. C. 2-Tonner. Motor Transport, vol. 37, no. 970, Oct. 1, 1923, pp. 414-417, 7 figs. Entirely new model for goods or passenger service embodying many special feature; 4-cylinder engine developing 30 b.hp. at 1000 r.p.m.; 4-speed gear box.

RADIATORS. Motor-Truck Radiator-Design, R. S. Wentworth. Soc. Automotive Engrs.—Jl., vol. 13, no. 5, Nov. 1923, pp. 393-394. Enumerates seven requirements dictated by necessity for greater reliability of truck radiators.

O

OIL ENGINES

AIRLESS-INJECTION. Solid Injection Fuel Systems of Oil Engines, Richard D. Watson. Oil Engine Power, vol. 1, no. 10, Oct. 1923, pp. 495-497. Notes on design of spray valves and fuel pumps for airless injection engines, with consideration of factors influencing problems that have to be met.

DEVELOPMENT. The Crude Oil Engine Johnstone-Taylor. Gas & Oil Power, vol. 19, nos. 215, 216 and 217 Aug. 6, Sept. 6 and Oct. 4, 1923, pp. 184-186, 203-205 and 11-14, 13 figs. Development of present designs. Convertible gas and oil engines; describes four-stroke and two-stroke engines.

MARINE CLYDE. Clyde Marine Oil-Engines, A. L. Mellanby. Inst. Mech. Engrs.—Proc., no. 4, June 1923, pp. 695-731, 15 figs. Deals with tonnage regulations; lubrication problems; starting and manoeuvring; power rating. Particular types of Clyde engines; examples of four- and two-stroke cycle engines; double-acting engines.

OIL FUEL

CHARACTERISTICS. Fuel Oil Characteristics And Advantages As Compared with Coal, A. P. Bjerregaard. Nat. Petroleum News, vol. 15, no. 42, Oct. 17, 1923, pp. 32A-32B. Some comparisons of B.t.u. values of various gravities of Mid-Continent fuel oils, and comparative price table of fuel oil and coal based on a B.t.u. value for fuel oil of 19,000-per-lb. and 10,000-per-lb. coal. methods for testing water content of fuel oil. Paper read before Purchasing Agents' Assn.

OPEN-HEARTH FURNACES

REGENERATORS. Open-Hearth Furnace Regenerators, Fred B. Quigley. Iron Age, vol. 112, no. 19, Nov. 8, 1923, pp. 1245-1246, 1 fig. Proportionate sizes of chambers for air and gas; insulation; doing away with gas regenerators suggested (Abstract.) Paper read before Am. Iron & Steel Inst. See also Iron Trade Rev., vol. 73, no. 17, Oct. 25, 1923, pp. 1172-1173 and 1181-1182, 1 fig.

OXY-ACETYLENE WELDING

APPLICATIONS. Practical Applications of Gas welding, E. A. Whittaker. Engineering, vol. 116, no. 3018, Nov. 2, 1923, pp. 571-572. Deals with repairs and construction of iron and steel, cast iron, aluminum, copper, brasses and bronzes. (Abstract.) Paper read before Instn. Welding Engrs.

EQUIPMENT MAINTENANCE. Maintaining Oxy-Acetylene Equipment in Service. Acetylene Jl., vol. 25, nos. 4 and 5, Oct. and Nov. 1923, pp. 201-204 and 206; and 234, 236 and 238, 5 figs. Proper maintenance of oxy-acetylene welding and cutting equipment.

P

PACKING

CONTAINERS. Solving the Shipping Container Problem, B. L. Huestis. Management & Administration, vol. 6, no. 5, Nov. 1923, pp. 575-580, 9 figs. Discusses faults in crate construction; wooden boxes; fiber boxes; testing of containers; method of testing by vibration; savings made by large manufacturers.

PAVEMENTS

MOISTURE CONTENT, EFFECT OF. A Different Angle of the Sub-drainage of Pavements, Monroe L. Patzig. Municipal & County Eng., vol. 65, no. 3, Sept. 1923, pp. 95-97, Author considers that moisture expansion is most likely cause of blow-ups, joint heaves, difference in elevation of slab ends, corring of slabs and other defects common to rigid pavements. See also article by H. W. Skidmore in same journal, no. 4, Oct. 1923, pp. 144-146, entitled Effects of Changing Air Temperature and Moisture Content on Behavior of Pavement Slabs, which is a discussion of above article.

PEAT

BOILER FUEL. Engineering Principles Involved in the Firing of Peat in Boiler Operation (Die Feuerungstechnik des Tortes im Dampfkesselbetrieb), W. Leder. Wärme, vol. 46, nos. 33, 34, 36, 37, and 38, Aug. 17, 24, Sept. 7, 14 and 21, 1923 pp. 363-367, 377-380, 400-404, 411-414, and 419-421, 3 figs. Properties of peat as technical fuel; thermal value, evaporative capacity and efficiency; behavior on grate; velocity of combustion; peat in mixture with other fuels; evaporating results with peat in different type of furnaces; tests with mixtures of peat and other fuels.

PHOTO-ELASTICITY

APPLICATION TO ENGINEERING PROBLEMS. Engineering Problems Solved by Photo-Elastic Methods, E. G. Coker. Franklin Inst.—Jl., vol. 196, no. 4, Oct. 1923, pp. 433-478, 34 figs. Lecture I: Improvements in apparatus; contact pressures and stresses. Lecture II: The testing of materials in tension; action of cutting tools. Bibliography.

PILES

CREOSOTED, SPECIFICATIONS FOR. Specifications for Creosoted Piles and Timber for use in Atlantic Coast Waters Infested With Marine Borers. Am. Ry. Eng. Assn.-Bul., vol. 25, no. 257, July 1923, pp. 84-87. Covers materials and treatment, and gives recommendations for handling and installation.

PIPE

WRAPPING MACHINES. Automatic Pipe-Wrapping Machine, Edward Houchins. Indian & Eastern Engr., vol. 52, no. 1, July 1923, pp. 18-19, 4 figs. Portable, automatic machine made by San Francisco firm, through which pipes of diameters up to 10 in. can be fed, and thoroughly wrapped so as to be impervious to moisture, at rate of 750 lin. ft. per hr.

PLANING

ROTARY, HIGH-SPEED. High-Speed Rotary Planing, Stafford Ransome. Engineer, vol. 136, nos. 3537, 3538 and 3539, Oct, 12, 19 and 26, 1923, pp. 388-390, 413-415, and 441-445, 15 figs. Oct. 12: Theory and practice; ridging and tracking; square and circular blocks; feed and its effect. Oct. 19: Cutters and cutter blocks. Oct. 26: High-speed rotary planing machine; variable feed gears; feeding-in tables; high-speed flooring machines; problem of pressures; driving.

POLISHING

ABRASIVES, APPLICATIONS TO WHEELS. Practical Hints for polishers, Francis D. Bowman Foundry, vol. 51, no. 21, Nov. 1, 1923, pp. 860-861, 3 figs. Helpful suggestions. touching on properties and preparation of glue, correct temperature in setting up and storing wheels together with method of applying abrasive to wheels.

PORTS

ADMINISTRATION METHODS. A Synopsis of the Methods Employed in the administration of Various Ports of the United States. World Ports, vol. 11, no. 11, Sept. 1923, pp. 17-47. Prepared by Mar. Bur. of Chamber of Commerce of U.S.

POWER PLANTS

COST KEEPING. Uniform Cost for Power Plants, Alfred Baruch. Power Plant Eng., vol. 27, nos. 12, 13, 14 and 15, June 15, July 1, 15 and Aug. 1, 1923, pp. 623-625, 671-673, 720-722 and 774-775, 3 figs. June 15: Labor records; pay-roll distribution; budget labor cost. July 1: Factors entering into intelligent analysis of operating expenses. July 15: Distribution of fixed expenses; interest and depreciation in plant cost. Aug. 1: Predetermination of rates and monthly comparison of plant costs.

PIPING STANDARDS. Standards in Power Plant Piping Practice. Power Plant Eng., vol. 27, no. 14, July 15, 1923, pp. 717-719, 3 figs. Commercial practice varies so that piping standards may become confusing. Points out many of the practices which must be watched for.

SOLID-INJECTION OIL ENGINES FOR. Solid Injection Engine in Isolated Power Plants, H. F. Briggs. Eng. World, vol. 23, no. 4, Oct. 1923, pp. 228-231,. Comparative cost analysis of twelve different prime movers; states that solid-injection oil engines require skilled attention, and when this is supplied will prove themselves thoroughly reliable and dependable; simplicity of design and cheapness of power output make them ideal prime mover for isolated power plant.

PRODUCER GAS

PEAT AS SOURCE OF. Producer Gas from Peat, G. W. Semmes. Manufacturers Rec., vol. 84, no. 16, Oct. 18, 1923, pp. 75-77. Survey of possibilities of peat as a gas producer; gas producers.

PULVERIZED COAL

BOILER FIRING. Powdered Coal Meets Load Variations in Blast-Furnace Gas plant. Power, vol. 58, no. 19, Nov. 6, 1923, pp. 718-721, 5 figs. In boiler installation in Ensley Works of Tennessee Coal, Iron & Railroad Co. pulverized coal supplements blast-furnace gas to maintain uniform supply of steam; outstanding features of plant are automatic control of gas and air mixture and feed of pulverized coal.

PUMPING STATIONS

CONSTRUCTION. Typical Power-Plants and Pumping-Stations for Water-Works, Charles B. Burdick. Am. City Mag., vol. 29, no. 5, Nov. 1923 pp. 467-471, 2 figs. Examples of recent pumping-station construction, with illustrations and figures of cost.

EQUIPMENT SELECTION. Equipment for Pumping Stations, A. L. Mullergren. Can. Engr., vol. 45, no. 14, Oct. 2, 1923, pp. 365-367. Considerations in selecting equipment; reliability, adequacy and economy principal factors; efficiency of central stations.

PUMPS

AXIFLO. Pumping Plants to Lower Water Level. Ariz. Min. Jl., vol. 7, no. 10, Oct. 15, 1923, pp. 6-8, 7 figs. Study of handling of rising water level in Salt River valley by engineers of Worthington Pump and Machinery Co. which led to development of new Axiflo pump.

PUMPS CENTRIFUGAL

HIGH-LIFT. High Lift Turbine Pumps. Beama, vol. 13, no. 67, Nov. 1923, pp. 317-320, 6 figs. Describes turbine pumps for high-lift conditions manufactured by Mirrless Watson Co. in two distinct forms, the ring and the barrel casing types.

R

RADIO COMMUNICATION

AMPLIFIERS, DISTORTION IN. Distortion in Low Frequency Amplifiers, S.O. Pearson. Wireless World, vol, 13, nos. 216 and 217, Oct. 3 and 10, 1923, pp. 3-6 and 40-44 6 figs. Chief causes of distortion in note magnifier and their effects, and suggestions in each case for elimination of distortion as far as possible.

RECEPTION, INTERFERENCES IN

RECEPTION, INTERFERENCES IN. Methods of Reducing Interference in Wireless Receiving Sets, E. W. Marchant. Wireless World, vol. 12. no. 202, June 30, 1923, pp. 426-431, 13 figs. Discusses three different kinds of disturbance which one is likely to suffer from in wireless receiving circuit, viz., interference due to atmospherics (or strays), interference due to signals from other stations, and interference due to locally induced currents, and methods of reducing them. Paper read before Radio Soc. Great Britain.

RADIOTELEPHONY

PRINCIPLES. The Elementary Principles of Wireless Telephony, E. Ogden. South Wales Inst. Engrs.—Proc. vol. 38, no. 8, Sept. 26, 1923, pp. 625-628 and (discussion) 628-630.

RAILS

TRANSVERSE FISSURES. Formation of Transverse Fissures in Steel Rails, James E. Howard. Eng. News-Rec., vol. 91, no. 18, Nov. 1. 1923, pp. 720-722. Abstract of latest report to Interstate Commerce Commission together with discussion

RAILWAY ELECTRIFICATION

ENGLAND. Railway Electric Traction, Roger T. Smith. Ry. Gas., vol. 39, no. 17, Oct. 26, 1923, pp. 511-512. Discusses question of railway electrification in England as an economic proposition. Address before Société des Ingénieurs Civils de France.

RAILWAY MOTOR CARS

ELECTRIC. Motor Cars for the Mersey Electric Railway. Ry. Gas., vol. 39, no. 18, Nov. 2, 1923, pp. 556-557, 1 fig. Particular of new motor cars for operating three and five-car trains; overall length 60 ft. 3½ in., width overall 8 ft.7 in., height from rail to top of roof 12 ft. 10 in. electro pneumatic control.

GASOLINE. Multiple Unit Control for Self-Propelled Cars. Ry. Rev., vol. 73 no. 17, Oct. 27, 1923,pp. 610-617, 11 figs. Describes new Mack car, electro-pneumatically controlled, equipped with six-cylender 120-hp. gasoline motor.

TYPES. Report of Committee ((Assn. Ry. Elec. Engrs.) on Self-Propelled Rail Cars. Ry. Elec. Engr., vol. 14, no. 11, Nov. 1923, pp. 333-338, 8 figs. Advantages and drawbacks of different types of railway motor cars and class of service for which they are fitted.

RAILWAY OPERATION

CAR POOLING. Car Pooling on the Pennsylvania, Geo. L. Fowler. Ry. & Locomotive Eng., vol. 36, no. 11, Nov. 1923, pp. 361-362. Its origin and effect on cost of repairs and facilitating transportation.

SLOW FREIGHT TRAFFIC. Slow Freight Traffic. Int. Ry.-Congress Assn.—Bul., vol. 5, no. 6, June 1923, pp. 558-589. Account of discussion dealing with: organization of slow-freight traffic in order to increase effective operation of rolling stock and lines; advisability of using, according to circumstances, heavy or light, fast or slow trains; through trains; pick-up trains and distributing trains; shuttle services

TRAIN CONTROL. Automatic Train Control on the Missouri Pacific R. R., Bertram H. Mann. Ry. Rev., vol. 73, no. 19, Nov. 10, 1923, pp. 681-683, 1 fig. Describes underlying principles of automatic train control so far as operation of trains, and its influence on track capacity, is concerned.

TRAIN DESPATCHING. Telephone Selector Systems in Use on Railroads, Chas. Stanley Rhoads. Ry. Signaling, vol. 16, no. 11, Nov. 1923, pp. 458-461, 3 figs. Methods of train despatching by telephone; selectors—description, uses and requirements.

RAILWAY REPAIR SHOPS

LOCOMOTIVE. Locomotive Shop Served by 180-Ton Crane: M.-K.-T. R. R. Eng. News-Rec., vol. 91, no. 19, Nov. 8, 1923, pp. 762-764, 4 figs. Transverse track layout; enlargement and future transfer table.

Progressive System for Locomotive Shops, Lawrence Richardson. Ry. Age, vol. 75, no. 17, Oct. 27, 1923, pp. 767-770, 2 figs. Straight-line method used in modern industrial plants applied to classified repairs.

RAILWAY SHOPS

ELECTRIC WELDING. Report of Committee (Assn. Ry. Elec. Engrs.) on Electric Welding. Ry. Elec. Engr., vol. 14, no. 11, Nov. 1923, pp. 367-369, 4 figs. Economic status of arc welding, and relative costs of electric arc welding and other processes, particularly oxy-acetylene.

RAILWAY SIGNALING

UTOMATIC BLOCK. Direct Current Automatic Block Signaling. Am. Ry. Assn. Signal Section—advance notice for meeting Nov. 14-15, 1923, pp. 111-114. Instruction for making train shunt resistance tests; and for testing resistance of switch circuit controller, shunting circuits and contracts; report on maximum resistance for switch circuit controllers, shunting circuits and contacts. Report of Committee IV.

ECONOMICS. Economics of Railway Signaling. Am. Ry. Assn. Signal Section—advance notice for meeting Nov. 14-15, 1923, pp. 145-157, 2 tables. Economic value of operating remote switches; savings effected by use of power switch machines for operation of remote switches as reported by railways. Report of Commitee I.

HIGHWAY CROSSING. Highway Crossing Signals on the N.Y.C. R.R.Ry. Rev., vol. 73, no. 18, Nov. 3, 1923, pp. 647-649, 4 figs. Gives circuits and methods of control and operation of highway crossing signals which have been installed by N. Y. Central at some of its busiest street intersections at grade.

INTERLOCKING. Mechanical Interlocking. Am. Ry. Assn. Signal Section—advance notice for meeting Nov. 14-15, 1923, pp. 96-110. Specification for electro-mechanical interlocking machine, unit electric levers, and locking. Report of Committee II.

POWER INTERLOCKING. Am. Ry. Assn. Signal Section—advance notice for meeting Nov. 14-15, 1923, pp. 18-23, 4 figs. Specification for location and layout for way stations; typical plans for joint occupancy of signal stations by telegraph and telephone apparatus. Report of Committee III.

RAILWAY TIES

HOLLOW ELASTIC. The Nature and Advantages of Elastic Railway Ties (Das Wesen und die Vorteile der elastischen Schienenunterstützung), H. Shieve. Verkehrstechnik, vol. 40, no. 37, Sept. 14, 1923, pp. 341-342, 3 figs. Discusses elastic hollow ties recommended by author and comparative tests with these and inelastic steel through-snaped ties heretofore in use.

REINFORCED-CONCRETE. The Stent Reinforced Concrete Railway Sleeper. Engineering, vol. 116, no. 3017, Oct. 26, 1923, pp. 536-537, 8 figs. Describes reinforced-concrete sleeper of block-and-tie pattern now in use on several railways in India, and points out advantages of system.

SPECIFICATIONS. Ties. Am. Ry. Eng. Assn.—Bul., vol. 25, no. 257, July 1923, pp. 10-15, 6 figs. Fundamentals to be considered in designs of substitute tics; care of ties after distribution; installation and keeping records of cross-tie test sections.

TREATMENT AND CARE. Treatment and Care of Railroad Ties, S. D. Cooper. Eng. and contracting (Railways), vol. 60, no. 4, Oct. 17. 1923, pp. 818-821, 2 figs. Describes practice of Atchison, Topeka & Santa Fe Ry. Paper read before Roadmasters & Maintenance of Way Assn.

RAILWAY TRACK

CROSSINGS. General Specifications for Highway Grade Crossings and Approaches Other Than Those for Which Requirements Are Stipulated by Law. Am. Ry. Eng. Assn.—Bul., vol. 25 no. 257, July 1923, pp. 25-27, 2 figs.

MAINTENANCE. Maintenance of Way—Improved Methods and results on the Lehigh Valley Railroad, G. L. Moore. Central Ry. Club—Official Proc., vol. 31, no. 4, Sept. 1923, pp. 1408-1417. Description of use of locomotive cranes for rail anchoring, track laying and rapid handling of material; important economies effected.

SPECIFICATIONS. Track. Am. Ry. Eng. Assn.—Bul., vol. 25, no. 257, July 1923, pp. 21-25. Addition to frog and switch plans; details of switch-stand target shapes; oiling track fixtures; specifications for laying of new track.

RAINFALL

RUN-OFF. Rainfall and Run-off. William T. Taylor. Elec. Rev., vol. 93, no. 2394, Oct. 12, 1923, pp. 524-526. Importance of rainfall records of catchment area; methods for determination of probable run-off.

RECTIFIERS

MERCURY-ARC. Conversion from Alternating to Direct Current by means of Mercury-Arc Rectifiers, R. L. Morrison. Engineering, vol. 116, nos. 3016 and 3017, Oct. 19 and 26, 1923, pp. 507-510,and 543-546, 24 figs. Describes development, object of which is to eliminate disadvantages of rotating machinery and to provide plant that can be compared in simplicity to ordinary static transformer; types and construction of rectifiers. Paper read before Brit. Assn.

THEORY OF. The Theory of Rectifier (Zur Theorie des Gleichrichters). Wissenschaftliche Veröffentlichungen aus dem Siemens-Konzern, vol. 3, no. 1, May 15, 1923. Contains following articles: The Change of Power Factor in the Passage from Generator to Rectifier, Heinrich Kaden, pp. 41-60, 24 figs. The Construction of Accurate Current and Voltage Curves for Multi-Phase Mercury-Vapor Rectifiers, Hermann Pflieger-Haertel, pp. 61-76, 7 figs.

REFRIGERATING MACHINES

AIR. Cooling With Air, M. Leblanc. Refrig. Eng., vol. 10, no. 3, Sept. 1923, pp. 101-106, 11 figs. Use of air as a refrigerating agent in place of chemicals; study of air refrigerating machines, including their cycle, fundamental observations, how cycle is effected in practical machines, conception of new machine, scavenging operations. and manner of realizing a machine with scavenging operations applied. From Revue Générale du Froid, Oct. 1922.

AUTOMATIC. Automatic Refrigerating Machinery, J. C. Goosmann. Ice & Refrigeration, vol. 63, no. 6, Dec. 1922, pp. 61-63, and vol. 64, nos. 2, 3 and 4, Feb., Mar. and Apr. 1923, pp. 131-135, 205- 210 and 320-323, 20 figs. Three general groups of refrigerating plants; semi- and fully automatic refrigerating machinery; lubrication; water-flow control; condenser safety valves.

RETAINING WALLS

PRECAST CONCRETE CRIBBING FOR. Precast Concrete Cribbing for Retaining Walls. Eng. News-Rec., vol. 91, no. 18, Nov. 1, 1923, pp. 718-719, 4 figs. Units placed easily and quickly; drainage and foundations simplified; extensive use in railway work.

ROAD CONSTRUCTION

EARTH. An Experiment in Earth Road Construction, Ben H. Petty. Eng. News-Rec., vol. 91, no. 19, Nov. 8, 1925, pp. 751-755, 2 figs. Highway extension work by Purdue University teaches back-district farmers good road methods.

ROADS

EARTH, OIL TREATMENT OF. Experimental Oiled Earth Roads in Iillinois, H. F. Clemmer and F. L. Sperry. Highway Eng. & Contractor, vol. 9, no. 4, Oct. 1923, pp. 27-30, 4 figs. Description of tests carried out by Illinois Division of Highways on use of oil for treatment of earth roads.

OILED. Illinois Counties Join State in Experimental Study of Oiled Roads, H. F. Clemmer and F. L. Sperry. Municipal and County Eng., vol. 65, no. 3, Sept. 1923 pp. 97-101, 2 figs. Account of tests being conducted with use of oil for treatment of earth roads; experiment with different kinds and grades of oil; traffic tests; application of oil.

TEST ROAD, PITTSBURG, CAL. The Test Highway at Pittsburg, California, Lloyd Aldrich. Municipal & County Eng., vol. 65, no. 4, Oct. 1923, pp. 174-181. Object of test is to secure information on relative merits of enough different types of pavement, including types embodying ideas of Columbia Steel Co., to enable engineers to design highways with greater certainty of results.

ROADS, ASPHALT.

PAVEMENT TYPES, SELECTION OF. The Selection of Types of Asphalt Pavement with Reference to Local Materials, Roy M. Green. Good Roads, vol. 65, no. 14, Oct. 3, 1923, pp. 107-108. Author calls attention to economic value of making through investigations of all sources of supply of materials for utiization in construction of pavement.

ROADS, CONCRETE

CONSTRUCTION. Construction of Concrete Pavements, Gordon Grant. Can. Engr., vol. 45, no. 19, Nov. 6, 1923, pp. 461-465, 4 figs. Reviews Canadian practice methods and equipment generally employed; plain versus reinforced concrete; placing concrete and finishing; results obtained in Canada. From paper read at Int. Road Conference, Sevile, Spain.

PRECAST SLABS. Concrete Road Built of Precast Slabs As Experiment. Eng. News-Rec., vol. 91, no. 18, Nov. 1, 1923, pp. 711-712, 4 figs. Slabs of three sizes were used in one mile of 18-ft. pavement laid ou adobe marsh near Suisu, Cal.

REINFORCEMENT. Reinforcement in Concrete Roads Worth Its Cost, H. Eltinge Breed. Eng. News-Rec., vol. 91, no. 120, Nov. 15, 1923, pp. 790-792. Experience and experiment both give proof of increased strength and endurance quantity and distribution of steel main problem; use cage bars and dowels.

TESTS. Test Types of Concrete Roads at Pittsburg. Cement & Eng. News. vol. 35, no. 10, Oct. 1923, pp. 27-30, 14 figs. Describes experiments carried out on a test road at Pittsburg, Cal., and results obtained; find thickened-at edge slab without reinforcing bars best able to withstand heavy traffic loads; reinforced slab second best.

S

SANDS, MOULDING

MINNESOTA. The Foundry Sands of Minnesota, G. N. Knapp. Univ. of Minn., Geol. Surveys—Bul., no. 18, 1923, 105, pp., 15 figs. Report of investigation begun in 1918. Geology; geological formations yielding foundry sands, loams and clays; list of Minnesota foundries and localities supplying them with foundry sands; laboratory methods of testing foundry sands, loams and clays; mechanical and mineral analyses.

TESTING AND STANDARDIZATION. The Testing of Moulding Sands with Special Reference to Standardization, C. W. H. Holmes. Foundry Trade Jl., vol. 28, nos. 372 and 373, Oct. 4 and 11, 1923, pp. 296-298 and 308-311, 1 fig. Chemical constitution; methods employed for mechanical grading sand; nature and estimation of bond; venting properties; strength or cohesiveness of sands; selection of standardization of tests. Paper presented to Paris Congress.

SEMI-DIESEL ENGINES

PRIMM. Outstanding Features in Modern Oil Engines, Julius Rosbloom. Ariz. Min. Jl., vol. 7, no. 11, Nov. 1, 1923, pp. 18-19, 2 figs. Details of "Primm" oil engine, a two-cycle semi-Diesel engine, manufactured by Power Mfg. Co. at Marion, Ohio, and principle of its operation.

SEPARATORS

OIL. The "Rocket" Oil Separator. Engineering, vol. 116, no. 3016, Oct. 19, 1923, pp. 492-493, 1 fig. Device can be installed on ship for purpose of recovering oil and discharging only clear water overboard; can also be installed on shore for treating oil discharge from ships in port. See also Petroleum Times, vol. 10, no. 250, Oct. 20, 1923, 557-559, 2 figs.

SEWAGE DISPOSAL

METHODS. Recent Developments in Sanitary Engineering, George W. Fuller. Can. Engr., vol. 45, no. 18, Oct. 30, 1923, pp. 447-450. Present status of sewage disposal methods; American and European methods of garbage and refuse disposal. Paper read before Instn. Sanitary Engrs., Lond.

TREATMENT PLANT RENEWAL. Renewing a Sewage Treatment Plant, W. A. Hardenbergh. Pub. Wks., vol. 54, No. 11, Nov. 1923, pp. 343-345, 4 figs. Effluent of septic tank improved by insertion of baffles and capacity of contact beds doubled by washing stone by means of home made apparatus.

SEWERS

CONCRETE. Typical Examples of Concrete Sewers. Can. Engr., vol. 45, no. 18, Oct. 30, 1923, pp. 441-446, 6 figs. Report of committee of Am. Concrete Inst. covering essential points of concrete sewer design and construction; advantages and disadvantages of principal types; plain versus reinforced construction.

SHAFTS

Critical Speed. The Critical Speed of Turbine Shafts (Die kritischen Drehzahlen von Turbinenwellen), Wilh. Müller. Zeit für technische Physik. vol. 4, no. 3, 1923, pp. 88-93, 3 figs. Describes theory of critical speeds of rotating shafts with constant and inconstant mass distribution, taking natural weight into consideration.

The Determination of the Critical Speeds of Elastic Shafts and Their Stability (Ueber die Bestimmung der kritischen Drehzahlen von elastischen Wellen und deren Stabilität), Theodor Pöschl. Zeit für angewandte Mathematik u. Mechanik, vol. 3, no. 4, Aug. 1923, pp. 297-312, 5 figs. Dynamic investigation prompted by troubles observed in operation of steam turbines and similar machines with high-speed elastic shafts and in disks mounted on these machines.

Critical Torsional Moment. The Critical Twisting Moment of Shafts (Das kritische Drillungsmoment von Wellen), R. Grammel. Zeit. für angewandte Mathematik u. Mechanik, vol. 3, no. 4, Aug. 1923, pp. 262-271, 4 figs. Calculation of critical moment of torsion for any given cross-sections.

SLATE

Slabs for Electrical Purposes. British Standard Specification for Slate Slabs for Electrical Purposes. British Eng. Standards Assn., No. 160, Aug. 1923, 4 pp., 1 fig. Specification covering tolerances on dimensions, tolerance on flatness, bevel, and enamel.

SNOW REMOVAL

Methods. The Snow-Removal Problem in American Cities. Am. City Mag., vol. 29, no. 4, Oct. 1923, pp. 347-353, 9 figs. Analysis of need for snow removal and outline of methods used in various cities.

SOLDERS

Aluminum. A New Aluminum Soldering and Welding Medium ("Hürco"), ein neues Aluminium-Löt- und Schweissmittel), Mac Wille. Fördertechnik u. Franchtverkehr, vol. 16, no. 18, Sept. 18, 1923, pp. 206-208, 5 figs. Describes new preparation known as Hürco solder, chief advantage of which is that it does not flow when melted but changes gradually into a pasty condition so that it can be molded as a plastic mass the same as sculpture clay.

SOOT BLOWERS

Mechanical. Economies of Mechanical Soot Blowers, Robert June. Power Plant Eng., vol. 27, no. 21, Nov. 1, 1923, pp. 1070-1073, 5 figs. Savings due to use of soot blowers; comparative costs of soot blowing.

STEAM

Specific Heat. Conclusions from Latest Investigations at Munich, Germany, of the Specific Heat of Steam (Folgerungen aus den neuesten Münchener Untersuchungen der spezifischen Wärme des Wasserdampfes), H. Schmolke. Wärme, vol. 46, no. 37, Sept. 14, 1923, pp. 409-410. Supplement to author's article in same journal, no. 23, 1923.

STEAM-ELECTRIC PLANTS

Manchester, England. England's Latest Generating Station, W. H. Onken. Elec. World, vol. 82, no. 20, Nov. 17, 1923, pp. 1010-1012. 6 figs. Features of Barton station of Manchester Corp.; it is of superpower type sanctioned by Great Britain's Electricity Commission and is typical of modern English steam-station practice.

Two Pressures, Operation with. Lorain Plant Operates With Two Pressures. Power Plant Eng., vol. 27, no. 22, Nov. 15,1923, pp. 1117-1123, 9 figs. Pressure of new 20,000-kw. unit is 100 lb. higher than on old unit.

STEAM POWER PLANTS

Natural Steam. Power and Boric Acid from Natural Steam in Tuscany. Chem. & Industry, vol. 42, no. 43, Oct. 26, 1923, pp. 1022-1024, 3 figs. Describes large chemical plant, in which volcanic steam is utilized first to produce electrical power and afterwards for manufacture of boric acid.

Remodeling. More Power with Less Coal at Saxony Mills Plant (St. Louis). Power, vol. 58, no. 20, Nov. 13, 1923, pp. 773-774, 1 fig. New chaingrate stokers in enlarged combustion chambers and addition of mixed-pressure turbo-generator to Corliss engine rope-drive plant, improve economy and increase capacity.

STEAM TURBINES

Development. Development of the Steam Turbine, Stanley S. Cook. Roy. Soc. Arts—Jl., vol. 71, nos. 3695, 3696 and 3697 Sept. 14, 21 and 28, 1923, pp. 729-738, 743-760 and 762-770, 33 figs. Sept. 14: Principle of compounding; early indications of directions of progress; marine development with direct-coupled turbines; problem of propeller; combination of turbine and reciprocating engine; passing of direct-coupled marine turbine. Sept. 21: Introduction of mechanical gearing; application to large powers in naval vessels; lubrication of thrust blocks and bearings; mercantile marine turbine; comparison of modern and early efficiencies; methods of attaching blades; reaction and impulse types; progress in economy and output of land turbines; problem of exhaust area. Sept. 28: Application of mechanical gearing to land turbines; geared turbo-generators; geared turbines for mill driving; direct-coupled turbo-alternators; construction of rotors; ventilation of stators; latest improvements in economy of turbines by reheating and cascade feed heating.

High-Pressure. Steam Turbines for High Pressures (Die Dampfturbinen für hohe Drücke), Karl Münichsdorfer. Zeit. des Bayerischen Revisions-Vereines, vol. 27, nos. 17 and 18, Sept. 15 and 30, 1923, pp. 129-130 and 142-143, 5 figs. Discusses change in superstructure of turbine caused by use of high-pressure steam; possibilities of introducing high-pressure turbines in power plants are exemplified.

Marine. *See Marine Steam Turbines.*

STEEL

Chrome-Vanadium. *See Chrome-Vanadium Steel.*

Cold Working. Manufacture of Bright-drawn Bar, Wire, and Cold-rolled Strip. Machy. (Lond.), vol. 23, no. 579, Nov. 1, 1923, pp. 129-133, 8 figs. Production methods employed by Arthur Lee & Sons, Sheffield.

Crystal Structure. Examination of Steel by the X-ray Spectrometer, Hermann H. Zoring. Army Ordance, vol. 4, no. 20, Sept.-Oct., 1923, pp. 77-83, 4 figs. Evidence shows that, at ordinary temperatures, in plain carbon steels of hyper-eutectoid composition, crystal structure, as shown by X-ray spectrometer, varies through continuous series from that existing when metal has been very rapidly cooled from temperature in or above critical range to that existing when cooling has been very slow from temperature above critical range.

Seasoning. The Seasoning of Steel, W. P. Wood. Am. Soc. for Steel Treating—Trans., vol. 4, no. 4, Oct. 1923, pp. 488-493. Describes experiment consisting in comparing tensile properties of several varieties of unhardened steel before and after exposure of one year to varying temperature of atmosphere.

Surface Hardening. Nitrogen in Iron and Steel: A New Method of Surface Hardening. Iron & Coal Trades Rev., vol. 107, no. 2904, Oct. 26, 1923, p. 624. Data on new method of surface hardening steel by mitrating it and on results of investigation into ferro-nitrogen alloys from article by Ad. Fry published in Stahl u. Eisen.

Test. Static and Dynamic Tests for Steel, J. M. Lessells. Am. Soc. for Steel Treating—Trans., vol. 4, no. 4, Oct. 1923, pp. 536-545, 11 figs. Deals with static and dynamic forms of testing, tensile test being taken as representative of former and repeated shock and fatigue as representative of latter; describes types of shock and fatigue testing machines with experimental results obtained.

The Relation Between the Dynamic and the Static Tensile Tests, Harold Albert Nisley. Army Ordnance, vol. 4, no. 20, Sept.-Oct. 1923, pp. 88-93, 4 figs. Investigation to determine relationship existing between results of static and dynamic tests for each heat treatment, and to show whether this relationship did, or did not, vary as function of structure of material.

STEEL CASTING

Acid Electric. Acid Electric Steel Castings, Larry J. Barton. Iron Age, vol. 112, no. 19, Nov. 8, 1923, pp. 1249 and 1299-1301, 1 fig. Cardinal points in good practice; scrap and making bottom; charging and melting down; high-carbon and chrome steel.

Converter vs. Electric. Comparison of Converter and Electric Steel Castings, Thomas Hill. West. Machy. World, vol. 14, no. 10. Oct. 1923, pp. 330-332. Analysis of differences in steels obtained; characteristics of some converter steels.

STEEL, HEAT TREATMENT OF

Critical Point. Changes in Property through Heat Treatment Below Critical Point (Eigenschaltsänderungen durch Wärmebehandlung unterhalb der Umwandlungspunkte), George Welter. Stahl u. Eisen, vol. 43, no. 43, Oct. 25, 1923, pp. 1347-1349, 2 figs. Losses through faulty annealing; influence of annealing temperature and duration on mechanical properties of steel wire; constant and gradual cooling in furnace; theoretical conclusions.

Hardening. Nitrogen in Iron, Steel and Special Steel. A New Surface Hardening Process (Stickstoff in Eisen, Stahl und Sonderstahl. Ein neues Oberflächenhärtungsverfahren), Ad. Fry. Stahl u. Eisen, vol. 43, no. 40, Oct. 4, 1923, pp. 1271-1279, 17 figs. Nitration stages of pure iron; structure of iron-nitrogen and iron-nitrogen-carbon systems; development of diagram of state; process of shrinkage-free surface hardening by means of nitration.

Heating and Cooling, Effect of. Changes in Structure Due to Heating and Cooling of Iron with the Aid of Hot Etchings (Beobachtungen über Gefügeänderungen beim Erhitzen und Abkuhlen des Eisens mit Hilfe von Heissätzungen), P. Oberhoffer and A. Hegger. Stahl u. Eisen, vol. 43, no. 42, Oct. 18, 1923, pp. 1322-1323, 3 figs. Report from Met. Inst. of Tech. Acad. of Aix-la-Chapelle.

Quenching Properties. Quenching Properties of Very Soft Steel (Sur la faculté de trempe de l'acier extra-doux à très haute température), M. Sauvageot and H. Delmas. Académie des Sciences—Comptes Rendus, vol. 176, no. 17, Apr. 23, 1923, pp. 1146-1148. Results of measurement of mechanical properties when a steel containing 0.09 per cent. C. was quenched in water at temperatures varying between 950 deg. cent. and melting point; describes experiments on annealing material quenched at high temperatures.

Stainless. Heat-Treatment of Steel with Special Reference to Production, J. W. Urquhart. Machy. (Lond.), vol. 23, no. 577, Oct. 18, 1923, pp. 85-87, 1 fig. Stainless and iron treatment; forging temperature; hardening and tempering; non-scaling of high-chromium steels; strength of chromiun steels after treatment; chrome and useful treatment limit; acid-proof chromes.

STEEL, HIGH-SPEED

Heat Treatment. Hints on Treating High Speed Steel and Its Use for Machining Operations. West. Machy. World, vol. 14, no. 10, Oct. 1923, pp. 320-321 and 323, 3 figs. Discusses forging, annealing, hardening, and drawing of high-speed steel and importance of careful heating; illustrations of turning and grooving operations of rolls in machine shop of Columbia Steel Co., Pittsburg, Cal.

STEEL MANUFACTURE

Cold-Worked Steel. The Manufacture of Cold-worked Steel. Machy. (Lond.), vol. 23, nos. 575, 576 and 577, Oct. 4, 11, and 18, 1923, pp. 1-9, 33-38 and 70-71, 23 figs. Methods employed by Kayser, Ellison & Co., Sheffield, England, in production of wire, bar and strip from high-grade crucible and electric alloy steels.

Converters. Practical Problems in the Operation of Large and Small Bessemer Converters (Praktische Betriebsfragen aus der Gross- und Kleinbessemerei), Huber Hermanns. Giesserei-Zeitung, vol. 20, nos. 16 and 17, July 15 and Aug. 1, 1923, pp. 297-300 and 325-327, 9 figs. Electric drive of converters; problems of transport; conveyance of pig iron and steel; foundry equipment.

Railway. The Future of Transportation by Rail, E. O'Brien. Engineering, vol. 116, no. 3012, Sept. 21, 1923, pp. 381-382, 1 fig. Survey of probabilities of future of rail transport with brief reference to past. Paper read before Brit. Assn.

Science, Indebtedness to. Transport and Its Indebtedness to Science, Henry Fowler. Engineering, vol. 116, no. 3012, Sept. 21, 1923, pp. 377-380, 1 fig. Discusses investigations which led to development and perfection of steam and internal-combustion engines; scientific work in aeronautics; advances in metallurgy. Address before Brit. Assn.

STREET RAILWAYS

Cars. A Brill New Single Truck. Tramway & Ry. World, vol. 54, no. 19, Oct. 18, 1923, pp. 209-211, 4 figs. Describes 79-E-X truck made by J. G. Brill Co.; carries body, without increasing wheelbase, in such a manner as to give it stability equal to another 1 ft. 6 in. wheelbase.

Street-Railway Cars. Elec. Ry. Jl., vol. 62, no. 13, Sept. 29, 1923. Contains following articles: Broad Trend of Car Development, pp. 473-474; Present Body Design Tendencies, pp. 475-481, 8 figs.; Facilities for Expediting Passenger Movement, pp. 482-490, 23 figs.; New Methods in Body Construction, pp. 491-501, 25 figs.; Advances in Car Lighting, Heating and Ventilating, pp. 502-510, 17 figs.; Mechanical and Electrical Equipment, pp. 511-519 and 536, 30 figs.; Interchangeability and Standardization, pp. 520-522, 2 figs.; Incorporating Merchandising Features in Design, pp. 523-528, 10 figs.; Cars for Use in Train Operation, pp. 529-536, 14 figs.

Track. Concrete Foundations, Robert B. Holt. Tramway & Ry. World, vol. 54, no. 19, Oct. 18, 1923, pp. 219-222, 2 figs. Consideration of strength, suitability and permanence of concrete foundations for tramway tracks. Mixing water; grading of aggregates; characteristics of sand; proper maturing; trass or puzzolana; ciment fondu.

STRESSES

Optical and Mechanical Determination. The Determination of Stresses at a Point in a Plate, E. G. Coker. Engineering, vol. 116, no. 3016, Oct. 19, 1923, pp. 512-514, 6 figs. Comparison of experimental methods for obtaining stress at point in plate by optical and mechanical methods. Communicate to Brit. Assn.

Optical Recorders. Optical Stress-Strain Recorders. Engineer, vol. 136, no. 3540, Nov. 2, 1923, pp. 479-480. Discusses Dalby's device which, in its present form, consists of two mirrors mounted on axes at right angles to each other, whereby ray of light from point source is reflected through lens and focussed on photographic plate.

SUBSTATIONS

Protection. Study of Substation Protection, R. V. Achatz. Telephony, vol. 85, no. 17, Oct. 27, 1923, pp. 28-33. Regulations governing protective apparatus; survey of current practice; annual per-station figures; information from insurance companies; operation of substation protectors; economic consideration.

SUPERHEATED STEAM

Developments. Superheating, John Neill. Inst. Mar. Engrs.—Trans., vol. 35, Oct. 1923, pp. 288-320 and (discussion) 320-329, 35 figs. Deals with recent developments.

SURGE TANKS

Spillway Combined with. Surge Tank and Spillway Combined on Pit River Plant No. 1. Eng. News-Rec., vol. 91, no. 16, Oct. 18, 1923, pp. 630-632, 4 figs. Heavily reinforced cylinder 60 ft. in diam. provides 1800 sec-ft. spillway capacity between tunnel and penstock.

T

TAR

Coke-Oven. Some of the Constituents of Coke-Oven Tar, John M. Weiss and Charles R. Downs. Indus. & Eng. Chem., vol. 15, no. 10, Oct. 1923, pp. 1022-1023, 1 fig. Author seeks to throw light on composition of neutral oils boiling above 200 deg. cent., both as to principal compounds present and their amount.

TELEPHONY

Automatic. Operating Speed of Automatic Telephone Equipment, Paul G. Andres. West Soc. Engrs.—Jl., vol. 28, no. 10, Oct. 1923, pp. 421-437, 21 figs. Deals with construction of automatic switches; time elements of lineswitch calling device, selector and imnulse repeater; accuracy and limitations of observed values.

Transmission Layout. Applied Telephone Transmission, J. S. Elston. Instn. P.O. Elec. Engrs. (pamphlet), no. 88, 94 pp., 34 figs. Describes detailed scheme of transmission layout. Deals with standard of transmission; traffic circulation and control: manual and automatic conditions; flexibility of cable plant. Discussion.

TERMINALS, LOCOMOTIVE

Design. Locomotive Terminals. West Soc. Engrs.—Jl., vol. 28, no. 9, Sept. 1923, pp. 373-390 and (discussion) 390-394, 2 figs. Contains following papers: Operating Department Requirements, R. N. Begien; Mechanical Department Requirements, L. K. Sillcox; Design of Railway Locomotive Terminals, W. T. Krausch.

TERMINALS, RAILWAY

Chicago Union Station. The Chicago Union Station, Its Design and Construction, J, D'Esposito. West. Soc. Engrs.—Jl., vol. 28, no. 9, Sept. 1923, pp. 357-372, 7 figs. Records important features of planning and execution of work embraced in general rearrangement of railway facilities known as Chicago Union Station project.

Design and Developments. Railroad Terminals. Am. Soc. Civil Engrs.—Proc., vol. 49, no. 7, Sept. 1923, pp. 1455-1606, 61 figs. Symposium containing following papers: Principles of Terminal Station Design, Alfred Fellheimer; Railroad Freight Terminal Problem in St. Louis, Missouri, Charles E. Smith; Street Development in Relation to Railroad Terminals, Jacob L. Crane, Jr.; Chicago Terminal Improvements, Illinois Central Railroad, D. J. Brumley; Chicago Terminal Improvements, Dearborn Station Group, Frederick E. Morrow; Chicago Terminal Improvements, Chicago, Rock Island and Pacific and New York Central Railways, Robert H. Ford; Chicago Union Station Development, J. D'Esposito; Modern Rail and Water Terminals with Reference to Chicago, Rufus W. Putnam; Modern Freight Terminal of the Pennsylvania Railroad System in Chicago, Ill., William L. R. Haines.

THREADING MACHINES

Double-End. New Double-End Threading Machine Operates Automatically. Automotive Industries, vol. 49, no. 16, Oct. 18, 1923, pp. 792-793, 2 figs. Has capacity for work up to ⅜ in. in diam. and 10 in.length; work fed intermittently from magazine at rear to position in line with die heads; power transmission through two-step cone pulley; built by Grant Mfg. & Machine Co.

TIDAL POWER

Utilization. The Utilization of Tides for the Production of Power for the Working and Lighting of Ports and for Maritine Works (Working of Lock-Gates, etc.), Alejandro Yanquez. World Ports, vol. 11, no. 11, Sept. 1923, pp. 48-55. Points out that when constructing works of ports, construction should be studied of closed docks and moles, with view to forming at one and same tine perfect shelters and utilization of natural power of tides. Paper before Int. Congress of Navigation, London.

TILE

Concrete Roofing. Making Concrete Roofing Tile. A. J. R. Curtis. Rock Products vol. 26, no. 21, Oct. 20, 1923, pp. 39-42, 8 figs. Form of concrete product which offers market for fine aggregate produced in excess of demand in many parts of country; plant required to produce roofing tile; curing equipment; characteristics of tile.

TIRES, RUBBER

Fabric Stresses in. Fabric Stresses in Pneumatic Tires, H. F. Schippel. Indus. & Eng. Chem., vol. 15, no. 11, Nov. 1923, pp. 1121-1131, 26 figs. Mathematical analysis of fabric stresses in pneumatic-tire carcasses.

TOLERANCES

German Standards. German Standards for Tolerances and Allowances in Machine Fits, Oscar R. Wikander. Am. Mach., vol. 59, nos. 19 and 20, Nov. 8 and 15, 1923, pp. 685-689 and 733-737, 12 figs. Presents standard sheets known as Dinorms issued by German Indus. Standards Committee.

Large. Large Tolerances; Their Influence on Determining the Dimensions of Structural Parts (Grosztoleranzen; ihr Einflusz auf die Maszbestimmung von Konstruktionsteilen), Th. Damm. Werkstattstechnik, vol. 17, no. 19, Oct. 1, 1923, pp. 565-570, 14 figs. Investigation, based on examples of machine and especially locomotive construction, to determine extent to which principles of German standard fit system (DIN) can be applied to the determination s of large tolerances.

TOOL MAKING

Standards for. The Manufacture of Tools and Fixtures (Die Werkzeugmacherei und der Vorrichtungsbau), Karl Haase. Werkstattstechnik, vol. 17, nos. 17 and 18, Sept. 1 and 15, 1923, pp. 513-520 and 553-556, 20 figs. Economic production by means of special tools and fittings wit aid of corresponding Standards, Presents Standard sheets for various fittings.

TRANSFORMERS

Distribution. Construction and Care of Distribution Transformers, L. G. Mason. Coal Age, vol. 24, no. 17, Oct. 25, 1923, pp. 623-627, 7 figs. Selecting best transformer for work; consideration of iron and copper losses; building transformer; testing; recommendations as to proper care.

TRANSPORTATION

Railway. Railroad Transportation. Am. Soc. Civil Engrs.—Proc., vol. 49, no. 7, Sept. 1923, pp. 1406-1454, 8 figs. Symposium containing following papers: Some Phases of Present-Day Railroad Transportation, John W. Kendrick; Transportation as Related to National Development, J. G. Sullivan; Railroads—The Arteries of Commerce, J. Rowland Bibbins; Federal Valuation of Railroads, Charles A. Morse; Consolidation of Railroads, John S. Worley.

TUBES

Butt Welding. Minimizing Distortion in Welding of Tubing, Marcel Piette. Can. Machy., vol. 30, no. 15, Oct. 11, 1923, pp. 22 and 24, 5 figs. Expansion of pieces in opposite sense beneficial; hammering during process on thick material and after welding on thin material diminishes contraction. Translated from Revue de la Soudure Autogene.

TUBING

Chrome-Molybdenum Steel. Physical Properties of Chrome-Molybdenum Steel Tubing, S. W. Thompson, Air Service Information Circular, vol. 5, no. 445, Aug. 1, 1923, 16 pp., 11 figs. . Investigation to determine variation in physical characteristics of three sizes of chrome-molybdenum steel tubing after quenching and drawing.

TUNNELS

New Zealand Railway. Arthur's Pass Tunnel—Construction and Electrical Equipment. Indus. Australian & Min. Standard, vol. 70, no. 1815, Sept. 13, 1923, pp. 402-404, 3 figs. Length of tunnel is 5 mi. 554 yd., all on straight; and it is lined throughout; sidewalls and footings are of mass concrete and arch is formed of concrete blocks; method of construction; electrification; overhead and locomotive equipment; auxiliary plant.

U

UNEMPLOYMENT

Problems. Employment and Unemployment. Int. Labour Rev., vol. 8, no. 3, Sept. 1923, pp. 385-413. Statistics; unemployment problems; unemployment insurance by industries.

V

VACUUM TUBES

Power Oscillators, as. Vacuum Tubes as Power Oscillators, D. C. Prince. Inst. Radio Engrs.—Proc., vol. 11, no. 5, Oct. 1923, pp. 527-550, 14 figs. Chapter VI: In "master oscillator" or "power amplifier" circuit oscillations are generated by small power source and then amplified; effect of variations in grid and plate circuit tuning upon output and losses is developed for both direct coupling to antenna circuit, and coupling through an intermediate circuit. Chapter VII: it is shown that considerable increases in efficiency and tube output can be obtained by introducing harmonics into plate voltage wave.

Thermionic Valves. Thermionic Valves and their Uses, J. A. Fleming. Practical Engr., vol. 68, no. 1908, Sept., 20, 1923, pp. 159-160. Its invention and subsequent improvements; thermionic oscillation generator; modern wireless telephone and telegraph valve receivers; thermionic telephone repeater. From pamphlet published by British Science Guild.

VALVE GEARS

Small Turbines. Valve Gears on Small Westinghouse Direct-Driven Turbines. Power, vol. 58, nos. 19 and 20, Nov. 6 and 13, 1923, pp. 730-731, and 770-773, 6 figs. Describes two general types one for sets up to 15 kw. which uses horizontal governor mounted on shaft, and second type which is applied to geared turbines and utilizes comparatively low-speed vertical governor geared to slow-speed shaft.

VAPORS

Pressure Measurements. Applications of Vapor Pressure Measurements, H. S. Davis and Mary D. Davis. Indus. & Eng. Chem., vol. 15, no. 10, Oct. 1923, 1075-1077, 1 fig. Vapor-pressure apparatus consists of two similar glass flasks connected to manometer tube and means whereby sealed glass containers full of liquids may be broken inside flasks; details of manipulation of such a device.

VARNISHES

Tests. Report of Sub-Committee IX on Varnish. Am. Soc. for Testing Matls., advance paper, no. 48s, for meeting June 25-29, 1923, 17 pp., 6 figs. The "Kauri" reduction test as accelerated method of determining durability of varnish; exposure test, and results; proposed methods of testing oleo resinous varnishes.

Tennessee. A Study of Some of the Smaller Undeveloped Water Power of Tennessee, J. A. Switzer. State of Tenn. Dept. Education, Division of Geol., Bul. 30, 1923, 24 pp., 27 figs. on supp. plates. Red River, Chestuee Creek, Cummins Falls, Harpeth River, Buffalo River, and Nolichucky River projects; "Narrows" of Caney Fork; Obed River, Piney River and Soddy Creek investigations.

VIADUCTS

Combined Steel and Concrete. Reconstruction of Sixteenth Street Viaduct in Denver, Elsie Eaves. Eng. News-Rec., vol. 91, no. 19, Nov. 8, 1923, pp. 750-752, 5 figs. Combination steel and reinforced-concrete structure designed so as to utilize existing portions and salvage old steel.

VIBRATIONS

Tests. Determination of Mechanical Performance by Means of Vibration Tests, C. Bethel. Elec. Jl., vol. 20, no. 10, Oct. 1923, pp. 371-373, 5 figs. Results of tests show great value of reproducing service vibrations experimentally to determine ability of piece of apparatus to meet actual service requirement.

VISCOSIMETERS

Standardization. The Standardization of Commercial Viscometers, Madison L. Sheely. Indus. & Eng. Chem., vol. 15, no. 11, Nov. 1923, pp. 1109-1114, 9 figs. Discusses need of standardization and advisability of expressing results in absolute units; gives calibration, set up, and operation of typical glass outflow type of viscometer, together with comparisons of various other similar types; data showing comparative results of viscosity determinations on various instruments; liquids and solutions suitable for standardization of commercial types of viscometers.

W

WAGES

Incentive Systems. Wage-Incentive Systems, Eugene Bouton. Soc. Automotive Engrs.—Jl., vol. 13, no. 5, Nov. 1923, pp. 380-383, 6 figs. Describes system involving group-piece-work plan for major assembly units and machining departments, and straight individual piece work for small parts; piece-work prices are established from data obtained in elemental time study, record of which is shown

WATER ELEVATORS

Developments. Recent Developments in Water Elevators, G. C. Gowlland. Roy. Engrs., Jl., vol. 37, no. 3, Sept. 1923, pp. 389-394, 5 figs. Describes canvas belt, Chaine-Hélice and Boulton water elevators.

WATER PURIFICATION

Machine for Removing Solids. A New Machine for Sifting of Solids from Liquids (Eine neue Maschine zur Aussiebung fester Stoffe aus Flüssigkeiten), R. Mensing. Gesundheits-Ingenieur, vol. 46, no. 42, Oct. 20, 1923, pp. 417-418, 1 fig. Describes machine patented by author which can be used for recovery of factory water from rivers lakes and canals; purification of cooling waters or of turbine-driving waters; purification of industrial water, municipal sewage; etc.

WATER SUPPLY

Surface, Canada. Surface Water Supply of Canada — St. Lawrence and Southern Hudson Bay Drainage, Ontario. Dominion Water Power Branch, Can. Dept. Interior, Water Resources Paper No. 38, 1923, 100 pp., 2 figs. on supp. plates. Results of Hydrometric investigations covering climatic year ending Sept. 30, 1922.

WATER TANKS

Concrete. Concrete Tanks for Railway Water Service, C. R. Knowles. Ry. Eng. Maintenance, vol. 19, no. 11, Nov. 1923, pp. 422-445. Discusses suitability of concrete for tanks; design; permanent location, and cost.

WATER TREATMENT

Purification Methods. Modern Methods of Water Purification, H. P. O'Callaghan. Surveyor, vol. 64, no. 1652, Sept. 14, 1923, pp. 195-196. Review of methods successfully practised at present time in treatment and purification of fresh-water supplied for both potable and industrial purposes. (Abstract.)

WATER TREATMENT

Taste and Odor Removal. Taste and Odor in New York City's Supplies, Frank E. Hale. Am. Water Works Assn., vol. 10, no. 5, Sept. 1923, pp. 829-837. Discusses organisms which have given offense from taste or odors; control of odors and taste.

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Length Measurements. Precise Length Measurements, J. E. Sears. Roy. Soc. Arts—Jl., vol. 71, nos. 3698, 3699 and 3700, Oct. 5, 12 and 19, 1923, pp. 775-791, 793-818 and 819-841, 49 figs. Oct. 5: Control of basic standards. Oct. 12: Determination of derived standards. Oct. 19: Practical applications.

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Flow. Weir Flow, Dempster Smith and William J. Walker. Instn. Mech. Engrs.—Proc., no. 4, June 1923 pp. 819-834, 6 figs. Account and results of experiments, in which attempt has been made to obtain rational expression for discharge of rectangular weir.

WELDING

Applications. Industrial Applications of Welding and Cutting and Their Possibilities, Am. Welding Soc.—Jl., vol. 2, no. 10, Oct. 1923, pp. 9-45, 38 figs. Possibilities of welding as a fabricating process and in repair field; describes application of arc welding electric arc cutting, oxy-acetylene welding, oxy-acetylene cutting, oxy-acetylene welding, resistance welding, and thermit welding.

Piping, Power-plant. The Use of Welding in Power-Plant Piping, Lewis J. Sforzini, Power, vol. 58, no. 21, Nov. 20. 1923, pp. 798-892, 12 figs. Results of author's experiences in extensive use of welded piping installations.

See also Electric Welding, Arc; Electric Welding, Resistance; Oxy-Acetylene Welding.

WINDMILLS

Drive for Dynamo. Wind-Driven Electric Lighting Plant. Engineering, vol. 116, no. 3018, Nov. 2, 1923, p. 571, 5 figs. Describes Lambert plant, consisting of wind wheel carried at top of lattice mast and driving a dynamo through chain gear.

Theory. General Theory of Windmills, Max M. Munk. Nat. Advisory Committee for Aeronautics—Tech. Notes, no. 164, Oct. 1923, 7 pp., 2 figs. Discusses application of slip-curve method to design and analysis of windmills.

WIRE

Copper. Report upon Tests on Hard Drawn Copper Wires and Cables for Overhead Transmission Lines. Instn. Elec. Engrs.—Jl., vol. 61, no. 322, Sept. 1923, pp. 997-1012, 6 figs. Report from Brit. Elec. and Allied Industries Research Assn. Material under test; range of samples tested; ultimate tensile strength; extension on fracture; limit of proportionality; modulus of elasticity; twist and wrap tests; results.

WIRE ROPE

Stresses. Stresses in Wire Rope (Beitrag zur Kenntnis der Vorspannungen in Drahtseilen), A. Werner. Glückauf, vol. 59, nos. 31 and 32, Aug. 4 and 11, 1923, pp. 741-745 and 772-777, 7 figs. Aug. 4: Theory of wire rope and present method of manufacture, especially recommending changes in form and tension; deformation of wire in lacing machine, Aug. 11: deformaöion in strands on making into rope, explained by mathematical calculations.

Decaying Roofs. Damp Rot in Wooden Roofs, Harland Seymour. Chem. Trade Jl. & Chem. Engr., vol. 73, no. 1896, Sept. 21, 1923, pp. 331-332. Its prevention and control.

Preservatives, Test of. A Fungus Bed Test of Wood Preservatives, Cloyd M. Chapman. Am. Soc. Testing Matls., advance paper, no. 65, for meeting June 25-29, 1923, 13 pp., 1 fig. Gives results of ten years' exposure in fungus bed of specimens of oak, cypress, spruce and yellow pine wood treated with thirty preservatives by three methods of treatment, cold dip, hot dip and boiling.

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Chemistry of. Chemistry of Wood, G. J. Ritter and L. C. Fleck. Indus. & Eng. Chem., vol. 15, no. 10, Oct. 1923, pp. 1055-1056. Results of analysis of heart-wood and sapwood of some American woods.

WORKMEN'S COMPENSATION

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X

X-RAYS

Materials Investigation. The X-Ray Examination of Materials, A. G. Warren. Instn. Elec. Engrs.—Jl., vol. 61, no. 322, Sept. 1923, pp. 949-959, 28 figs. Describes aspects of radiography as seen from author's viewpoint; lines along which progress may be expected.

Z

ZINC

Electrothermic. The Electrothermic Metallurgy of Zinc, B. M. O'Harra. U. S. Bur. Mines, Bul. 208, 1923, 103, pp., 43 figs. partly on suppl plates. Cowles Brothers' process; de Laval process and electric zinc smelting in Scandinavia; de Laval cyclone, Casoretti and Bertani, Salgues, Thierry, Taylor, shaft Gin induction, Louvrier, Queneau, Fulton electric-resistance briquet, Nathusius, and other furnaces; Stansfield's experiment; Johnson, Imbert-Thomson-Fitzgerald, Cote and Pierron process; Work of F. T. Snyder and Canada Zinc Co.; smelting experiments of Canadian government; Perterson's experiments; zinc plant of elektrometallurgischewarke, Horrem, Germany; zinc condensation problem; commercial possibilities of electric zinc smelting; selected bibliography.

ZINC ORE

Flotation. Selective Flotation of a Complex Zinc-Lead Ore, George J. Young. Eng. & Min. Jl., —Press, vol. 116, no. 11, Sept. 15, 1923, pp. 453-456, 2 figs. 2 flow sheet on supp. plate. Experimental work of Consolidated Min. & Smelting Co. of Can. on Sullivan ore is successful; new mill erected at Kimberley, and zinc and lead products to be shipped to trail.

ENGINEERING INDEX — Supplementary List

B

BRIDGES, RAILWAY

Calculation, German Rules for. New German Rules for Railway Bridge Calculations. Int. Ry. Congress—Bul., vol. 5, no. 10, Oct. 1923, pp. 916-922, 1 fig. Extract from Zentralblatt der Bauverwaltung, nos. 51 and 53, 1922, giving synopsis of most important specifications, accordinh to new German rules for 1922, for calculations in connection with metal railway bridges.

Steel. Steel Railway Viaduct Over Deep Creek, J. R. Grant. Can. Eng., vol. 45, no. 17, Oct. 23, 1923, pp. 421-422, 5 figs. Describes single-track viaduct built for Pacific Great Eastern Ry.; bridge is over 1192 ft. long and 270 ft. high; describes erection methods.

C

CABLES, ELECTRIC

Telephone. The Rhineland Cable, F. A. Buchholz. Eng. Progress, vol. 4, no. 6, June 1923, pp. 105-197, 5 figs. Particulars of underground telephone cable tending from Berlin to Rhine. Construction of line and cable; developments in cable construction during construction period and how they were utilized; increasing range of cable by induction coils.

COAL MINES

Concrete in. The Uses of Concrete In and Around a Coal Mine, Luke Lindoe. Can. Min. Jl., vol. 44, nos. 35 and 43, Aug. 31, and Oct. 26, 1923, pp. 688-692 and 838-842, 8 figs. Aug. 31: Surface structures. Oct. 26: Underground structures.

COAL MINING

Blasting Kruskoff Method. A New Way To Increase Lump Coal Production, Alfred Stettbacher. Explosives Engr., vol. 1, no. 7, Sept. 1923, pp. 181-184 and 204, 9 figs. Describes method invented by Herman Kruskopf, of Dortmund, used in Ruhr district, which saves explosives, cuts costs in blasting rock, and reduces explosions in gaseous and dusty mines.

Economical Methods. Ways of Operating Mines That Would Lower Cost. Coal Age, vol. 24, no. 19, Nov. 8, 1923, pp. 691-694, 1 fig. Report of Nat. Coal Commission on underground management in bituminous mines; points out economy of machine loading.

Longwall System. Working a Mine by Longwall Advancing, Homer Cote. Coal Industry, vol. 6, no. 10, Oct. 1923, pp. 424-426, 1 fig. A suggested method for working thin seams which secures quick initial production at moderate cost; good extraction, reduced trackage and simplified ventilation.

COKE

Combustibility. The Combustibility of Coke, H. D. Greenwood. Gas World, vol. 79, no. 2046, Oct. 6, 1923, pp. 18-19. Reactive surface and cellular structure; carbonizing conditions and coke structure; importance of porosity hardly justified.

CONCRETE CONSTRUCTION

Harbor Works. Concrete and Reinforced Concrete — Their Application to the Harbor Work of Three Ports in Spain — Means to Insure Their Preservation and Their Watertightness, World Ports, vol. 11, no. 11, Sept. 1923, pp. 55-79. Report presented at Inst. Congress of Navigation, London.

Monolithic Concrete System. Poured Concrete Houses in Holland. Concrete & Constructional Eng., vol. 18, no. 10, Oct 1923, pp. 655-659, 7 figs. Describes monolithic concrete construction system invented by Greve, a Dutch architect which is a new system possessing two special features, viz., method of shuttering whereby walls may be poured complete or for one story at a time at one operation, and composition of concrete of which buildings are formed; composition of concrete known as Korrelbeton.

CONCRETING

Cold-Weather. Fundamentals of Cold Weather Concreting. Eng. & Contracting (Buildings), vol. 60, no. 4, Oct. 24, 1923, pp. 843-847, 7 figs. Methods for winter work. From booklet of Portland Cement Assn.

CONVEYORS

Overhead. The Adaptibility of the Overhead Conveyor, Matthew W. Potts. Indus. Management (N. Y.), vol. 66, no. 5, Nov. 1923, pp. 292-299, 10 figs. Deals with hoists, monorails and telphers.

D

DREDGES

Bucket. Steam Shovels and Bucket Dredgers for Excavating Work, ter Ohanessian. Eng. Progress, vol. 4, no. 6, June 1923, pp. 108-110, 6 figs. Influence of nature of ground; choice of driving power; economy of mechanical excavating work; shovels with adjustable discharge.

ROTARY CUTTERS FOR. Rotary Cutters for Sand and Gravel Dredges, Jean M. Allen. Rock Products, vol. 26, no. 22, Nov. 3, 1923, pp. 16-18, 6 figs. Details of device for insuring a regular feed of solids to pump which also protects it from entrance of large stones.

E

ELECTRIC FURNACES

FIAT. The New Electric Steel Furnaces at the Fiat Works in Turin, G. Vitali. Electrician, vol. 91, no. 1366, Sept. 21, 1923, pp. 305-306, 4 figs. Description of Fiat furnaces, and excellent results obtained from them. Abstract from Elektrotecbnische Zeit.

TOOL TEMPERING. Electric Furnaces in Tool Room on I. C. Ry. Elec. Engr., vol. 14, no. 10, Oct. 1923, pp. 314-315, 5 figs. Describes equipment at Burnside (Chicago) shop of Illinois Central, consisting of electric furnaces and ovens for hardening and drawing purposes; Hoskins carbon resistor furnace, return hend coil furnace made by Elec. Heat. Apparatus Co. and others.

ELECTRIC TRANSMISSION LINES

SAG AND LOAD. Nomogran for Overhead Lines. (Das Freileitungs-Grundnomogramm), Karl Riedlinger. Elektrotechnik u. Maschinenbau, vol. 41, no. 38, Sept. 23, 1923, pp. 549-558, 4 figs. General charts for determination of stress and sag of all overhead wiring and rope.

F

FORTIFICATIONS

PERMANENT. Some Ideas on the Future of Permanent Fortification Resulting from Experiences of the Great War, R. P. Pakenham-Walsh. Roy. Engrs. Jl., vol. 37, no. 3, Sept. 1923, pp. 448-462. Consideration of extent to which fortifications existing at ourhreak of war fulfilled purpose of their designers, and investigation of failures.

G

GARBAGE COLLECTION

ST. PAUL, MINN. Garhage Collection in Saint Paul, James W. Routh. Puhlic Works, vol. 54, no. 10, Oct. 1923, pp. 307-309, 2 figs. Lowered cost and improved service secured by substitution of trailers, horsedrawn for collections and tractor-drawn in trains for three to pig farms, for team and wagon collection formerly employed, and still retained temporarily over a large part of city.

GAS DISTRIBUTION

PROBLEMS. Distribution Design Committee Report, Robert G. Griswold. Am. Gas Jl., vol. 119, no. 20, 1923, pp. 465-468 and 470-471, 1 fig. Demand prohlem; notes on taking pressures; durahility on mains; Report delivered hefore Am. Gas Assn.

I

INTERNAL-COMBUSTION ENGINES

BRITISH TYPES. The Shipping, Engineering and Machinery Exhibition. Automobile Engr., vol. 13, no. 181, Oct. 1923, pp. 308-315, 20 figs. Description of British internal-combustion-engine section.

L

LOCOMOTIVES

INTERNAL-COMBUSTION. Crude Oil Motor Locomotive. Engineering, vol. 116, no. 3018, Nov. 2, 1923, pp. 553-554, 12 figs. partly on p. 555. Details of locomotive huilt by Swedish firm; engine is 2-cylinder 2-cycle machine with crank-case compression, provided with hot-hulh ignition, and centrifugal governor controlling fuel pump.

M

MINE HOISTING

COAL MINES. Selecting Equipment for Vertical Shaft Hoisting, M. A. Maxwell. Coal Age, vol. 24, no. 16, Oct. 18, 1923, pp. 581-585, 4 figs. Greater necessity for shaft hoisting due to mining of deeper seams; selecting drum shape and type of electric drive; describes various types of hoist-control equipment.

CONTROL EQUIPMENT. Mine-Hoist Control Equipment for Large Installations, H. W. Chadbourne. Coal Age. vol. 24, no. 18, Nov. 1, 1923, pp. 659-661, 5 figs. Advantages of Ilgner-War-Leonard system; high-efficiency hoisting; automatic control features; auxiliary hoisting motors for men and repairs.

MINE LOCOMOTIVES

SAFETY IN HAULAGE. Safety in Mine Locomotive Haulage, G. F. MacWilliams. Coal Mine Management, vol. 2, no. 10, Oct. 1923, pp. 23-28. Deals with requirement of locomotives, motors, bumpers, care of wheels, how treads are repaired, trolley wire, restricted use of sand, and mine cars. Address delivered before Nat. Safety Council.

MINES

VENTILATION. Notes on Mine Air Conditioning, Martin J. Lide. Min. Congress Jl., vol. 9, no. 11, Nov. 1923, pp. 397-402, 6 figs. Discusses conditioning of mine air in its relation to (a) more rapid production and accumulation of dust with intensitive production due to cutting machines, owner drills, loading machines, etc., and wider distribution of this dust throughout mine, due to large volumes of air currents, (b) seasonal and periodic drying out of mines, with danger of a general dust explosion originating from some local explosion, and (c) rapid cracking and disintegration of mine roofs with resulting casualties from rock falls, due to alternate expansion and contraction of roofs resulting from continual alternate wetting and drying out of roofs with variations in external atmospheric conditions.

N

NICKEL

USES. Industrial Uses of Nickel, Alfred Mond. Can. Min. Jl., vol. 44, no. 40, Oct. 5, 1923, pp. 785-786. Outlines post-war development of nickel industry; new uses for nickel, including nickel coinage.

O

OIL FUEL

GASIFICATION. External and Internal Gasification (Ueber äussere und innere Vergasung), S. della Porta. Motorwagen, vol. 26, no. 25, Sept. 10, 1923, pp. 377-378. Discusses process of gasification, and investigates, gasification from viewpoint of distrihution of gabified fuel in the air.

OIL SHALE

COLORADO, UTAH AND WYOMING. Our Oil Shale Industry, Lawrench C. Phipps. Min. Congress Jl., vol. 9, no. 11, Nov. 1923, pp. 405-406. Data regarding vast area of oil shale lands in Colorado. Utah and Wyoming, which promise to meet all increase demands for oil; oil produced from these shales has proved to be equal, if not superior, to highest grade petroleum.

P

PEAT

MINNESOTA DEPOSITS. The Peat Deposits of Minnesota, E. K. Super. University of Minn., Geol. Survey—Bul., no. 16, 1919, 261 pp., 48 figs. partly on supp. plates. Origin, occurrence and uses of peat; peat deposits of Minnesots; description of localities by counties.

PETROLEUM

BIBLIOGRAPHY. Recent Articles on Petroleum and Allied Substances, H. Britton. U.S. Bur. of Mines, Aug. 1923, 34 pp. Articles on history and geograpbic occurrence; geology and origin; development and production; transportation, storage and distribution; properties and their determination; refining and refineries; utilization; legislation; statistics; etc.

POLES, CONCRETE

TESTS. Significant Study of Concrete Poles by the Cleveland Railway Co., A. J. R. Curtis. Concrete, vol. 23, no. 3, Sept. 1923, pp. 100-101, 4 figs. Results of tests on solid concrete poles, hollow concrete poles, beavy-type and ligbt-type steel poles.

R

RAILWAY ELECTRIFICATION

NORWAY. Electrifiction of Railway from Narvik to Risksgränsen in Norway (Den elektriserte Ofothane), Hj. Schreiner. Teknisk Ukeblad, no. 33, Aug. 31, 1923, pp. 271-275, 8 figs. Description of Norwegian part of railway hetween Lulea, Sweden and Narvik, Norway; transmission line will carry single-pbase current at 80,000 volts and 15 cycles, which will he reduced to 16,200 volts in two transformer stations, each having two 1500-kva transformers,

RAILWAY OPERATION

TRAIN CONTROL. Train Control Ry. Signaling, vol. 16, no. 11, Nov. 1923. Contains following articles: Train Control Experience of C. & E. I., pp. 438-440, 4 figs.; C. & A. Tests National Train Control, pp. 441-442, 2 figs.; C. & N. W. Tests G. R. S. Train Control, pp. 443-445, 8 figs.

REFRACTORIES

CHECKERBRICK. Effect of Size and Physical Properties on the Heat Absorption of Checkerhrick, O. A. Hougen and David H. Edwards. Chem. & Met. Eng., vol. 29, no. 18, Oct. 29, 1923, pp. 800-803, 6 figs. Account of tests on various refractories wbich resulted in establishing useful facts as to relative merits of possible refractory materials.

REFUSE DISPOSAL

DUMPING PLATFORM. New York's Concrete Municipal Dump, Frank W. Skinner. Public Works, vol. 54, no. 10, Oct. 1923, pp. 313-314, 4 figs. Describes an elevated platform enclosing base of Brooklyn bridge tower, for dumping refuse onto scows, which affords 630 lineal feet of cantilevered dumping floor with easy approach and exit ramps.

ROADS, CONCRETE

CONSTRUCTION. Laying Concrete Pavements, Clifford Older. Can. Engr., vol. 45, no. 19, Nov. 6, 1923, pp. 472-473. Modern methods as described in a report presented at Int. Road Congress, Seville, Spain.

S

SCALES

RAILWAY SERVICE. Specifications for the Manufacture and Installation of Motor-Truck, Built-In, Self-Contained, and Portable Scales for Railroad Service. Am. Ry. Eng. Assn.—Bul., vol. 25, no. 257, July 1923, pp. 40-60.

SCRAP

UTILIZATION. Saving Money from Scrap Materials. Indus. Management (Lond.), vol. 10, no. 9, Nov. 1, 1923, pp. 242-243. Examples of savings effected hy utilization of scrap material in large electrical works.

SEWAGE DISPOSAL

GAS PRODUCTION FROM SLUDGE. Recovery and Utilization of Gas from Putrefying Chambers of Municipal Imhoff Tanks (Gewinnung und Verwertung des Gases aus Faulräumen städticsher Kläranlagen), H. Blunk and F. Sierp. Gesundheits-Ingenieur, vol. 46, no. 40, Oct. 6, 1923, pp. 393-397, 5 figs. Describes plant for production of gas from sewage; composition of gases, heat value and application; economy of plant.

TREATMENT. Sewerage Works Betterments at Marion, Ohio, George B. Gascoigne. Am. City Mag., vol. 29, no. 5, Nov. 1923, pp. 511-515, 3 figs. Reasons for betterments; financing storm sewers; describes sewage treatment works.

SEWERS

MAINTENANCE. Sewer Maintenance in Dayton, Ivan E. Houk. Pub. Works. vol. 54, no. 9, Sept. 1923, pp. 291-294, 4 figs. Cleaning by flushing, hy macbine, buckets, wheelharrows, horse-drawn scoop and other cleaning methods; sewer gases; annual cost of maintenance.

SLAG

BLAST-FURNACE. Utilization of Blast Furnace Slag for Construction Purposes, C. L. McKenzie. Iron Age, vol. 112, no. 18, Nov. 1, 1923, pp. 1173-1174. Its use in road vuilding. (Abstract.) Paper read before Am. Iron & Steel Inst.

SMOKE

PHYSICO-CHEMICAL INVESTIGATION. The Physico-Chemical Investigation of Smoke as a Basis for Its Abatement and Utilization (Die physikalisch-chemiscbe Erforschung des Rauches als Grundlage seiner Bekämpfung und Verwertung), V. Kohlschutter. Mettall u. Erz. vol. 20, no. 19, Oct. 8, 1923, pp. 345-353. Results of application of physical cbemistry to investigation of smoke.

SOIL

SETTLING. The Causes of Settling of the Soil in Case of Groundwater Depressions and of Caving In of Banks in Case of Lowering of Sea Level (Ueber die Ursacben von Bodensetzungen bei Grundwasserabsenkungen und von Ufer-Abbrücben hei der Ahsenkung von Seespiegeln), E. Meyer Peter. Schweizerische Bauzeitung, vol. 82, no. 12, Sept. 22, 1923, pp. 147-148, 2 figs.

STEEL

AUTOMOBILE, FAILURES IN. Failures in Steel Parts. Automohile Engr., vol. 13, no. 181, Oct. 1923, pp. 298-299, 10 figs. Notes on causes of breakage in common automohile components.

STAINLESS. Stainless Steel, with Particular Reference to the Milder Varieties (Stainless Iron), John H. G. Monypenny. Am. Inst. Min. & Met. Engrs.—Trans., no. 1277-S, Nov. 1923, 17, pp., 18 figs., also (abstract) in Min. & Metallurgy, vol. 4, no. 203, Nov. 1923, pp. 574-475. Structure and general properties of steel containing 11 to 14 per cent of chromium after different forms of heat treatment and effect on sucb material of variations in carhon content; effect of variations in composition and heat treatment on resistance to corrosion of such high-chromium steel; special properties produced in such steel when carbon content is reduced to 0.10 per cent.

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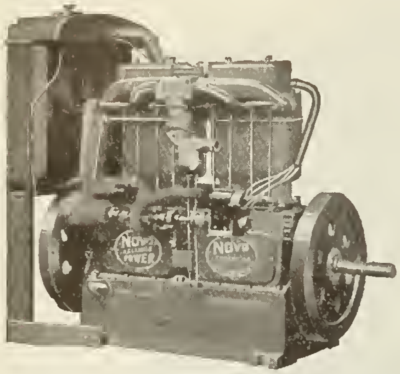

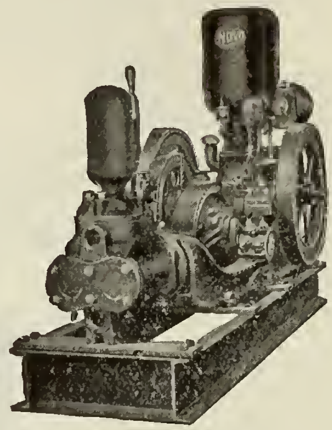

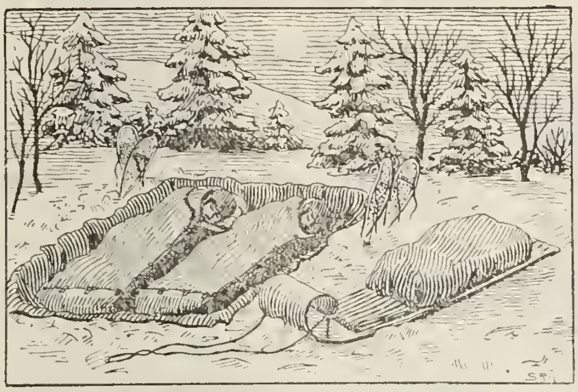

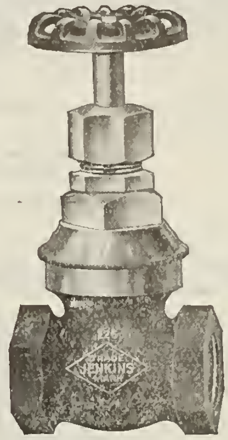

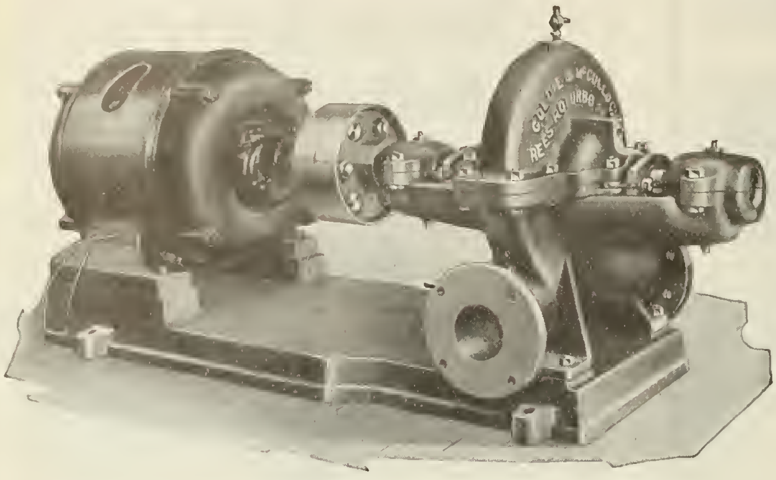

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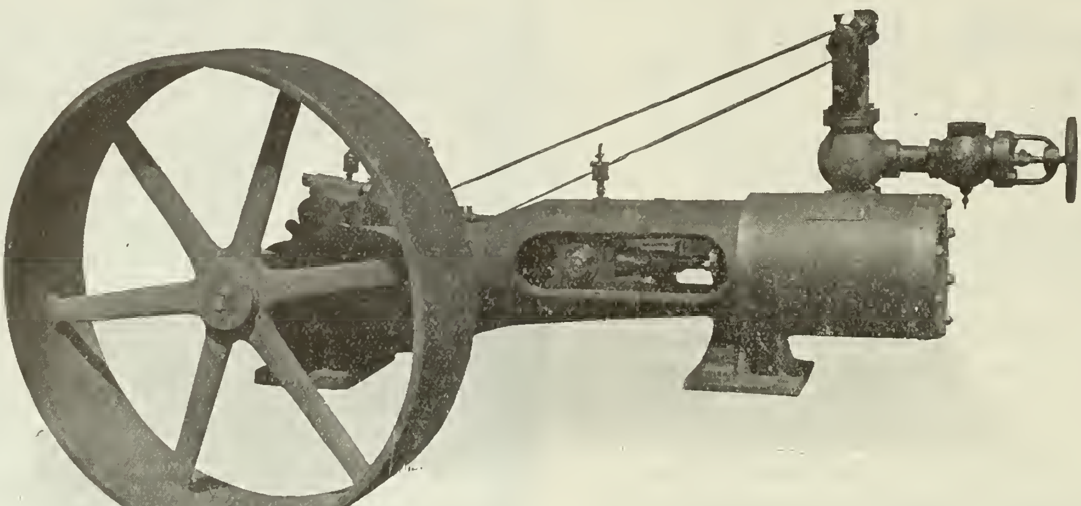

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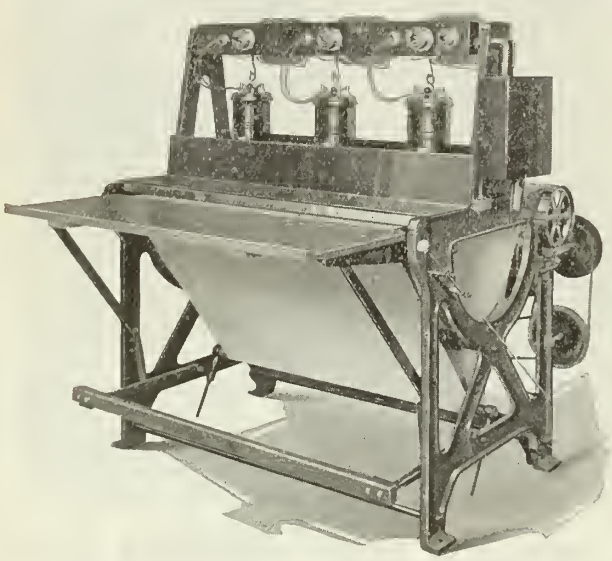
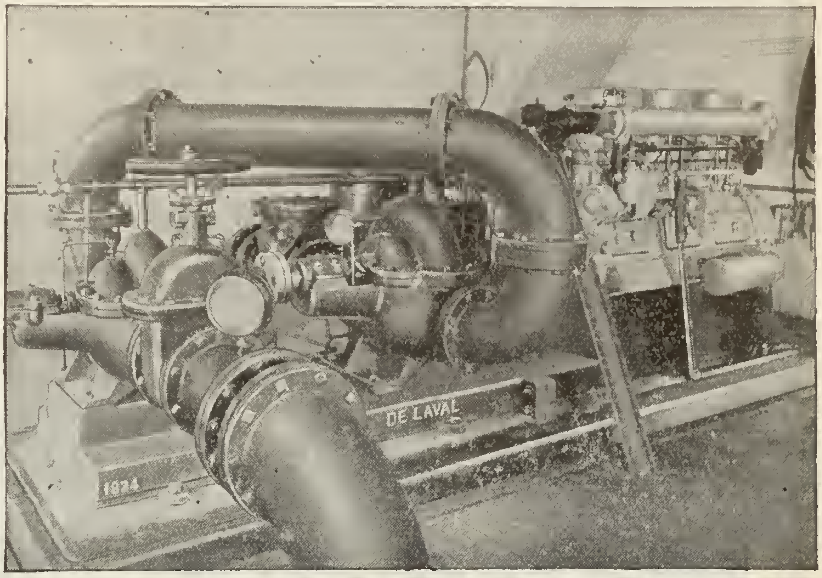
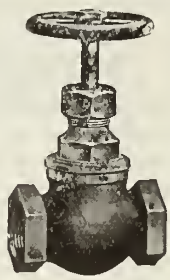
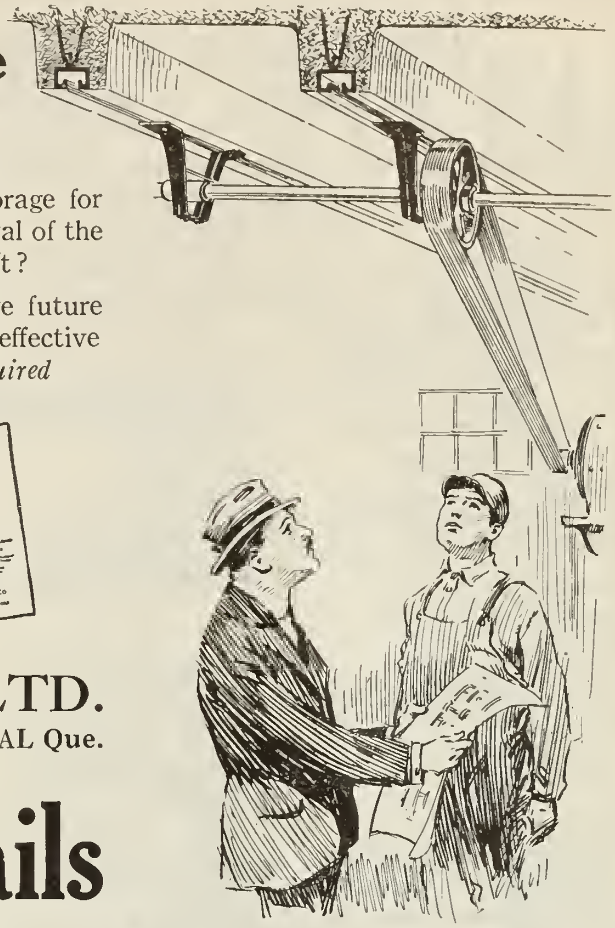



DE LAVAL
1924



A year from now—can the line shaft be moved?



In building that factory, it's easy to provide anchorage for present requirements, but how about the future removal of the shafting a few inches, or several feet to the right or left?

Midwest Box Rails—the long continuous inserts—solve future as well as present anchorage problems. They also act as effective reinforcement, *reducing the area of reinforcing steel required*

Get this FREE Book

The Midwest Data Book of construction details should be in the hands of every architect, engineer or contractor ***before*** he starts an industrial building job. Send to Dept S-11 for a copy.

MIDWEST CANADA LTD.

83 Craig St. West MONTREAL Que.

MIDWEST Box Rails

TRADE MARK

Correct Lubrication Eliminates Wear

The special lubricating compound in which the Trident (Enclosed) Gear Train is immersed and in which it revolves, will not wash away. It stays on the gear train, protecting, preserving and lubricating it, ensuring years of accurate operation.

A Trident for every purpose—Disc. Crest, Compound, Protectus. Full details upon request.

Neptune Meter Co., Limited

Factory and Head Office

1197 King Street W. Toronto, Ont.

Manitoba: Walsh and Charles, 406 Tribune Bldg., Winnipeg.
Maritime Province: Jas. Robertson, St. John, N.B.
British Columbia: Gordon & Belyea Ltd., 148 Alex. St., Vancouver.

Purchasers' Classified Directory

A Selected List of Equipment, Apparatus and Supplies

For Alphabetical List of Advertisers see page 44

A

Acids:
Nichols Chemical Co., Ltd.
Air Brakes:
Canadian General Electric Co., Ltd.
Air Coolers:
Laurie and Lamb.
Alumina Sulphate:
Nichols Chemical Co., Ltd.
Ammonia Controlled Water Regulators:
Under-Feed Stoker Co., of Canada, Ltd.
Ammonia Valves and Fittings:
Crane Ltd.
Anchorage Equipment:
Midwest Canada, Ltd.
Angles:
Dominion Bridge Co., Ltd.
Hamilton Bridge Works Co., Ltd
Arches, Flat:
Combustion Engineering Corp., Ltd.
Asphalt:
Imperial Oil Ltd.
Ash Handling Equipment:
Combustion Engineering Corp. Ltd.
Automatic Air Valves:
Jenkins Bros., Ltd.
Automatic Underfeed Stokers:
Combustion Engineering Corp., Ltd.
Taylor Stoker Co., Ltd.
Automobiles:
Ford Motor Co., of Canada, Ltd.

B

Balls, Chromang Grinding:
William Kennedy & Sons, Ltd.
Balls, Steel:
Canadian S.K.F. Co., Ltd.
Bar Benders:
Koehring Co., of Canada, Ltd.
Bar Cutters:
Koehring Co., of Canada, Ltd.
Barge Cranes:
Industrial Works.
Bars, Reinforcing:
Algoma Steel Corp., Ltd.
British Empire Steel Corp., Ltd.
Burlington Steel Co., Ltd.
Bars, Steel & Iron:
Burlington Steel Co., Ltd.
Steel Co., of Canada Ltd.
Beams:
Dominion Bridge Co., Ltd.
Hamilton Bridge Works Co., Ltd.
Bearings, Ball:
Canadian S.K.F., Co., Ltd.
Openshaw & Bennett, Ltd.
Bearings, Fibre:
Diamond State Fibre Co., of Canada, Ltd.
Bearings, Roller:
Canadian S.K.F. Co., Ltd.
Belting:
Dunlop Tire and Rubber Goods Co., Ltd.
General Supply Co., of Canada, Ltd.
Jones and Glassco, Regd.
Blowers, Centrifugal:
De Laval Steam Turbine Co.
Blue Print Machinery:
Instruments Ltd.
J. Frank Raw Co., Ltd.
Boilers:
E. Leonard & Sons, Ltd.
Waterous Engine Works Co., Ltd.
Boilers, Heating:
Engineering & Machine Works of Canada, Ltd.
E. Leonard & Sons, Ltd.
Taylor Stoker Co., Ltd.
Boilers, Marine:
Engineering & Machine Works of Canada, Ltd.
Boilers, Power:
Engineering & Machine Works of Canada, Ltd.
Boilers, Portable:
E. Leonard & Sons, Ltd.
Boilers, Return Tubular:
Babcock-Wilcox & Goldie-McCulloch Co., Ltd.
Bolts:
British Empire Steel Corp., Ltd.
Steel Co., of Canada, Ltd.
Books:
John Wiley & Sons, Inc.
Renouf Publishing Co.
Bridges, Highway:
Hamilton Bridge Works Co., Ltd.
Bridges, Steel:
Canadian Bridge Co., Ltd.
Dominion Bridge Co., Ltd.
Hamilton Bridge Works Co., Ltd.
Broadcasting Equipment:
Marconi Wireless Telegraph Co., of Canada, Ltd.
Northern Electric Co., Ltd.
Buckets, Clamshell, Grab:
Industrial Works.
Buckets, Clamshell, Orange-peel:
F. H. Hopkins & Co., Ltd.
Bucket Loaders:
Mussens Ltd.
Builders Supplies:
Jno. E. Russell Co., Ltd.
Building Papers:
Barrett Co., Ltd.
Buildings, Steel:
Canadian Bridge Co., Ltd.
Dominion Bridge Co., Ltd.
Hamilton Bridge Works Co., Ltd.
MacKinnon Steel Co., Ltd.

C

Cars, Dump:
Hydro Salvage Syndicate.
Mussens Ltd.
Car Dumpers:
Canadian Mead-Morrison Co., Ltd.
F. H. Hopkins & Co., Ltd.
Car Equipment Specialties:
Dominion Insulator & Mfg. Co Ltd.
Car Pullers:
Canadian Mead-Morrison Co., Ltd.
Car Wheels, Chilled Iron.
Canada Iron Foundries, Ltd.
Cargo Cranes:
Industrial Works.
Casements, Steel:
Canadian Metal Window & Steel Products, Ltd.
Trussed Concrete Steel Co., of Canada, Ltd.
Castings:
William Kennedy & Sons, Ltd.
Castings, Brass:
Engineering & Machine Works of Canada, Ltd.
Superheater Co., Ltd.
Castings, Bronze:
Engineering & Machine Works of Canada, Ltd.
Castings, Car and Locomotive:
Canadian Steel Foundries, Ltd.
Castings; Ferro-Alloy.
Canadian Steel Foundries, Ltd.
Castings, Iron:
Canada Iron Foundries, Ltd.
Engineering & Machine Works of Canada, Ltd.
Gartshore-Thomson Pipe and Foundry Co., Ltd.
E. Leonard & Sons, Ltd.
Superheater Co., Ltd.
Castings, Steel:
Canadian Steel Foundries, Ltd.
Catenary Materials:
Dominion Insulator & Mfg., Co. Ltd.
Cement, Dealers:
Jno. E. Russell Co., Ltd.
Cement Gun:
General Supply Co., of Canada, Ltd.
Cement, Manufacturers:
Canada Cement Co., Ltd.
Cement, Waterproofing:
Dominion Tar & Chemical Co., Ltd.
Chains:
Link-Belt, Ltd.
Chains, Silent:
Jones and Glassco, Regd.
Channels:
Dominion Bridge Co., Ltd.
Hamilton Bridge Works Co., Ltd.
Chemist, Industrial:
Milton Hersey Co., Ltd.
Chimneys:
Combustion Engineering Corp., Ltd.
Circuit Breakers:
Dominion Engineering Agency, Ltd.
Clamshell Buckets:
Industrial Works.
Coal:
British Empire Steel Corp., Ltd.
Coal Handling Equipment:
Canadian Mead-Morrison Co., Ltd.
Combustion Engineering Corp., Ltd.
Dominion Bridge Co., Ltd.
Link-Belt, Ltd.
Coke:
British Empire Steel Corp., Ltd
Cooling Air Filters:
Midwest Canada, Ltd.
Compressor Filters:
Midwest Canada, Ltd.
Compressors:
General Supply Co., of Canada, Ltd.
Compressors, Air:
Canadian Westinghouse, Co., Ltd.
Hydro Salvage Syndicate.
Compressors, Ammonia:
Taylor Stoker Co., Ltd.
Compressors, Centrifugal.
De Laval Steam Turbine Co.
Concrete Inserts, Continuous:
Midwest Canada, Ltd.
Concrete Mixers:
General Supply Co., of Canada, Ltd.
F. H. Hopkins & Co., Ltd.
Hydro Salvage Syndicate.
Koehring Co., of Canada, Ltd.
Mussens Ltd.
Condensers, Synchronous & Static
Canadian General Electric Co., Ltd.
Condensite Celoron Silent Gears.
Diamond State Fibre Co., of Canada Ltd.
Construction Material:
Northern Electric Co., Ltd.
Contractors:
E. G. M. Cape & Co.
Chick Contracting Co., Ltd.
E. O. Leahey & Co., Ltd.
Randolph MacDonald Co., Ltd.
Contractors' Plant and Supplies.
F. H. Hopkins & Co., Ltd.
Controllers, Electric:
Canadian Westinghouse Co. Ltd.
Conveyors:
Canadian Mead-Morrison o., Ltd.
Combustion Engineering Corp., Ltd.
Conveyors, Belt and Screw:
Link-Belt, Ltd.
Conveyors, Portable Belt:
Mussens Ltd.
Couplers, Car and Locomotive:
Canadian Steel Foundries. Ltd.
Combination Crane Pile Drivers:
Industrial Works.
Cranes, Electric:
Industrial Works.
Cranes, Locomotive:
F. H. Hopkins & Co., Ltd.
Industrial Works.
Link-Belt, Ltd.
Mussens Ltd.
Cranes, Pillar:
Industrial Works.
Cranes, Transfer:
Industrial Works.
Cranes, Travelling:
Dominion Bridge Co., Ltd
Cranes, Tunnel:
Industrial Works.
Cranes, Wrecking:
Industrial Works.
Creosote Oils:
Barrett Co., Ltd.
Dominion Tar & Chemical Co., Ltd.
Cross Arm Braces, Steel:
Burlington Steel Co., Ltd.
Crushed Stones:
Jno. E. Russell Co., Ltd.
Crushers, Jaw, Gyratory:
F. H. Hopkins & Co., Ltd.
Culvert Pipe:
Canada Lock Joint Pipe, Ltd.
Gartshore-Thomson Pipe and Foundry Co., Ltd.
Pedlar People, Ltd.
Culverts, Metal:
Pedlar People, Ltd.
Culverts, Road:
Canada Lock Joint Pipe, Ltd.

D

Damp Proof Coating:
Dominion Tar and Chemical Co., Ltd.
Damper Regulation:
Under-Feed Stoker Co., of Canada, Ltd.
Derricks:
Canadian Mead-Morrison Co., Ltd.
Mussens Ltd.
Dies:
Pratt & Whitney Co., of Canada, Ltd.
Doors, Fireproof:
Canadian Metal Window and Steel Products, Ltd.
Draughting Supplies:
Instruments, Ltd.
J. Frank Raw Co., Ltd.
Dredges:
Canadian Mead-Morrison Co., Ltd.
Drill Chucks:
Canadian S.K.F., Co. Ltd.
Dumb Waiters, Electric:
Turnbull Elevator Co., Ltd.

E

Economizers:
Combustion Engineering Corp., Ltd.
General Supply Co., of Canada Ltd.
Electric Cranes, Locomotive, Pillar, Transfer, Wrecking:
Industrial Works.
Electrical Appliances:
Northern Electric Co., Ltd.
Electrical Instruments:
Instruments, Ltd.
Electrical Supplies:
Northern Electric Co., Ltd.
Elevator Safety Gates:
Turnbull Elevator Co., Ltd.
Elevators, Freight:
Turnbull Elevator Co., Ltd.
Elevators, Passenger:
Turnbull Elevator Co., Ltd.
Elevators, Push Botton:
Turnbull Elevator Co., Ltd.
Enamels, Acid & Fume Resisting:
Dominion Paint Works, Ltd.
Enamels, Industrial Lighting:
Dominion Paint Works, Ltd.
Engines, Gas and Oil:
Canadian Fairbanks-Morse Co., Ltd.
Engines, Steam:
Babcock-Wilcox & Goldie-McCulloch Co., Ltd.
Laurie and Lamb.
E. Leonard & Sons. Ltd.
Excavators:
Engineering & Machine Works of Canada, Ltd.
Excavators, Dragline:
Koehring Co., of Canada, Ltd.
Exhaust Steam Injectors, Locomotive:
Superheater Co., Ltd.
Expanded Metal:
Pedlar People Ltd.

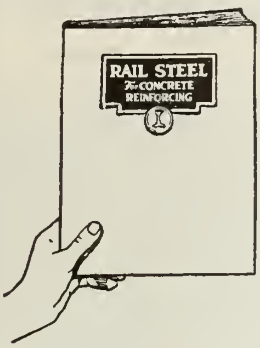
F

Fan Engine Regulators:
Under-Feed Stoker Co., of Canada, Ltd.
Feed-Water Heaters, Locomotive:
Superheater Co., Ltd.
Fence Posts, Steel:
Burlington Steel Co., Ltd.
Fibre, Hard Vulcanized:
Diamond State Fibre Co., of Canada, Ltd.
Fillers, Wood and Metal:
Dominion Paint Works, Ltd.
Filters, Air:
Midwest Canada, Ltd.
Fire Alarm Apparatus:
Northern Electric Co., Ltd.
Fireproofing, Hollow Tile:
Interlocking Tile Co., Ltd.
Fish Paper:
Diamond State Fibre Co., of Canada, Ltd.
Floortyle:
Pedlar People, Ltd.
Forgings:
British Empire Steel Corp., Ltd
Dominion Bridge Co., Ltd.

BURLINGTON STEEL
COMPANY, LIMITED
HAMILTON CANADA

Toughness

A material which possesses toughness is defined by Webster as one possessing flexibility without brittleness; capability of resisting great strain or severe abuse; strength. The enormous strain which railroad rails receive in track service is ample proof that they possess toughness to a very high degree. They withstand, unprotected, the pounding of heavy equipment, whereas the reinforcing bars rolled from these rails are imbedded in concrete and although constantly stressed they are not directly subjected to shock and impact. The logical conclusion, therefore, is that rail steel having proved its ability to withstand abuse as a rail, unprotected by any surrounding medium, possesses the quality of toughness and that this same steel rolled into reinforcing bars, the additional heating and rolling of which still further improves the steel, also possesses toughness. Then, when the bars are imbedded in concrete they possess resistance to stress far in excess of any demands that will ever be made upon them as a concrete reinforcement.



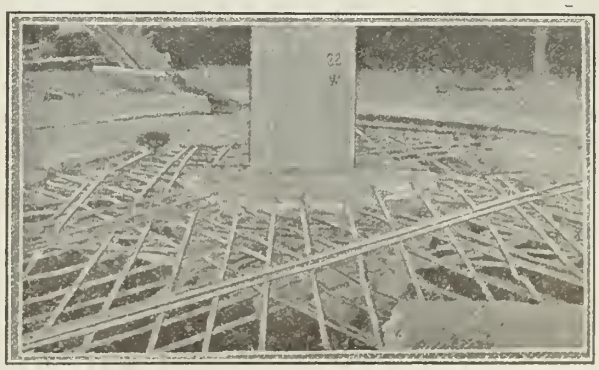
Send for This Valuable Book—FREE

The first and only authoritative and comprehensive treatise on concrete Reinforcing Bars and containing most important information on the manufacture, qualities, and use of Rail Steel Bars.

In 1917, Professor Talbot, of the University of Illinois, conducted a series of tests on the Western Newspaper Union Building which was being wrecked for the new Union Passenger Station. This building was nine years old and of the flat slab type reinforced throughout with rail steel reinforcing. After various loadings which failed to exceed the elastic limit of any of the bars, a weight of about 1600 lbs. was dropped on the floor, above the column capital of the floor below, until the capital and the slab had been entirely shattered. This same method was followed on the floor slabs between columns until the bars were entirely exposed. The bars where then cut out with an acetylene flame. It should be noted that after this severe abuse the bars had to be cut—they did not break under the terrific impact of the weight, which is conclusive proof that Rail Steel Bars possess excess toughness as a reinforcing medium imbedded in concrete.

Specify your reinforcing steel to meet A.S.T.M. Specifications A-16-14 or Canadian Engineering Standards Association A-9-1923-B.

Showing full floor load of 913 lbs. per square foot



Arrangement and condition of bars around column

Purchasers' Classified Directory

Friction Clutches:
- Dodge Manufacturing Co., Ltd.

Fuel, Oil:
- Imperial Oil, Ltd.

Furnaces, Automatic:
- Under-Feed Stoker Co., of Canada, Ltd.

G

Gantry Cranes:
- Industrial Works.

Gasoline:
- Imperial Oil, Ltd.

Gauges:
- Pratt & Whitney Co., of Canada, Ltd.

Gear Reductions:
- Hamilton Gear & Machine Co

Gears:
- Dominion Engineering Works Ltd.
- Hamilton Gear & Machine Co
- Link-Belt, Ltd.

Gears, Machine Cut:
- Jones and Glassco, Regd

Gears, Silent, Waterproof:
- Diamond State Fibre Co., of Canada, Ltd.

Gears, Double Helical:
- De Laval Steam Turbine Co.

Generators:
- Canadian General Electric Co., Ltd.
- Canadian Westinghouse Co. Ltd.

Grab Buckets:
- Canadian Mead-Morrison Co., Ltd.

Ground Joints Unions:
- Dart Union Co., Ltd.

H

Hammer, Steam:
- Industrial Works.

Hangers:
- Dodge Manufacturing Co., Ltd.

Heaters, Boiler Feed-Water:
- Babcock-Wilcox & Goldie-McCulloch Co., Ltd.

Heating Material:
- Crane Ltd.

Hoisting Engines:
- Canadian Mead-Morrison Co., Ltd.
- F. H. Hopkins & Co., Ltd.
- Mussens Ltd.

Hoists, Electric:
- Hydro Salvage Syndicate.
- Taylor Stoker Co., Ltd.

Hoists, Hydraulic:
- Turnbull Elevator Co., Ltd.

Hoists, Mono-Rail:
- Taylor Stoker Co., Ltd.

Hydraulic Press Control Systems:
- Taylor Stoker Co., Ltd.

I

Industrial Electric Control:
- Canadian General Electric Co., Ltd.
- Dominion Engineering Agency, Ltd.

Insulated Rail Joints, Continuous
- Rail Joint Co., of Canada, Ltd.

Insulating Compounds:
- Dominion Tar & Chemical Co., Ltd.

Insulation, Fibre and Celoron:
- Diamond State Fibre Co., of Canada, Ltd.

Insulators, Porcelain:
- Dominion Insulator & Mfg., Co. Ltd.

J

Joints, Filler Paving:
- Barrett Co., Ltd.

K

Kerosene:
- Imperial Oil Ltd.

L

Leaders, Pile Drivers:
- Industrial Works.

Lightning Arrestors:
- Canadian General Electric Co., Ltd.
- Dominion Engineering Agency Ltd.

Lighting Equipment, Industrial and Street:
- Canadian General Electric Co., Ltd.

Locomotives:
- F. H. Hopkins & Co., Ltd.
- Mussens Ltd.

Locomotive Cranes:
- Industrial Works.

Locomotives, Electric:
- Canadian General Electric Co., Ltd.
- Canadian Westinghouse Co., Ltd.
- Hydro Salvage Syndicate.

Lubricating Oils & Greases:
- Imperial Oil Ltd.

M

Machinery:
- Canadian Fairbanks-Morse Co., Ltd.
- Hydro Salvage Syndicate.
- Charles Walmsley & Co., (Canada), Ltd.

Machinery, Special:
- Dominion Engineering Works, Ltd.

Marine-Machinery:
- William Kennedy & Sons, Ltd.

Material Handling Plants:
- Canadian Mead-Morrison Co., Ltd.

Measuring Tapes:
- Lufkin Rule Co., of Canada, Ltd.

Merchant Bars:
- British Empire Steel Corp., Ltd.

Metal Lath:
- Pedlar People, Ltd.
- Trussed Concrete Steel Co. of Canada, Ltd.

Milling Cutters:
- Pratt & Whitney Co., of Canada, Ltd.

Mining Machinery:
- William Kennedy & Sons. Ltd.

Motors:
- Canadian Fairbanks-Morse Co. Ltd.
- Dominion Engineering Agency Ltd.

Motor Cars:
- Ford Motor Co., of Canada, Ltd.

Motors, Electric:
- Canadian General Electric Co., Ltd.
- Canadian Westinghouse Co. Ltd.

Motor Oils:
- Imperial Oil Ltd.

Motor Trucks:
- Ford Motor Co., of Canada, Ltd.

N

Nails:
- British Empire Steel Corp., Ltd.

O

Oil Burning Equipment:
- Combustion Engineering Corp., Ltd.

Oil Purifiers, Centrifugal:
- De Laval Steam Turbine Co.

P

Packing:
- Dunlop Tire & Rubber Goods, Co., Ltd.

Paints, Acid Resisting:
- Dominion Paint Works, Ltd.

Paints, Anti-Corrosive:
- Dominion Paint Works, Ltd.

Paints, Concrete:
- Dominion Paint Works, Ltd.

Paints, Damp-proof:
- Dominion Paint Works, Ltd.

Paints, Graphite:
- Dominion Paint Works, Ltd.

Paints, Machinery:
- Dominion Paint Works, Ltd.

Paints, Metal Protectives:
- Barrett Co., Ltd
- Dominion Paint Works, Ltd.

Paper Mill Machinery:
- Dominion Engineering Works, Ltd.
- Charles Walmsley & Co., (Canada), Ltd.

Paving and Paving Materials:
- Dominion Tar & Chemical Co., Ltd.

Penstocks:
- Engineering & Machine Works of Canada, Ltd.
- Horton Steel Works, Ltd.

Pile Drivers:
- Industrial Works.

Pinions:
- Hamilton Gear & Machine Co.

Pipe Coils:
- Superheater Co., Ltd.

Pipe, Concrete:
- Canada Lock Joint Pipe, Ltd.
- Jno. E. Russell Co., Ltd.

Pipe Couplings, Union
- Dart Union Co., Ltd

Pipe Fittings:
- Crane Ltd.

Pipe, Lead:
- Steel Co. of Canada, Ltd.

Pipe Lines:
- Canada Lock Joint Pipe, Ltd.

Pipe, Lock Joint:
- Canada Lock Joint Pipe, Ltd.

Pipes, Cast Iron:
- Canada Iron Foundries, Ltd.
- Gartshore-Thomson Pipe and Foundry Co., Ltd.
- General Supply Co., of Canada Ltd.
- National Iron Corp., Ltd.

Pipe Lock Bar:
- General Supply Co., of Canada, Ltd.

Pipes, Reinforced Concrete:
- Canada Lock Joint Pipe, Ltd.

Pipes, Wrought Iron:
- Crane Ltd.

Pitch:
- Dominion Tar & Chemical Co., Ltd.

Plates, Brass and Copper:
- Openshaw & Bennett, Ltd.

Plates, Steel:
- British Empire Steel Corp., Ltd.
- Hamilton Bridge Works Co., Ltd.
- Vulcan Iron Works, Ltd.

Plumbing Material:
- Crane Ltd.

Posts, Indicator:
- Jenkins Bros., Ltd.

Porcelain, Insulators:
- Dominion Insulator & Mfg. Co., Ltd.

Power Apparatus:
- Northern Electric Co., Ltd

Power Plant Equipment:
- Instruments, Ltd.

Propellor Wheels:
- Wm. Kennedy & Sons, Ltd

Publishers:
- John Wiley & Sons, Inc.
- Renouf Publishing Co.

Pulleys:
- Canadian S.K.F. Co., Ltd.
- Dodge Manufacturing Co., Ltd.

Pulleys, Fibre:
- Diamond State Fibre Co. of Canada, Ltd.

Pulp Grinders:
- Engineering & Machine Works of Canada, Ltd.
- Charles Walmsley & Co., (Canada), Ltd.

Pulp Mill Deckers:
- Engineering & Machine Works of Canada, Ltd.

Pulp Mill Machinery:
- Waterous Engine Works Co., Ltd.
- William Hamilton Co., Ltd.

Pulpwood Machinery:
- Canadian Mead-Morrison Co., Ltd.
- Charles Walmsley & Co., (Canada), Ltd.

Pulverized Fuel Systems:
- Combustion Engineering Corp., Ltd.
- Under-Feed Stoker Co., of Canada, Ltd.

Pump Governors:
- Under-Feed Stoker Co., of Canada, Ltd.

Pump Valves:
- Jenkins Bros., Ltd.

Pumps:
- Canadian Fairbanks Morse Co. Ltd.
- Dominion Engineering Works, Ltd.
- General Supply Co., of Canada, Ltd.
- Charles Walmsley & Co., (Canada), Ltd.

Pumps and Condensers.
- Babcock-Wilcox & Goldie-McCulloch Co., Ltd.

Pumps, Centrifugal:
- De Laval Steam Turbine Co.
- Laurie & Lamb.

Pumps, Hydraulic:
- Taylor Stoker Co., Ltd.

Pumps Oil,
- Taylor Stoker Co., Ltd

R

Radiator Valves:
- Jenkins Bros., Ltd.

Radio Receiving Sets:
- Marconi Wireless Telegraph Co. of Canada, Ltd.
- Northern Electric Co., Ltd.

Rail Bonds:
- Dominion Insulator & Mfg., Co Ltd.

Rail Joints:
- Rail Joint Co., of Canada, Ltd.

Rail Saw (Portable):
- Industrial Works.

Rails:
- F. H. Hopkins & Co., Ltd.

Railroad Spikes:
- Steel Co., of Canada, Ltd.

Railway Ties:
- Canadian Tie & Lumber Co., Ltd.

Railway Equipment:
- Canadian General Electric Co., Ltd.

Rawhide Pinions:
- Hamilton Gear & Machine Co.

Rawlplugs:
- Dominion Engineering Agency Ltd.

Reamers:
- Pratt & Whitney Co., of Canada, Ltd.

Receptacles, Fibre:
- Diamond State Fibre Co., of Canada, Ltd.

Recording Instruments:
- Combustion Engineering Corp., Ltd.

Refrigerating Machinery:
- Taylor Stoker Co., Ltd.

Reinforcing Steel:
- Burlington Steel Co., Ltd.
- Trussed Concrete Steel Co., of Canada, Ltd.

Reservoir Fittings:
- Guest & Chrimes, Ltd.

Rivets:
- British Empire Steel Corp., Ltd.

Road Materials:
- Dominion Tar & Chemical Co., Ltd.

Road Oils & Preservatives:
- Barrett Co., Ltd.

Road Rollers:
- Dominion Insulator & Mfg. Co., Ltd.

Road Tar:
- Dominion Tar & Chemical Co., Ltd.

Roofing Cement:
- Dominion Tar & Chemical Co., Ltd.

Roofing Material:
- Dominion Tar & Chemical Co., Ltd.

Roofings, Metal:
- Pedlar People Ltd.

Roofing, Prepared:
- Barrett Co., Ltd.

Rolling Mill Rolls:
- Canadian Steel Foundries, Ltd.

Roofs, Built up, Felt & Pitch:
- Barrett Co., Ltd.

Rope Wheel:
- Dodge Manufacturing Co., Ltd.

Rope, Wire:
- Dominion Wire Rope Co., Ltd.

Rubber Goods, Mechanical:
- Dunlop Tire & Rubber Goods Co., Ltd.
- Jenkins Bros., Ltd.

Rules Steel and Wood:
- Lufkin Rule Co., of Canada, Ltd

S

Safes:
- Goldie & McCulloch Co., Ltd.

Sash, Steel:
- Canadian Metal Window & Steel Products, Ltd.
- Trussed Concrete Steel Co., of Canada, Ltd.

Sawmill Machinery:
- Waterous Engine Works Co., Ltd.
- William Hamilton Co., Ltd.

Scales:
- Canadian Fairbanks-Morse Co., Ltd.

Screening Equipment:
- Link-Belt, Ltd.
- Charles Walmsley & Co., (Canada), Ltd.

Sewer Pipe:
- Canada Lock Joint Pipe, Ltd
- Jno. E. Russell Co., Ltd.

Shaftings:
- Dodge Manufacturing Co., Ltd.

Shafting, Anchorage:
- Midwest Canada, Ltd.

Sheets:
- Steel Co., of Canada Ltd.

Sheating:
- Barrett Co., Ltd.

Shingles, Prepared Asphalt:
- Barrett Co., Ltd.

Skip Hoists:
- Canadian Mead-Morrison Co. Ltd.

Smoke Stacks:
- Engineering & Machine Works of Canada, Ltd.

Remember The Journal when buying apparatus.

Purchasers' Classified Directory

Smoke Stacks:
Horton Steel Works, Ltd.
Sodas:
Nichols Chemical Co., Ltd.
Speed Reducers, Gear:
Hamilton Gear & Machine, Co.
Sprinkler Tanks:
Horton Steel Works, Ltd.
Steel Head Frames:
Hamilton Bridge Works Co., Ltd.
Steam Heating Specialties:
C. A. Dunham Co., Ltd.
Steam Shovels,
F. H. Hopkins & Co., Ltd.
Mussens, Ltd.
Steam Traps:
C. A. Dunham Co., Ltd
Steel Plate Construction:
Horton Steel Works, Ltd.
Steel Rails:
British Empire Steel Corp., Ltd.
Stokers:
Combustion Engineering Corp., Ltd.
Under-Feed Stoker Co., of Canada, Ltd.
Waterous Engine Works Co., Ltd
Stokers, Side-feed:
Under-Feed Stoker Co., of Canada, Ltd.
Stokers, Under-feed:
Combustion Engineering Corp., Ltd.
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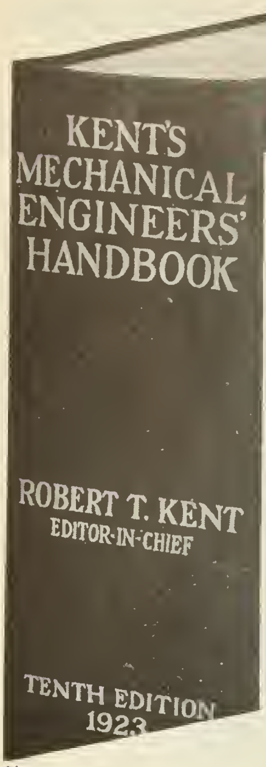

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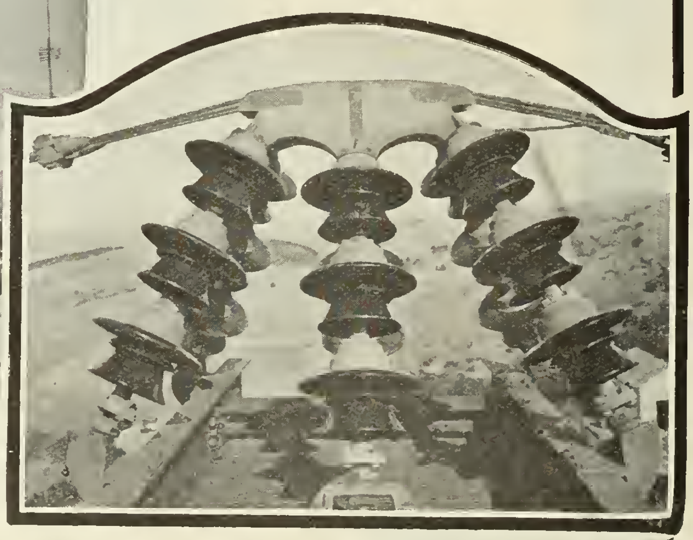


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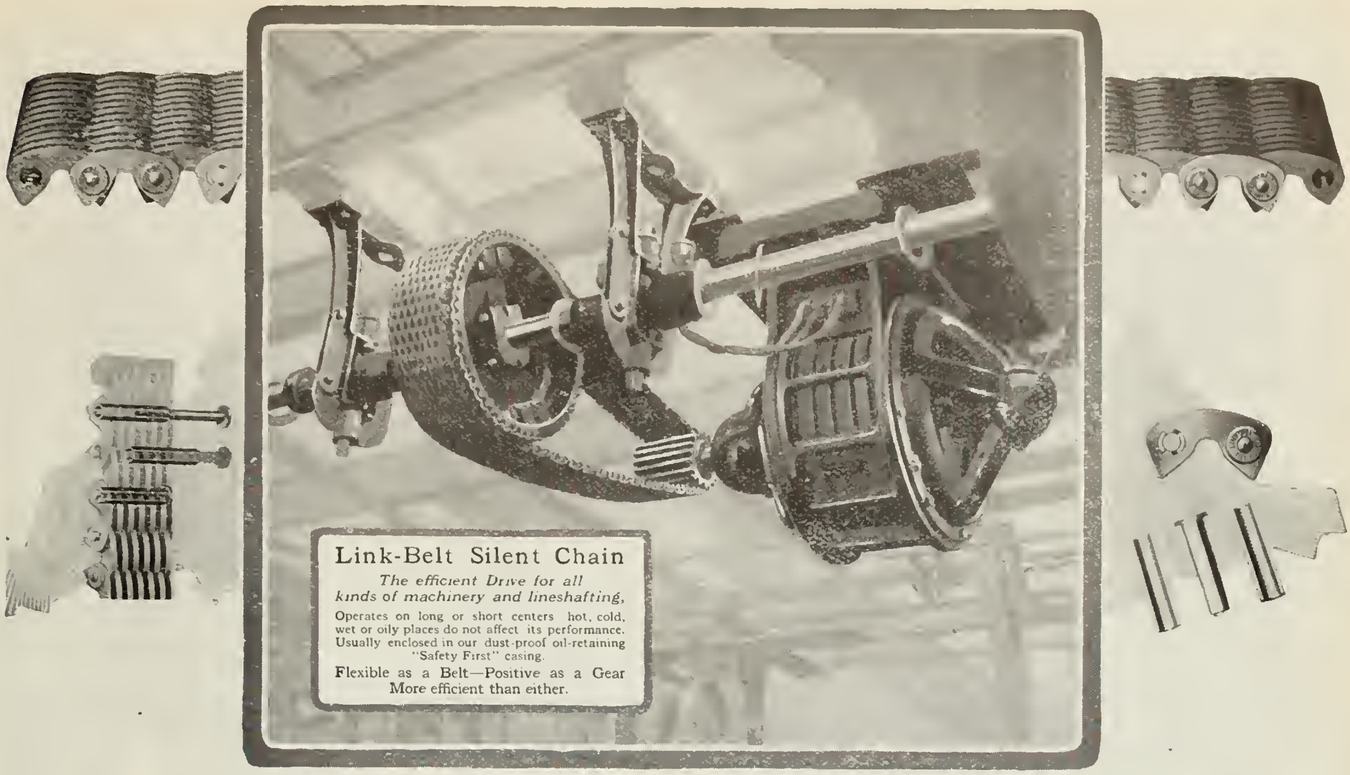

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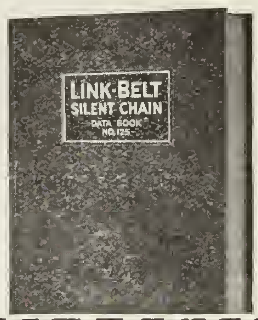

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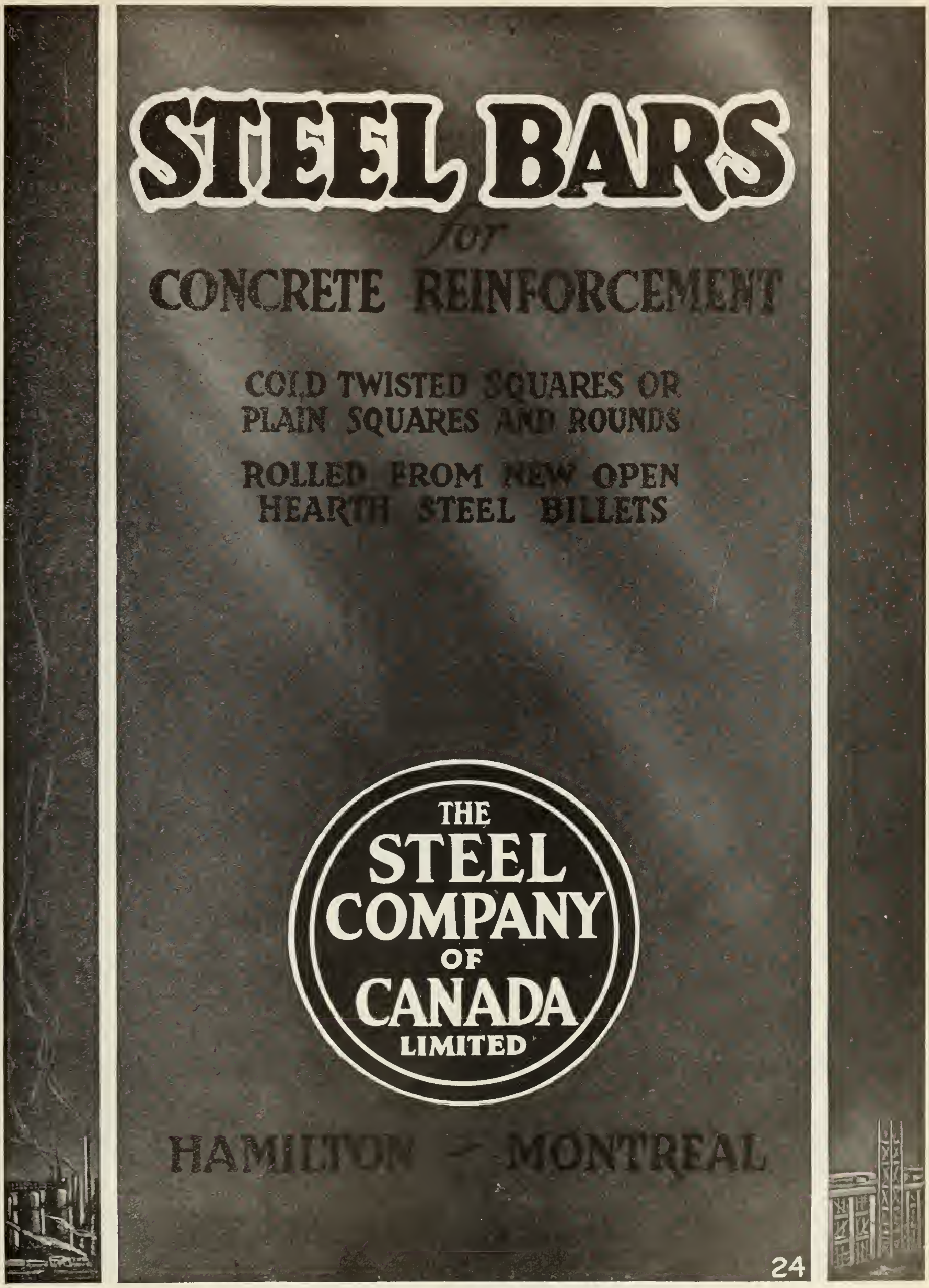
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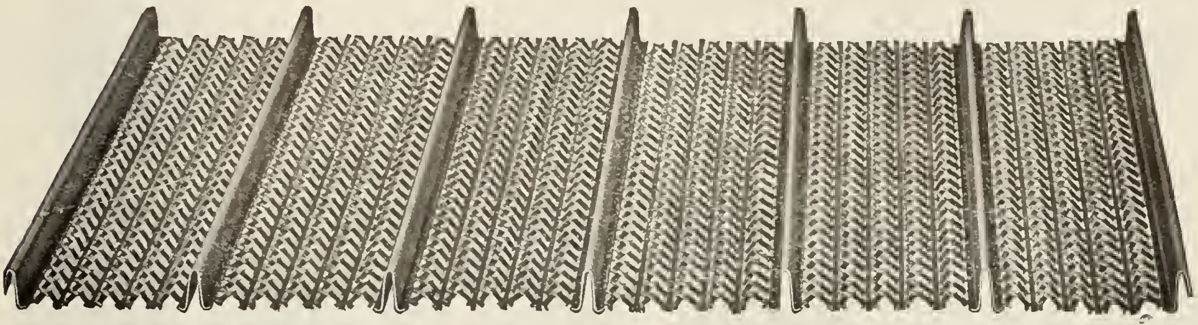

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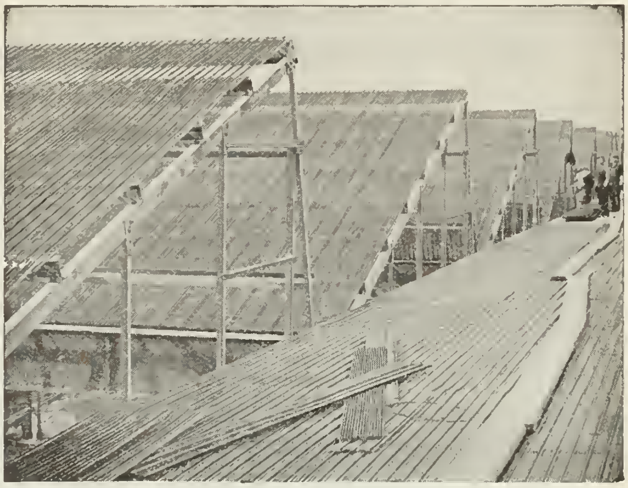

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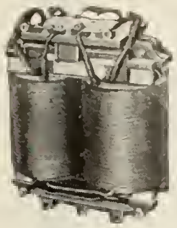

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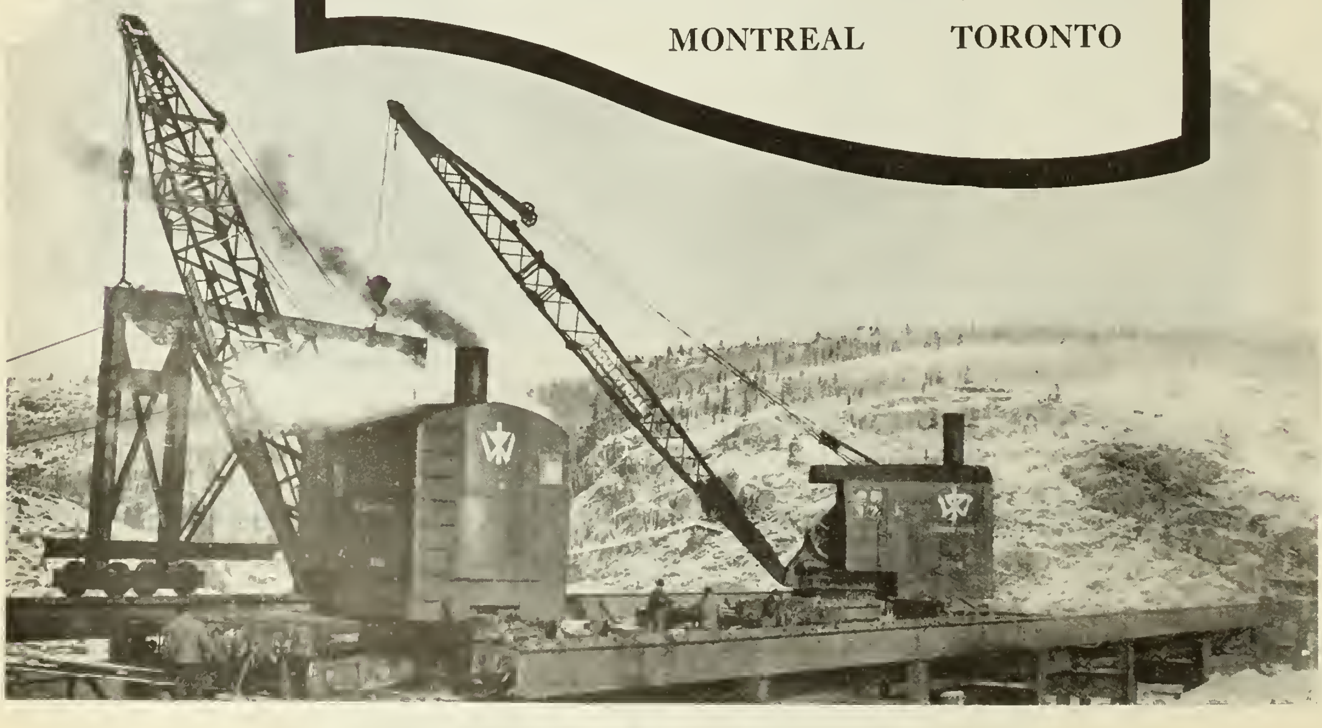

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THE

ENGINEERING JOURNAL

THE JOURNAL OF THE ENGINEERING INSTITUTE OF CANADA

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Report of Council for the Year 1923

Nineteen twenty-three was an important year for *The Institute* in that the recommendations made by the Committee on Policy were embodied in new by-laws, endorsed by the members, and put into effect during the year. As a result of these changes every member of *The Institute* resident in Canada becomes associated with a branch, and is thus in closer touch with *Institute* affairs.

The second portion of the report of the Committee on Classification and Remuneration, relating to fees of practising engineers, was received during the year, and together with the report received in nineteen twenty-two, relating to classification and remuneration of engineers on salary, was adopted as a guide for the benefit of the members of the engineering profession.

The Committee on Student Activities reported during the year, making definite suggestions designed to have *The Institute* take a greater interest in the welfare of the students. These constructive suggestions, published in the October Journal, are being put into effect.

The branches of *The Institute* have, without exception, maintained or increased their activities, and show results which are worthy of the highest commendation. A new branch was established under favourable auspices in the valley of the Saguenay in August, its annual report showing that in common with other branches it has risen to a realization of its responsibilities and possibilities.

Although the year nineteen twenty-three has, in general, been somewhat unsettled and chaotic, engineering activity in Canada has been fairly normal.

The finances of *The Institute* are in sound condition, the operating surplus being somewhat larger than was estimated in the budget.

During the year an Institute Fuel Committee was established with representation from all parts of Canada, followed by the establishment of branch fuel committees in most of the branches. The committee is engaged in studying the entire fuel situation and it is believed that the report of the committee will be an important one.

The Council regrets to record that during the year we were called upon to suffer the loss of the President of *The Institute*, Mr. Arthur T. St. Laurent, B.A., C.E., who passed away five weeks after assuming office. Several former officers and prominent members of *The Institute* were also called away during the year including William McNab, elected February third, eighteen eighty-seven, for nine years librarian, and two years a councillor, and Percival W. St. George, a charter member, member of the first Council, eight years a councillor and four years vice-president, and in addition, one of the twelve Honorary Members of *The Institute*, Baron Shaughnessy of Montreal and Ashford, Ireland.

Meetings

On Tuesday, January twenty-third, nineteen twenty-three, the thirty-seventh annual general meeting of *The Institute* was held at headquarters in Montreal. With the exception of a luncheon during the noon-hour recess, the meeting was devoted entirely to business sessions. Following the confirming of the minutes of the previous annual meeting, scrutineers to report on the result of the officers ballot, and auditors for the ensuing year, were appointed. This business was followed by the presentation of the report of Council and the reports of the various committees and branches of *The Institute*. During the meeting announcement was made of the establishment of a Past-Presidents' Fund for the purpose of providing revenue to donate prizes for papers presented either at branch or professional meetings. A luncheon was held in the Salle Dore of the Mount Royal Hotel, at which the retiring-president's address was delivered.

During the year there was only one general professional meeting held. This meeting was at St. John, New Brunswick, on September twenty-sixth and twenty-seventh and at it the following papers were presented:

"The St. John Drydock", by E. G. Cameron, A.M.E.I.C.

"Loud Speakers and Public Address Systems," by H. J. Vennes, A.M.E.I.C., (At the New Brunswick Telephone Company's Building.)

"Locomotive Tonnage Rating," by W. U. Appleton.

"Metallurgical Reheating Furnaces for Blooms, Billets and Slabs," by A. P. Theuerkauf, M.E.I.C.

"A Lump of Coal," by K. L. Dawson, A.M.E.I.C.

The meeting centred around the completion of the St. John drydock, in the construction of which members of *The Institute* played such an important part. The programme proved most interesting to those in attendance, and in addition to the papers mentioned above, there was a boat trip around the harbour of St. John, with the inspection of the new drydock; a luncheon at Courtenay bay, when the members were the guests of the St. John Drydock and Shipbuilding Company; a trip to Musquash, where the members were entertained at dinner by the New Brunswick Construction and Building Company; a luncheon at the Paradise Grill, when the members were the guests of the St. John Branch; and entertainment in the form of motor trips and golf during the afternoon of the second day. The programme concluded with a dinner at the Riverside Golf and Country Club.

Roll of The Institute

The election of new members has added two hundred and forty-four names to the membership roll of *The Institute*, during the year nineteen twenty-three. These are divided into the following grades:—Twenty-seven Members, eighty-two Associate Members, thirty-three Juniors, ninety-nine Students and three Affiliates.

Transfers from one grade to another in *The Institute* were as follows:—Associate Member to Member, forty; Junior to Associate Member, forty; Student to Member, two; Student to Associate Member, eleven; Student to Junior, twenty-eight.

A summary of these elections and transfers is given below. The names of those elected or transferred are published each month in the *Journal*, immediately following election and are added to the official membership roll as acceptances are received.

Elections

Month	Members	Associate Members	Juniors	Students	Affiliates
January	..	..	..	4	..
February	4	15	2	6	..
March	5	6	3	13	..
April	5	9	7	11	1
May	1	10	4	3	..
June	..	..	..	..	..
July	1	8	2	5	..
August	3	7	1	2	..
September	1	8	6	1	1
October	2	5	1	19	..
November	3	7	4	4	..
December	2	7	3	31	1
	27	82	33	99	3

Transfers

Month	A.M. to M.	Jr. to A.M.	S. to M.	S. to A.M.	S. to Jr.
January	..	..	..	..	..
February	5	7	1	2	4
March	13	6	..	2	6
April	4	3	..	..	3
May	9	7	..	..	3
June	..	..	..	..	..
July	4	..	1	..	3
August	1	6	..	..	1
September	2	4	..	2	4
October	..	3	..	1	..
November	1	3	..	3	3
December	1	1	..	1	1
	40	40	2	11	28

Removals from the Roll

There have been removed from the membership roll during the year nineteen twenty-three, by resignation or on account of non-payment of dues:—eight Members, thirty Associate Members, seven Juniors, twenty Students, and one Affiliate. A detailed list of the resignations accepted is as follows:—

Members
Boving, Jens Orton
Johnson, Sydney B.

Associate Members
Anderson, Lt.-Col. T. V., D.S.O.
Baggs, Edwin
Berg, Hans E.
Bourbonnais, Adelphus O.
Buteau, Jos. A.
Cookson, Cecil Henry
Ellis, John
Fairlie, William Alex.
Frith, Arthur C.
Galloway, Andrew
Graves, Robert Pitt
Heywood, E. P.
Lewis, Donald
McGhie, W. G.
Nares, Basil L.
Reid, A. C.
Shaw, Jock Brown
Stewart, Lt.-Col. J. Crossley, D.S.O.
Tremblay, Jos. A.
Trottier, J. Paul
Wilmot, Major L. A., M.C.
Wilson, Harry Vance

Juniors
Black, A. Percival
Campbell, H. M.
Dorken, Herbert Walker
Gardner, Douglas B.
King, Perry
Whitehall, P.

Students
Birchard, Major E. Russel
Challenger, J. O.
Devenny, J. P.
Dunlop, P. J.
Gardner, J. G.
Gnaedinger, Paul Ernest
Hornell, D. Roy
James, Victor A.
Kingham, J. R.
Peck, W. Swanzey
Price, Lloyd M.
Reed, Gordon
Reynolds, H.
Sharpe, Clarence B.
Sherwood, Thos. K.
Stewart, W. D.
Wallot, Albert
Winter, L. A. G.

Affiliate
Smith, Samuel William

Deceased Members

During the year nineteen twenty-three, the deaths of twenty-eight of *The Institute's* members have been reported.

Honorary Member
Shaughnessy, Lord, K.C.V.O.

Members
Burnyeat, John P.
Clement, William Alex.
Hering, Rudolph, D.Sc.
Hesketh, Lt.-Col. James A., C.M.G., D.S.O.
Hunt, Robert Woolston
Legrand, Joseph Gaston
McNab, William
Powell, Lt.-Col. Archibald Olin
Scott, William
St. Laurent, Arthur

Associate Members
Addison, George Dickson
Baker, Lieut. Dennis
Bigger, Charles A.
Bray, Lennox T.
Drummond, Richard
*Ellis, J. G. St. J.
Goodman, Norbert
Hall, Lieut. Thomas E. A.
Hendry, William A.
Latta, William
Rainboth, Geo. Louis
Young, William Irving

Junior
Stewart, Lieut. Henry W.

Students
Armstrong, H. M.
Carbonneau, J. Emile
MacLean, Henry Keith
Stokes, Laverne Franklin

*Killed in Action, authentic information of which has been received during the year.

Total Membership

The membership of *The Institute* at present totals five thousand, one hundred and ninety-four, while there are two hundred and thirty-eight applications which have been favourably received, the addition of the names of these applicants to the roll being delayed pending the receipt of their formal acceptance of election. The membership according to grades is shown in the accompanying table:

Honorary Members	11
Members	1,141
Associate Members	2,456
Juniors	471
Students	1,072
Affiliates	43
	5,194
Elections — acceptances pending	238
	5,432

Respectfully submitted,

WALTER J. FRANCIS, M.E.I.C., *President.*
FRASER S. KEITH, M.E.I.C., *Secretary.*

Library and House Committee

The President and Council,

Following up the excellent work of last year's Library and House Committee, your committee exercised supervision over the new books being received, and was also instrumental in securing through *The Journal* a large number of donations of books on the list compiled by the previous committee. Although the list of books was estimated to cost five hundred dollars, as granted by Council, it is a pleasure to announce that the complete list was secured for two hundred and eleven dollars. Your committee is strongly of the opinion that a sufficient grant should be made to catalogue the entire library and add each year sufficient new technical books to keep the library thoroughly up to date for technical reference.

Your committee is also of the opinion that a definite sum should be set aside each year to provide for depreciation on the headquarters property.

There was expended on the library during the year nineteen twenty-three:—

New books		$211.17
Binding, — Magazines, transactions, *Journal*		271.01
Subscription for 1923	$120.55	
Subscriptions for 1924 and few 1925	119.45	240.00
Sundries		15.43
		$737.61

The following publications are available in the reading rooms at headquarters:

Lounge Room

Canadian Bookman
Canadian Magazine
Goblin
Harper's Magazine
Life
Literary Digest
Printers Ink
Punch
Sketch
Strand Magazine
World's Work
Illustrated London News
National Geographic Magazine
North American Review
La Revue des Deux Mondes
L'Illustration de Paris
La Revue Trimestrielle

Technical Reading Room

Aeronautical
American City
American Institute of Electrical Engineers, Journal
Annales de l'Energie
Arts et Métiers
Beama
Building Notes
Bus Transportation
Canada Lumberman
Canadian Engineer
Canadian Machinery
Canadian Mining Journal
Canadian Patent Office Record
Canadian Railway and Marine World
Chemical and Metallurgical Engineering
Chimie et Industrie
City Managers Magazine
Colorado Engineer
Combustion
Commercial Intelligence Journal
Compressed Air Magazine
Concrete
Contract Record and Engineering Review
Construction
Cornell Civil Engineer
De Ingenieur
Electrical News
Electrical Railway Journal
Electrical Review
Electrical World
Engineer, The
Engineering
Engineering and Boiler House Review
Engineering and Mining Journal
Engineering News-Record
Engineers and Engineering
English Electric Journal
Explosives Engineer
Ferro-Concrete
Gas Engineer
Good Roads
Heating and Ventilating
Highway Engineer and Contractor
Indian Engineering
Industrial Canada
Industrial Digest
Industrial Management
Ingenieur-Zierschrift
Iron Age
Iron and Steel of Canada
Institution of Electrical Engineers, Journal of the
La Houille Blanche
La Technique Moderne
Le Génie Civil
Marketing
Mechanical Engineering
Mechanical World
Michigan Technic
Military Magazine
Mining and Metallurgy (A.I.M.M.E.)
Monthly Weather Review
Municipal Engineering
Municipal Review of Canada
National Electric Light Association, Bulletin.
Paper Trade Journal
Power
Power Notes
Practical Engineer and Engineers Gazette
Professional Engineer
Public Works
Pulp and Paper Magazine
Pure Iron Era
Railway and Locomotive Engineering
Railway Review
Steamship
Steel Structures
Times Engineering Trade Supplement
Town Planning Institute of Canada, Journal
Wireless World and Radio Review

In addition to this list there are available the year books of various universities and publications of university technical societies, besides recent government and special reports on engineering matters.

In view of the large amount of space being taken by the photographs of past-presidents, it is recommended that the frames containing photographs of presidents be reduced to approximately one quarter the present size.

Particular attention is directed to the presentation to *The Institute* by W. L. Scott, M.E.I.C., of a steel engraving of Robert Stephenson.

The library of *The Institute* has received many contributions during the past year, all of which are gratefully acknowledged. Lists of the books and publications donated have been published from month to month in *The Journal* and may be found on pages 104, 214, 304, 346, 374, 420, 472, 518 and 562 of volume VI.

In addition the following donations are acknowledged with thanks:—

Presented by T. J. McMinn, M.E.I.C.

A Treatise on Waterworks for Conveying and Distributing Supplies of Water, by Charles Storrow, published in 1835.

Presented by the estate of the late William McNab, M.E.I.C.

Elementary Graphic Statics and the Construction of Trussed Roofs, by N. Clifford Ricker.
The Forth Bridge, reprinted from Engineering, February 28th, 1890.

Presented by the estate of the late Herbert Wallis, M.E.I.C.

Institution of Mechanical Engineers.
- Proceedings — 1868-1914.
- General Index to Proceedings — 1847-1910 (2 volumes).
- Journals — 1914-1922.
- Library Catalogue — 1887.

Institution of Civil Engineers.
- Proceedings — Volumes 59-212. (1880-1921).
- Index to Proceedings — Volumes 1 to 170 (3 volumes).
- Name index — Volumes 1 to 58.
- Presidential addresses for the years 1896-1919.

Reports of the Commission of Conservation.
- Annual reports Nos. 1 to 10.
- Altitudes in Canada.
- Forests of British Columbia.
- Sea Fisheries in Eastern Canada.
- Lands, Fisheries and Game, Minerals — 1911.
- Water Powers of Canada — 1911.
- Trent Watershed Survey.
- Fire Waste in Canada.
- Water Works and Sewage Systems.
- Forest Protection in Canada — 1913-1914.
- Fur Farming in Canada.
- Long Sault Rapids — St. Lawrence River.
- Water Powers of Manitoba, Saskatchewan and Alberta.
- Forest Conditions of Nova Scotia.
- Water Works of Canada.
- The Canadian Oyster.
- Conservation of Coal in Canada.

Respectfully submitted,

J. A. DUCHASTEL, M.E.I.C., *Chairman.*

Finance Committee

The President and Council,

In presenting the financial statement of the year nineteen twenty-three your committee takes pleasure in reporting a favourable balance on the year's operations. Early in the year a budget was prepared with a view to controlling operating expenses, this budget being maintained throughout the year.

The arrears of fees collected were approximately nine hundred dollars more than a year ago, but the entrance fees were almost two thousand dollars less. This, however had been anticipated in the budget. Current fees were estimated at twenty-seven thousand dollars, the amount collected being within one half of one per cent of that amount. An amount of seven hundred dollars has been written off for bad debts, and a reserve of five hundred dollars deducted from the accounts receivable of *The Journal.* In addition to branch rebates of six thousand, one hundred and twenty-four dollars, the branches have received through branch news and commission the sum of one thousand, two hundred and seventy-five dollars and thirty-three cents.

Victory Bonds to the value of four thousand dollars were purchased at a slight premium with money taken from current revenue, these bonds being in the custody of the treasurer, in accordance with a previously decided policy to set aside all entrance fees and life memberships to pay off the mortgage on the headquarters building.

Your committee urges the strictest economy in operating *The Institute*, keeping in view the object of making it of the greatest usefulness to the branches and the individual. *The Institute* is not in a financial condition yet to incur any extraordinary expenditures, and in view of the additional rebates which will be received by the branches next year, *The Institute* finances will require very close supervision.

Respectfully submitted,

F. P. Shearwood, M.E.I.C., *Chairman.*
Alex. Bertram, M.E.I.C., *Treasurer.*

STATEMENT OF ASSETS AND LIABILITIES AS AT 31st, DECEMBER 1923

Assets

Property Account		$ 89,041.64
Furniture:		
Balance at 1st Jan. 1923	$ 3,954.40	
Additions during year	95.50	
	$ 4,049.90	
Less 10% depreciation	404.99	
		3,644.91
Library:		
Estimated value of books	5,127.30	
Less 10% depreciation	512.73	
		4,614.57
Stationery on hand, as per inventory		495.38
Gold medal		45.00
Investments:		
Canada Permanent Mortgage Corporation stock, 20 shares par value $10.00 each	215.00	
Montreal Light, Heat & Power Consolidated stock, 6 shares par value $100.00 each	120.50	
		335.50
Accounts Receivable:		
Journal	4,800.66	
Advances to branches	450.00	
Sundry	177.24	
	5,427.90	
Less Reserved for bad and doubtful accounts	500.00	
		4,927.90
Arrears of fees, — estimated		2,500.00
Cash:		
Canadian Bank of Commerce — Current account	1,897.19	
Savings account	547.81	
Petty cash on hand	100.00	
		2,545.00
Unexpired insurance		284.60
Special funds, as per schedule No. 1 attached:		
Investments Victory Loan	14,669.51	
Cash in savings bank accounts	3,331.90	
		18,001.41
		$126,435.91

Liabilities

Mortgage on property:		
Royal Institute for the Advancement of Learning	$ 20,000.00	
Interest accrued to date	233.33	
		$ 20,233.33
Accounts payable:		
Sundry	605.61	
Advances to branches	1,524.22	
		2,129.83
Special funds:		
As per schedule No. 1 attached		18,001.41
Surplus account:		
Balance at 1st January 1923	84,443.24	
Less appropriated to mortgage fund	4,132.80	
	80,310.44	
Add surplus for year	5,260.90	
Special contribution	500.00	
		86,071.34
		$126,435.91

Montreal, 10th January, 1924.
Verified, as per our report of this date.
(Signed) Riddell, Stead, Graham & Hutchison, C.A.
Auditors.

Schedule No. 1 — Special Funds

Mortgage Fund			
Balance at 1st January 1923		$8,136.71	
Add Appropriation		4,132.80	$12,269.51
Represented by:			
Victory bonds, par value	$12,000.00		
Cost price	12,269.51		
Leonard Medal			
Balance at 1st January 1923		$ 528.64	
Paid for medal		30.00	
		498.64	
Add Bond interest		27.50	
Bank interest		.94	527.08
Represented by: Victory bond	$500.00		
Balance in bank	27.08		
	$527.08		
Plummer Medal			
Balance at 1st January 1923		$ 504.03	
Paid for engraving medal		5.42	
		$ 498.61	
Forward		$ 498.61	
Add Bond interest		27.50	
Bank interest		.31	$ 526.42
Represented by: Victory bond	$500.00		
Balance in bank	26.42		
	$526.42		
Prize Fund			
Balance at 1st January 1923		$497.09	
Add bank interest		15.01	512.10
Represented by: Balance in bank	$512.10		
Fund for Relief of Members' Families			
Balance at 1st January 1923		$1,558.97	
Add Bond interest		77.00	
Bank interest		5.26	1,641.23
Represented by: Victory bond	$1,400.00		
Balance in bank	241.23		
	$1,641.23		
Past President's Fund			
Past President's Fund			2,525.07
Represented by: Balance in bank	$2,525.07		
			$18,001.41

STATEMENT OF REVENUE AND EXPENDITURE FOR THE YEAR ENDED 31st DECEMBER 1923

Revenue

Membership fees:		
Arrears	$ 4,458.68	
Current	26,890.29	
Advance	492.83	
Entrance	3,215.60	
Life	300.00	$35,357.40
Interest:		
On overdue fees	415.10	
On victory bonds	550.00	
On savings bank account	88.97	1,054.07
Dividends:		
Canada Permanent Mortgage Corporation stock	24.00	
Montreal Light, Heat & Power Company stock	36.00	60.00
Journal:		
Revenue		36,035.25
Year Book		1,209.50
Rent of hall		640.00
Certificates		262.75
Badges		18.99
Bad debts recovered		182.69
Sundry revenue		2.78
		$ 74,823.43

Expenditure

Building expense:		
Interest on mortgage	$ 1,400.00	
Taxes	1,494.11	
Water rates	203.70	
Fuel	913.00	
Insurance	88.65	
Light and gas	290.12	
Caretaker — wages and service	1,210.25	
Repairs and expense	314.48	$ 5,914.31
Office expense:		
Salaries, secretary and office staff	13,431.59	
Office supplies and stationery	1,668.83	
Postage and telegrams	1,709.22	
Auditors' fees	200.00	
Telephone	254.60	
Messengers and express	43.21	
Miscellaneous expense	333.86	
Legal expense	20.00	17,661.31
Publications:		
Transactions	4,285.28	
Journal	29,433.79	33,719.07
General expense:		
Annual and professional meetings expense	1,166.31	
Travelling expense, secretary	1,298.00	
Branch stationery	256.18	
Students' prizes	100.00	
Library expenses and magazines	740.79	
10% written off furniture	404.99	
10% written off books	512.73	
Bank exchange and discounts	173.69	
Committee expenses	142.08	
Bad debts written off	699.06	
Examination expense	35.00	
Special donation	225.00	
Grant, Canadian Engineering Standard 1922-23	400.00	6,153.83
Rebates to branches:		
As per schedule No. 2 attached		6,114.01
Balance — Excess of revenue over expenditure for the year ended 31st, December 1923		5,260.90
		$ 74,823.43

Montreal, 10th January, 1924.
Verified:
(Signed) Riddell, Stead, Graham & Hutchison, C.A.
Auditors.

Legislation and By-Laws Committee

The President and Council,

Your committee has already reported suggesting amendments to the by-laws, published in the December issue of *The Engineering Journal*, page five hundred and forty. The proposed amendments are as follows:—

Section 12. Amend to read:—

The officers of *The Institute* shall be a president, five vice-presidents, one councillor from each branch having less than two hundred corporate members, two councillors from each branch having two hundred and less than four hundred corporate members, three councillors from each branch having four hundred corporate members, and an additional councillor from each branch for each two hundred corporate members over four hundred.

Section 13. Amend the first paragraph to read:—

The term of office of the president shall be one year, of the vice-presidents two years, and of the councillors one year, except in the case of councillors representing branches entitled to two or more councillors. The term of office for such councillors shall be two years for those representing branches entitled to two councillors, and three years for those representing branches entitled to three or more councillors. At least one councillor shall be elected each year from each branch.

Section 18. Add under list of standing committees:—

An engineering sections committee.

Replace paragraph four, section 18, by paragraphs one and two, section 24:—

The council at any time, may appoint special committees to report upon engineering subjects or upon other matters of interest to *The Institute.* The annual general meeting may recommend to the council the appointment of special committees, and such recommendations shall be considered by the council at the first meeting following the annual general meeting.

Special committees shall perform their duties under the supervision of the council, and shall report to the council.

Section 21. First paragraph, fourth line, change the word "meeting" to "meetings".

Section 22. Replace the third paragraph by the following:—

The right of prior publication of all papers accepted to be read at a branch or professional meeting is reserved by *The Institute.* Any such paper not accepted for publication shall be returned promptly to the author. No paper shall be considered eligible for any of the prizes of *The Institute,* which has been published elsewhere prior to its publication by *The Institute.* unless published with the consent and approval of the publications committee, officially transmitted by the secretary.

Section 24. (New section.) Engineering Sections Committee.

The engineering sections committee shall be composed of a chairman who is a member of council, and a representative from each branch. This committee shall promote the establishment of sections corresponding to any of the recognized branches of the engineering profession, such as chemical, civil, electrical, mechanical, mining, hydraulic, railway, industrial, highway, municipal and structural, in the various branches of *The Institute.*

This committee shall be responsible for the formation and continuation of sections in *The Institute* corresponding to any of the generally recognized branches of the engineering profession by correlating and co-ordinating into *Institute* sections, similar sections of the various branches, with such officers and activities as the council may from time to time approve.

It shall encourage and promote the exchange of papers between similar sections of the various branches, and shall assist the papers committee in securing papers for professional meetings.

Section 25. (Newly numbered section.) Adoption of Specifications

(This appeared as paragraph (b) under section twenty-four.)

Renumbering of sections. Renumber all sections thereafter, changing present section twenty-five to twenty-six.

Section 27. New title: — Consideration of Applications for Admission or for Transfer.

Change first sentence to read:—

Immediately upon receipt of an application the secretary shall forward copies of all papers and correspondence in connection therewith to the secretary of the branch, if any, to which the applicant belongs.

Section 38. Delete the words, "except as provided in by-law 41".

Section 39. Amend to read:—

At the time of his election a corporate member may compound all future annual fees by a single payment of two hundred and fifty dollars. A corporate member in good standing after ten years of corporate membership may compound his future annual fees by a single payment of one hundred and fifty dollars, and after fifteen years of corporate membership by a single payment of one hundred dollars. The money thus received shall be invested and only the income thereof used for the current expenses of *The Institute.* Should an Associate Member compound his fees, he shall be subject to section 26 as regards transfer, and shall also be required to pay a transfer fee.

Section 53. Add the words "and Juniors" after "corporate members", six words from the end.

Section 66. Add:—

Vacancies in the nominating committee as announced at the annual general meeting shall be filled by council from the nomination or nominations submitted by the branch in which the vacancies occur.

Section 67. Amend paragraph four to read:—

The officers' ballot shall be forwarded by the nominating committee to reach headquarters not later than the fifteenth day of September, for presentation to council at a meeting to be held not later than the thirtieth day of September, and should be accompanied by a letter of acceptance of nomination from each nominee.

Amend paragraph five to read:—

The council shall examine the officers' ballot submitted by the nominating committee. If the council find a nominee ineligible for the office for which he is nominated, or should the consent in writing of a nominee to appear on the officers' ballot not be furnished before the first meeting of council in October, or should any nominee after such consent withdraw his name, such name shall be deleted, and the council shall substitute another name therefor. The words "Proposed by Nominating Committee" and "Proposed by Council" shall be printed conspicuously on the ballot, to indicate the manner of nomination of all nominees.

Section 68. Amend first paragraph to read:—

Not later than the seventh day of November, the secretary shall mail to each corporate member of *The Institute* the officers' ballot, as prepared by the nominating committee and the council.

Your committee recommends that a special committee be appointed by the incoming Council to study the branch by-laws with a view to drafting a new set of branch by-laws which would serve as a model for all branches.

Respectfully submitted,

WALTER J. FRANCIS, M.E.I.C., *Chairman.*

Board of Examiners and Education Committee

The President and Council,

On behalf of the Board of Examiners and Education I beg to present the following report for the year 1923:—

Four candidates presented themselves for examination under schedules B and C, with the results indicated in the following table.

Schedule	Number examined	Passed	Failed
B	4	1	3
C electrical engineering	1	1	
C highway engineering	1	1	
C railway engineering	1	1	
C structural engineering	1	1	
Total examinations	8	5	3

Respectfully submitted,

H. M. MACKAY, M.E.I.C., *Chairman.*

Students' Prizes Committee

The President and Council,

Your committee has examined eight papers submitted by Student members for consideration in connection with the award of students' prizes.

The general standard of all eight papers is comparatively low, none of them being rated at more than about 70 per cent, based on the usual methods of examination. The four best papers presented are as follows, in the order of merit:

"The Acid Plant, its Function and Operation in the Sulphite Mill," by W. H. Barnes, S.E.I.C.;

"Water Purification," by C. P. Reaper, S.E.I.C.;

"Local Transportation on Rails," by J. R. Dunbar, Jr.E.I.C.;

"Hoisting Machinery," by G. M. Dick, S.E.I.C.

Mr. Barnes' paper may be classified in the chemical section, Mr. Reaper's in the general or civil section, Mr. Dunlop's in the mechanical or railway section, and Mr. Dick's in the mechanical or mining section, being more mechanical than mining. While the committee feels that the standard of all the papers is comparatively low, the concensus of opinion is that it might be well to grant the above four prizes in order to stimulate interest amongst the younger members, and the committee therefore suggests that council give this matter their consideration.

Respectfully submitted,

FREDERICK B. BROWN, *Chairman.*

Council approved of the award of four student prizes to those named in the report.

Publications Committee

The President and Council,

Your committee on Publications was not called upon to perform any arduous duties during the past year, although on several occasions advice was given to the secretary regarding the publication of papers presented.

In reviewing the situation for the past year it is felt that while numerous papers were presented there were but few of such outstanding merit as to warrant being preserved in *Institute* transactions.

Your committee recommends that the following papers be preserved for the transactions of *The Institute:*

	Title	Author
1.	Principles of Three-Wire Distribution for Electric Railways	W. N. Smith, M.E.I.C.
2.	Irrigation in British Columbia	E. A. Cleveland, M.E.I.C.
3.	Automatic Box Car Unloaders for Grain	F. Newell, M.E.I.C.
4.	Principles and Practice for Valuation of Public Utilities	R. A. C. Henry, M.E.I.C.
5.	Power Factor	W. G. H. Cam, A.M.E.I.C.
6.	Electrons, Atoms and the Ether	W. B. Cartmel, M.E.I.C.
7.	Relay Protection for Radial Transmission and Distribution Systems	P. Ackerman, A.M.E.I.C.
8.	The Cost of Industrial Power	J. A. Burnett, M.E.I.C.
9.	The Design and Economics of City Refuse Destructors	F. A. Combe, M.E.I.C.
10.	Self-corrosion of Buried Lead Pipes	J. W. Shipley and W. N. Smith, M.E.I.C.
11.	Improvements to Moncton Yard and Engine Facilities	S. B. Wass, A.M.E.I.C.
12.	Railway Electrification	A. L. Mudge, A.M.E.I.C.
13.	Advantages to be Gained from Pulverizing Canadian Fuels	H. D. Savage.

Respectfully submitted,

FREDERICK B. BROWN, M.E.I.C., *Chairman.*

Code of Ethics

The President and Council,

Your committee's report on the proposed Code of Ethics was published on page five hundred and forty-seven of *The Journal*, December, nineteen twenty-three.

Respectfully submitted,

FREDERICK B. BROWN, M.E.I.C.
F. P. SHEARWOOD, M.E.I.C.

Nominating Committee—1924

The following nominations to the Nominating Committee for the year 1924 have been made by the various branches, have been noted by Council, and are herewith presented to be announced at the annual meeting in accordance with the by-laws.

Halifax Branch	O. S. Cox, A.M.E.I.C.
Cape Breton Branch	A. P. Theuerkauf, M.E.I.C.
St. John Branch	S. C. Webb, A.M.E.I.C.
Moncton Branch	J. D. McBeath, M.E.I.C.
Saguenay Branch	H. G. Cochrane, A.M.E.I.C.
Quebec Branch	A. B. Normandin, A.M.E.I.C.
Montreal Branch	D. C. Tennant, M.E.I.C.
Ottawa Branch	Alex. Ferguson, M.E.I.C.
Peterborough Branch	B. L. Barns, A.M.E.I.C.
Kingston Branch	L. T. Rutledge, M.E.I.C.
Toronto Branch	J. M. Oxley, M.E.I.C.
Hamilton Branch	C. H. Marrs, M.E.I.C.
London Branch	H. A. Brazier, M.E.I.C.
Niagara Peninsula Branch	A. C. D. Blanchard, M.E.I.C.
Border Cities Branch	F. P. Flett, A.M.E.I.C.
Sault Ste. Marie Branch	J. W. LeB. Ross, M.E.I.C.
Winnipeg Branch	J. N. Finlayson, M.E.I.C.
Saskatchewan Branch	A. C. Garner, M.E.I.C.
Lethbridge Branch	John Dow, M.E.I.C.
Edmonton Branch	R. J. Gibb, M.E.I.C.
Calgary Branch	A. S. Dawson, M.E.I.C.
Vancouver Branch	Wm. Smaill, M.E.I.C.
Victoria Branch	Patrick Philip, M.E.I.C.

Papers Committee

The President and Council,

Your Papers Committee's activities during the past year have been mainly confined to following out the policy and adopting the suggestions of last year's committee in assisting the branches to secure papers.

Reprints of meritorious papers have from time to time been sent to smaller branches in order that they might be discussed and the branch get the benefit of having the printed paper before them.

Through the co-operation of the Council we have been enabled to supply speakers at a number of the branches, and assisted the general professional meeting of the maritime provinces by arranging for a special address from a Montreal member.

Arrangements have been concluded whereby the maritime branches are to have an address from Doctor Howard T. Barnes, an eminent authority on ice formation, who is scheduled to visit the branches in New Brunswick and Nova Scotia early in the new year.

It is believed that this policy can be enlarged upon to the extent that branches will exchange speakers and thus draw them into a closer bond of union.

Respectfully submitted,

CHAS. M. MCKERGOW, M.E.I.C., *Chairman.*

Fuel Committee

The President and Council,

On behalf of the chairman and members of the Fuel Committee of *The Institute*, I submit the following brief progress report:

The Fuel Committee of *The Institute* was constituted by Council on April 23rd, 1923, with 12 members, and power to add to their number was given. There are to-day 24 members as follows —

F. A. Combe, M.E.I.C., chairman; R. W. Augus, M.E.I.C., M. J. Butler, M.E.I.C., C. V. Corless, M.E.I.C., J. R. Donald, A.M.E.I.C., J. T. Farmer, M.E.I.C., Walter J. Francis, M.E.I.C. (*ex-officio*), F. W. Gray, A.M.E.I.C., A. R. Greig, M.E.I.C., B. F. Haanel, M.E.I.C., R. A. C. Henry, M.E.I.C., Fraser S. Keith, M.E.I.C., A. D. LePan, A.M.E.I.C., G. C. Mackenzie, M.E.I.C., C. A. Magrath, M.E.I.C., E. V. Moore, M.E.I.C., James McEvoy, M.E.I.C., G. D. Macdougall, M.E.I.C., D. H. McDougall, M.E.I.C., G. R. Pratt, A.M.E.I.C., C. A. Robb, M.E.I.C., R. A. Ross, M.E.I.C., J. A. Shaw, M.E.I.C., F. L. Wanklyn, M.E.I.C., R. S. L. Wilson, A.M.E.I.C., Lesslie R. Thomson, M.E.I.C., secretary.

Shortly after the constitution of the committee a meeting was called in Montreal on May 31st, 1922, of representatives of the Fuel Committee, representatives of the Dominion Fuel Board, and representatives of The Canadian Institute of Mining and Metallurgy in order that a free discussion might indicate the most likely channels through which *The Institute's* Fuel Committee might co-operate with the represented bodies, concerned in the solution of the general Canadian fuel problem.

Soon after this, several circulars were sent to all members of *The Institute's* Fuel Committee with the object of:

(a) Obtaining the views of each one as to proper course of action to pursue
(b) Crystallizing, if possible, the specific objective of *The Institute's* Fuel Committee
(c) To make plans for a subsequent meeting in Montreal with representatives of the whole committee, in order to discuss, and formulate a final report.

All the replies received to the circulars were digested and re-circulated to the members of the committee. The following formula was ultimately agreed upon as expressing most clearly the opinion of the majority of the members of the Fuel Committee regarding their special objectives:—

The General Fuel Committee of *The Engineering Institute of Canada* will concern itself solely with the sources, production, transportation and distribution of fuels to the various parts of Canada as a whole.

In addition it was agreed to suggest to the branch fuel committees that they should concern themselves with:

The economical utilization of the different fuels available in each locality, and to educational campaigns regarding proper use of heating equipment and domestic fuel, for the benefit of the householder.

In order also to reach a basis of discussion on fuel policy, a special review of the Canadian fuel problem was prepared and submitted for criticisms to the Montreal members. After revising in accordance with their suggestions, this "Fuel Review" was issued on November 7th, 1923, to all members of the committee with the request that it be subjected to a very close scrutiny and criticism. It is hoped that this Fuel Review may form the basis of the final written report of the committee to Council.

Your committee is engaged at present in digesting the criticisms of this review as received from the members, and also in laying plans for a meeting of representatives of the committee to be held in the near future in Montreal. As the cost of this meeting is to be defrayed in part by Council, the committee wishes to record its thanks and appreciation for the assistance thus rendered.

All of the foregoing is respectfully submitted.

LESSLIE R. THOMSON, M.E.I.C., *Secretary.*

Canadian Engineering Standards Committee

The President and Council,

On behalf of the members nominated by the Council on the Main Committee of the Canadian Engineering Standards Association, I beg to submit the following report

General

The Engineering Institute of Canada's representatives on the above committee are now:

Walter J. Francis, M.E.I.C., retires March 1924
Sir Alex. Bertram, M.E.I.C., retires March 1925
Prof. C. J. McKenzie, M.E.I.C., retires March 1926

H. H. Vaughan, M.E.I.C., is chairman of the Association, Sir Alex. Bertram, M.E.I.C., and D. H. McDougall, M.E.I.C., are vice-chairmen, and a very large number of members of the Main Committee and of the various working committees, are members of *The Engineering Institute of Canada.*

The number of members of the Association is now over 300 and the work is being carried on by 13 sectional committees and 32 sub-committees and panels.

Publications

During the past year the following publications have been issued:—

No. G8-1923, Standard General Specification for Commercial Bar Steel.

No. A9-1923, Standard Specifications for Reinforcing Materials for Concrete.

No. C10-1923 Standard Specification for Regular Tungsten Incandescent Lamps.

It is expected that specifications for Wire Strand, Watthour Meters, Wood Poles for Transmission Lines, Concrete Poles, and Railway Fences and Gates, will be among those to be published shortly.

Work in Progress

The following notes give an outline of the work of some of the more active committees up to October 31st, 1923.

Movable Bridges

Work is being continued on the Draft Specification for Movable Bridges, and it is hoped that this document will very shortly be ready for criticism by the Sectional Committee.

Concrete Poles

A Draft Specification for Concrete Poles for Transmission Lines has been drawn up, considered by the committee, and circulated for further criticism.

Concrete and Reinforced Concrete

The various panels of this sub-committee have made substantial progress; the draft report of the Panel on Construction and Design is now ready for circulation and criticism by the sub-committee.

Road Materials and Construction

Satisfactory progress has been made with the organization of the various sub-committees of this sectional committee, which are now as follows:

Sub-Committee A Road and Bridge Foundations and Sub-Grade Preparation.
" " B Earth Roads.
" " C Gravel, Sand & Clay Roads.
" " D Broken Stone Roads
" " E Bituminous Roads
" " F Concrete Roads
" " G Block Pavements
" " H Road Structures (less Bridges).

A preliminary report has already been received from Sub-Committee G, and is being circulated for comment.

Screw Threads

The committee has been in communication with the B.E.S.A., and the A.E.S.C., with a view of initiating discussions as to the possibility of such modification in the screw thread standards of the two countries as might eventually lead to practical interchangeability of thread work.

Steel Structures for Buildings

A sub-committee is being organized for the purpose of drawing up a C.E.S.A., Specification for Steel Structures for Buildings. This specification will deal with steel construction for buildings in the same way that the C.E.S.A., Bridge Specifications treat of Steel bridge construction. It is hoped that such a document would serve as a model for, and may eventually be adopted by local building authorities in the formulation of their city building by-laws. A specification of this nature has been drawn up in the United States by the American Institute of Steel Construction and the subject is also receiving considerable attention from the American Society of Civil Engineers.

Wire Strand

Through the kindness of the Steel Company of Canada, a very complete series of tests has been made on samples of strand, made up in accordance with the draft specification. The draft specification is now almost in its final form and in being criticized in the light of the results of the tests in question.

Watthour Meters

The draft of this report is well advanced and final amendments are under discussion.

Canadian Electrical Code

After considerable but unavoidable delay, the conference on a Canadian Electrical Code, to which invitations were issued by the Minister of Trade and Commerce, took place in Ottawa on May 22nd, and 23rd, and while it was not possible to arrange for the attendance of representatives from all of the nine provinces, the interests of Ontario, Quebec, and British Columbia were taken care of. As a result of the conference, it was agreed to recommend that a committee, to be called the "C.E.S.A. Committee on Canadian Electrical Code" should be formed, on which the provincial, municipal and other interests concerned should be represented; that this committee should have power to obtain representation from any interests which may be found desirable, and that it should take any measures necessary to secure the co-operation of municipal and other authorities concerned. The conference further recommended that this committee be composed of nominees of the following:

The nine Provincial Governments
The Dominion Government Departments of Public Works and Insurance
The Board of Railway Commissioners for Canada
The Engineering Institute of Canada
The Canadian Institute of Mining and Metallurgy
The Royal Architectural Institute of Canada
Canadian Manufacturers Association
Electrical Supply Manufacturers Association
Electrical Contractor-Dealers Association
The several Canadian Fire Underwriters' Associations
Canadian National Railways
Canadian Pacific Railway.

It was further recommended that the chairman of the proposed C.E.S.A., Committee on the Canadian Electrical Code would appoint the necessary sub-committees to draft proposals for:—

(a) Specifications for testing and approval of electrical material, devices and fittings.
(b) Rules for installation and maintenance of electrical equipment.

The Main Committee has approved of these recommendations and the organization is proceeding, while information is being collected regarding the rules now in force in various parts and cities of the Dominion.

It is gratifying to note that Nova Scotia and Manitoba Governments have now joined in the movement.

Traffic Signals for Highways

The work of this sectional committee has been divided among three sub-committees:

A. Signals on level crossing of Steam and Electric Railways.
B. Signals on Vehicles.
C. Signals on Highways other than those at Level Crossings.

George Mountain, M.E.I.C., chief engineer, Board of Railway Commissioners, is chairman of Sub-Committee A. G. C. Parker, A.M.E.I.C., departmental secretary, Department of Public Highways, Toronto, is chairman of Sub-Committee B, and Professor A. T. Laing, Dept. of Highway Engineering, University of Toronto, will preside over Sub-Committee C. The membership of these sub-committees is now being arranged. Co-operation with the similar committee of the American Engineering Standards Committee, has been arranged for.

Gasoline and Lubricating Oils

The interim report on this subject has been approved for publication.

Sectional Committee on Aircraft Parts

During the past six months, the various parts of the A.E.S.C., Aeronautical Safety Code, when issued in draft form, have been forwarded to the C.E.S.A., for comment and criticism. They have been laid before members of our Sectional Committee on Aircraft Parts for this purpose, and the resulting suggestions have been forwarded to the A.E.S.C.

Railway Fences and Gates

Draft specifications have been sent out to all members of the sub-committee, and comments are now being received.

Cast Iron Pipe

The Sub-Committee on Cast Iron Pipe has been organized, has held its first meeting, and a preliminary draft specification is being prepared.

Commercial Bar Steel

The specification prepared by the Sub-Committee on Commercial Bar Steel was published in June. This specification covers the ordinary grades of commercial bar steel as handled by jobbers and employed for general purposes.

Agricultural Machine Parts

Information has been received through the Canadian Manufacturers Association, indicating that some further progress has been made in connection with the adoption by agricultural machinery manufacturers, of uniform standards for carriage bolts, machine bolts, plow bolts, and nuts for the same. Movement along these lines has also been taking place in the United States and information regarding the Canadian work has been furnished to the A.E.S.C.

Co-operation

A sectional committee organized by the A.E.S.C., is about to consider a revision of the American Standard Specification for Fire Tests of Materials and Construction, this having been originally published by the American Society for Testing Materials as their standard. When this question was discussed in the United States in 1916. the Canadian Society of Civil Engineers was represented upon the committee, and as a request for co-operation in the revision has been received, the Council of *The Institute* has been requested to suggest the name of a representative and has nominated J. Penrose Anglin, M.E.I.C. for this position. It is hoped in this way to arrive at a revised specification which will be substantially acceptable in this country as well as in the United States.

Finance

The expenditure of the Association has grown with its work and an appeal for funds to commercial and technical firms and organizations will shortly be made.

The Minister of Trade and Commerce has kindly placed in the estimates a credit of $10,000.00 to carry on this work.

The demands for a thorough standardization of materials has grown rapidly in the past two years. This calls for increased expenditure on the part of the Standards Association to meet these demands. I would therefore call upon all members of *The Institute* who are associated with the leading manufacturing industries in Canada to use their influence to see that additional support be given the Association to meet their requirements. A circular letter is being issued by the secretary of the Association making this appeal to their generosity. Such action on the part of *The Institute* will appeal to the public and place us in a position to carry on this important work in a more effective manner.

Respectfully submitted,
Alex. Bertram, M.E.I.C. *Vice-President.*

Canadian National Committee of International Electro-Technical Commission

The President and Council,

The report of the meeting of the Advisory Committee on Rating of Electrical Machinery, held at Geneva in November, 1922, was received in March. Advantage had been taken of the presence of so many delegates to arrange at the same time for meetings of the advisory committees on symbols, standard pressures, overhead transmission, and screw lamp caps and holders, which reports have also come to hand for consideration.

In June an interesting report was received from the general secretary describing his visit to Petrograd and Moscow.

In October the second session of the International Conference on High Tension Transmission was held in Paris to consider and collate the information obtained in answer to the extensive Belgian questionnaire circulated early in the year.

A plenary meeting of the I.E.C., was planned to be held in Rome in December and a programme had been prepared and circulated when it was unavoidably postponed until next year.

However, a council meeting was held in Paris on December 3rd, at which a plan was worked out to avoid unnecessary delay in the adoption and publication of unanimously accepted reports of advisory committees when no plenary meeting was in view.

Early in the year the members of the Canadian National Committee received copies of the special number of the "Revue Générale de l'Electricité" published in connection with the celebration of the centenary of the discoveries of Ampère.

In November the British proposals for high pressure tests for insulators were circulated.

During the year the I.E.C., had to mourn the loss by death of M. Maurice Leblanc, past-president, who passed away suddenly in Paris on October 27th, in his sixty-sixth year.

Respectfully submitted,
L. A. Herdt, M.E.I.C., *President,*
H. A. Dupre, *Secretary,*
Canadian National Committee, I.E.C.

Committee on Uniform Steam Boiler Specifications

The President and Council,

The work now before your committee on Uniform Boiler Specifications is to have the provinces of Quebec, Nova Scotia, New Brunswick and Prince Edward Island adopt the interprovinical rules now in use in the remaining provinces of the Dominion.

In regard to Quebec, while no formal steps have been taken by the government towards adopting them, copies of the rules have been placed in the hands of interested officials and interviews had with others indicate that the question is being considered with interest.

In Nova Scotia and New Brunswick, D. W. Robb, M.E.I.C., a member of your committee is still actively engaged in interviewing members of the government and has been assured that the question will receive consideration in the near future.

It appears that there is no way to force this issue and best results may be obtained by patiently and persistently keeping before the governments the advisibility of adopting these rules.

Respectfully submitted,
L. M. Arkley, M.E.I.C., *Chairman.*

Committee on Classification and Remuneration

The report of the committee on Classification and Remuneration was published in the October 1923 issue of *The Journal*, page 461.

Honour Roll and War Trophies Committee

The President and Council,

After giving very serious consideration to the question of a memorial to those who served overseas, your committee has come to the conclusion and recommends that a bronze tablet be erected in *The Institute* headquarters in honour of those who fell, and also a record in bronze be prepared containing the names of all who served overseas, it being anticipated that such memorials would cost between four and five thousand dollars. Your committee further recommends that the money be raised by popular subscription from the members of *The Institute,* with the suggestion of a maximum subscription of ten dollars.

Should the above proposal be approved it is further recommended that competitive designs be called for from members of *The Engineering Institute of Canada,* and that a prize of say one hundred and fifty dollars be awarded to the successful designer of the tablet to those who fell, and one hundred dollars to the designer of the tablet to those who served.

Respectfully submitted,
C. J. ARMSTRONG, M.E.I.C., *Chairman.*

Past Presidents' Prize Fund

The President and Council,

Enclosed herewith is a cheque in favour of *The Engineering Institute of Canada* to the amount of twenty-five hundred and twenty-five dollars and seven cents, being the amount subscribed by the past-presidents for the purpose of establishing a Past-Presidents' Prize Fund.

Although Mr. Phelps Johnson, who originated the idea, suggests a special gold badge, a design of which accompanies this report, the question as to the form of the prize is left open to those administering the fund. Regulations drafted by Mr. Johnson and concurred in by the three immediate past-presidents, Messrs. R. A. Ross and J. G. Sullivan and the writer, are attached:

Proposed Regulations

This fund established in nineteen twenty-three by contributions of the then living past-presidents may be added to by future past-presidents who wish to contribute to it.

The fund shall be administered by three immediate past presidents of any year.

The administrators may award each year from the income of the fund, prizes of such nature and in such number as they consider advisable to the authors of papers on engineering or economic subjects submitted by corporate members, juniors, students or affiliates of *The Institute,* and first disclosed to headquarters or to a branch of *The Institute.*

Rules effective for 1923-1924

The year for which the prizes are awarded shall be from July first to June thirtieth, but the first award is to cover the full year nineteen twenty-three and to June thirtieth nineteen twenty-four.

Papers in competition for the prizes shall be judged by a committee of members of *The Institute* appointed by the Council.

Papers eligible in competition to be the bona fide work of the contributors and must not have been made public before submission to *The Institute.*

The award of prizes shall be announced at annual meetings of *The Institute.*

Signed on behalf of the Past-Presidents' Prize Fund,
J. M. R. FAIRBAIRN, M.E.I.C.

Committee on Deterioration of Concrete in Alkali Soils

The President and Council,

The annual report of our committe last year contained a complete review of the organization, objects and early activities of the committee, and any members who may be interested are referred to the report which was published in full in the February issue of *The Journal* for 1923. This year a brief progress report is presented covering the general activities of the year just passed.

Examination of the test specimens in the field has been carried out, and some new blocks installed but our main efforts have been confined to the chemical research, in which field much work has been done and results obtained which we have every confidence will make a valuable contribution to science generally and especially towards an understanding and solution of the problem on which we are engaged.

The financial situation as will be seen from the attached statement is very satisfactory and we have now sufficient funds in the bank to enable us to carry on the research for at least two more years.

Field Work during 1923

No extensive field work has been undertaken since the original installation of test specimens in the fall of 1921. Additional specimens have been made and installed from time to time as new compounds and treatments which might have merit in prolonging the life of concrete have been brought to the attention of members of the committee. Specimens containing each material have been installed at each of the three exposure sites, Cassils, Alta., Grandora, Sask.., and Deacon, Man.

Yearly inspections have been made of the condition of the blocks at each site and samples of the alkaline ground water to which the specimens are exposed have been secured for analysis. While some cases of partial and complete disintegration have occurred it is yet too early to attempt to draw definite conclusions as to the relative durability of the different concretes. In general, those concrete in which various integral waterproofing compounds and so called alkali-proof compounds have been employed have failed to show that there is any advantage to be gained by using them, in fact most specimens so treated show less resistance to the action of the salts in the ground water than similar blocks that have not been treated.

Chemical Work

Report by Dr. T. Thorvaldson, Director of the Chemical Investigation.

Co-operation with the field experiments on blocks has been continued, analyses being made from time to time of the ground water from the experimental plots as well as some of the waterproofings and integral compounds used in the field work.

The work on the action of sulphate solutions on Portland cement, as mentioned in the last report, where intimate contact was effected by shaking the powdered cement with various solutions has been discontinued for the present as the interpretation of the results obtained must depend largely on work with the individual substances present in cement. Further, satisfactory methods for analyzing the solid phase after decomposition so as to determine the quantity of each chemical substance present, were not obtained. The work done on the effect of hydrogenion concentration on disintegration of cement has given some interesting results, and this method is being used in all the series of experiments where applicable. When large enough samples of the silicates and aluminates contained in cement are obtained we intend to carry on further work on electroendosmosis with membranes of these substances in the pure state with the hope of getting at the fundamental factors in the effect of alkalinity on the deterioration of concrete.

The work on the effect of salt solutions on the contraction and expansion of mortars is still being continued and promises to supply a method of connecting up the microscopic work with the results on briquettes and bars.

The experiments on the pure constituents of Portland cement have got well started. Small quantities of the three compounds tricalcium aluminate ($3CaO.Al_2O_3$), tricalcium silicate ($3CaO.SiO_2$) and dicalcium silicate ($2CaO.SiO_2$) have been prepared using very pure raw materials. These raw materials were white marble, containing 98.8 per cent $CaCO_3$, as the source of calcium; commercial flint, containing 99.5 per cent SiO_2, as the source of silica; and pure alumina made in the laboratory from alum as the source of Al_2O_3.

The preparation of the three above mentioned compounds involved from eight to ten heat treatments of the mix, the furnace being held at the proper temperature for a period of three or four hours. The resulting clinker was withdrawn and suddenly cooled and then finely ground. This process was continued until microscopic examinations showed that the product was entirely homogeneous, special tests being made to ensure the entire absence of free lime.

First, a series of tests was made with the three constituents of cement and solutions of sodium sulphate and magnesium sulphate. All of the compounds were attacked and decomposed, but the time required for the decomposition varied, being greatest with the dicalcium silicate. Samples of each of the compounds were hydrated and two series of tests made with each of the hydrated constituents. One series was made with solutions of varying concentration of sodium sulphate and one with solutions of magnesium sulphate of similar strengths. All of these hydrated compounds were decomposed by the sulfate solutions, the progress of the decomposition being observed with the petrographical microscope and a record kept of the changes by means of photomicrographs. These tests are not yet completed.

The aluminates present in the French high-alumina cements are also being prepared and these will be studied in the same way.

The writer took the opportunity given by a visit to Toronto in May of this year to go to New York in order to have a conference with the members of the Committee of the National Research Council dealing with the deterioration of cement in sea water. He spent a day in conference with Wm. G. Atwood, director of the committee, and A. A. Johnson, assistant to the director. It is gratifying that the Committee of the National Research Council has come to the same conclusion as your Committee on Deterioration of Concrete came to several years ago, namely, that the only reasonable method of attack is to make an extended study of the fundamental reactions of cement clinker and hydrated cement with salt solutions. This makes their chemical problem identical with ours as far as it is a laboratory problem. The Committee of the National Research Council has not progressed further than to plan their chemical work, but we look forward to close co-operation when they begin their work.

Your chemical work has been carried on during the year under the writer's supervision by the following:

G. R. Shelton, Ph.D., chemist and petrographer.
D. Wolochow, M.A. — until August 1st, 1923.
R. K. Lamour, B.Sc. — part time.
F. H. L. Taylor, B.Sc. — part time.
H. A. Woodward, B.Sc. — part time.
A. D. Robinson — May to September inclusive.

Financial

The following summary of expenditures and receipts as to December 1st, 1923, is submitted. A detailed and itemized statement of expenditures to December 1st, 1922 was sent to the financial supporters of this research last year and a further itemized statement of all expenditures from December 1st, 1922 to December 1st, 1923 is being sent this year.

Total Expenditures to December 1st, 1923

General	Committee meetings, travelling expenses	$ 1,628.66	
	Misc., telegrams, office expenses, etc.	353.85	$ 1,982.51
Physical Tests	Travelling allowances and expenses	$ 1,123.66	
	Materials and special equipment	1,696.11	
	Freight and cartage	325.79	$ 3,145.56
Chemical Research	Travelling expenses	$ 278,45	
	Salaries	13,828.72	
	Materials and equipment	4,517.90	$18,625.07
	Grand total		$23,753.14

Total Receipts to December 1st, 1923

	1921	1922	1923	Total
Research Council	$5,000	$5,000	$ 5,000	$15,000.00
Canada Cement Company	3,000	3,000	3,000	9,000.00
Saskatchewan	3,000	3,000	3,000	9,000.00
Alberta	1,000	1,000		2,000.00
Canadian Pacific Railway	1,000	1,000	1,000	3,000.00
City of Winnipeg	200	200	300	700.00
Interest on bank account				139.41
Total Receipts				$38,839.41
Total Expenditures				$23,753.14
Balance in bank				$15,086.27

Expenditures Year Dec. 1st, 1922 to Dec. 1st, 1923

General			$ 134.64
Physical			22.18
Chemical	Salaries	$ 6,794.18	
	Materials	595.17	7,389.35
Total			$ 7,546.17

From the above statements it will be seen that the financial situation as far as the committee is concerned is quite satisfactory. We have actually received the third payments from all contributors with the exception of the province of Alberta, who have intimated that owing to the stringency of their financial affairs that it would be impossible for them to make their third payment.

On the other hand the city of Winnipeg very generously increased their contribution this year by 50 per cent.

The expenditures for the past year as will be noted were expended almost entirely on the chemical work and as salaries constituted the major portion, it will be seen that on the present basis we have sufficient funds to continue our reserach for another two years without further contributions.

All of which is respectfully submitted,

C. J. MACKENZIE, M.E.I.C., *Chairman,*
Committee on The Deterioration of Concrete in Alkali Soils.

Students' Activities Committee

The President and Council,

After careful study of the best methods of establishing closer relations between *The Institute* and the students at engineering colleges and schools with a view to bringing the students ultimately into membership in *The Institute*, your committee have the honour to report the following conclusions:—

1. Any methods of propaganda among students which would give universal success throughout the whole of Canada must be of such a character that they could be applied at certain of the larger centres where *The Institute* has to contend with competition from special engineering societies in securing the membership of university students.

2. The interest to be taken by engineering students in the affairs of *The Institute* must always depend on the efforts of the branch of *The Institute* where each engineering school is situated.

3. Any attempt to organize all the engineering students of a college into a local branch or chapter of *The Institute* would result in friction between *The Institute* and other technical or semi-technical organizations at larger branches such as mentioned in paragraph No. 1.

It is therefore recommended:—

(a) That in each of the branches of *The Institute* where there are schools of engineering, a committee be appointed each year to organize and carry on the best methods of advancing E.I.C. interests among the students and that one or more representatives of the students' own society be included in said committee. It is also suggested that at least one member of the faculty be included in the committee.

(b) Suggestions for assisting the students to a closer interest would be:

Introducing students to older members of *The Institute*.

Branch meetings at which students give papers and can be invited to join in discussions.

Making it perfectly clear to all students at the engineering school that they are cordially welcome to attend meetings of the branch whether they are Student members or not.

Offering from time to time to furnish speakers from among members of *The Institute* to the students' own society meetings where such a society exists.

The holding of informal smokers and similar social meetings, inviting students not only to attend but to contribute to the entertainment.

(c) That the aims, functions and general policy of *The Institute* should be brought to the attention of all students entering the engineering school, but the more active propaganda with a view to membership in *The Institute* should be confined to students in the third and fourth years, and should be presented by corporate members of *The Engineering Institute* in consultation, as far as practicable, with members of the Faculty who have first-hand acquaintance with the individual students.

While this recommendation need not be rigidly adhered to, it is felt that it would to some extent prevent the joining of students who will afterwards drop out.

It is naturally understood that under varying local conditions, the branch committee on student activities will not always feel constrained to follow all of the recommendations given above and will undoubtedly develop other methods and means as result of experience.

Respectfully submitted,

GEO. R. MACLEOD, M.E.I.C., *Chairman.*

Committee on Biographies

The President and Council,

Seven biographies of deceased engineers have already been completed, seven others are in process of preparation; authors are being sought for eight others. These memoirs generally range in length from 2,000 to 4,000 words, but some have exceeded this latter limit, the length having been left to the discretion of the writer.

As a policy, the committee has endeavored to have biographies of early engineers completed first. Those of a more recent period should follow later.

Members of *The Institute* must remember that the collection of authentic information respecting deceased engineers is very often a slow and difficult undertaking, and that with busy men, it means quite a sacrifice of time. For that reason, the committee bespeaks the patience of the membership of *The Institute* generally.

The publication in *The Journal* of *The Institute* of the biographies already prepared is contemplated beginning at an early date.

Respectfully submitted,

PETER GILLESPIE, M.E.I.C., *Chairman.*

Ontario Provincial Division

The President and Council,

On behalf of the Ontario Provincial Division, and in pursuance of *Institute* by-law No. 63, the undersigned beg to report that during last year it began to appear that there scarcely seemed any advantage in keeping the division actively functioning any longer, as substantially all the objects for which it had been created were either attained or in a fair way towards being accomplished. In view of this the disbandment of the division was discussed by those members of the executive who attended the last annual meeting in Montreal, and subsequently all the members were circularized as to their opinion thereof.

The vote on the question was substantially unanimous in favour of disbandment, and consequent thereon the activities of the division ceased. We therefore now beg to report this fact to you, and to advise that the division is consequently no longer functioning, this of course with the understanding that should it be found advisable to revive it this could easily and quickly be done, as provided for in section 58 of *The Institute* by-laws.

At the time the above vote was taken there was just one question outstanding which might possibly be handled by the division, this being a proposal by E. M. Proctor, A.M.E.I.C., of Toronto, that representations might be advantageously made as to certain desirable changes in the Ontario Local Improvement Act. After considering the matter it was decided that the best way would be to appoint a committee to go into the question, and this has accordingly been done, this committee consisting of Mr. Proctor, who is chairman, Colonel W. H. Magwood, M.E.I.C., of Cornwall, and W. C. Miller, A.M.E.I.C., of St. Thomas, with power to add to their numbers. It has been arranged that the committee will report to the vice-president of *The Institute* resident in Ontario, who at present is General C. H. Mitchell, M.E.I.C., of Toronto.

On behalf of the Ontario Provincial Division,

W. H. MAGWOOD, M.E.I.C., *Chairman.*

C. R. YOUNG, M.E.I.C., *Vice-Chairman.*

A. B. LAMBE, A.M.E.I.C., *Secretary.*

Branch Reports

Border Cities Branch

The President and Council,

The executive of the Border Cities Branch begs to submit the following annual report for the year ending December 31st, 1923.

Report of Chairman

It is gratifying to again report a distinct increase in membership this year, entirely apart from the gain through the addition of non-resident members. At the present time there is a resident branch membership of 96 as compared with 77 a year ago and 56 in 1921. Through the non-resident clause, 20 members have been added to the roll. Of the resident members, there is a large percentage who may be classified as "unavailable", but it has been a matter of some concern to the executive that the increase in attendance has not kept pace with increased growth. There has been a noticeable increase in the Student members of the branch during the year just closed and one of the problems of the incoming executive will be that of actively interesting these men in the work of *The Institute.*

The papers presented throughout the year have been of a high standard and those who have heard every paper have profited most. The policy of holding dinner-meetings has been followed throughout the year and has been found to be satisfactory preliminary to the paper of the evening.

It is a matter of regret that business affairs have removed Past-Chairman Geo. F. Porter, M.E.I.C., temporarily from our midst, but it is hoped that he and his associates will return in the spring with a contract for the erection of the Sydney bridge which will add fresh laurels to those won at Quebec.

Report of Membership Committee

While it is desirable to enroll every eligible member for *The Institute* it sometimes appear that a person's interest in the branch or in *The Institute* wanes shortly after enrollment. Rather than have a concerted drive for more members, it is evident that stimulation of the present membership towards more regular attendance is more to be desired. The growth of the branch in two years is shown in the following table:

	1921	*1922*	*1923*
Members	13	15	16
Associate Members	29	38	43
Juniors	9	12	14
Students	5	11	22
Affiliates	0	1	1
Total	56	77	96

These figures represent an increase of 70 per cent in two years. The non-resident members are as follows:—

Members	3
Associate Members	9
Juniors	3
Students	35
Total	21

The combined membership, resident and non-resident, is 117.

A detailed statement of membership changes is given herewith: Members through transfer 1; new Associate Members 2; Associate Members through transfer 3; Junior through transfer 1; transferred Student to Junior 1; Students through transfer 11; removal through death 1. We regret to record the loss through death of Lennox T. Bray, A.M.E.I.C.

Meetings

Regular meetings 8; average attendance 28.

Jan. —"The Panama Canal," D. A. Molitor, M.E.I.C.
Feb. —"Canadian Electric Development," S. E. McGorman, M.E.I.C.
Mar.—"The Detroit Filtration Plant," Theodore Leisen.
Apr. —"The Future of the Engineering Profession," Fraser S. Keith, M.E.I.C.
May —"Engineering Legislation," Geo. F. Porter, M.E.I.C.
"The Manufacture of Salt," H. A. Wilson, Jr.E.I.C.
"Aims of the Engineering Institute and the Necessity for Branches," W. H. Baltzell, M.E.I.C.
"Personal Experiences as Related to Errors and Averages," D. A. Molitor, M.E.I.C.
Oct. —"Sewerage Problems of Detroit," C. W. Hubbell.
Nov.—"Low Temperature Distillation of Coal," W. R. McGie.
Dec. —Annual meeting with election of officers.

Advertising Committee

The Border Cities Branch has a splendid opportunity to make *The Journal* a direct source of branch revenue through the inducement of local industrial or other concerns to use it as an advertising medium. A start was made this year with prospects for increased space in 1924.

Branch Committees

The following committees were active during the year:—

Papers and Entertainment.

Jan. to May, — W. J. Fletcher, A.M.E.I.C., (chairman); O. J. Hein, A.M.E.I.C.; E. J. McIntire, A.M.E.I.C.

Oct. to Dec., — A. J. M. Bowman, A.M.E.I.C., (chairman); S. E. McGorman, M.E.I.C.; D. A. Molitor, M.E.I.C.

Membership.

L. McGill Allan, A.M.E.I.C., (chairman); J. E. Porter, A.M.E.I.C.; A. B. Richardson, A.M.E.I.C.

Advertising.

L. E. Collins, Jr.E.I.C., (chairman); H. C. McMordie, A.M.E.I.C.

Nominating.

H. Thorne, M.E.I.C.

Financial Statement

Receipts

To balance in bank		$205.48
Rebates from Headquarters	$113.75	
Branch news	20.00	
Advertising	21.50	
		155.25
Collections at dinner-meetings		113.50
Bank interest		5.10
		$479.33

Expenditures

Notices and printing	$ 28.35
Postage and miscellaneous	10.50
Dinner-meetings	158.23
Flowers	30.00
Typing	10.00
Balance on hand	242.25
	$479.33

Respectfully submitted,

WILL. H. BALTZELL, M.E.I.C., *Chairman.*
J. CLARK KEITH, A.M.E.I.C., *Secretary-Treasurer.*

Calgary Branch

The President and Council,

On behalf of the Executive Committee of the Calgary Branch we beg to submit the following report for the year ending December 31st, 1923.

At the annual meeting on March 11th, 1923, the following officers were elected:—

Chairman......V. M. Meek, A.M.E.I.C.
Vice-Chairman..F. E. Emery, A.M.E.I.C.
Secretary.......J. A. Spreckley, A.M.E.I.C.
Treasurer.......G. P. F. Boese, A.M.E.I.C.
Auditors.......A. Fraser, A.M.E.I.C., and J. J. Hanna, A.M.E.I.C.
Executive......A. S. Chapman, A.M.E.I.C., W. J. Dick, M.E.I.C., and J. Haddin, M.E.I.C.
Ex-officio members of the executive, — P. J. Jennings, M.E.I.C., and B. L. Thorne, M.E.I.C.

V. A. Newhall, A.M.E.I.C., was subsequently appointed a member of the committee in place of W. J. Dick, M.E.I.C., who removed to the Edmonton district. W. St. J. Miller, A.M.E.I.C., was appointed branch editor.

Meetings

The executive held eight meetings, with an average attendance of six, at which the regular business of the branch was transacted.

Ten general meetings were held at which the average attendance was forty-eight. To following is a list of these meetings:—

Jan. 15—"**Canadian National Parks,**" Major C. G. Child, B.Sc., A.M.E.I.C., resident engineer of the Rocky Mountain Parks.

Jan. 29—"**The Aeroplane,**" by Major G. M. Croil.

Feb. 12—"**Possible Irrigation Development in Alberta and Saskatchewan,**" V. M. Meek, A.M.E.I.C., acting commissioner of irrigation. R. S. Stockton, M.E.I.C., superintendent of operation and maintenance, C.P.R., Western Section, described the engineering features of operation and maintenance in connection with large irrigation schemes.

Feb. 26—"**Coal Formation in Alberta,**" (paper by Major C. C. Richards, M.E.I.C.), read by Lt.-Col. F. M. Steel, D.S.O., M.E.I.C.

Mar. 10—Annual meeting.

Mar. 26—"**Progress of Street Railway Track Design in Great Britain from the year 1870,**" by W. J. Gale, A.M.E.I.C.

Aug. 25—Luncheon and address on Imperial Oil Refinery works, followed by a visit to the plant at Ogden. C. M. Moore, superintendent.

Nov. 15—"**The Responsibilities of the Engineer in Civic Life,**" I. P. MacNab, M.E.I.C.

Nov. 26—"**Financial Difficulties in Irrigation Development,**" D. W. Hays, M.E.I.C., consulting irrigation engineer.

Sept. 10—"**Western Canada Waters for Boiler Purposes,**" Thos. Lees, A.M.E.I.C., district engineer of the Canadian Pacific Railway for Alberta.

The branch is indebted to the several speakers for contributing to the success of the programme, to the Programme Committee for the excellent entertainment provided, to the Press of Calgary for its co-operation, and to the Calgary Board of Trade for the free use of their comfortable rooms for meetings.

At the annual meeting W. J. Dick, M.E.I.C., offered a prize of the value of twenty-five dollars for the best paper submitted by a Junior of *The Institute*, provided three compete. These papers will be read at an early date.

At a farewell dinner to Geo. W. Craig, M.E.I.C., on April 27th, 1923, he was presented with framed photographs of the three reinforced concrete bridges erected in the city under his direction. Mayor Webster was among those present and Mr. Craig was heartily congratulated on his appointment with the Asphalt Association at Chicago.

During the summer a golf competition was arranged with the Chartered Accountants of Calgary.

Membership

The membership of the branch compares with the end of last year as follows:—

	Jan. 1st, 1923	Dec. 31st, 1923 Resident	Dec. 31st, 1923 Non-Resident
Members	22	19	1
Associate Members	67	68	10
Juniors	7	5	4
Students	5	2	1
Affiliates	1	1	0
Affiliates of the Branch	7	8	0
	109	103	16

There has been a net loss of members by removals due to economic conditions.

Approximately 50 per cent of the members are in the service of the Dominion, Provincial and City governments, while 25 per cent are with the Canadian Pacific Railway Company, 20 per cent with other industrial companies, and 5 per cent are in private practice.

The branch was represented at the convention of the Western Canada Irrigation Association in Penticton, B.C., by R. S. Stockton, M.E.I.C., and W. H. Snelson, A.M.E.I.C.

Respectfully submitted,

F. E. Emery, A.M.E.I.C., *for the Chairman.*
J. A. Spreckley, A.M.E.I.C., *Secretary.*

Financial Statement

For financial year ending December 31st, 1923

Revenue

Interest on bonds and savings	$ 50.93	
Rebates	182.00	
Branch news	66.28	
Branch Affiliates	15.00	
		$314.21

Expenditure

Meetings, etc	$ 62.70	
Stenographic services	24.87	
Printing and miscellaneous expenses	130.67	
		218.24
		$ 95.97
Bank balance at December 31st, 1923	$311.98	
Bank balance at December 31st, 1922	269.08	
	$ 42.90	
Amount of rebates and branch news due from Headquarters	$ 53.07	
		$ 95.97

Assets

Cash in bank	$311.98
Market value of securities	818.55
Fees collectable from Branch Affiliates	24.00
Rebates, — Branch news due from Headquarters	53.07
Surplus at December 31st, 1923	$1,207.60

Liabilities

Nil.

Surplus at December 31st, 1922	$1,110.21
Increase in value of assets	97.39

Audited and found correct.

A. Fraser, A.M.E.I.C. } *Branch*
J. J. Hanna, A.M.E.I.C. } *Auditors.*

G. P. F. Boese, A.M.E.I.C.
Treasurer.

Cape Breton Branch

The President and Council,

On behalf of the Executive Committee of the Cape Breton Branch, we beg to submit the following report for the year ending December 11th, 1923.

At the last annual meeting the following officers were elected:

Chairman, — K. H. Marsh, M.E.I.C.

Committeemen, — Horace Longley, M.E.I.C., C. C. Curtis, M.E.I.C.

At a meeting of the executive held in July, A. P. Theuerkauf, M.E.I.C., and S. C. Mifflen, A.M.E.I.C., were appointed members of the executive in place of Mr. Marsh and Mr. Curtis who resigned on account of leaving the province. Mr. Longley was appointed chairman, and Mr. McMaster vice-chairman.

Membership

The present membership of the branch is forty-two, which is the same number as at this time last year,new members having been balanced by members leaving the district. In addition to the above there are eight applications pending.

Meetings

The following meetings were held during the past year:—

Dec. 12—Annual meeting — "**Abnormal Friction Loss in a 12-inch Pipe Line**", J. G. H. Purves, M.E.I.C.

Jan. 9—"**Shaft Sinking,**" D. A. Y. Colquhoun, Jr.E.I.C.

Mar. 7—"**Mechanical Stokers,**" John T. Farmer, M.E.I.C.

Mar. 20—Dinner at Boscobel.

Apr. 17—"**Coke Manufacture with Bye-Product Recovery,**" E. C. Tonge, A.M.E.I.C.

May 19—Visit to Coke Manufacturing Department of The Dominion Iron and Steel Company.

June 2—Dinner at Pottles Lake, North Sydney.

Sept. 18—"**General Advance of Radio Since the Early Days of Marconi,**" J. W. Mullin, A.M.E.I.C.

Oct. 16—"**Metallurgical Re-heating Furnaces for Blooms, Billets and Slabs,**" A. P. Theuerkauf, M.E.I.C.

Nov. 13—"**The Application of Fuel to a Steel Plant,**" M. W. Booth, A.M.E.I.C.

Nov. 20—Dance and social evening.

Finances

Financially we have just about held our own. At the last annual meeting we had a balance on hand of $79.02. This has been slightly increased to $92.97, but unpaid bills for $12.80 will reduce this amount to $80.17.

Balance on hand at last annual meeting, bank	$ 63.32	
cash	15.70	$ 79.02

Receipts

Rebates from Headquarters	$ 11.95	
	44.06	
	37.25	$ 93.26
Local dues — Last quarter 1922	$ 28.00	
1st quarter 1923	80.00	
2nd quarter 1923	30.00	
3rd quarter 1923	60.00	
4th quarter 1923	32.00	$230.00
Sale of photographs		1.25
Total		$403.53

Expenditures

Rent for one year to Jan. 31, 1924	$180.00	
Printing	32.42	
Telegrams	3.72	
Postage, stationary, etc	9.97	
Presentations	24.50	
Deficit on dinner Mar. 20th	12.10	
Deficit on dinner June 2nd	47.85	$310.56
Cash on hand	$ 25.68	
Cash in bank	67.29	92.97
Total		$403.53

Collections of local dues have been only fair, there being $126.00 outstanding on this account.

Respectfully submitted,

HORACE LONGLEY, A.M.E.I.C., *Chairman.*

DONALD W. J. BROWN, Jr.E.I.C., *Secretary-Treasurer.*

Edmonton Branch

The President and Council,

We beg to submit herewith an annual report covering some of the activities of the Edmonton Branch for the calendar year 1923.

Five general meetings have been held, at which meetings papers have been read on the following subjects:

Feb. 14—"**Edmonton Power Plant,**" W. J. Cunningham, superintendent Edmonton power plant.
"**Highways,**" H. G. Dimsdale, M.E.I.C.
"**Soil Survey,**" Dr. Wyatt, University of Alberta.

Mar. 14—"**Combustion Problems and Furnace Designs,**" C. A. Robb, M.E.I.C.
"**Why Our Wheat Goes via American Ports,**" John Armstrong, late chief engineer Hudson's Bay Railway.

Apr. 18—"**Report of the Edmonton Branch Committee on Testing of Local Concrete Materials,**" C. C. Sutherland, A.M.E.I.C., chairman of the committee.
"**House Heating Furnaces,**" R. T. Hollies.
"**Grading of Coal,**" N. C. Pitcher.

Nov. 28—"**Engineering Details of a Natural Gas Plant,**" H. C. Hill, chief engineer, Northwestern Utilities, Ltd., Edmonton.

Dec. 13—"**Some Applications of Law to Engineering,**" Professor Kleven, University of Alberta.

During the same period the Executive Committee has met on five occasions. The branch by-laws are at present in course of revision by the executive, with a view to bringing same up to date and into line with other branches of *The Institute.*

The branch has recently appointed committees on fuel and membership.

At December 1923 the membership is as follows:

	Resident	*Non-resident*	*Total*
Members	11	1	12
Associate Members	42	7	49
Juniors	3	1	4
Students	4	1	5
Total	60	10	70

Financial Statement
for calendar year 1923

Balance on hand at Jan. 1st		$121.31
Receipts		
Rebates — Jan., Feb., Mar.	$ 40.00	
Rebates — Apr., May, June, July, Aug.	27.50	
Rebates — Sept., Oct., Nov., Dec.	23.89	
Branch news during year	5.56	
		96.95
		$218.26

Expenditures

Total disbursements	$158.76	
Balance at December 31st	59.50	
		$218.26

Respectfully submitted,

R. S. L. WILSON, A.M.E.I.C., *Chairman.*

W. R. MOUNT, A.M.E.I.C., *Secretary-Treasurer.*

Halifax Branch

The President and Council,

The Executive Committee of the Halifax Branch for the year 1923 respectfully submits this report of the activities of the Halifax Branch.

Notable among the meetings of the year was one which was undertaken by a committee of the students of Nova Scotia Technical College. The chairman and all the speakers were students of the fourth year, one from each of the courses in mining, electrical, civil and mechanical engineering. The four papers which were read were exceptionally good and it was very gratifying to see that the speakers had not yet passed the stage where they could keep their remarks within a time limit. In this case it was fifteen minutes.

When the territory of the branch was extended to include all that part of Nova Scotia which is westward of the eastern boundaries of the counties of Pictou and Halifax, the executive recommended to the branch that the by-laws be changed to give the branch district members representation on the Executive Committee. After the necessary legal formalities a letter ballot was submitted with the ballot for the election of officers for the year 1924. The voting was unanimously in favour of increasing the number of members who will constitute the Executive Committee from six to ten, of whom four shall be residents of the territory of the branch which is more than twenty-five miles from the city of Halifax. It is recognized that the income of the branch is not sufficient at present to cover the expenses of out-of-town members to all the sessions of the Executive Committee in addition to the other expenses which must be met from it. Nevertheless it is expected that the new executive will be able to find ways to make knowledge and enthusiasm of its out-of-town members available and effective to the general economy of the branch.

Last June the resignation of O. S. Cox, A.M.E.I.C., was regretfully received by the Executive Committee in particular, and by the branch. We have already recorded our appreciation of the excellent service which he willingly gave us on the minutes of the branch and we are glad to have this opportunity of publicly stating it. The circumstances which made it necessary for him to resign are regretted by every member.

After the appearance in the October *Journal* of the report of the Committee on Classification and Remuneration, a committee was appointed to obtain from each member of the branch his opinions concerning its adequacy and workability. The work of this committee is progressing toward completion. Some forty replies have been received, but the committee reports that it is hard to get some members to express any opinion at all.

Our annual meeting this year was a function which all who attended look back to as a departure from our ordinary way, which is to be commended and considered as a precedent. For sociability and interest in branch affairs it set a record which will be hard to beat. It made such an appeal to all that suggestions have been made already that the Executive-Committee-elect attempt to make the next annual meeting a financial success also.

Meetings

During the year 1923 the branch has held seven meetings as follows:—

Jan. 4—Regular monthly meeting at which the chairman was Commander R. H. Wood, M.E.I.C., and the speaker J. F. Paige, operating manager of the Halifax Shipyards, who lectured on "**The Development of Shipbuilding and Marine Engineering**". The lecture was given in the Assembly Hall of the Nova Scotia Technical College which was decorated for the occasion by a committee consisting of H. W. L. Doane, M.E.I.C., chairman, R. P. Freeman, A.M.E.I.C., W. F. McKnight, A.M.E.I.C., H. B. Pickings, A.M.E.I.C., and A. L. Dobson, S.E.I.C.

Feb. 2—Regular monthly meeting, Professor F. R. Faulkner, M.E.I.C., in the chair. The speaker was Col. F. W. W. Doane, M.E.I.C., city engineer, who took as his subject "**Some Problems of the Municipal Engineer**". This was a supper meeting held in the Green Lantern. There were 33 present.

Mar. 9—Regular monthly meeting, Professor D. W. Munn, A.M.E.I.C., in the chair. W. B. Mackay, A.M.E.I.C., spoke on "**Some Recent Developments in Ventilation**". His address was given in the Green Lantern after a supper during which the members indulged in singing for the first time from the song sheets which the Council had just supplied. Present 42.

Apr. 13—Regular monthly meeting for which all arrangements were made and papers prepared by student members. W. B. Wyman, S.E.I.C., was in the chair and the students' orchestra of Nova Scotia Technical College dispersed sweet music throughout the evening. Short papers were read by the following:
H. W. Humphrey, S.E.I.C., "**Recent Tests on Concrete**".
G. H. Burchell, "**Radio Telephony**".
L. G. Gauvin, "**Automobile Troubles and their Remedies**".
J. C. Dawson, "**Oil Shale**".
This meeting was remarkable for the large number of student members who were present and the large number of corporate members who were absent.

May 18—Regular monthly meeting: — Chairman, R. W. McColough, A.M.E.I.C.; speaker, Colonel Boyden; subject, "**Concrete Specifications in Highway Construction**"; place, the Assembly Hall of the Nova Scotia Technical College. Present 25.

Nov. 1—Regular monthly meeting in the Green Lantern. Professor F. R. Faulkner, M.E.I.C., in the chair. Animated discussions on the next annual meeting, the report on classification and remuneration, the changes in the by-laws made necessary by the extension of the territory of the branch. At this meeting the branch nominating committee was appointed. Present 21.

Dec. 20—Annual meeting and dinner in the St. Julien room of the Halifax hotel. Short talks by R. T. MacIlreith, L.L.B., member of the Board of Commissioners of Public Utilities of the Province of Nova Scotia, A. S. MacMillan, chairman of the Provincial Highways Board, Province of Nova Scotia, Colonel P. Benoit and Major Henshaw of the Engineering Corps of the Garrison. The most enjoyable and profitable annual meeting which this branch has ever had.

Membership

The membership of the Halifax Branch now stands as follows:—

	Resident	*Non-resident*	*Total*
Honorary Members	1	..	1
Members	22	16	38
Associate Members	37	35	72
Juniors	8	6	14
Students	9	11	20
Total	77	68	145

Financial Statement

Receipts

Rebates from Headquarters	$147.62	
Payments for Branch news	53.07	
Receipts from annual meeting	49.00	
Balance from 1922	224.55	
Total receipts		$474.24

Expenditures

Stamps and post cards	$ 25.87	
Telegrams	2.36	
Meetings	11.60	
Exchange on cheques	.45	
Miscellaneous	6.80	
Stenographer	25.50	
Journal subscriptions Branch Affiliates	4.00	
Repayment of loan from Council	50.00	
Branch furniture and supplies	54.75	
Honorarium to secretary	50.00	
Expenses of annual meeting	122.23	
Total expenditures		353.58
Balance		$120.66
Cash on hand and in bank	$ 76.46	
Due from Headquarters	54.20	
Total		$120.66

Audited and found correct:
W. F. McKnight, A.M.E.I.C.
J. F. Lumsden, A.M.E.I.C.

Respectfully submitted,
F. R. Faulkner, M.E.I.C., *Chairman.*
K. L. Dawson, A.M.E.I.C., *Secretary-Treasurer.*

Hamilton Branch

The President and Council,

The Executive Committee of the Hamilton Branch submits the following report for the year 1923.

The branch year dates from June 1st. The following compose the executive committees during 1923:—

January to June.		June to December.
H. U. Hart, M.E.I.C.	Hon. Chairman	H. U. Hart, M.E.I.C.
F. W. Paulin, M.E.I.C.	Chairman	J. W. Tyrrell, M.E.I.C.
J. W. Tyrrell, M.E.I.C.	Vice-Chairman	W. G. Milne, A.M.E.I.C.
W. F. McLaren, M.E.I.C.	Sec.-Treasurer	W. F. McLaren, M.E.I.C.
H. G. Bertram, M.E.I.C. (1 yr)		J. J. MacKay, M.E.I.C. (1 yr)
P. M. Smith, M.E.I.C. (1 yr)		C. H. Marrs, M.E.I.C. (1 yr)
J. J. MacKay, M.E.I.C. (2 yrs)		F. P. Adams, A.M.E.I.C. (2 yrs)
C. H. Marrs, M.E.I.C. (2 yrs)		C. J. Nicholson, A.M.E.I.C. (2 yrs)

Ex-officio

E. H. Darling, M.E.I.C.... Past-Chairman F. W. Paulin, M.E.I.C.

Meetings

The following meetings were held:—

Jan. 23—"**Rail Carbon Steel,**" J. B. Carswell, A.M.E.I.C., illustrated with lantern slides; attendance 50.

Mar. 12—"**Discussion on the Report of the Railway Situation in Hamilton,**" led by J. W. Tyrrell, M.E.I.C., Noulan Cauchon, A.M.E.I.C., (Ottawa) and F. W. Paulin, M.E.I.C.; attendance 50.

Apr. 6—"**Japanese Developments and Pacific Wanderings,**" Stephen Q. Hayes of Pittsburgh.
This was a joint meeting with the Toronto Section A.I.E.E. held in the Westinghouse auditorium. After the meeting refreshments were served by the Canadian Westinghouse Company; attendance 150.

Apr. 27—The branch entertained the out-of-town members at dinner. Papers were read on "**Roads and Pavements**", F. P. Adams, A.M.E.I.C., Brantford, Guy R. Marston, A.M.E.I.C., Simcoe, and D. T. Black, A.M.E.I.C., Galt; attendance 35.

May 10—Annual meeting. Reports presented and elections announced. Paper read by Lt.-Col. H. C. Boyden on "**Recent Developments in Concrete**"; attendance 100.

Nov. 1—Annual banquet with President Walter J. Francis, M.E.I.C., and Secretary Fraser S. Keith, M.E.I.C., as guests; attendance 50.

Dec. 14—"**Asbestos Production**" — Canadian Johns Manville Company.

Membership

	Dec. 31st, 1922	*Dec. 31st, 1923 Resident*	*Non-Res.*	*Total*
Members	22	21	3	24
Associate Members	57	59	12	71
Juniors	10	13	2	15
Students	27	33	17	50
Branch Affiliates	48	37	..	37
Total	164	163	34	197

Financial Statement

Receipts

Brought forward	$307.02	
Journal subscription	10.00	
Rebates	175.47	
Branch news	54.05	
Branch Affiliates	95.70	
		$642.24

Expenses

Printing and postage	$ 72.16	
Rent of halls	22.00	
Annual dinner	33.29	
Stenographer	50.00	
Journal subscriptions	10.00	
Miscellaneous	91.95	
Balance	362.84	
		$642.24

Respectfully submitted,

J. W. Tyrrell, M.E.I.C., *Chairman.*
W. F. McLaren, M.E.I.C., *Secretary-Treasurer.*

Kingston Branch

The President and Council,

The Executive Committee of the Kingston Branch submits the following report for the year 1923.

Meetings were held on the second and fourth Tuesdays of the first three months and last three months of the year. It is not possible to conduct meetings over a greater period than this, since the majority of the members are not in the city from early spring until late summer.

Meetings

Nine meetings were held during the year as noted below:—

Jan. 9—"**The Influence of Power and Load Factors on Power Costs,**" Professor D. M. Jemmett, A.M.E.I.C., Queen's University.

Feb. 5—"**Modern Types of Reaction Turbines,**" H. S. Van Patter, A.M.E.I.C., Dominion Engineering Company, Montreal.

Feb. 20—"**Methods and Plants used in Highway Construction,**" Professor W. L. Malcolm, M.E.I.C., Queen's University, Kingston.

Feb. 27—"**New Method of Measurement of Water Flow in Penstocks,**" N. R. Gibson, M.E.I.C., American Niagara Falls Power Co.

Mar. 12—"**The Exploration Trip to the Arctic in 1922,**" J. D. Craig, M.E.I.C., International Boundary Commission, Ottawa.

Apr. 4—Annual dinner. H. S. Person, managing director of the Taylor Society of New York spoke on "**Scientific Management applied to an Industry**".

Oct. 14—"**Recent advances in Prime Movers,**" Professor L. M. Arkley, M.E.I.C., Queen's University, Kingston.

Nov. 1—Annual meeting.

Nov. 26—"**Bacteriology as applied to Sanitation,**" Dr. Reed, Queen's University, Kingston.

Membership

The approximate membership of the branch is as follows:—

Honorary Member	1
Members	12
Associate Members	28
Juniors	3
Students	40
Affiliate	1
Total	85

The decrease in membership from last year is partly due to the redistribution of branch areas, but more so to the loss of Student members in the large graduating class from Queen's University in April 1923.

Financial Statement

The following is a financial statement for the year 1923:—

Receipts

Jan. 1	Cash on hand	$ 93.72	
Jan. 15	Rebates on fees	4.75	
	Branch news	8.06	
Apr. 30	Dinner collections	36.25	
May 23	Rebates on fees	52.75	
	Branch news	22.23	
June 30	Bank interest	1.83	
Oct. 9	Rebates on fees	22.75	
Dec. 31	Rebates from Headquarters	15.95	
			$258.29

Expenditures

Jan. 1 to Dec. 31,	total disbursements	$166.66	
Dec. 31	Credit balance	91.63	
			$258.29

Respectfully submitted,

T. A. McGinnis, M.E.I.C., *Chairman.*
A. Jackson, A.M.E.I.C., *Secretary-Treasurer.*

Lakehead Branch

The President and Council,

On behalf of the Executive Committee I beg to submit the following report of the Lakehead Branch. This report is the first full year report to Council from this branch.

Membership

Up to the time of the change in territory of each branch, authorized by Council July 9th, 1923, the Lakehead Branch membership consisted of 32 corporate members and 3 non-corporate members. With the larger district allotted by Council to this branch our membership increased, so that, at December 31st, 1923, it consisted of 37 corporate members and 8 non-corporate members.

Meetings

Due to an unusually busy season of construction at the "Head of the Lakes", the meetings of the branch were not held on regular schedule. From January to May, inclusive, meetings were held on the first Monday of each month in Port Arthur and Fort William alternately. From June to September, inclusive, no meetings were held. After September, meetings were held on October 1st, and November 5th, and there was no meetings held in December. The meeting of November 5th, was in the form of a dinner at the Kaministiquia Club, Fort William.

At the annual meeting, May 7th, in Port Arthur, the following officers were elected for 1923-24:—

Chairman, — G. H. Burbidge, M.E.I.C.
Vice-Chairman, — H. S. Hancock, A.M.E.I.C.
Secretary-Treasurer, — Geo. P. Brophy, A.M.E.I.C.
Executive Committee, — J. Antonisen, M.E.I.C., D. G. Calvert, A.M.E.I.C., W. T. Moodie, M.E.I.C., C. B. Symes, A.M.E.I.C.

Also, at this meeting, F. Y. Harcourt, M.E.I.C., and W. T. Moodie, M.E.I.C., were nominated to represent the Lakehead Branch on the Council of *The Institute.*

Financial Statement

Revenue

Balance in bank, December 31st, 1922	$ 39.33	
Rebates from Headquarters	51.13	
Branch news	4.73	
Dinner, November, 1923	8.00	
		$103.19

Expenditure

Telegrams	$ 2.19	
Postage	4.00	
Exchange on cheques	.30	
Dinner, November, 1923	23.75	
Balance in bank, December 31st, 1923	72.24	
Cash on hand	.71	
		$103.19

Respectfully submitted,

Geo. P. Brophy, A.M.E.I.C., *Secretary-Treasurer.*

Lethbridge Branch

The President and Council,

The executive of the Lethbridge Branch begs to submit the following report for the calendar year 1923.

This report covers part of two branch years, and the administration of the branch has been under the direction of the following committees:—

1922 — 1923		*1923 — 1924*
C. M. Arnold, M.E.I.C.	Chairman	C. D. MacKintosh, M.E.I.C.
G. S. Brown, A.M.E.I.C.	Sec.-Treas.	G. S. Brown, A.M.E.I.C.
S. G. Porter, M.E.I.C.		S. G. Porter, M.E.I.C.
C. D. MacKintosh, M.E.I.C.		G. N. Houston, M.E.I.C.
H. W. Meech, A.M.E.I.C.		John Dow, M.E.I.C.
H. G. Cochrane, A.M.E.I.C.		H. P. Keith, A.M.E.I.C.

Membership

	Member	*Associate Member*	*Junior Student Affiliate*	*Total*
Gain to branch membership	2	–	2	4
Loss to branch membership	4	1	–	5
Gain to branch dist. membership	11	3	–	14

1922		*1923*	
Members	9	Members	11
Associate Members	21	Associate Members, (Resident)	19
		(Non-resident)	11
Juniors	3	Juniors	2
Students	3	Students, (Resident)	3
		(Non-resident)	3
Associate	1	Affiliate	1
Branch Affiliates	27	Branch Affiliates	27
Total	64	Total	77

Net gain in membership: 13.

During the past year, owing to the change of branch districts we have gained eleven Associate Members and three Students; also two branch Members, four Associate Members and one Junior having left the district. There are three applications pending, one of which is from an Affiliate. All these applications are approved by the executive.

Meetings

During the year the branch has held five executive meetings and ten general meetings. The following addresses were given:—

Jan. 27—"Law as applied to Contracts," W. S. Ball, city solicitor, Lethbridge, Alberta.

Feb. 10—"Coal Mining," W. Meldrum, assistant engineer, Galt Mines, Lethbridge, Alberta.

Feb. 24—"Electrical Power Plants," John Watson, R.P.E., superintendent Lethbridge power plant, Lethbridge, Alta.

Mar. 10—"Mining and Smelting of Precious Ores," F. H. Hutton, Lethbridge, Alberta.

Mar. 24—"The design and Construction of Locomotives," G. H. Nowell, divisional master mechanic, C.P.R., Lethbridge, Alberta.

Apr. 28—"Water Purification," Mr. Vallance, sanitary engineer, Lethbridge, Alberta.

Nov. 3—"Geological Formation of Coal Fields," W. Meldrum, assistant engineer, Galt Mines, Lethbridge, Alta.

Nov. 17—"The Relation of the Waters of Western Canada to Steam Boilers," W. Lees, M.E.I.C., C.P.R. district engineer, of Water Supply for Alberta.

Dec. 1—"Construction of the Banff-Windermere Highway," C. A. Davidson, construction engineer of Alberta.

Dec. 15—"Recondition of the Cowley Bridge," C. F. Draper, M.E.I.C., bridge engineer, C.P.R.

Financial Statement

Trial Balance as at March 10th, 1923.

	Dr.	Cr.
General fund		$113.98
Treasurer	$113.98	
Headquarters		50.00
Dues account	135.01	
Membership account		135.01
Headquarters	50.00	
	$298.99	$298.99

Receipts

Cash in bank, Mar. 11th, 1922	$125.93	
Rebates	59.25	
Branch Affiliates due	90.00	
Branch news	9.88	
Refund on *Journal* subscriptions	1.50	
		$286.56

Disbursements

Printing	$ 28.86	
Books and stationery	18.65	
Sundries	49.57	
Journal subscriptions	34.50	
Dues collected on account, headquarters forwarded	41.00	
Cash in bank, Mar. 10th, 1923	113.98	
		$286.56

Assets

Cash in bank	$113.98	
Fees owing by Branch Affiliates	59.50	
Rebates due from sundry members	75.63	
		$249.11

Liabilities

Advance from Headquarters	$ 50.00	
Net assets	199.11	
		$249.11

We have examined the vouchers and papers of the Lethbridge Branch, *The Engineering Institute of Canada*, also the statement drawn up by G. S. Brown, A.M.E.I.C., secretary-treasurer, and find same to be correct and a true account of the standing of the branch.

P. M. Sauder, M.E.I.C.,
C. L. Dodge, A.M.E.I.C.
Auditors.

Statement — March 11th, 1922 to December 31st, 1923.

Receipts

Rebates	$ 58.75	
Branch Affiliate dues	49.00	
Bank interest	2.69	
Branch news	13.89	
		$124.33

Expenditures

Advance repaid Headquarters	$ 50.00	
Institute Journal	23.30	
Printing	28.35	
Sundries	43.50	
		$145.15

Assets

Rebates due from Headquarters, Dec. 31st, (as per wire)	$ 13.25	
Cash in bank	88.16	
Cash on hand	5.00	
Rebates from Headquarters, outstanding	6.63	
Branch Affiliates dues, outstanding	9.50	
		$122.54

Liabilities

Accounts payable	$ 8.00

Respectfully submitted,

John Dow, M.E.I.C., *Chairman.*
George S. Brown, A.M.E.I.C., *Secretary-Treasurer.*

London Branch

The President and Council,

On behalf of the Executive Committee, we beg to submit the following report for the year ending December 31st, 1923.

Seven executive, eight regular, and two special meetings of the branch were held during the year. Many prominent engineers delivered addresses at the branch meetings. Papers were also presented by members representing the various activities of the branch.

A committee was appointed on April 6th, to investigate the practicability of using Alberta coal in western Ontario. The committee presented their report at a special meeting December 12th. This report will probably appear in a later issue of *The Journal.*

Membership

During the past year the membership of the branch has increased from 60 to 80.

	1922	1923
Members	13	13
Associate Members	24	34
Juniors	10	12
Students	13	21
	60	80

Financial Statement

Revenue

Balance in bank January 1st, 1923	$ 62.47	
Rebates from Headquarters (dues and branch news)	128.20	
Surplus from annual dinner	3.25	
Special entertainment fund (subscriptions)	29.00	
Interest at bank	.77	
	223.69	
Rebate due from Headquarters	12.50	
		$236.19

Expenditures

Notices and printing	$ 16.33	
Postage	15.23	
Telegrams	1.18	
Janitor's services	8.00	
Rental of chairs	7.50	
Stenographer's services	10.00	
Filing case — including freight, etc	85.99	
Entertaining out-of-town speakers	26.60	
Express charges	1.00	
Special entertainment expenses	10.97	
Cigars	6.00	
Sundries	6.00	
Adjusting error in last year's bank balance	10.64	
	205.44	
Balance in bank	18.25	
Rebate due from Headquarters	12.50	
		$236.19

Balance in bank	$ 18.25	
Rebate due from Headquarters	12.50	
		30.75
Bills payable		14.60
Net credit as at December 31st		$16.15

Respectfully submitted,

E. V. Buchanan, M.E.I.C., *Acting Chairman*
E. A. Gray, Jr.E.I.C., *Secretary-Treasurer.*

Moncton Branch

The President and Council,

On behalf of the Executive Committee, we beg to submit the fourth annual report of the Moncton Branch.

The Executive Committee held several meetings during the year 1923, and transacted a considerable amount of business. There were seven meetings of the branch held during the year, three were supper meetings, which continue to be most popular with the members, and one meeting was held at Mount Allison University, Sackville, N.B.

We regret to say, that owing to a number of our members being transferred, the membership of our branch has been reduced from 88 to 75, and of the present membership, sixteen are non-resident members. The membership at present consists of:—

	Resident	*Non-Resident*	*Total*
Members	10	1	11
Associate Members	26	10	36
Juniors	5	3	8
Students	16	2	18
Affiliates	2	..	2
Total	59	16	75

The annual meeting of the branch was held on June 1st, and the following officers were elected for 1923-24:—

Chairman, — W. B. MacKenzie, M.E.I.C.
Vice-Chairman, — F. O. Condon, M.E.I.C.
Secretary-Treasurer, — M. J. Murphy, A.M.E.I.C.
Executive Committee, — H. J. Crudge, A.M.E.I.C.
E. G. Evans, M.E.I.C.
J. D. McBeath, M.E.I.C.
*G. C. Torrens, A.M.E.I.C.
*C. S. G. Rogers, A.M.E.I.C.
*A. S. Gunn, A.M.E.I.C.
*A. F. Stewart, M.E.I.C., *ex-officio.*

*Members of the Executive holding office for another year.

Financial Statement

The financial statement for the year ending December 31st, 1923 is as follows:—

Revenue

Balance from 1922	$122.40	
Rebates on dues and branch news	104.12	
Tickets sold for supper-meetings	95.25	
Donations	5.15	
Bank interest	2.66	
	329.58	
Rebate due from Headquarters	24.14	
Total		$353.72

Expenditures

Postage	$ 6.42	
Expenses of meetings	126.80	
Printing	31.28	
Telegrams and telephones	4.44	
Purchase of attache case	18.65	
Incidental expenses	34.85	
Total	222.44	
Balance not including rebate due from Headquarters	107.14	
Rebates due from Headquarters	24.14	
		$353.72

Respectfully submitted,

FRED CONDON, M.E.I.C., *Chairman.*

M. J. MURPHY, A.M.E.I.C., *Secretary-Treasurer.*

Montreal Branch

The President and Council,

It now becomes my duty as presiding officer of this branch for the past year, and on behalf of the executive, to present to you an account of our stewardship.

With the ordinary course of meetings of the branch you are already familiar, and the report of the Papers and Meetings Committee will furnish you with a resume of what has been accomplished. In regard to the programme carried out, I think we have just cause for congratulation. I believe that in general interest it compares favourably with those of preceding seasons. The general level of the addresses presented has been well maintained; the range of subjects dealt with has been fairly representative of the various branches of engineering embraced by *The Institute.* Naturally, some few occasions have stood out as of particular interest and on several occasions valuable discussions have followed the presentation of papers.

Reference may perhaps be permitted to one or two of these papers, which, on account of their timeliness or special interest, have aroused more than usual attention both within and outside of our membership.

In April, F. W. Cowie, M.E.I.C., presented a carefully prepared paper of the subject of Transportation Routes in Canada. This important subject drew out discussion on the part of members and a number of visitors to such an extent that the executive set apart a second evening for the continuation of the discussion, which was fully justified by the sustained discussion which resulted.

The autumn session was opened with a discussion on an allied topic; that of the development of the St. Lawrence Water Way, introduced by E. A. Forward, M.E.I.C. It was found desirable on this occasion also to prolong the discussion to a second evening. On this occasion, besides a number of visitors interested in shipping, we had the privilege of having with us members from other branches of *The Institute,* both of which added to the interest of the discussion.

In both the cases named the executive were able to arrange for advance copies of the paper to be placed in the hands of members. This added greatly to the value of the papers, and opened up the opportunity for more intelligent discussion. In similar cases this procedure is commended to the attention of future executives, and will no doubt be followed out whenever practicable.

The executive of the branch for the year 1923 consisted of the following personnel, and in all, nine meetings were held:—

Chairman	John T. Farmer, M.E.I.C.
Vice-Chairman	O. O. Lefebvre, M.E.I.C.
Secretary-Treasurer	E. A. Ryan, A.M.E.I.C.
Executive	Lt.-Col. R. Bickerdike, M.E.I.C.
	F. A. Combe, M.E.I.C.
	C. J. Desbaillets, M.E.I.C.
	P. B. Motley, M.E.I.C.
	A. C. Tagge, M.E.I.C.
	D. C. Tennant, M.E.I.C.
Past-Chairman	J. A. Duchastel, M.E.I.C.
President	Walter J. Francis, M.E.I.C.
Members of Council	Frederick B. Brown, M.E.I.C.
	J. M. R. Fairbairn, M.E.I.C.
	Geo. R. MacLeod, M.E.I.C.
	C. M. McKergow, M.E.I.C.
	R. A. Ross, M.E.I.C.
	F. P. Shearwood, M.E.I.C.
	Arthur Surveyer, M.E.I.C.
	K. B. Thornton, M.E.I.C.

The first action of the executive was to appoint a Papers and Meetings Committee. It was found that all the members of the outgoing committee who had not been elected to other offices were prepared to carry on, and gentlemen were found to fill up the vacancies. Outside of the ordinary routine business, a number of important questions have been dealt with.

The Fuel Committee

Early in the year the suggestion was brought forward to appoint a committee to look into the fuel situation in the Montreal district. This met with the unanimous approval of the executive and your chairman was given authority to appoint such a committee. As a result, F. A. Combe, M.E.I.C., was asked to head this committee and after some deliberation the personnel of the committee was completed as follows:—

F. A. Combe, M.E.I.C., Chairman.
J. T. Farmer, M.E.I.C., *Ex-Officio*
R. Beausoleil.
J. R. Donald, A.M.E.I.C.
F. W. Gray, A.M.E.I.C.
W. L. Helliwell.

This committee got promptly to work and held a number of meetings. They quickly came to the conclusion that it was beyond their powers to exercise anything in the nature of control of the fuel situation; but that it could be materially helped by the dissemination of accurate and reliable information. It was decided that the press formed the best means for reaching the general public and through the kind and much appreciated co-operation of *The Montreal Star,* a series of popular articles were published in that paper in the spring and again in the autumn. Much gratifying comment on the usefulness of these articles has come to hand, and members will be interested to learn that the second series of articles is now in course of reproduction in pamphlet form.

It is gratifying to us, as a branch, to find that the foundation of this local fuel committee attracted the favourable attention of the council of *The Institute.* In due course it was decided to form a general fuel committee of *The Institute,* and the chairman of our local committee, Mr. Combe, was asked to head this committee.

About the same time a communication was received from the chairman of the Canadian Committee of the National Fire Protection Association suggesting co-operation of *The Institute* with this Association. This matter was felt to be of interest and importance, but for various reasons action was delayed. *The Engineering Institute* is recognized as a member of the National Fire Protection Association, and it is desired that closer co-operation should be effected. This matter was referred to the Council for consideration and it was also decided to ask the Papers Committee to arrange for a general meeting at which this subject could be taken up. This will doubtless be carried out in the near future.

The visit of the American Society of Mechanical Engineers to Montreal in May was an occasion of much interest to the engineering fraternity; a joint committee of *The Institute* and local A.S.M.E. members was already in existence to act as a local committee for this convention. Beyond this, your executive felt that the Montreal Branch should take some distinct part in the entertainment of the American society, and it was decided that this should take the form of a smoker. In order not to burden the ordinary branch funds too heavily, a special subscription was invited for this purpose with the result that the net cost to the branch budget only amounted to $120.98. To judge from the appreciative comments heard from our guests at the time and since, this effort was well worth while, and has left behind enduring pleasant memories of the Montreal visit among those who participated.

In approaching its duties at the beginning of its term, the executive set before them the expression of the objects of *The Engineering Institute* which you will find set forth month by month on the cover of *The Journal* over the crest of *The Institute*. Particularly, we were impressed with the concluding phrase "To enhance the usefulness of the profession to the public". That has been the spirit which inspired such action as the formation of Fuel Committee, and the discussion of subjects of general interest. In this connection a marked feature of the past year has been the fact that outside institutions have on several occasions approached us to co-operate with them in matters of public interest.

From time to time the executive have delegated members to represent *The Institute* at meetings called to deal with various movements. Among these may be mentioned: — Traffic control in Montreal, The adoption of daylight saving, International Mathematical Congress, Code of building by-laws for Montreal, South shore bridge.

It is gratifying to find that other bodies have developed the habit of looking to *The Engineering Institute* for support and co-operation in their projects. In this connection, a phase of the subject developed in discussion at an executive meeting which it is perhaps opportune to touch on at this time. It was pointed out that in appointing a delegate to lend support to any particular movement, *The Institute* could not go further than express general approval of the project and by no means bound itself to adopt any personal views expressed by its representative as the views of the Branch or *The Institute* as a whole.

It was considered that this point should be made clear in accepting any invitation to appoint a representative; and that also the same point should be made clear to, and understood by, the representative appointed. I believe all members will readily acknowledge the wisdom of such reservations, and will bear them in mind if called upon at any time to act as a representative of *The Institute*. It is of course necessary to rely on the discretion of such a representative, as frequently such appointments have to be made rather hurriedly under executive authority and without the opportunity of any general discussion.

Membership

As regards membership, the growth of the branch during the past twelve months has been steady and satisfactory, without being phenomenal. At this date the number of members enrolled coming within the jurisdiction of the Montreal Branch is as follows:—

				Increase
Honorary Members	Resident	2	2	
Members	Resident	200		
	Non-resident	16		
		—	216	31
Associate Members	Resident	372		
	Non-resident	56		
		—	428	78
Juniors	Resident	62		
	Non-resident	9		
		—	71	3
Students	Resident	274		
	Non-resident	30		
		—	304	4
Affiliates	Institute	9	9	3
	Branch	17	17	2
			1,047	121

It should be noted that the increase shown does not indicate that that number of new members have been elected to *The Institute* and attached to the Montreal Branch. To some extent the increase is accounted for by transfers from other branches.

Meetings

The report of the Papers and Meetings Committee of the Montreal Branch for the year 1923, is as follows.

The committee has met on a number of occasions throughout the year for a discussion of methods that would make the Thursday evening meetings more interesting. They have also considered the papers proposed and discussed probable speakers who might be obtained to give addresses.

The accompanying list gives the various meetings held throughout the year together with the subject presented and the speaker who gave the same. These meetings have been fairly well attended and it is gratifying to note the interest that the younger men especially have taken in them.

The committee has considered various means of making *The Institute* meetings as representative as possible of the widely diversified engineering field represented in Montreal. They have considered the types of papers that would make the Montreal Branch as a whole the most interested in the evening addresses. They have found that this is a subject that has been under consideration by the Montreal

Date	*Subject*	*Author*	*Attendance*
Jan. 8	"Scientific Methods of making Concrete" (illustrated)	Dr. D. A.Abrams, M.E.I.C	140
Jan. 18	"Notes on trip over Electrified Sections of the Chicago, Milwaukee and St. Paul Railway"	Arthur L. Mudge, A.M.E.I.C.	85
Jan. 25	"Meters — Gas and Electric"	E. J. Turley, A.M.E.I.C.	70
Feb. 1	"The employment of Radio Telegraphy and Telephony in connection with Forest Fire Patrols"	Major W. A. Steel	90
Feb. 8	"The Construction of the Gouin Dam"	Major J. H. Brace, M.E.I.C.	65
Feb. 15	"Loud Speakers and Public Address Systems"	H. J. Vennes, A.M.E.I.C.	110
Feb. 22	"Air Compressors"	E. S. Winslow, A.M.E.I.C.	60
Mar. 1	"Causerie sur l'exploitation des Tramways de Montreal	Paul Seurot, M.E.I.C	40
Mar. 8	"Power Problems in Manitoba"	J. L. Busfield, M.E.I.C	80
Mar. 15	"Automatic Telephony"	C. O. Schnebly and E. A. Knight	90
Mar. 22	"Electrical Construction Work"	F. H. Farmer, M.E.I.C	85
Apr. 5	"Engineering Features of the Rubber Industry"	W. E. Henthorne	70
Apr. 19	"Transportation Routes in Canada and their Relation to enduring Production"	F.W. Cowie, M.E.I.C	220
Apr. 26	"Notes on Metals in Engineering Service"	G. Sproule, A.M.E.I.C	50
May 3	Discussion of paper on "Transportation Routes in Canada"		160
Oct. 4	"St. Lawrence Deep Waterways"	E. A. Forward, M.E.I.C	200
Oct. 11	Discussion of paper on "St. Lawrence Deep Waterways"		160
Oct. 18	"Fuel Economizers"	J. B. Hesford	80
Oct. 25	"Recruiting and Training Methods in a large Electrical Industry"	John Mills	70
Nov. 1	"Wood Preservation"	Richard V. Look, Affiliate, E.I.C.	50
Nov. 8	"The Use of the Aeroplane in Surveying and Engineering"	Ellwood Wilson, M.E.I.C.	85
Nov. 15	"Induction Co-ordination as a Practical Problem"	J. L. Clarke, A.M.E.I.C.	110
Nov. 22	"The Young Man in Engineering"	Fraser S. Keith, M.E.I.C.	100
Nov. 29	"Metallurgical Notes"	W. G. Dancey	75
Dec. 6	"Irrigation in Brazil"	T. W. McConnell	140
Dec. 13	"The cost of Hydro-Electric Power and the effects theron of Power Factor, Load Factor and Diversity Factor"	Prof. C. V. Christie, A.M.E.I.C.	130
Dec. 20	Annual meeting.		

organization from the beginning of its existence either under its present form or under the one that preceeded it. Since the field of engineering has broadened very much during the last five or ten years due to progress and development in the mechanical, hydraulic, electrical and physical fields, this question is far more insistent than it has ever been before.

To obtain the feeling of the members in this matter a letter requesting suggestions was sent to all members of the branch. The replies received seemed on first reading to show considerable diversity of opinion but on further study the committee found that there was lack of interest on the part of many who looked for more complete technical information in many papers that turned out to be of a more general nature.

We believe this situation will be best met in such cases by the various engineering sections of the branch segregating themselves for the discussion of their own more technical problem.

A certain proportions of meetings of general interest would of course be necessary and advisable.

H. W. Fairlie, A.M.E.I.C., *Chairman,*
Papers and Meetings Committee.

Finances

Referring to the financial status of the branch, I think the only criticism that might be made is that, if anything, we have perhaps been unnecessarily parsimonious in our appropriations for special features in the year's programme. The explanation of this is that at the outset your executive felt some uncertainty as to how the change in the system of rebates allowed by headquarters was going to affect the revenue of the branch; and, as a consequence, it was decided to adopt a policy of economy in every way possible, so as not to impair the financial position. It was decided by the council not to put into effect the changes in rebates until the beginning of 1924, so that the anticipated deficit in revenue did not materialize, and in fact owing to the careful watch kept on the expenditure side of the account by our treasurer, becomes in effect a net profit on the year's operations.

In looking further into the question of future revenue, I am pleased to say that under the new system it appears to me that the decrease in rate of rebate from 25 per cent to 20 per cent will be at least offset by the greater number of members' dues in the wider territorial limits allotted to the branch on which the branch will receive a rebate. Therefore, I feel the prospect is that future executives will find themselves less constricted by questions of finance, and will, as a consequence, be in a position to add to the attractiveness and value of the branch activities.

Financial Statement

Revenue

Ordinary:			
Branch news		$ 37.09	
Commissions on advertising		22.50	
Affiliates dues		117.00	
Rebates — Nov. and Dec.	$138.75		
Jan. to Mar.	886.50		
Apr. to Sept.	491.50		
		1,516.75	
Interest on savings deposits		10.34	
			$1,703.68
Extraordinary:			
Subscriptions to A.S.M.E. fund		$497.08	
Special subscriptions		22.80	
			519.88
Cash in bank, January 1st, 1923			549.60
			$2,773.16

Expenditures

Ordinary:		
Post card notices	$553.07	
Other printing, multigraphing, stamps	147.58	
Stationery	6.20	
Secretary's honorarium	300.00	
Clerical assistance	100.00	
Telephone service and telegrams	36.10	
Moving pictures and lantern slides	36.10	
Subscriptions to *Journal* for Branch Affiliates	31.00	
Miscellaneous expenses; gratuities, reporting, meeting, etc.	148.15	
		1,358.20
Extraordinary:		
Expenses of A.S.M.E. smoker		618.06
		$1,976.26
Cash in bank, savings a/c		269.48
Cash in bank, current a/c		527.42
		$2,773.16

Respectfully submitted,
J. T. Farmer, M.E.I.C., *Chairman.*
E. A. Ryan, A.M.E.I.C., *Secretary-Treasurer.*

Niagara Peninsula Branch

The President and Council,

Another year in the life of the Niagara Peninsula Branch has been brought to a successful close. The meetings, a list of which follows, have been well attended. The picnic, already reported at length in *The Journal,* was all that could be asked.

Meetings

Feb. 22—"**Water Measurements for Hydraulic Efficiency Tests,**" N. R. Gibson, M.E.I.C.
Dinner-meeting at St. Catharines. Attendance 50.

Mar. 22—"**The Esquimault Dry Dock,**" H. M. Scott, M.E.I.C.
Dinner-meeting at Niagara Falls. Attendance 46.

Apr. 10—"**The Profession,**" F. S. Keith, M.E.I.C.
Dinner-meeting at Welland. Attendance 83.

May 29—Annual meeting. "**The Association of Professional Engineers of the Province of Ontario,**" Willis Chipman, M.E.I.C.
Dinner-meeting at Niagara Falls. Attendance 72.

July 18—Picnic at Queen Victoria Niagara Falls Park. Attendance 100.

Sept. 15—Trip over Port Colborne industries. Attendance 54.

Oct. 27—Trip over Welland ship canal.
"**Northern Ontario,**" Balmer Neilly and Professor H. E. T. Haultain, M.E.I.C.
Dinner-meeting at St. Catherines. Attendance 96.

Dec. 7—Trip over Queenston power house.
"**Symposium on Fuel.**"
Dinner-meeting at Niagara Falls. Attendance 42.

The membership of the branch shows a net gain of 10, as follows:—

	1922	*1923*	*Loss*	*Gain*
Members	24	19	5	..
Associate Members	87	88	..	1
Juniors	22	19	3	..
Students	14	30	..	16
Affiliates	1	..	1	..
Branch Affiliates	8	10	..	2
	156	166	9	19

By-Laws

The by-laws of the branch have been thoroughly revised by a committee appointed for that purpose. The report of the committee has been accepted, and the draft has been approved by Council. It is expected that by the time this is in print, that a letter ballot will be in the hands of the branch members. The branch is deeply indebted to the committee for the thorough manner in which they carried out their work.

Financial Statement

Receipts

Balance on hand, January 1st, 1923	$190.28	
Rebates, branch news, advertising, commissions	309.83	
Affiliates fees	22.50	
Proceeds of meetings, net	62.05	
		$584.66

Expenditures

Printing, stationery, notices	$106.35	
Expenses meetings	98.55	
Stenographic services	21.37	
Postage, telephones, express	14.85	
Secretary's honorarium	100.00	
Balance on hand, January 1st, 1924	243.54	
		$584.66

Respectfully submitted,
S. R. Frost, A.M.E.I.C., *Chairman.*
R. W. Downie, A.M.E.I.C., *Secretary-Treasurer*

Ottawa Branch

The President and Council,

On behalf of the Managing Committee of the Ottawa Branch, we beg to submit the following report for the calendar year 1923.

Notable progress has taken place during the year and all matters affecting the membership of the Ottawa Branch were dealt with in a gratifying manner.

Eleven meetings of the Membership Committee were held during the year and 32 applications for membership were dealt with. The substantial addition to the membership is a criterion of the flourishing condition of the branch and is due to the activity of the Membership Committee.

The luncheons and evening meetings held during the year were a decided success, the average attendance being most encouraging and amply attest the popularity of these functions. The speakers were all of high calibre and a wide diversion was evident in the subjects presented.

The annual "Popular Lecture" was given by C. P. Edwards, O.B.E., A.M.E.I.C., director of radiotelegraphs, Department of Marine and Fisheries; his subject "Radio" attracted wide interest and was attended by a large and representative audience made up not only of the profession, but of the general public as well.

Publicity was carried on in a comprehensive manner, due largely to the generous co-operation of the local and Canadian Press: both of the leading Ottawa papers recorded the maximum amount of space and in many cases supplemented advance notices and reports of current events by timely and effective editorials.

The balance sheet shows that we had a successful financial year. The statement of assets and liabilities shows that we have added $180.28, so that we now have a working capital of $1,944.14.

During the year the Managing Committee held 11 meetings. In addition the branch held evening meetings and luncheons.

Proceedings and Publicity

During the year eight luncheons and nine evening meetings of the branch were held as follows:—

Jan. 3—Complimentary luncheon at Chateau Laurier, to Dr. Wm. Bowie, chief of division of geodesy and G. T. Rude, chief of division of Tides and Currents, United States Coast and Geodetic Survey, Washington.

Jan. 11—Annual meeting — Daffodil Tea Rooms.

Jan. 18—Annual ball under the distinguished patronage of their Excellencies the Governor General and Lady Byng; at the Chateau Laurier.

Feb. 1—"**Mining in Ontario,**" John McLeish, B.A., M.E.I.C., director of the Mines Branch, Dept. of Mines; evening meeting at the Victoria Memorial Museum.

Feb. 15—"**The Arctic Expedition of 1922,**" J. D. Craig, B.Sc., M.E.I.C.; evening meeting at the Victoria Memorial Museum.

Mar. 1—"**Mount Everest,**" Major E. O. Wheeler, M.C.R.E.; evening meeting at the Victoria Memorial Museum.

Mar. 15—"**Wood and Its Possibilities,**" W. Kynoch, B.Sc.F., F.E., F.R.S.A., superintendent of the Forest Products Laboratory; evening meeting at the Victoria Memorial Museum.

Mar. 20—"**Radio**" — The annual popular lecture by C. P. Edwards, O.B.E., A.M.E.I.C., director of Radiotelegraphs, Department of Marine and Fisheries, past chairman of the Ottawa Branch; evening meeting at the Victoria Memorial Museum.

Apr. 5—"**The Valley of the Nile,**" Joseph Keele, B.Sc., M.A.; luncheon meeting at Chateau Laurier.

Apr. 19—"**Financing Water Power Developments,**" A. J. Nesbitt, president of Nesbitt, Thomson and Company, Ltd., Investment Brokers; luncheon meeting at Chateau Laurier.

May 14—"**Concrete Highway Investigations and Specifications,**" Col. H. C. Boyden; evening meeting at Victoria Memorial Museum.

May 16—"**Are Adequate Salaries to Technical and Scientific Men Vital to Efficiency in the Government Service,**" Col. E. Lester Jones, A.M.; director of the United States Coast and Geodetic Survey; luncheon meeting at the Chateau Laurier.

Oct. 18—"**Public Service Rendered by the Engineering Profession,**" Dr. J. H. King, M.D., C.M., F.A.C.S., minister of Public Works; luncheon meeting at the Chateau Laurier.

Oct. 31—"**Canada's Part in Industrial Standardization,**" R. J. Durley, M.B.E., Ma.E., M.E.I.C., secretary of Canadian Engineering Standards Association; luncheon meeting at the Chateau Laurier.

Nov. 13—"**The Design and Construction of Scientific Instruments,**" Robert S. Whipple, managing director of Cambridge and Paul Instrument Co.; luncheon meeting at the Chateau Laurier.

Nov. 15—"**Storage Reservoirs in the Province of Quebec,**" O. O. Lefebvre, M.E.I.C., chief engineer of the Quebec Streams Commission; evening meeting at the Victoria Memorial Museum.

Dec. 12—"**Expert Evidence,**" Harold Fisher, K.C., M.L.A.; luncheon meeting at the Chateau Laurier.

The attendance at luncheons and evening meetings may be taken as an indication that these forms of entertainment and edification meet with the approval of the members. The average attendance at luncheons has been well over 100 and at evening meetings almost 400.

The result of a sustained policy of inviting prominent men to the luncheons is having the effect of heightening the prestige of *The Institute* and cannot but advance the status of its members.

The hearty thanks of the branch is due to the local and Canadian Press who have freely opened their columns, both news and editorial, to advance notices and reports of meetings. The progress in the past few years in this respect is marked.

Membership

During the year the Committee on Membership held eleven meetings and dealt with 32 applications as follows:—

Members	4	
Associate Members	13	
Juniors	3	
Branch Affiliates	5	
		25
Transfers to full Member	4	
Transfers to Associate Member	3	
		7
Total		32

During the year the total membership increased from 398 to 408 and the corporate membership from 311 to 320.

The branch regrets to report the loss by death during the year of one Member, Mr. A. St. Laurent who, at the time of his death, was president of *The Institute*, and two Associate Members, Messrs. C. A. Bigger, and G. L. Rainboth.

The following table shows in detail the comparative figures of the branch membership for the years 1921, 1922 and 1923:—

	1921	*1922*	*1923*
Honorary Members	1	2	2
Members	89	100	113
Associate Members	168	211	207
Juniors	35	32	30
Students	25	19	18
Affiliates	2	6	6
Branch Affiliates	19	28	32
Total	339	398	408

Rooms and Library

The policy of the branch remains unchanged as regards the question of securing permanent quarters. Part of the furniture, owned by the branch is still on loan to the Minto Skating Club and the remainder is stored in an unused office. The library is situated on the third floor of the Journal building where it has been consulted by members under the same conditions as have prevailed in previous years.

The exchange of information, referred to in previous reports, between the different libraries comprising the Library Association of Ottawa has been continued and to some extent systematized. This should prove of great value to enquirers by directing them to the most promising sources of information.

During the year accessions were received from Col. Duncan Macpherson, M.E.I.C., K. M. Cameron, M.E.I.C., F. H. Peters, M.E.I.C., G. W. Volckman, M.E.I.C., the Headquarters of *The Institute* and a number of government agencies.

Advertising in the Journal

Commissions due the branch for advertising secured in *The Journal* during 1923 amounted to $219.57, which is practically equal to the rebates received from 110 Associate Members.

Finances

The financial position of the branch continues to be highly satisfactory as may be seen by reference to the attached statements of assets and liabilities and receipts and expenditures.

The branch closes the year with a balance of $436.46 in the bank, $1.16 in cash on hand, and $1,000.00 in Victory bonds, a total balance on hand of $1,437.62. In addition to this balance the branch has assets of $96.50 in rebates due from Headquarters, $14.45 due from Headquarters for branch news, and $219.57 for advertising in *The Journal*, and $176.00 in furniture, equipment, etc., making a total of $1,944.14.

The income for the last two years is, for 1922 — $875.42 and for 1923 — $1,014.36; the expenditure, for 1922 — $890.78 and for 1923 — $979.32. The branch has an annual income of $55.00 from its Victory bonds.

While the balance sheet shows substantial increases over last year due to growth in membership and branch activities, the statement of assets and liabilities shows we have added to our assets by $180.28, we now having a working capital and equipment amounting to $1,944.14.

Financial Statement

Receipts and Expenditures for the year ending December 31, 1923

Receipts

Balance in bank, Jan. 1st, 1923	$399.48	
Cash on hand, Jan. 1st, 1923	3.10	
Interest on Victory bonds	82.50	
Rebates from Headquarters:—		
Nov. and Dec. 1922	56.75	
Quarter ending Mar. 31, 1923	359.75	
April to Aug. 1923	276.00	
Branch news — Dec. 1922	10.00	
Branch news — Jan. to April 1923	30.00	
Branch news — May to Aug. 1923	24.74	
Journal advertising 1922	91.03	
Branch Affiliate fees	66.00	
Refund from Ball Committee	14.10	
Proceeds from sale of luncheon tickets	260.75	
Advance from secretary for petty cash	5.00	
Bank interest	12.59	
		$1,691.79

Expenditures

Chateau Laurier for luncheons	$561.25	
Daffodil Tea Room — Annual meeting	44.40	
Office supplies	17.68	
Printing	40.54	
Subscription to *Engineering Journal*	6.00	
Crabtree Co. — for half tones	16.71	
Insurance	2.00	
Advance to Ball Committee for 1923	15.00	
Advance to Ball Committee for 1924	15.00	
Advertising	88.20	
A. B. Lambe—expenses of Proceedings Committee	23.90	
Scrims — for flowers	35.00	
C. P. Edwards — annual popular lecture	16.18	
Sundries — Lantern operator, gratuities, etc.	75.02	
Petty cash — postage, etc.	97.29	
M. F. Cochrane — for general annual meeting	200.00	
Balance in bank, Dec. 31st, 1923	436.46	
Balance cash on hand	1.16	
		$1,691.79

Assets and Liabilities for year ending December 31, 1923.

Assets

Furniture (cost $200.00)	$ 80.00	
Library:—		
Book cases (cost $72.50)	50.00	
Bound magazines (nominal)	1.00	
Books	25.00	
Rebates due from Headquarters:—		
on 1923 fees	96.50	
for Branch news	14.45	
for advertising	219.57	
Stationery and equipment	20.00	
Victory bonds due December 1, 1937	500.00	
Victory bonds due November 1, 1934	500.00	
Cash in bank	436.46	
Cash on hand	1.16	
		$1,944.14

Liabilities

Surplus	$1,944.14	
		$1,944.14

Audited and found correct: Noel Ogilvie, M.E.I.C.

Officers for 1924

The annual meeting of the branch will be held in Ottawa on January 10th, when the officers and members of the Managing Committee will be elected for the year 1924.

Respectfully submitted,

O. S. Finnie, M.E.I.C., *Chairman.*

F. C. C. Lynch, Affiliate E.I.C., *Secretary-Treasurer.*

Peterborough Branch

The President and Council,

On behalf of the Executive Committee we beg to submit the annual report of the Peterborough Branch for the calendar year of 1923.

Meetings

Thirteen meetings were held during the year, as follows:—

Jan. 11—"The Operation and Maintenance of Generating and Transmission Systems," H. C. Don Carlos, chief operating engineer, Hydro-Electric Power Commission of Ontario.

Jan. 28—"The Chemistry of Insulating Varnishes," George S. Parlour, materials engineer, Canadian General Electric Company, Peterborough.

Feb. 8—"The Great Lakes-St. Lawrence Waterway," Major Alexander C. Lewis, M.P.P., secretary of the Canadian Deep Waterway and Power Development Association.

Feb. 22—"Einstein's Theory of Relativity and Gravitation," Professor L. T. Rutledge, M.E.I.C., Queen's University.

Mar. 8—"Street Lighting," R. M. Love, street lighting engineer, Canadian General Electric Company, Toronto.

Mar. 22—"The Paper Converter," R. A. Brown, manager of the Canadian Nashua Paper Company of Peterborough.

Apr. 12—"Asbestos and its Uses," Robert Abbott, manager, Canadian Raybestos Company, of Peterborough.

May 8—"Highway Construction," Colonel H. C. Boyden, Chicago, consulting engineer for the Portland Cement Association.

May 10—Annual meeting.

Oct. 11—"The Fuel Problem," F. A. Combe, M.E.I.C., chairman of the Fuel Committee of The Institute and chairman of the Montreal Branch Fuel Committee.

Oct. 25—"Application of Electric Arc Welding," J. B. Minns, B.A.Sc., Canadian General Electric Company, Toronto.

Nov. 20—Annual banquet.

Dec. 13—"Gold Mining," A. F. Brigham, general manager, Hollinger Consolidated Gold Mines, Timmins, Ontario.

The average attendance at the meetings was 49.

Membership

The membership of the branch is as follows:—

Members	22
Associate Members	42
Juniors	10
Students	19
Affiliates	2
Branch Affiliates	23
Total	118

The following is the financial statement for the calendar year 1923.

Financial Statement

For the year ending December 31st, 1923

Receipts

Balance in bank, January 1st, 1923	$ 46.22	
Rebates and *Journal* news	134.93	
Affiliates fees and *Journal* subscriptions	60.00	
Receipts — annual dinner	151.50	
Bank interest	.39	
		$393.04

Expenditures

Rent	$ 50.00	
Affiliates subscriptions to *Journal*	29.34	
Annual dinner expense	159.64	
Printing	65.53	
Speaker and meeting expenses	27.60	
Lunch	7.50	
Funeral expenses	19.79	
Insurance on lantern and moving picture machine	10.50	
Postage, war-tax, etc	6.28	
Balance in bank, December 31st, 1923	16.86	
		$393.04

Signed — A. B. Gates, A.M.E.I.C., *Treasurer.*

Respectfully submitted,

R. S. Dobbin, M.E.I.C., *Chairman.*

R. C. Flitton, A.M.E.I.C., *Secretary.*

Quebec Branch

Au Président et au Conseil,

Le Conseil de la Section de Québec a l'honneur de vous soumettre son rapport annuel pour l'année 1923 comme suit:—

Rôle des Membres

	Résidents	*Non résidents*	*Total*
Membres	16	8	24
Membres Associés	57	37	94
Junior	8	8	16
Etudiants	15	18	33
Affilié	1	—	1
Total des membres			168

Assemblée Annuelle

L'assemblée annuelle de la Section de Québec a été tenue le 21 mai 1923, sous la présidence de M. A. R. Décary, M.E.I.C. — Les officiers dont les noms suivent ont été élus pour l'année 1923:—

Président..............M. A. R. Décary, M.E.I.C.
Vice-Président..........M. A. B. Normandin, A.M.E.I.C.
Secrétaire.............M. Hector Cimon, A.M.E.I.C.
Conseillers.............MM. Paul Joncas, A.M.E.I.C.,
S. L. deCarteret, A.M.E.I.C.,
L. C. Dupuis, A.M.E.I.C.,
T. E. Rousseau, A.M.E.I.C.,
S. S. Oliver, A.M.E.I.C.,
J. E. Gibault, A.M.E.I.C.

Assemblées

Le Conseil de la Section de Québec a tenu neuf assemblées durant l'année 1923.

Les déjeûners et assemblées du soir de chaque mois ont eu lieu régulièrement du mois de novembre 1922 au mois de mai 1923.

Le 10 mars 1923, une très intéressante excursion a été faite à Boischatel pour visiter les usines de la Citadel Brick and Paving Block Company Limited à cet endroit. — A nos différents déjeuners et assemblées du soir, nous avons eu fréquemment l'occasion de compter parmi nous des membres de l'*Institut*, étrangers à notre branche, ainsi que des personnages de marque dans la vie publique. Toutes nos réunions ont assemblé la presque totalité des membres de notre branche, et la presse a toujours eu l'amabilité de donner de très bons comptes-rendus de nos travaux.

Toutes les questions soumises par le Conseil Général à la Section de Québec ont été étudiées, discutées et transigées.

Notre section a suivi avec intérêt les travaux de l'*Institut* et a prêté son plein concours à toutes les questions ayant pour but de protéger et de promouvoir les intérêts de l'*Institut* et de ses membres.

Notre Comité Spécial s'est occupé de surveiller, de faire une étude sérieuse et de faire un rapport aussi complet que possible sur toutes les demandes d'admission qui ont été référées à notre branche, et les recommandations nécessaires ont été faites au Conseil Général de l'*Institut* qui a bien voulu en tenir compte.

Causeries

Les causeries suivantes ont été faites à nos différents déjeuners et assemblées du soir:—

"**Possibilité de l'utilisation de l'énergie cinétique de l'air,**" par M. Gabriel Henry, A.M.E.I.C.

"**Développements récents apportés dans la construction des turbines hydrauliques,**" par M. Julian C. Smith, M.E.I.C.

"**L'Avenir de la Profession d'Ingénieur,**" par M. Fraser S. Keith, M.E.I.C., Secrétaire-Général.

"**L'Histoire et les procédés modernes de la fabrication de la brique,**" par M. P. A. Galarneau, Gérant, Citadel Brick Co.

"**La préparation du bois à pâte,**" par M. S. L. deCarteret, A.M.E.I.C.

"**Nos ressources forestières,**" par M. Avila Bédard, ingénieur forestier.

"**De l'utilité des recherches,**" par M. Augustin Frigon, D.Sc., A.M.E.I.C.

"**Approvisionnement en eau et modes de correction,**" par M. T. J. Lafrenière, M.E.I.C.

"**Enquêtes et devis de divers types de routes en béton,**" par le Col. H. C. Boyden, de l'Association "Portland Cement".

Etat financier de l'année 1923

Recettes		
Caisse au 1er janvier 1923	$245.85	
Intérêts sur compte de banque	3.43	
Remises du Bureau Chef:—		
Cotisations des membres	150.00	
Nouvelles pour *Journal*	17.09	
Annonces pour *Journal*	47.42	
		$463.79
Dépenses		
Impressions, timbres, etc.	$ 44.15	
Dépenses pour assemblées	76.00	
Dépenses de voyages	65.15	
Divers	184.00	
		$369.30
Solde au 1er Janvier 1924		$ 94.49

Respectueusement soumis,

ALBERT R. DECARY, M.E.I.C., *Président.*
HECTOR CIMON, A.M.E.I.C., *Secrétaire-Trésorier.*

The President and Council,

The executive of the Quebec Branch begs to present the following annual report on the work of said branch during the year 1923:—

Membership

	Resident	*Non-resident*	*Total*
Members	16	8	24
Associate Members	57	37	94
Juniors	8	8	16
Students	15	18	33
Affiliate	1	—	1
Total membership			168

Annual Meeting

The annual meeting of the Quebec Branch was held on May 21st, 1923, under the presidency of A. R. Decary, M.E.I.C. The following officers were elected for the year 1923:—

President.................A. R. Decary, M.E.I.C.
Vice-President............A. B. Normandin, A.M.E.I.C.
Secretary.................Hector Cimon, A.M.E.I.C.
Councillors...............Paul Joncas, A.M.E.I.C.,
S. L. deCarteret, A.M.E.I.C.,
L. C. Dupuis, A.M.E.I.C.,
T. E. Rousseau, A.M.E.I.C.,
S. S. Oliver, A.M.E.I.C.,
J. E. Gibault, A.M.E.I.C.

Meetings

The executive of the Quebec Branch held nine meetings during the year 1923.

The regular monthly luncheons and evening meetings of the branch were held from the month of November 1922 to the month of May 1923.

On March 10th, 1923, a most interesting visit of inspection was made to the plant of the Citadel Brick and Paving Block Company, Limited, at Boischatel. It has been our pleasure to have frequent opportunities of welcoming outside members of our *Institute* and also prominent men in public life at our different luncheons and evening meetings. All our meetings did gather together practically the full membership of the branch, and a very good publicity of the activities of the branch was given through the press.

All questions submitted by the Council of *The Institute* have been studied, discussed and transacted.

Our branch has followed with interest *The Institute* deliberations and has devoted its full energy to all matters aiming to the protection and promotion of the interest of *The Institute* and its members.

Our special committee has followed closely, studied seriously and made as complete report as possible on all applications for membership which have been referred to this branch, and the necessary recommendations have been made to the Council of *The Institute* who has kindly taken them into consideration.

Addresses

The following addresses were made at our different luncheons and evening meetings:—

"**Possibilities for the Utilization of Wind Power,**" by Gabriel Henry, A.M.E.I.C.

"**Recent advances in Water Wheel Designs,**" by Julian C. Smith, M.E.I.C.

"**The Future of the Engineering Profession,**" by Fraser S. Keith, M.E.I.C., general secretary.

"**The History and Modern Process of the Manufacture of Bricks,**" by P. A. Galarneau, manager, Citadel Brick Company.

"**The Manufacture of Pulp Wood,**" by S. L. deCarteret, A.M.E.I.C.

"**Our Forest Resources,**" by Avila Bédard, forestry engineer.

"**The Usefulness of Scientific Researches,**" by Augustin Frigon, D.Sc., A.M.E.I.C.

"**Water Supplies and how to Treat Them,**" by T. J. Lafrenière, M.E.I.C.

"**Concrete highway investigations and specifications,**" by Col. H. C. Boyden of the Portland Cement Association.

Financial Statement for the year 1923

Revenue		
Cash in bank, Jan. 1st, 1923	$245.85	
Bank interest	3.43	
Rebates from Headquarters: — Members' fees	150.00	
Branch news	17.09	
Advertising	47.42	
		$468.79

Expenditures

Printing, stamps, etc.	$ 44.15	
Expenses of meetings	76.00	
Travelling expenses	65.15	
Miscellaneous	184.00	
		$369.30
Balance on hand, January 1st, 1924		$ 94.49

Respectfully submitted,

ALBERT R. DECARY, M.E.I.C., *Chairman.*
HECTOR CIMON, A.M.E.I.C., *Secretary-Treasurer.*

Saguenay Branch

The President and Council,

The Saguenay Branch was inaugurated at a general meeting held on August 10th, 1923, at Messrs. Price Brothers' Staff-House at Kenogami. Several of the most prominent members of *The Institute* were present among whom were President Walter J. Francis, M.E.I.C., Secretary Fraser S. Keith, M.E.I.C., and Councillor Frederick B. Brown, M.E.I.C.

The president, after making a few very appropriate remarks on the new branch and its duties, declared the branch in existence, after which the following officers were elected:—

Chairman	W. G. Mitchell, M.E.I.C.
Vice-Chairman	C. N. Shanly, A.M.E.I.C.
Secretary-Treasurer	Burroughs Pelletier, A.M.E.I.C.
Executive Committee	H. V. Bignell, A.M.E.I.C.,
	A. Duperron, A.M.E.I.C.,
	J. F. Grenon, A.M.E.I.C.,
	Georges LaMothe, A.M.E.I.C.,
	N. F. McCaghey, A.M.E.I.C.

The meeting then had the pleasure of hearing President Walter J. Francis, M.E.I.C., W. G. Mitchell, M.E.I.C. (the newly elected chairman), J. T. Farmer, M.E.I.C., Frederick B. Brown, M.E.I.C., A. F. Dyer, A.M.E.I.C., H. S. Van Scoyoc, M.E.I.C., Fraser S. Keith, M.E.I.C., and J. F. Grenon, A.M.E.I.C., say a few words each, on subjects relating to the engineering profession. Sir William Price being obliged to leave early had previously addressed the meeting.

Following the inauguration meeting the Saguenay Branch has held several committee meetings for the purposes of drawing up a set of by-laws, and organizing the branch on an efficient basis as regards its activities and programme.

The following committees have been named: Membership, J. P. Chapleau, A.M.E.I.C., (chairman), L. A. Dubreuil, A.M.E.I.C., G. B. Snow, A.M.E.I.C.; Papers, C. N. Shanly, A.M.E.I.C., (chairman), H. G. Cochrane, A.M.E.I.C., A. Duperron, A.M.E.I.C. The latter committee although the season was far advanced when it came into existence, has so far progressed that a programme for the coming winter's lectures will be announced shortly. Several prominent members of *The Institute* are expected to figure on this programme.

Pending this future programme of lectures, the branch has had the pleasure of hearing Rear-Admiral W. J. Anstey on the "Progress of Engineering in the Royal Navy". Judging by the appreciation of those present the future lectures of the branch are going to be very popular amongst the members.

The branch is looking forward to the coming year when it will be finally organized and definitely on the road to follow the exemple so ably set by its numerous sister branches in promoting the interests of the engineering profession.

Financial Statement

The financial status of the Saguenay Branch as at December 31st, 1923, is as follows:—

Receipts

Cheque received from Headquarters	$100.00	
Rebates to Dec. 31st, due from Headquarters	2.38	
		$102.38

Expenditures

Expenses re lecture by Admiral W. J. Anstey	$ 13.00	
Stationery and postage	3.00	
	$ 16.00	
Balance in bank	84.00	
Rebates due from Headquarters	2.38	
		$102.38

Respectfully submitted,

W. G. MITCHELL, M.E.I.C., *Chairman.*
BURROUGHS PELLETIER, A.M.E.I.C., *Secretary-Treasurer.*

Saskatchewan Branch

The President and Council,

On behalf of the Executive Committee, we beg to submit the annual report for 1923. We would point out that as our branch year ends on February 28th, the period covered by this report refers to a portion of two branch years, which were controlled by different executives.

The year 1923 has been one of generally depressed conditions throughout the west, which did not allow for a large increase in our branch membership due to the lack of engineering work. There has been a loss due to the removal of several of our members to points outside the branch jurisdiction, but we are pleased to report the consideration of seventeen new applications for membership and by the amendments to *The Institute* by-laws several additions have been made to our branch membership of non-resident members, so that we feel the branch to-day stands in a very healthy condition.

As our branch comprises the largest area of any branch in the Dominion it is difficult for the majority of our members to receive the full benefit of branch meetings, as they reside some distance from branch headquarters. This feature is fully appreciated by the executive, whose aim at all times has been to further provide for the non-resident members. Suggestions for improvement along these lines are always welcome and they will receive the careful consideration of the executive. In order to stimulate greater interest in the meetings, the Papers and Library Committee have inaugurated a change in policy, whereby some speakers from outside the engineering profession were invited to address the branch on topics associated with engineering, but not necessarily technical.

We have been fortunate in securing the dining room of the Parliament Buildings for our luncheons and meetings, where better accommodation at reduced rates has been secured. This change, it is hoped, will provide for a substantial increase in attendance. The several committees of the branch have been quite active. The Papers and Library Committee under the chairmanship of S. R. Parker, A.M.E.I.C., arranged for a splendid list of speakers and social functions, and the Entertainment Committee under the chairmanship of H. N. MacPherson, A.M.E.I.C., added considerable "pep" to the meetings, which was much appreciated by all.

The annual summer meeting of the branch, which was held at Estevan, Saskatchewan, on August 17th, and 18th, proved to be the premium event of the year for those who were fortunate enough to attend. Together with the visitors from the Winnipeg Branch, we were royally entertained by the various organizations and industries of the district, and a hearty invitation to return for a future meeting at an early date will receive the careful consideration of the coming year's executive.

During 1923 the executive held nine meetings at which the routine business of the branch was attended to. Twelve regular and special meetings were held, the majority of them being proceeded by a dinner. The following sets out the particulars of the regular and special meetings.

Jan. 11—"Wireless Telephony," S. R. Parker, A.M.E.I.C., Dept. of Telephones, Saskatchewan Government.
"Electrons," C. W. Doody, Dept. of Telephones, Saskatchewan Government.

Jan. 24—"Scientific Methods of Industrial and Commercial Lighting," J. A. Daly, manager, Northern Electric Company, Regina.

Feb. 6—Ladies night and social evening.

Feb. 22—"Engineering Cost Accounting," E. A. Markham, A.M.E.I.C., superintendent, Poole Construction Company, Regina.

Mar. 6—Annual meeting, election of officers, reports, banquet and theatre party.
"Underground Electrical Construction as a Factor in the Conservation of Streets and Highways," Mr. Cowley, superintendent of Electric Light and Power, Saskatoon.

Mar. 22—"Is the Development of a City Limited by lack of Facilities for Disposing of Sewage and a Good Water Supply," G. D. Mackie, M.E.I.C., city commissioner, Moose Jaw.

Apr. 12—"Water Supply and Irrigation as Affecting Saskatchewan," Wm. Pearce, M.E.I.C., Dept. of Natural Resources, C.P.R., Calgary.

Aug. 17-18-Annual summer meeting at Estevan, Sask., including visits to mines, lignite briquetting plant and various plants and points of interest. Banquet and address on "Saskatchewan Coals for Boiler and Domestic Purposes", J. B. Hamilton, A.M.E.I.C., town engineer, Estevan, Sask.

Sept. 22—Visit to Condie dam, and luncheon as guests of the C.U. McManus Construction Company, and T. C. Main, A.M.E.I.C., chief engineer of C.N.R.

Oct. 11—"**Civil Aviation**," Capt. T. Spence, secretary, Saskatchewan Branch, Canadian Air Force Association.
Nov. 8—Ladies night and social evening, "**Bird Life of Saskatchewan**," F. Bradshaw, chief game guardian, province of Saskatchewan.
Dec. 13—"**International Finance**," Professor W. W. Swanson, University of Saskatchewan, Saskatoon.

Financial Statement
March 1st to December 31st, 1923

Revenue		
Bank balance, March 8th, 1923	$ 84.36	
Branch dues	228.20	
Rebates from Headquarters, Jan. to Aug.	190.44	
Meetings	273.00	
Sundries	14.31	
		$790.31
Expenditures		
Rebates to Headquarters	$ 30.60	
Meetings	358.55	
Stationery, printing and postage	57.57	
Sundries	22.65	
Honorarium to secretary-treasurer, on account	100.00	
Scholarships to University 1922 and 1923	200.00	
Bank balance	7.79	
Cash on hand	13.15	
		$790.31
Assets		
Bank balance, Dec. 31st, 1923	$ 7.79	
Cash on hand	13.15	
Outstanding Branch dues	298.00	
Outstanding Headquarters rebates	162.50	
Furniture and library	50.00	
		$531.44
Liabilities		
Branch dues paid in advance	$ 5.00	
Accounts payable	121.25	
Surplus	405.19	
		$531.44

Respectfully submitted,
A. C. GARNER, M.E.I.C., *Chairman.*
D. A. R. McCANNEL, A.M.E.I.C., *Secretary-Treasurer.*

Sault Ste. Marie Branch

The President and Council,

On behalf of the Executive Committee I beg to report on the operations for the year 1923 for Sault Ste. Marie Branch as follows: The branch held ten meetings all of which were fairly well attended. The experiment of holding the monthly meetings at the residences of the several members was abandoned after the March meeting. Since then all have been held at the Y.W.C.A., beginning with a dinner at 7.00 p.m., followed by the business meeting. The inconvenience of going to the right house was the determining factor in trying to find a convenient and suitable place for the branch to meet, and the Y.W.C.A., has answered all requirements, being convenient, suitable and comfortable to say nothing of the pleasure of the members while enjoying the hospitality of the superintendent of the institution.

Meetings

Jan. 25—Meeting at the residence of B. E. Barnhill, M.E.I.C., chairman. Paper by J. L. Lang, M.E.I.C., D. & O.L.S., on "**Roads and Road Building**".
Mar. 1—Meeting at the residence of J. H. Jenkinson, A.M.E.I.C. At this meeting we were to have had a paper or address on aviation by Mr. Avery, forester of the Spanish River Pulp and Paper Company, but owing to his unavoidable absence from the city we discussed many interesting rumours current at the time. These included "the First Robin", "Wolf Stories" true and otherwise in fact the "Folk Lore" of the north country.
Mar. 23—Meeting at the residence of the secretary. This was the last trial of the private residence meeting scheme. It was a stormy night and the secretary lives at the other end of nowhere, the snow was deep and falling so fast the two members ten minutes apart in arriving saw no sign of each other nor was there any trail for the second man to follow. We had no paper the speaker could not get through. Those present discussed the possibilities of getting a more convenient place of meeting and K. G. Ross, A.M.E.I.C., chairman of the Entertainment Committee was instructed to see what could be done.
Apr. 25—Meeting at the Y.W.C.A. Address by Mr. Avery on "**Aviation**" which proved very interesting to the 20 members present. Practically all of whom entered into the discussion following.
June 4—The meeting of May which was postponed was addressed by Capt. F. A. Dallyn, B.A.Sc., M.E.I.C., on "**Sanitation**". At this meeting we had a number of the medical profession as guests who greatly appreciated the address and who discussed some of the features of it.
June 11—Mr. Boyden of the American Cement Association addressed the meeting on "**Concrete Road Construction**" and answered the many questions of the members and guests.
Sept. 27—C. C. Hayward of the Walsh Fire Clay Products Company, addressed this meeting on "**The manufacture of Fire Clay Products**", illustrating his remarks with slides of the company's works. The guests of the evening were the several users and dealers in such articles and were much interested in the address.
Oct. 25—C. H. Speer, M.E.I.C., discussed the "**Report of the Hydro-Electric Commission on the Water Power in St. Mary's River available of Sault Ste. Marie**". To this meeting were invited the Mayor James Dawson; Chairman of the Public Utilities Commission Dr. Shannon, and Secretary of the Board of Trade W. E. Wolfe, who took great interest in the subject which is of very great importance to the city. J. W. LeB. Ross, M.E.I.C., superintendent of the Ship Canal and H. A. Morey, A.M.E.I.C., also took part in presenting the subject. The Mayor and other guests also took part in the discussion following.
Nov. 30—W. S. Wilson, A.M.E.I.C., gave a paper on "**Central Heating**", applying the idea to a portion of the city. This was a very well attended meeting and one of the most interesting papers of the season.
Dec. 28—The annual meeting. The Nominating Committee reported the result of the election of officers for the year 1924, as follows:—
Chairman, L. R. Brown, A.M.E.I.C.
Vice-Chairman, Wm. Seymour, M.E.I.C.
Secretary-Treasurer, W. S. Wilson, A.M.E.I.C.
Executive Committee, J. W. LeB. Ross, M.E.I.C., and R. J. Caswell, A.M.E.I.C.
Nominating Committee, C. H. E. Rounthwaite, A.M.E.I.C., H. H. Robertson, A.M.E.I.C., H. H. Cantwell, A.M.E.I.C.

Financial Statement

For the Year ending December 31st, 1923

Receipts		
Balance on hand, January 1st, 1923	$ 92.11	
Rebates from Headquarters	69.25	
Dues of Branch Affiliates	15.00	
Receipts from *Journal* advertising and Branch news	84.00	
Subscriptions to *Journal*	8.00	
Subscriptions to defray costs of dinners	72.00	
Total		$340.36
Disbursements		
Meetings and general expense	$190.77	
Subscriptions to *Journal* remitted to Headquarters	10.00	
	$200.77	
Balance on hand December 31st, 1923	139.59	
		$340.36
Assets		
In current account Royal Bank	$ 81.84	
Cash on hand	57.75	
		$139.59

Respectfully submitted,
C. H. E. ROUNTHWAITE, A.M.E.I.C., *Secretary-Treasurer.*

St. John Branch

The President and Council,

Herewith is the sixth annual report of the St. John Branch of *The Engineering Institute of Canada* for the year ending December 31st, 1923.

Meetings

During the year there have been ten meetings of the executive when business of the branch has been dealt with. Ten meetings of the branch have been held in St. John, at which papers were read in addition to a social evening in February and the annual dinner-meeting in May.

In February the branch held a joint meeting with the Engineering Society of the University of New Brunswick at Fredericton. Four papers were delivered by members of this branch on city surveying, harbour engineering, waterworks construction and railway maintenance engineering. A similar trip is proposed in 1924 to give non-resident members a chance to attend a branch meeting.

In June the branch had as dinner guests Walter J. Francis, M.E.I.C., president of *The Institute*; U. Valiquet, M.E.I.C., C. R. Coutlee, M.E.I.C., Ottawa, and H. G. Acres, M.E.I.C., Niagara Falls.

On September 26th and 27th, the Maritime General Professional Meeting with a total registration of one hundred and fifty was held in St. John. Five papers were read, visits paid to two engineering works, three luncheons and a banquet held. Officers of *The Institute* attenting this meeting were Walter J. Francis, M.E.I.C., president; F. P. Shearwood, M.E.I.C., vice-president; and Fraser S. Keith, M.E.I.C., general secretary. This meeting has enabled our members to become acquainted with visiting members, and has resulted in a better appreciation of *The Institute* by both its members and the general public.

On October 29th, the work of a number of our members was given prominence when the St. John drydock at Courtenay bay was opened. This event was made a civic half-holiday and attended by upwards of a hundred visitors from central Canada and eastern United States.

Membership

Under the re-allocation of territory this branch now claims as members those living in the nine western counties of New Brunswick.

The branch membership on December 31st, 1923, is as follows:—

Grade	*Resident*	*Non-resident*	*Total*
Members	13	10	23
Associate Members	30	11	41
Juniors	9	4	13
Affiliates	2	–	2
Students	6	3	9
Branch Affiliates	3	–	3
Totals	63	28	91

Total at end of 1923 91, total at end of 1922, 69, net gain 22.

Applications for admission pending: — resident 2; non-resident 2.

Financial Statement

Receipts

Balance December 31st, 1922	$151.42	
Rebates from Headquarters	95.75	
Branch news from Headquarters	46.82	
Dues and subscriptions from Branch Affiliates	18.00	
Entertainment receipts	145.08	
Maritime Professional Meeting	532.00	
Total		$989.07

Expenses

Stationery and printing	$ 43.50	
Postage	14.10	
Dinners and entertainment	183.13	
Hall and meeting expenses	80.25	
Journal subscriptions (Branch Affiliates)	6.00	
Refund of loan to Headquarters	50.00	
Sundries	6.14	
Maritime professional meeting	522.85	
Total		$905.97
Balance (December 31st, 1923)		$ 83.10

Respectfully submitted,

HARRY F. BENNETT, A.M.E.I.C., *Chairman.*

W. J. JOHNSTON, A.M.E.I.C., *Secretary-Treasurer.*

Toronto Branch

The President and Council,

On behalf of the Executive of the Toronto Branch the undersigned present herewith the annual report of the branch for the year 1923. The practice of the Toronto Branch for some time past has been to elect its executive in March, so that the calendar year is covered in part by one executive and in part by another. This method has been found desirable, as it makes one executive wholly responsible for the programme and activities of the branch during the winter session. The arrangement of a programme and the carrying of it out are facilitated through having one administration solely and entirely responsible for it.

The executives for the period January to March 1923, and March to December 1923, are as follows:—

January to March, 1923		*March to December, 1923*
Wm. Storrie, M.E.I.C.	Chairman	C. R. Young, M.E.I.C.
E. G. Hewson, M.E.I.C.	Vice-Chair.	J. M. Oxley, M.E.I.C.
O. M. Falls, A.M.E.I.C.	Sec.-Treas.	J. A. Knight, A.M.E.I.C.
Peter Gillespie, M.E.I.C.	Executive	Peter Gillespie, M.E.I.C.
G. G. Powell, M.E.I.C.		T. R. Loudon, M.E.I.C.
M. V. Sauer, M.E.I.C.		J. G. R. Wainwright, A.M.E.I.C.
R. C. Muir, M.E.I.C.		N. D. Wilson, A.M.E.I.C.
N. D. Wilson, A.M.E.I.C.		R. C. Muir, M.E.I.C.
W. A. Duff, M.E.I.C.		A. C. Oxley, A.M.E.I.C.
C. H. Mitchell, M.E.I.C.	*Ex-Officio*	C. H. Mitchell, M.E.I.C.
C. R. Young, M.E.I.C.		R. O. Wynne-Roberts, M.E.I.C.
G. T. Clark, A.M.E.I.C.		G. T. Clark, A.M.E.I.C.
R.C.Wynne-Roberts, M.E.I.C.		Wm. Storrie, M.E.I.C.

Membership

The membership of the Toronto Branch has fallen off very slightly during the year 1923, due very largely to the fact that the number of engineering students in the university has decreased by about 200, and with it the number of student numbers attached to the branch. A slight reduction in the membership is also due to the fact that a large amount of territory formerly attached to the Toronto Branch has been allocated to the Sault Ste. Marie Branch. The membership as at December 31st, 1923, is 647, as classified in the following table. For 1922 the membership was 661. Considering the large drop in student membership resident within the territory of the Toronto Branch, it is seen that the branch has really more than held its own in the matter of membership.

Membership at December 31st, 1923.

	Branch Residents	*Branch Non-residents*	*Total*
Members	123	3	126
Associate Members	262	22	284
Juniors	53	6	59
Students	145	21	166
Affiliates	6	—	6
Branch Affiliates	6	—	6
	595	52	647

Meetings

During the year the executive has held 16 meetings, most of which have been called at 7.30 p.m., on the evenings of the regular meetings. This practice makes it possible to carry on the business of the branch with a minimum loss of time on the parts of the members of the executive.

The present executive has inaugurated the policy of holding occasional luncheon meetings addressed by prominent speakers. The first one was held on April 19th, and was addressed by President Walter J. Francis, M.E.I.C., who spoke on *Institute* affairs, and particularly on the fuel situation. There was an attendance of 175 members. On October 12th, another luncheon meeting was addressed by E. J. Mehren, editor of Engineering News-Record, on the subject of Engineering Research. This was also well attended, there being 125 members and guests present. It is planned to hold at least one more luncheon meeting during the term of office of the present executive. The policy has been shown to be a sound one, in that many members who did not attend the evening meetings will make it a point to attend the luncheon meetings downtown. In addition, the social side of these meetings has proved to be a valuable asset. During the year 1923, there were 15 evening meetings held. Beginning with the autumn session meetings have been held in room 22, Mining building, University of Toronto, as the lecture room of the Engineers' Club has been found too small for comfort. The policy of seeking larger quarters uptown has resulted in an improved attendance. The average attendance for the meetings, beginning October 18th, has been 69.

In planning the programme for the present winter session, the policy of the executive has been to select subjects which would have as wide an appeal as possible. While highly specialized topics are of great interest to certain members, the numbers so interested represent but a small fraction of the total membership. It has been planned to draw attendance from as wide a circle of members as possible.

The subjects considered at the evening meetings for the year 1923, with the list of speakers is as follows:—

Jan. 11—Annual dinner, Engineers' Club.

Jan. 18—Discussion of report of Branch Committee on Fees, led by Frank Barber, M.E.I.C.

Feb. 1—**"Analysis of Ball Paths in Tube Mills by High Speed Photography,"** supplemented by a talk on **"Some Recent Psychology"**, Professor H. E. T. Haultain, M.E.I.C.

Feb. 8—**"Rainfall and Its Measurement,"** Sir Frederick Stupart.

Feb. 15—**"The Railway Situation in the Toronto District,"** H. K. Wicksteed, M.E.I.C.

Feb. 22—Joint Meeting with Canadian Section, American Waterworks Association, under auspices of the latter. Discussion of paper **"Methods of Purifying Public Water Supplies"**, by Norman J. Howard.

Mar. 1—**"Electrification of the Chicago, Milwaukee and St. Paul Railroad,"** A. L. Mudge, A.M.E.I.C.

Mar. 8—**"Federal Valuation of Railways in U.S.A.,"** Arthur Crumpton, M.E.I.C.

Oct. 18—"The Rise of the Engineer." Inaugural address of the chairman of the branch, Professor C. R. Young, M.E.I.C.
Oct. 25—"The Highway Situation in Ontario," Hon. Geo. S. Henry, minister of public works and highways for Ontario.
Nov. 1—"Expert Evidence," Hon. Mr. Justice William Renwick Riddell. Joint meeting with Toronto Section A.I.E.E., Toronto Section, A.S.M.E., Toronto Branch, Canadian Institute of Chemistry, Society of Chemical Industry, and Toronto Chapter Illuminating Engineering Society.
Nov. 8—"A Proper Freight Rate for Coal," M. J. Butler, C.M.G., M.E.I.C., past-president, *The Engineering Institute of Canada.*
Nov. 15—Smoker in the East Common room, Hart House, University of Toronto; with addresses by President Walter J. Francis, M.E.I.C., and General Secretary Fraser S. Keith, M.E.I.C.
Nov. 22—"Patents," Herbert J. S. Dennison, patent attorney.
Nov. 29—"Recent Developments on the T. & N.O. Ry.," S. B. Clement, M.E.I.C.
Dec. 6—"Inspection of Materials," R. J. Marshall, M.E.I.C.
Dec. 13—"Heating," F. R. Ewart, M.E.I.C.

Committees

The work of the branch has been greatly facilitated by the active services of the various branch committees. Meetings of the branch have been given excellent publicity due to the work of the Publicity Committee. The Committee on Students' Relations has been doing good work in enlisting the co-operation of students in the branch meetings. Amendments to the branch by-laws have been prepared after thorough study by the Committee on By-laws, and are shortly to be put to vote by the branch membership. The Library Committee is busily engaged having a catalogue made, not only of the books belonging to the branch, but all engineering publications in the libraries of the city. The branch Fuel Committee has been actively at work in carrying on its part of the investigation now being conducted by *The Institute's* Fuel Committee.

The chairmen of the various committees of the branch are as follows:—

Finance Committee	J. M. Oxley, M.E.I.C.
Publicity Committee	L. W. Wynne-Roberts, A.M.E.I.C.
Programme Committee	C. R. Young, M.E.I.C.
Committee of Fees	Frank Barber, M.E.I.C.
Students' Relations	T. R. Loudon, M.E.I.C.
Reception Committee	R. O. Wynne-Roberts, M.E.I.C.
By-Laws Committee	N. D. Wilson, A.M.E.I.C.
Fuel Committee	M. J. Butler, C.M.G., M.E.I.C.
Library Committee	A. C. Oxley, A.M.E.I.C.

Financial Statement

Financially the branch is in excellent condition, having cash on hand in excess of that on hand at the end of 1922. The statement of revenue and expenditures is as follows:—

Revenue

Cash on hand, Jan. 1st, 1923	$ 994.40	
Receipts from banquet, Jan. 11, 1923	110.00	
Rebates and Branch news	1,091.34	
Interest to Dec. 31, 1923	23.10	
Affiliates fees	30.00	
		$2,148.84

Expenditure

Advertising and printing	$ 289.60	
Engineers' Club rent, 1922	200.00	
Secretary's honorarium	100.00	
Library Committee, on account	31.40	
Expenses of banquet, Jan. 11, 1923	131.75	
Stenographic services	77.82	
Expenses re luncheon meetings	85.05	
Secretary's expenses re annual meeting	31.00	
Rent of room 22, Mining building	9.00	
Flowers for late President St. Laurent	25.51	
Office furniture	38.00	
Insurance	21.15	
Stamps	10.00	
Cash on hand, Dec. 31st	1,098.56	
		$2,148.84

Respectfully submitted,

C. R. Young, M.E.I.C., *Chairman.*

J. A. Knight, A.M.E.I.C., *Secretary-Treasurer.*

Vancouver Branch

The President and Council,

On behalf of the Executive Committee, I have the honour to report on the affairs of the Vancouver Branch, for the year 1923, as follows:—

General Meeting

The attendance at the general meetings of the branch, averaged about 25, as compared with 30 for 1922, and 45 during 1921. This means that the average attendance during the past year has only been about 16 per cent of the active membership.

The general meetings of the branch during 1923 numbered six, as follow:—

Feb. 19—Debate: Students of the University of British Columbia. "Resolved that the building of the Second Narrows bridge is in the best interests of the city and surrounding municipalities".
Affirmative: Arts.
Negative: Applied Science. (winners)
May 3—Lecture: "Irrigation in Mesopotamia", Major Geo. B. Hull, A.M.E.I.C., formerly district irrigation officer, Bagdad.
May 19—Inspection at Stave Falls hydro-electric plant. The members of the party were the guests of the British Columbia Electric Railway Company, Ltd.
June 20—Inspection at Britannia Mines. This trip was held jointly with the Mining Section of the Vancouver Board of Trade. A special steamer was chartered, to take the party to Britannia Beach, Howe Sound. The members, while at the mine and the mill, were the guests of the Britannia Mining and Smelting Company.
Nov. 23—Lecture: "Notes on Recent Developments in Municipal Engineering", W. B. Greig, A.M.E.I.C., engineer, corporation of Point Grey. Mr. Greig gathered this data during a recent tour of the larger cities of the Western States. The paper was illustrated with screen views.
Dec. 19—Annual general meeting.

Executive Committee

The Executive Committee held seven meetings during the year. Considerable routine business was transacted, but the few matters of special interest which were dealt with, did not require any noteworthy proceedings to dispose of them.

General Review of 1923 Business

Institute Nominating Committee

James Muirhead, M.E.I.C., was appointed by the Executive Committee on January 11th, to represent the Vancouver Branch during 1923.

Membership Committee

The Membership Committee was expanded to include the whole Executive Committee. Major Geo. A. Walkem, M.E.I.C., and W. H. Powell, M.E.I.C., were especially active among the science students of the University of British Columbia, resulting in the receipt of about 15 applications for Student membership. Regarding higher grades in *The Institute*, three applications for membership have been received, as a direct result of the efforts of this committee, while several more are pending.

Other Business

Among other matters which received attention during the year were, the Moberley Fund, the *Institute* Fuel Inquiry, Advertising in *The Journal*, and the programme of meetings and summer trips.

There is nothing of special interest to report in connection with these matters, except that two of the proposed summer trips were abandoned on account of the comparatively poor attendance experienced on the first two excursions.

Branch Elections

Our branch by-laws require that branch elections be conducted by letter-ballot. For the election held in December, 1922, the secretary mailed 131 letter-ballots, but only 50, or 38 per cent, were marked and returned. Similarly, for the present election, 132 ballots were mailed, but only 50 members voted. This fact is worth noting, in view of the annual expenditure of nearly $20.00 involved in the election and annual meeting.

Quarters

The office and library of the Vancouver Branch, at 930 Birks Bldg., costs the branch $240.00 per annum, paid to the Association of Professional Engineers of B.C., as the branch's share of the rental of joint quarters. The advantage of this arrangement is that the branch has the use of good quarters in a convenient location, and close connection with the Association of Professional Engineers, at an annual expense which is at least $120.00 less than what would have to be incurred if the branch occupied separate quarters.

It would, however, be greatly to our advantage if the joint quarters could so be arranged, that a meeting room, capable of seating about 40 persons, would be available without payment of additional rental. Under existing conditions, an outlay of from $5.00 to $10.00 for rental of a hall, has to be made every time the branch holds a general meeting. This is a matter which should be pressed. The council of the Association of Professional Engineers has had the matter under consideration; but if the urgency of it is pointed out, there is no doubt that a satisfactory solution of the problem can be attained.

Library

Under the existing arrangement with the other societies occupying the quarters at 930 Birks building, which provides a joint library for the use of the members, the library is undoubtedly increasing in value. The fruits of Mr. Wheatley's labours as librarian are very evident in the general improvement of the room and the increasing patronage. But the library itself is not what it might be, if the interest in it were more general. We have gone too far to retrench. What is now of vital importance is a definite library policy, followed by concerted effort directed by a strong committee.

At the present time, a considerable assortment of useful and interesting periodicals of a technical nature are available for the benefit of any and every member of *The Institute* who cares to visit the library. The librarian is seriously handicapped, however, through lack of adequate shelving, which renders efficient filing an impossibility. The books, while containing valuable material, need proper indexing, and should be supplemented by a selection of the more outstanding recent engineering works, to bring the library up to date. The most commonsense basis on which to fix a library policy, under present financial circumstances, would appear to be to a modest sum, sufficient to provide a small but efficient library which will encourage rather than discourage the use of it. Once appreciation of its possibilities is firmly established in the minds of our members, their interest will carry it on.

By-Laws

A thorough revision of the branch by-laws should be undertaken by a competent committee. After adoption by the branch, the advisability of issuing printed copies in booklet form to our members should be considered.

Membership

Grade	*Dec. 19th, 1923*	*Dec. 19th, 1922*
Members	55	50
Associate Members	75	81
Juniors	2	5
Students	23	16
Affiliates	1	1
Total	156	153

The recent allotment of Non-Resident members to the Vancouver Branch by action of the Council in July, 1923, is as follows:—

Members	18
Associate Members	50
Juniors	10
Students	5
Affiliates	1
Total	84

The by-laws of the branch should be amended to cover this Non-Resident membership.

Committees

During the past year, such sub-committees as were required, were, for the sake of convenience, appointed from the members of the Executive Committee. There are, however, a number of members of the branch whose advise and assistance would not only benefit the Executive Committee, but whose interest in branch affairs would help to stimulate activity in the other 84 per cent. It would therefore seem desirable to have these gentlemen well represented on our sub-committees during the year 1924.

Financial Statement

The following is the treasurer's statement as at December 19th, 1923:—

Receipts

Balance on hand, Dec. 19th, 1922	$274.54		
Less Swan Donation	25.00		
		$249.54	
Rebates on fees, Nov. 1922 to Nov. 1923		270.63	
Branch news, Nov. 1922 to Nov. 1923		29.73	
Rental of lantern		2.00	
Total			$551.90

Expenditures

Rent, 930 Birks bldg	$240.00	
Board of Trade Auditorium	10.00	
Technical School Auditorium	10.00	
Printing	26.35	
Postage	13.94	
Telegrams	4.09	
Stationery, etc	5.72	
Addressograph	.98	
Bank exchange	.70	
Honorarium to secretary	50.00	
Canadian Engineer subscription	3.15	
Miscellaneous	1.50	
Balance, Dec. 19th, 1923	185.47	
Total		$551.90

There are no outstanding accounts to be paid. The balance of $185.47 on hand at the date of this report, which covers fees and branch news for 13 months, shows a shrinkage for the year of $64.07 as compared with a shrinkage of $89.42 for the year 1922. At this rate, the present cash surplus will probably disappear in a little over two years. The assets of the branch, covering furniture and library have not been valued.

Donation by A. D. Swan, M.E.I.C.

On March 28th, 1921, A. D. Swan, M.E.I.C., donated a sum of $25.00 to be used by the branch for a student's prize. This amount was overlooked in the 1922 report, but has been deducted from our branch funds in the report for this year. This amount should be placed in the hands of a special committee, to be applied in the way suggested by the donor, Mr. Swan.

Moberley Fund

This fund is invested in Victory bonds, whose par value is $400.00. The accrued coupon and savings bank interest to date amounts to $188.65.

At the present time this fund is growing at the rate of about $25.00 annually. If the savings be added to the principal about the end of 1924, and a further purchase of $200.00 worth of 5 per cent Victory bonds be made, the annual interest return would amount to $30.00.

This suggests that the fund could be used advantageously, to endow a student's prize, if such a policy would meet with the approval of the original trustees of the fund.

Respectfully submitted,

P. H. BUCHAN, A.M.E.I.C., *Secretary-Treasurer.*

Victoria Branch

The President and Council,

On behalf of the Executive Committee I beg to present the following report for your consideration:—

Membership

The strength of this branch as advised from Headquarters on November 5th, is as follows:—

Members	32
Associate Members	34
Juniors	3
Students	2
Total	71

The following branch members left the city during the year:—T. Rognaas, A.M.E.I.C., R. H. Vaughan, A.M.E.I.C.

New members arriving during the year or returned to this city include the following:—

G. B. Mitchell, M.E.I.C.	J. R. Grant, M.E.I.C.
A. L. Carruthers, M.E.I.C.	G. Phillips, A.M.E.I.C.
J. McGown, M.E.I.C.	G. B. Dixon, A.M.E.I.C.
J. Hunter, M.E.I.C.	K. M. Chadwick, A.M.E.I.C.
W. W. Bell, M.E.I.C.	W. S. Lawrence, Jr.E.I.C.

Meetings

The activities of the branch during the year included lectures and visits of inspection, but I regret to report that not more than a score of our membership took any interest and not more than a dozen indicated an inclination to regularly support the branch by their attendance at these affairs. The lectures were as follows:—

"Mount Everest Expedition (1921)," Major E. O. Wheeler, D.S.O., R.E.

"Science of Geology as applied to War Operations," Professor R. W. Brock, M.A., F.G.S., F.R.C.S.

"Description of Victoria Gas Company's Plant," F. H. Hewlings
"Marine Borers," Professor C. McLean Fraser.
"Charting Operations on the B.C. Coast," H. D. Parizeau, A.M.E.I.C.

The following visits of inspection were made:—

Plant of Victoria Gas Company, by the courtesy of F. H. Hewlings, superintendent.

Government Meteorological Observatory, (Gonzales Hill), by the courtesy of Napier Denison.

D. G. Survey Ship "Lillooet", by the courtesy of H. D. Parizeau, A.M.E.I.C.

Financial Statement

Balance sheet, Dec. 1st, 1922, to Dec. 1st, 1923

Balance in bank, 1922	$ 60.17	
Cash in hand, 1922	9.08	
		$ 69.25
Receipts		
Fees from Dec. 1st, 1922, to Nov. 30th, 1923	$159.50	
Rebates from Headquarters	145.23	
	$304.73	
Disbursements		
Rent of room, Nov. 1st, 1922, to Nov. 30th, 1923	$123.00	
Insurance on office property	5.45	
Postage	13.00	
Stationery	11.50	
Typing	9.15	
Printing notices	20.78	
Reception debit balance	32.83	
Honorarium	50.00	
Chamber of Commerce, membership	25.00	
Rental of halls for lectures	13.50	
Magazines	16.50	
Light	1.68	
Janitor	3.00	
Exchange on cheque	.92	
	$326.31	
Excess of disbursements over receipts		$ 21.58
Balance in hand		$ 47.67
Assets		
Bank balance	$ 38.89	
Cash	8.78	
		$ 47.67

In concluding this report I should like to express the opinion that due to the inconvenience of meeting the local assessments during the recent years of what might be called "hard times", we have lost the support of a considerable number of *Institute* members resident in the city which has created a situation unfavourable for successful accomplishment of the purposes for which the branch organization exists. That is, instead of getting the members together and at least acquainted with one another, there is the danger of having two camps — the minority consisting of those supporting and controlling the branch organization and a not altogether inarticulate majority consisting of those who do not willingly support the branch and have no control over its activities and who are conscious that a portion of their dues paid to Montreal are contributed to the expenses of the branch organization.

I wish to thank the chairman for his patient guidance and assistance in the little I was able to accomplish as secretary during the past year.

Respectfully submitted,

Hugh Peters, A.M.E.I.C., *Branch Secretary.*

Winnipeg Branch

The President and Council,

On behalf of the Winnipeg Branch we beg to submit the following report for the year 1923:—

Membership

The membership of the branch at this date is 278 and of the branch district 29, a total of 307, distributed as follows:—

	Branch	*Branch District*	*Total*
Members	46	3	49
Associate Members	149	21	170
Juniors	25	3	28
Students	27	2	29
Affiliates	5	–	5
Branch Affiliates	26	–	26
	278	29	307

Meetings

Sixteen regular meetings were held during the year with an average attendance of 55. Excluding the meeting of January 17th, which was open to the public, the average attendance was 47. The Executive Committee held 12 meetings during the year. The following is a detailed list of the regular meetings:—

Date	*Subject*	*Speaker*	*Attendance*
Jan. 4	"Automatic Fire Protection"	J. C. Davis, A.M.E.I.C.	24
Jan. 17	"Manufacture of Galvanized Iron" (moving picture)	D. M. Buck	180
Feb. 1	Report of General Professional Meeting	J. G. Sullivan, M.E.I.C.	40
Feb. 15	"Three Wire Trolley Distribution"	W. N. Smith, M.E.I.C.	34
Mar. 1	"Marketing of Grain"	Jas. Stewart	51
Mar. 15	"Use of Powdered Fuel under Steam Boilers"	Col. H. D. Savage	89
Apr. 5	"Lignite Plant at Bienfait"	J. M. Leamy, M.E.I.C.	61
Apr. 19	"Progress Report Committee on Roads"	M. A. Lyons, A.M.E.I.C.	29
May 3	Annual meeting		41
Sept. 20	"Electric Furnaces for Smelting Iron and Steel"	J. R. Eckley	53
Oct. 4	"The selection and operation of a Railway Motor Coach"	W. M. Scott, M.E.I.C.	26
Oct. 18	"Corporation Finance"	M. F. Wardhaugh	39
Nov. 1	"Combustion of Canadian Coals"	T. A. Marsh	59
Nov. 15	"Transportation Routes"	J. G. Sullivan, M.E.I.C., W. Sanford Evans	59
Dec. 6	"Transportation Routes"	J. M. Campbell, W. N. Smith, M.E.I.C.	75
Dec. 20	"Merit and Money"	Professor Jones	17

On July 11th, a branch golf competition was held at the Southwood Course, in which 32 members took part.

General

The branch suffered severe losses during the year in the death of two of its prominent members, Col. J. A. Hesketh, M.E.I.C., and J. G. Legrand, M.E.I.C., and in the retirement of George L. Guy, M.E.I.C., energetic secretary of the branch for five years.

The Plummer medal for 1922 was awarded to W. N. Smith, M.E.I.C., and Dr. Shipley, for a paper read before the branch.

Members of the branch were elected or appointed to the following public positions:—

R. J. Swain, A.M.E.I.C., mayor, city of St. Boniface.
J. G. Sullivan, M.E.I.C., alderman, city of Winnipeg.
D. L. McLean, A.M.E.I.C., deputy minister of Public Works, Manitoba.
W. E. Hobbs, A.M.E.I.C., deputy provincial secretary, Manitoba.

Financial Statement

The financial statement of the branch is as follows:—

Receipts		
Local dues	$456.00	
Rebates from Headquarters	384.00	
Branch news	27.09	
Bank interest	18.92	
Bond interest	27.50	
Miscellaneous	13.75	
Total receipts	927.26	
Bank balance, Dec. 31st, 1922	580.80	
Cash in hand and with secretary, Dec. 31st, 1922	304.68	
		$1,812.74
Expenditures		
Total expenditures	$604.73	
Bank balance, Dec. 31st, 1923	1,172.01	
Cash in hand and with secretary, Dec. 31st, 1923	36.00	
		$1,812.74
Assets		
Cash balance	$1,208.01	
Rebates, last quarter	83.25	
Advertising	18.00	
Local dues in arrears, 50 per cent written off	591.00	
Office furniture and library, 5 per cent depreciation	323.62	
War bonds	500.00	
		$2,723.88
Liabilities		
Accounts payable		67.75
Surplus		$2,656.13

Respectfully submitted,

A. McGillivray, A.M.E.I.C., *Chairman.*

P. Burke-Gaffney, A.M.E.I.C., *Secretary-Treasurer.*

THE

ENGINEERING JOURNAL

THE JOURNAL OF
THE ENGINEERING INSTITUTE
OF CANADA

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Annual General Meeting

The Annual Meeting called in Montreal, on Tuesday, January twenty-second, was presided over by President Francis, who called for the reading of the minutes of the last annual meeting, and after the appointment of the scrutineers the meeting was adjourned to Ottawa to reconvene at the Chateau Laurier, on Wednesday, January twenty-third, at 10.00 a.m. An account of this meeting will be found in another column of this issue of *The Journal.*

The McCharles Prize

Announcement is made that an award of the McCharles Prize, instituted by the University of Toronto, will shortly be made. This is a distinguished prize for engineers, inventors and scientific research workers. It carries not only a very high honour but a cash value of one thousand dollars. The first award was made in 1910, a second during the war, and the present one will constitute the third.

This prize was established in connection with the bequest of the late Aeneas McCharles of the value of $10,000. and is awarded on the following terms and conditions, namely, that the interest therefrom shall be given from time to time, but not necessarily every year, like the Nobel prizes in a small way:—

(1) To any Canadian from one end of the country to the other, and whether student or not, who invents or discovers any new and improved process for the treatment of Canadian ores or minerals of any kind, after such process has been proved to be of special merit on a practical scale; (2) Or for any important discovery, invention or device by any Canadian that will lessen the dangers and loss of life in connection with the use of electricity in supplying power and light; (3) Or for any marked public distinction achieved by any Canadian in scientific research in any useful practical line. The term "Canadian" for the purpose of the award means any person Canadian born who has not renounced British alliance; and in the first of the three cases provided for by the bequest, domicile in Canada is an essential condition.

Every candidate for the prize is required to be proposed as such in writing by some duly qualified person. A direct application for a prize will not be considered.

No prize will be awarded for any discovery or invention unless it shall have been proved to the satisfaction of the awarding body, to possess the special practical merit indicated by the terms of the bequest.

The order of priority in which the three cases stand in the wording of the bequest will be observed in making the award; that is, "the award shall go *cæteris paribus* to the inventor of methods of smelting Canadian ores; and, failing such inventions, to the inventor of methods for lessening the dangers attendant upon the use of electricity; and only in the third event, if no inventors of sufficient merit in the field of metallurgy and electricity present themselves, to the inventor distinguished in the general field of useful scientific research."

The committee of award, appointed by the governors of the University is composed of an expert in each subject of mineralogy, electricity and physics and four others; it includes the deans of the engineering faculties at McGill, Toronto and Queen's universities.

It is desirable that wide publicity be given throughout Canada to this prize and the committee of award is announcing that it will receive nominations for candidates up to the 1st of March. Nominations may be made direct to Dean Mitchell, chairman of the committee, at the University of Toronto.

A Correction

In the list, published in the January issue, of the enrollments at the various universities, due to an error, an important engineering centre was omitted, being the department of engineering, Mount Allison University, where a splendid course is given.

There are registered at Mount Allison, fifteen students in the sophomore year, and ten in the first year and in addition there are several arts students taking engineering options with a view to completing both courses in six years.

Ottawa Meeting Attains High Standard

Members of *The Institute* who had attended previous meetings in Ottawa, anticipated much from the recently concluded annual and general professional meeting. Expectations were fully realized. Visiting members who enjoyed the hospitality of the Ottawa Branch during the two days' gathering are loud in their praises of the efficient manner in which every detail of the splendid programme was arranged and carried out.

The officers and members of the Ottawa Branch who made the plans and who were untiring in their efforts to ensure the greatest possible success for the meeting are to be most heartily congratulated, for there never has been an engineering gathering in this country made more enjoyable by the local members, or which, in any degree, for completeness of detail or happiness of arrangement, could out-rival the meeting held at Ottawa, January twenty-third and twenty-fourth.

The thanks of the entire *Institute* are due in no uncertain measure to those loyal members of *The Institute* who sacrificed so much of their time, and placed for the benefit of *The Institute*, not only the resources of the branch, but their well known capacity for providing entertainment, both technical and social, of the very highest possible order. It will be a satisfaction to the Ottawa Branch officers and members to know that their efforts are appreciated; that their meeting was ideal from every viewpoint, and that they have added considerably to the influence and prestige of the engineering profession by the manner in which they carried out all the detail necessary for such a successful convention. Those who were unable to go missed two days of keen enjoyment and the inspiration that always results from meeting fellow engineers in an atmosphere of good fellowship and mutual co-operation.

The formal votes of thanks passed at the last session, and also by the Council of *The Institute* which met during the meeting, to all those responsible for making the meeting a success, can scarcely convey to those to whom thanks are due, the real warmth of feeling towards them for what they have done to promote engineering interest and activity. From the chairman and officers of the Ottawa Branch to the humblest member of every committee their work was well and truly done, reflecting credit on their ability, their enthusiasm, and the fine spirit of co-operation behind it all. For many a day the visitors will look back with pleasure upon this happy gathering, and it is hoped that the Ottawa members will feel some compensation in the knowledge of the fact that the meeting was an unqualified success, and that what they did is greatly appreciated.

Well done — Ottawa.

Students' Prizes

As announced at the annual meeting student prizes for the best papers in their respective sections will be awarded as follows:—

Chemical —
"The Acid Plant, its Functions and Operations in the Sulphite Mill," by W. H. Barnes, S.E.I.C.

General or Civil —
"Water Purification," by C. P. Reaper, S.E.I.C.

Railway —
"Local Transportation on Rails," by J. R. Dunbar, Jr.E.I.C.

Mechanical—
"Hoisting Machinery," by G. M. Dick, S.E.I.C.

It is a pleasure to announce that during the coming year an additional prize is available for Juniors and Students, being represented by books to the value of twenty-five dollars contributed by Mr. A. D. Swan, M.E.I.C., for the best paper on "Students Apprenticeship System as Applicable to the Dominion". This prize is open to any Student or Junior of *The Institute.* Those desiring to write an essay on this subject should prepare manuscript and submit it to the headquarters office of *The Institute* not later than October first of the current year. The prize will be awarded by the Students' Prizes Committee of *The Institute.*

A committee has been appointed by *The Institute* to study apprenticeship systems, consisting of Mr. A. D. Swan, chairman, and Messrs. F. P. Shearwood and K. B. Thornton.

Prizes for Successful Designs

The annual meeting endorsed the recommendation of the Honour Roll and War Trophies Committee for the erection at headquarters of a bronze tablet in honour of the members of *The Institute* who fell while on active service, and also a record in bronze of all who served overseas. It is proposed to raise the necessary money by popular subscription, with a maximum of ten dollars.

A prize of one hundred and fifty dollars is to be awarded to the successful designer of the honour roll memorial, and one hundred dollars to the designer of the record in bronze of all who served.

The honour roll tablet will contain approximately eighty-three names, and the bronze record will contain approximately one thousand names.

Any Member, Associate Member, Junior or Student of *The Institute* may submit a design or designs. All designs should be in the hands of the Secretary not later than the last day of May, nineteen twenty-four.

To Catalogue the Library

In the report of the Library and House Committee it was recommended that a sufficient grant should be made to catalogue the entire library at headquarters and add each year sufficient new technical books to keep the library thoroughly up to date for technical reference. This report having been adopted by the annual meeting it will devolve upon the incoming Library and House Committee to make arrangements for carrying out this important work. It is proposed to follow the system used in the Engineering Societies Library in New York, and to get the matter well under way during the coming summer when the library is not so extensively used.

Kelvin Medal Award

According to information received from the secretary of the Institution of Civil Engineers of Great Britain, the second triennial award of the Kelvin Medal was made to Professor Elihu Thomson of Lynn, Mass., U.S.A., at a meeting of the Award Committee, comprising the presidents of the principal representative British engineering institutions, held at Westminster, on December fourteenth, nineteen hundred and twenty-three.

Eminent Railway Builders

Three of Canada's Railway Engineers whose record embodies much of the history of Railway Construction in Canada

A unique record of Canadian railway pioneer engineers is embodied in a photograph forwarded by the Vancouver Branch, taken in Vancouver on October 26th, 1923, of three prominent members of *The Institute* whose record for continued service in the survey and construction of railways is possibly without parallel. They are — reading from left to right, H. J. Cambie, M.E.I.C., eighty-seven years of age; T. H. White, M.E.I.C., seventy-six years of age; and J. H. Kennedy, M.E.I.C., seventy-two years of age. They are all resident in Vancouver and each is a life member of *The Engineering Institute of Canada*.

Each has been identified with one of the three great transcontinental railroads now operating in British Columbia, as chief engineer on the location and construction of the original main lines within the Province, pioneered through the wilderness of mountains, canyons, forests and plains by feats of engineering skill and perseverence not surpassed and scarcely equalled in any other part of the world. Each one is enjoying excellent health, and occupies the very highest place in the respect and esteem of the members of the engineering profession together with the general public. Another very interesting coincidence lies in the fact that each one possesses the apparently magic name "Henry".

H. J. CAMBIE, M.E.I.C. T. H. WHITE, M.E.I.C. J. H. KENNEDY, M.E.I.C.

Henry John Cambie, M.E.I.C., was born on October 25th, 1836, in County Tipperary, Ireland. He had charge of the location of the present main line of the Canadian Pacific Railway from the Coast to Griffin Lake, and was chief engineer of the world-famous construction through the Fraser Canyon from Yale to Lytton, and also the construction of the section from Savona Ferry to Shuswap Lake.

Mr. Cambie has been continuously associated with the Canadian Pacific Railway and its predecessor, the Government Railway, for sixty-eight years. His name is perpetuated by the station on the C.P.R., Cambie, on the giant loop below Glacier. Mr. Cambie explored, surveyed and planned the whole course of the C.P.R., through a large section of the province of British Columbia, and under his direct supervision the part that runs through the canyons of the Fraser was built. At the age of eighty-seven he is still hale and hearty, enjoying the love and esteem of his fellow men.

Thomas Henry White, M.E.I.C., was born on January 27th, 1848, at St. Thomas, Ontario. He was chief engineer of the location and construction of the present main line of the Canadian National Railway, from the Yellowhead Pass, down the North Thompson and Fraser Canyons to New Westminster. It is interesting to note that he was Mr. Cambie's right-hand assistant during the work in the Fraser Canyon.

Mr. White has always been popular with his fellow engineers, being noted for abundant good nature, keen sense of humour, and an absolute fairness in all his associations.

James Henry Kennedy, M.E.I.C., was born on March 3rd, 1848, in Carleton County, Ontario. He had charge of the location of the Great Northern Railway's main line in British Columbia, under the Vancouver, Victoria and Eastern Rly., charter, from Laurier to the Coast. As chief engineer, he built the first section in the Province, from Laurier to Grand Forks, through the Kettle Valley country, and afterwards constructed the longer section from Chopaka to Brookmere, through the difficult Similkameen and Tulameen Valleys.

Mr. Kennedy enjoys to a high degree the esteem of his fellow engineers and is appreciated for his true worth and his marked accomplishments.

The complete record of the life-work of each of these pioneer railroaders is full of interesting reminiscence, and the monuments of their handiwork are to be seen in practically every province of the Dominion. Although British Columbians take great pride in the achievements of these men, they nevertheless feel that they belong to Canada, from coast to coast.

It is a pleasure to publish this unusual photograph and pay a tribute to three men who have played a large part in the history of railway construction in Canada.

Thirty-Eighth Annual Meeting

Meeting at Montreal

The Annual General Meeting of *The Institute* was convened at headquarters, on January twenty-second, nineteen twenty-four. President Walter J. Francis, M.E.I.C., declared the meeting open at 10.45 a.m.

Reading of Minutes

It was moved by K. B. Thornton, M.E.I.C., seconded by John T. Farmer, M.E.I.C., that the minutes of the thirty-seventh annual meeting as published on page ninety-five in the February 1923, issue of *The Journal*, be taken as read and approved. Motion carried.

Appointment of Scrutineers

It was moved by Brig.-Gen. C. H. Mitchell, C.M.G., M.E.I.C., seconded by Professor Ernest Brown, M.E.I.C., that Messrs. Geo. E. Bell, M.E.I.C., and J. A. Lalonde, A.M.E.I.C., be appointed scrutineers to report the result of the officers' ballot to the secretary. Motion carried.

Appointment of Auditors

It was moved by K. B. Thornton, M.E.I.C., seconded by General Bertram, M.E.I.C., that Messrs. Riddell, Stead, Graham and Hutchison, be the auditors of *The Institute* for the ensuing year. Motion carried.

Motion to Adjourn

It was moved by Colonel C. N. Monsarrat, M.E.I.C., seconded by Doctor R. A. Ross, M.E.I.C., that the meeting adjourn to resume the business of the annual meeting, at the Chateau Laurier, Ottawa, on January twenty-third, at ten a.m. Motion carried.

Meeting at Ottawa

The adjourned annual meeting was reconvened at the Chateau Laurier, Ottawa, on Wednesday, January twenty-third, at 10.15 a.m., with President Walter J. Francis, M.E.I.C., in the chair.

Report of Council

It was moved by John T. Farmer, M.E.I.C., seconded by A. F. Macallum, M.E.I.C., that the report of Council, as published on page fifty-one of the February 1924 *Journal* be adopted. Motion carried.

Reports of Committees

Library and House Committee: — It was moved by Geo. R. MacLeod, M.E.I.C., seconded by R. deB. Corriveau, M.E.I.C., that the report of the Library and House Committee, as published on page fifty-three of the February 1924 *Journal,* be adopted. Motion carried.

Finance Committee: — It was moved by C. H. Keefer, M.E.I.C., seconded by Geo. A. Mountain, M.E.I.C., that the report of the Finance Committee as published on page fifty-four of the February 1924 *Journal,* be adopted. Motion carried.

Legislation and By-law Committee: — It was moved by Brig.-Gen. C. H. Mitchell, C.M.G., M.E.I.C., seconded by Geo. R. MacLeod, M.E.I.C., that the report of the Legislation and By-laws Committee, as published on page fifty-six of the February 1924 *Journal,* be adopted. Motion carried.

Board of Examiners and Education Committee: — It was moved by A. F. Macallum, M.E.I.C., seconded by C. H. Keefer, M.E.I.C., that the report of the Board of Examiners and Education Committee, as published on page fifty-six of the February 1924 *Journal,* be adopted. Motion carried.

Students' Prizes Committee: — It was moved by Geoffrey Stead, M.E.I.C., seconded by Prof. C. R. Young, M.E.I.C., that the report of the Students' Prizes Committee, as published on page fifty-seven of the February 1924 *Journal,* be adopted. Motion carried.

Publication Committee: — It was moved by Brig.-Gen. C. H. Mitchell, C.M.G., M.E.I.C., seconded by A. R. Decary, M.E.I.C., that the report of the Publications Committee as published on page fifty-seven of the February 1924 *Journal,* be adopted. Motion carried.

Code of Ethics Committee: — It was moved by C. H. Keefer, M.E.I.C., seconded by F. P. Shearwood, M.E.I.C., that the report of the Code of Ethics Committee, as published on page fifty-seven of the February 1924 *Journal,* be received by the meeting and referred back to Council for further action. Motion carried.

Nominating Committee: — It was moved by Brig.-Gen. C. H. Mitchell, C.M.G., M.E.I.C., seconded by R. M. Hannaford, M.E.I.C., that the Nominating Committee-1924, as published on page fifty-seven of the February 1924 *Journal,* be approved. Motion carried.

Papers Committee:—It was moved by John T. Farmer, M.E.I.C., seconded by Geo. R. MacLeod, M.E.I.C., that the report of the Papers Committee, as published on page fifty-seven of the February 1924 *Journal,* be adopted. Motion carried.

Fuel Committee: — It was moved by Chas. Warnock, A.M.E.I.C., seconded by E. A. Forward, M.E.I.C., that the report of the Fuel Committee, as published on page fifty-eight of the February 1924 *Journal,* be adopted. Motion carried.

Canadian Engineering Standards Committee: — It was moved by Geo. A. Mountain, M.E.I.C., seconded by Geo. R. MacLeod, M.E.I.C., that the report of the Canadian Engineering Standards Committee, as published on page fifty-eight of the February 1924 *Journal,* be adopted. Motion carried.

Canadian National Committee, International Electro-Technical Commission: — It was moved by G. Gordon Gale, M.E.I.C., seconded by R. M. Hannaford, M.E.I.C., that the report of the Canadian National Committee of the International Electro-Technical Commission, as published on page sixty of the February 1924 *Journal,* be adopted. Motion carried.

Uniform Steam Boiler Specifications Committee: — On motion of C. E. W. Dodwell, Hon.M.E.I.C., seconded by Willis Chipman, M.E.I.C., the report of the Uniform Steam Boiler Specifications Committee, as published on page sixty of the February 1924 *Journal,* was adopted.

Classification and Remuneration Committee: — It was moved by John Henderson, A.M.E.I.C., seconded by Professor C. R. Young, M.E.I.C., that the report of the Classification and Remuneration Committee, as published on page 461 of the October 1923 *Journal,* be received by the meeting for discussion and that it be referred back to Council. Motion carried.

Honour Roll and War Trophies Committee: — On motion of Brig.-Gen. C. H. Mitchell, C.M.G., M.E.I.C., seconded by Geo. A. Mountain, M.E.I.C., the report of the Honour Roll and War Trophies Committee as published on page sixty-one of the February 1924 *Journal* was adopted.

The report of the Honour Roll and War Trophies Committee which was endorsed at the annual meeting recommended the erection at headquarters of a bronze tablet in honour of the members of *The Institute* who fell while on active service, and also a record in bronze of all who served overseas. The proposal being to raise the necessary money by popular subscription with a maximum of ten dollars.

During the discussion on this report it was suggested by John Henderson, A.M.E.I.C., that a photograph of these tablets be published in *The Engineering Journal*, to which suggestion Brig.-Gen. C. H. Mitchell, C.M.G., M.E.I.C., added that the best possible photographic reproduction of the tablets should be secured and that a copy suitably mounted and framed be presented to each branch of *The Institute*, the expenses incurred in the preparation of these photographs to be detrayed from the memorial fund.

WALTER J. FRANCIS, M.E.I.C.
President of the Institute for 1924

Past-presidents' Prize Fund: — It was moved by J. M. R. Fairbairn, M.E.I.C., seconded by K. B. Thornton, M.E.I.C., that the report of the Past-Presidents' Prize Fund, as published on page sixty-one of the February 1924 *Journal*, be adopted. Motion carried.

Committee on Deterioration of Concrete in Alkali Soils: — It was moved by C. E. W. Dodwell, Hon.M.E.I.C., seconded by Geo. R. Macleod, M.E.I.C., that the report of the Committee on Deterioration of Concrete in Alkali Soils, as published on page sixty-one of the February 1924 *Journal*, be adopted. Motion carried.

Students' Activities Committee: — It was moved by Geo. R. MacLeod, M.E.I.C., seconded by U. Valiquet, M.E.I.C., that the report of the Students' Activities Committee, as published on page sixty-three of the February 1924 *Journal*, be adopted. Motion carried.

Committee on Biographies: — It was moved by Geo. T. Clarke, A.M.E.I.C., seconded by R. F. Uniacke, M.E.I.C., that the report of the Committee on Biographies, as published on page sixty-three of the February 1924 *Journal*, be adopted. Motion carried.

Ontario Provincial Division: — It was moved by A. B. Lambe, A.M.E.I.C., seconded by Prof. C. R. Young, M.E.I.C., that the report of the Ontario Provincial Division, as published on page sixty-three, of the February 1924 *Journal*, be received by the Meeting and referred back to Council for further action. Motion carried

Gzowski Medal Committee: — The recommendation of the Gzowski medal committee that there should be no award of the Gzowski medal for the year 1923, was announced.

Plummer Medal Committee: — The recommendation of the Plummer medal committee that there should be no award of the Plummer medal for the year 1923, was announced.

Leonard Medal Committee: — The recommendation of the Leonard medal committee that the Leonard medal be awarded to F. W. Gray, A.M.E.I.C., for his paper on "The Development of the Coal Industry in Canada", published in the Monthly Bulletin of The Canadian Institute of Mining and Metallurgy, October, 1922, page 1051, was announced and approved.

J. B. CHALLIES, M.E.I.C.
Elected Vice-President for Zone C.

Reports of Branches

Branch reports were presented as follows, and on motion by Geo. R. MacLeod, M.E.I.C., seconded by N. F. Ballantyne, A.M.E.I.C., these reports were adopted.

February 1924, "Journal"		February 1924, "Journal"	
Border Cities Branch	64	Niagara Peninsula Branch	72
Calgary Branch	64	Ottawa Branch	72
Cape Breton Branch	65	Peterborough Branch	74
Edmonton Branch	66	Quebec Branch	74
Halifax Branch	66	Saguenay Branch	76
Hamilton Branch	67	Saskatchewan Branch	76
Kingston Branch	68	Sault Ste. Marie Branch	77
Lakehead Branch	68	St. John Branch	77
Lethbridge Branch	68	Toronto Branch	78
London Branch	69	Vancouver Branch	79
Moncton Branch	70	Victoria Branch	80
Montreal Branch	70	Winnipeg Branch	81

At this point President Francis called upon Past-President Geo. A. Mountain, M.E.I.C., to preside while the report of the scrutineers was presented.

Officers for 1924

On behalf of the scrutineers appointed at the opening session in Montreal, George E. Bell, M.E.I.C., read the report giving the following results of the ballot for the election of officers and members of Council for the year nineteen twenty-four:—

President............... Walter J. Francis, M.E.I.C.
Vice-Presidents Zone b—J. B. Challies, M.E.I.C.
Zone c—F. P. Shearwood, M.E.I.C.
Arthur Surveyer, M.E.I.C.
Zone d—F. A. Bowman, M.E.I.C.

*Councillors:—
Halifax Branch District—F. R. Faulkner, M.E.I.C.
Hamilton Branch District— R. K. Palmer, M.E.I.C.
Lakehead Branch District—W. T. Moodie, M.E.I.C.
Lethbridge Branch District—G. N. Houston, M.E.I.C.
Niagara Peninsula Br.Dist.—F.W. Clark, A.M.E.I.C.
Ottawa Branch District—K. M. Cameron, M.E.I.C.
St. John Branch District—F. P. Vaughan, M.E.I.C.
Toronto Branch District—E. G. Hewson, M.E.I.C.
Victoria Branch District—H. M. Bigwood, A.M.E.I.C.

J. L. RANNIE, M.E.I.C.
Chairman, Ottawa Branch for 1924.

Installation of Newly-Elected President

Geo. A. Mountain, M.E.I.C., then called upon C. E. W. Dodwell, Hon. M.E.I.C., and Brig.-Gen. C. H. Mitchell, C.M.G., M.E.I.C., to escort the newly-elected President, Walter J. Francis, M.E.I.C., to the chair. Mr. Francis in accepting the office of President, spoke briefly of his great appreciation of the honour that was being conferred upon him.

Tribute to Memory of the late President Arthur St. Laurent

The meeting went on record, by a unanimous resolution, which was passed by a standing silent vote, recording the sense of severe loss sustained by *The Institute* in the death of President Arthur St. Laurent.

*At a meeting of Council held at the Chateau Laurier, on Thursday, January twenty-fourth, nineteen twenty-four, at 4.15 p.m., the following were appointed councillors, representing:

Border Cities Branch District—W. H. Baltzell, M.E.I.C.
London Branch District—H. B. R. Craig, M.E.I.C.
Peterborough Branch District—R. L. Dobbin, M.E.I.C.
Saguenay Branch District—C. N. Shanly, A.M.E.I.C.

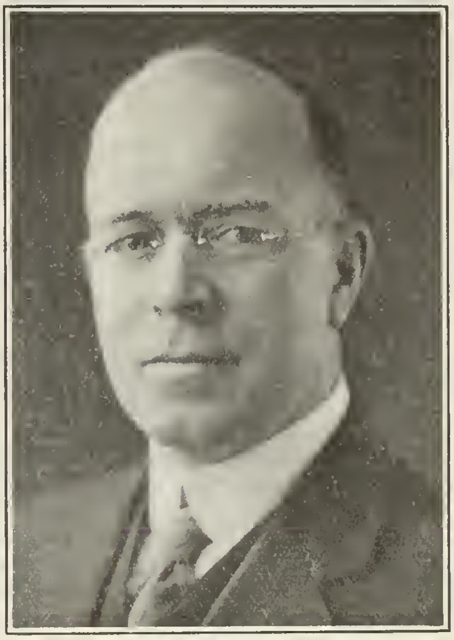
Correspondence

The secretary then read letters which had been received from Past-President Lt.-Col. R. W. Leonard, M.E.I.C., John A. Dresser, president, Canadian Institute of Mining and Metallurgy, and Geo. C. Mackenzie, M.E.I.C., secretary, Canadian Institute of Mining and Metallurgy, expressing regrets at their inability to attend the annual meeting of *The Institute.*

Messages were also received from vice-president, Geo. A. Walkem, M.E.I.C., past president R. A. Ross, M.E.I.C., councillor Geo. D. Macdougall, M.E.I.C., and from a number of presidents and secretaries of American Engineering Societies expressing regrets at being unable to attend.

Vote of Thanks

On motion by John T. Farmer, M.E.I.C., and seconded by Geo. R. MacLeod, M.E.I.C., a hearty vote of thanks was extended to the retiring officers, members of the Ottawa Branch, and to all others who had assisted in making the annual general and general professional meetings such an outstanding success.



K. M. CAMERON, M.E.I.C.
Elected Councillor for Ottawa Branch District.

The meeting was adjourned at 12.00 o'clock noon.

Luncheon

At the luncheon which was held in the main dining room of the Chateau Laurier, presided over by Branch Chairman, J. L. Rannie, M.E.I.C., *The Institute* was honoured by the presence of His Excellency the Governor-General of Canada. His Worship the Mayor of Ottawa extended a hearty welcome to the visiting members, on behalf of the Capital City, and on behalf of the Ottawa Branch the visitors were welcomed by Past-President Geo. A. Mountain, M.E.I.C. All out of town members were the guests of the Ottawa Branch at this luncheon.

First Session of General Professional Meeting

The first session of the professional meeting was held in the banquet room of the Chateau Laurier at 2.30 p.m., Wednesday, January twenty-third. At this meeting Sir W. Sefton Brancker, K.C.B.,etc., director of civil aviation of Great Britain Air Ministry, London, presented an address on "Progress in Civil Aviation" which was listened to with

C. P. EDWARDS, A.M.E.I.C.
Chairman of General Committee of Annual Meeting

the greatest interest and which brought forth a number of questions from the audience on points of recent progress in aviation.

The second paper was provided by Dr. Charles Camsell, M.E.I.C., deputy minister of mines, Canada, on the subject of "The Fuel Problem".

Annual Banquet

The annual banquet of *The Institute* took place in the main dining room of the Chateau Laurier, at 7.30 p.m., Lieut. Commander C. P. Edwards, O.B.E., A.M.E.I.C., presiding. At this banquet President Walter J. Francis, M.E.I.C., gave a short and intensely interesting address on the growth of *The Institute*, during the past thirty-eight years, in membership and activities. Progress in so far as increase in membership is concerned was graphically shown by a lantern slide of curves of total membership, corporate membership and non-corporate membership, for each year since *The Institute* was founded.

Smoker

At 9.00 p.m., sharp the members left the banquet hall for the ball room where the annual smoker was held and where they enjoyed the very excellent programme provided for their entertainment.

Second Session of General Professional Meeting

The second session of the professional meeting opened at 9.30 a.m., on Thursday, January twenty-fourth, with a paper by D. W. MacLachlan, M.E.I.C., on the "St. Lawrence Deep Waterway Problem". This paper dealt with a subject of very wide interest and following the reading of the paper a lengthy discussion took place. Those taking part in the discussion were, J. R. Harper, president, the Niagara Falls Power Company, H. G. Acres, M.E.I.C., hydraulic engineer, Hydro-Electric Power Commission of Ontario, Dr. Howard T. Barnes, former director of physics, McGill University, F. A. Gaby, M.E.I.C., chief engineer, Hydro-Electric Power Commission of Ontario, John Murphy, M.E.I.C., and others. When, according to the programme, it was time to meet for luncheon the discussion had not been completed and the meeting unanimously resolved to continue the discussion immediately upon the conclusion of the luncheon.

Luncheon

The luncheon on the second day of the general professional meeting, was held in the Chateau Laurier, with J. L. Rannie, M.E.I.C., chairman of the Ottawa Branch, presiding. At this luncheon, Mr. Hamnett P. Hill was the guest of honour, and addressed those present on "Col. By and the Rideau Canal".

Visit to Nickel Plant at Deschenes, Que.

During the afternoon the members of *The Institute* visited the plant of the British-America Nickel Corporation, at Deschenes, Quebec, where through the kindness of President E. N. Rhodes, they were given an opportunity to inspect the plant. Special cars, for the members of *The Institute* inspecting the plant, were provided through the courtesy of the Hull Electric Railway Company. At Deschenes the members were received by R. L. Peek, M.E.I.C., refinery manager, and were treated to afternoon tea served by the company.

The Annual Ball

The programme concluded with the annual ball of the Ottawa Branch, held in the ball room of the Chateau Laurier, on the evening of January twenty-fourth, under the distinguished patronage of their Excellencies the Governor-General and Lady Byng of Vimy.

Annual Meeting Registration

At Montreal

1 MacLeod, G. R., Montreal.
2 Mitchell, C. H., Toronto.
3 Bell, G. E., Montreal.
4 Hannaford, R. M., Montreal.
5 Lalonde, J. A., Montreal.
6 Blumenthal, S., Montreal.
7 Ketterson, A. R., Montreal.
8 Motley, P. B., Montreal.
9 McAllister, W. J., Montreal.
10 Westbye, P. P., Peterborough, Ont.
11 Thompson, Frank B., Montreal.
12 Bertram, Alex., Montreal.
13 Morrisey, T. S., Montreal.
14 Thornton, K. B., Montreal.
15 Sheppard, Norman E. D., Montreal.
16 Francis, Walter J., Montreal.
17 Keith, Fraser S., Montreal.
18 Ryan, E. A., Montreal.
19 Combe, F. A., Montreal.
20 Dobbin, R. L., Peterborough, Ont.
21 Ross, R. A., Montreal.
22 Marrotte, L. H., Montreal.
23 Engel, N. L., Montreal.
24 Smith, K. H., Halifax, N.S.
25 Bickerdike, Jr. R., Montreal.
26 Colle, Samuel S., Montreal.
27 Lawrence, Wm. D., Montreal.
28 Surveyer, Arthur, Montreal.
29 Pratley, P. L., Montreal.
30 Montsarrat, C. N., Montreal.
31 Farmer, John T., Montreal.
32 Helbronner, P. M., Montreal.
33 Gnaedinger, F. Theo., Montreal.
34 Brown, E., Montreal.
35 Kelly, Albert J., Montreal.
36 MacNab, S. D., Montreal.
37 Norris, J. H., Montreal.
38 Chambers, Hugh, Montreal.
39 Howard, R. F., Montreal.
40 Denis, L. G., Montreal.
41 Wilson, J. C., Montreal.
42 Swabey, H. W. B., Montreal.
43 Copeland, L. B., Rouses Point, N.Y.
44 Walker, R. M., Montreal.
45 Perkins, G. C., Montreal.
46 Baxter, John, Montreal.
47 Peden, Alexander, Montreal.
48 Cageorge, N., Montreal.
49 Peden, Ernest, Montreal.
50 Tait, J. L. M., Montreal.
51 Armstrong, D. B., Montreal.
52 Hawkes, H. H., Montreal.
53 Tennant, D. C., Montreal.

At Ottawa

54 Francis, Walter J., Montreal.
55 Edwards, C. P., Ottawa.
56 Harkom, J. W., Melbourne, Que.
57 Thomson, W. Chase, Montreal.
58 Berry, Robert C., Ottawa.
59 Rush, Walter A., Ottawa.
60 Price, Chas. A., Ottawa.
61 Keith, Fraser S., Montreal.
62 Marr, Norman, Ottawa.
63 Sheppard, Norman E. D., Montreal.
64 Desy, L. A., Montreal.
65 Lawson, W. S., Ottawa.
66 Johnston, J. T., Ottawa.
67 Beale, A. M., Ottawa.
68 Brydone-Jack, E. E., Victoria, B.C.
69 MacRae, A. E., Ottawa.
70 Barton, H. M., Ottawa.
71 Keefer, Charles H., Ottawa.
72 Putman, C. V., Ottawa.
73 Martindale, E. S., Ottawa.
74 Delaute, F. J., Ottawa.
75 Browne, G. A., Ottawa.
76 Finnie, O. S., Ottawa.
77 Horsey, G. F., Ottawa.
78 Mountain, Geo. A., Ottawa.
79 Seymour, Horace L., Toronto.
80 Mitchell, C. H., Toronto.
81 Decary, A. R., Quebec.
82 Viens, E., Ottawa.
83 Norrish, B. E., Montreal.
84 Vaughan, Frank P., St. John, N.B.
85 Boulton, W. J., Ottawa.
86 McKenna, J. A., Ottawa.
87 Withrow, F. D., Ottawa.
88 Hazen, H. T., Toronto.
89 Dunn, G. C., Toronto.
90 Baldwin, R. A., Toronto.
91 Busfield, J. L., Montreal.
92 Wright, A. C., Ottawa.
93 Hirsch, L. I., Ottawa.
94 Richan, Geo. F., Ottawa.
95 Hanington, C. F., Ottawa.
96 Waterous, C. A., Brantford, Ont.
97 Byrne, J. H., Ottawa.
98 Roberts, S. O., Ottawa.
99 Peters, F. H., Ottawa.
100 Rannie, J. L., Ottawa.
101 Dawson, W. Bell, Ottawa.
102 Gale, G. Gordon, Ottawa.
103 Wheaton, L. H., Halifax, N.S.
104 Pitts, C. M., Ottawa.
105 McEwen, G. G., Ottawa.
106 Fetherstonhaugh, E. P., Ottawa.
107 Emra, F. H., Ottawa.
108 Thornton, K. B., Montreal.
109 Hannaford, R. M., Montreal.
110 Combe, F. A., Montreal.
111 MacLeod, Geo. R., Montreal.
112 Stephen, C., Flight Comdr., Montreal.
113 Harcourt, R. H., St. Catharines.
114 Macphail, Alexander, Kingston.
115 Warren, W. C., Ottawa.
116 Ferguson, Alex., Ottawa.
117 Craig, J. D., Ottawa.
118 Farmer, John T., Montreal.
119 Bell, G. E., Montreal.
120 Clunn, T. H. G., Ottawa.
121 McLachlan, D. W., Ottawa.
122 Young, C. R., Toronto.
123 Lindsay, G. A., Ottawa.
124 Daubney, C. B., Ottawa.
125 Clark, George T., Toronto.
126 Craig, H. C., Ottawa.
127 Killaly, A. L., Peterborough.
128 Peden, Ernest, Montreal.
129 Ballantyne, N. F., Ottawa.
130 Cameron, K. M., Ottawa.
131 Cameron, E. G., St. John, N.B.
132 Stewart, J. R., Renfrew.
133 Cole, L. H., Ottawa.
134 Eardley-Wilmot, V. L., Ottawa.
135 Richards, W. A., Ottawa.
136 Ramsay, E. M., Ottawa.
137 Sabourin, A. G., Quebec.
138 Sauer, M. V., Montreal.
139 St. Laurent, J. E., Winnipeg.
140 Worsfold, C. C., New Westminster.
141 Cram, H. R., Ottawa.
142 Roland, J. W., Halifax.
143 Burch, G. F., Montreal.
144 Corriveau, R. deB., Ottawa.
145 Fripp, F. B., Moncton.
146 Sherwood, L., Ottawa.
147 Dodwell, C. E. W., Halifax.
148 Stewart, Wm. J., Ottawa.
149 Shearwood, F. P., Montreal.
150 Dubuc, A. E., Montreal.
151 Gronau, Wm. F., Montreal.
152 Taylor-Bailey, W., Montreal.
153 Mattice, W. A., Ottawa.
154 Fleming, Robert, Toronto.
155 Hogg, T. H., Toronto.
156 Blanchard, A. C. D., Niagara Falls.
157 Macallum, A. F., Ottawa.
158 Field, R. H., Ottawa.
159 Murphy, S. J., Ottawa.
160 Stead, Geoffrey, St. John, N.B.
161 Brown, William L., Ottawa.
162 Bird, F. G., Ottawa.
163 McLean, W. A., Toronto.
164 Hertzberg, H. F. H., Ottawa.
165 Hertzberg, C. S. L., Toronto.
166 Scheman, C. H., Bridgeburg, Ont.
167 Reid, F. B., Ottawa.
168 Hendry, M. C., Halifax.
169 Kensit, H. E. M., Ottawa.
170 Dunn, Thos. H., Ottawa.
171 Scovil, Stuart S., Ottawa.
172 Kester, F. H., Walkerville.
173 Larochelle, J. E., Ottawa.
174 Galbraith, J. S., Toronto.
175 Anderson, J. W., Ottawa.
176 Chipman, Willis, Toronto.
177 Bélanger, A. A., Ottawa.
178 Miller, F. F., Napanee.
179 Valiquet, U., Ottawa.
180 Lamoureux, Jos. A., Ottawa.
181 Grant, Alex. J., St. Catharines.
182 Jost, E. B., Ottawa.
183 Yuill, Russell, Cornwall.
184 Knight, J. A., Toronto.
185 Dunne, Hugh J., Ottawa.
186 Daubney, Jas. E., Ottawa.
187 MacRostie, N. B., Ottawa.
188 Dennis, W. M., Ottawa.
189 Smaill, A. E., Ottawa.
190 Chaloner, Chas., Ottawa.
191 Bertrand, J. N. T., Isle Verte, Que.
192 Hotchkiss, C. P., Ottawa.
193 Smith, Fred. G., Ottawa.
194 Forward, E. A., Montreal.
195 Ghysens, A., Montreal.
196 Cochrane, M. F., Ottawa.
197 McCallum, G. H., Ottawa.
198 Goodwin, H. W., Ottawa.
199 Cooper, P. E., Montreal.
200 Rochester, L. B., Montreal.
201 Coo, C. W., Toronto.
202 Henham, Robert, Ottawa.
203 Gray, A., St. John, N.B.
204 Oxley, J. Morrow, Toronto.
205 Davy, H. M., Ottawa.
206 Warnock, Chas., Montreal.
207 Henderson, John. Ottawa.
208 Hay, Alan K., Ottawa.
209 Sproule, F. A., Ottawa.
210 Cauchon, J. E. N., Ottawa.
211 Forde, J. P., Victoria.
212 Doncaster, P. E., Nelson, B.C.
213 Ogilvie, W. M., Ottawa.
214 Hodgson, J. P., Vancouver.
215 Bryce, W. F. M., Ottawa.
216 Nelles, Douglas H., Ottawa.
217 Smith, K. H., Halifax.
218 Grant, Gordon, Ottawa.
219 Massey, A. W. K., Montreal.
220 Wilgar, W. P., Kingston.
221 Seibert, Fred. V., Ottawa.
222 Melville, J. L., Ottawa.
223 Meikle, A. U., Ottawa.
224 Uniacke, R. F., Ottawa.
225 Wicksteed, H. K., Toronto.
226 Haycock, R. L., Ottawa.
227 Pinhey, C. H., Ottawa.
228 Drake, R. L., Ottawa.
229 Dawson, S. G., Ottawa.
230 Gleeson, L. J., Ottawa.
231 Jones, A. M., Ottawa.
232 Higman, Ormand, Ottawa.
233 Jarvis, R. R., Ottawa.
234 Wimberley, A. C., Ottawa.
235 O'Sullivan, E., Montreal.
236 Kilburn, D. G., Ottawa.
237 Odell, R. K., Ottawa.
238 Lambe, A. B., Ottawa.
239 Dansereau, J. L., Montreal.
240 Benny, W. W., Ottawa.
241 McNiven, J. J., Ottawa.
242 Camsell, Charles, Ottawa.
243 Harcourt, F. Y., Port Arthur.
244 Strome, I. R., Ottawa.
245 Thompson, H. A., Ottawa.
246 Bissett, Jas. R., Ottawa.
247 Chapleau, S. J., Ottawa.
248 Gibson, Norman R., Niagara Falls.
249 Harper, John L., Niagara Falls.
250 Bowden, W. A., Ottawa.
251 Freeland, E. E., Ottawa.
252 Jones, H. W., Ottawa.
253 Dobbin, R. L., Peterborough.
254 Westbye, P. P., Peterborough.
255 Craig, H. B. R., London.
256 Fairbairn, J. M. R., Montreal.
257 Lambart, H. F. J., Ottawa.
258 Amiot, P. E., Rimouski.
259 Askwith, F. C., Ottawa.
260 Cowper, G. C., Ottawa.
261 Fuller, W. J., Sault Ste. Marie.
262 Pratley, P. L., Montreal.
263 Wolff, M., Montreal.
264 Matheson, A. J., Ottawa.
265 Milne, J. A., Ottawa.
266 Volckman, G. W., Ottawa.
267 Allen, L. E., Ottawa.
268 Ramsay, J. H., Ottawa.
269 Phillips, C. S., Ottawa.
270 Lamb, H. J., Toronto.
271 Ames, A. J., Ottawa.
272 Ogilvie, Paul, Ottawa.
273 Roy, L. deB., Ottawa.
274 Jamieson, D. W., Ottawa.
275 Moore, W. J., Ottawa.
276 Joy, Joseph, Montreal.
277 Dalton, G. F., Ottawa.
278 McArthur, J. J., Ottawa.
279 Blais, Robert, Ottawa.
280 St. Laurent, A. A., Ottawa.
281 Murphy, J. J., Ottawa.
282 Christie, C. V., Montreal.
283 Bell, A. Netlam, Montreal.
284 Booker, G. E., Montreal.
285 Denis, L. G., Montreal.
286 Harkness, A. L., Montreal.
287 Lafreniere, T. J., Montreal.
288 Smaill, Wm., Vancouver.
289 Fraser, R. J., Ottawa.
290 Magwood, W. H., Cornwall.
291 Hervey, C. L., Montreal.
292 Haanel, B. F., Ottawa.
293 Alexander, R. C. F., Ottawa.
294 Wilson, L. R., Montreal.
295 Surveyer, Arthur, Montreal.
296 Lefebvre, O. O., Montreal.
297 McNaughton, A. G. L., Ottawa.
298 Akins, J. R., Ottawa.
299 Forneret, V. F. W., Ottawa.
300 MacKay, B. R., Ottawa.
301 McKay, Robt. B., Ottawa.
302 Wilson, A. W. G., Ottawa.
303 Spence, H. S., Ottawa.
304 Desbarats, G. J., Ottawa.
305 McLeish, John, Ottawa.

306 Holland, Franklin E., Montreal.
307 Seens, J. W., Montreal.
308 Hume, D. C. M., Ottawa.
309 Trotter, H. L., Montreal.
310 Gale, A. V., Hull.
311 Parkinson, N. F., Ottawa.
312 Winter, F. W., Ottawa.
313 Howard, R. F., Montreal.
314 Ells, S. C., Ottawa.
315 Bowman, C. A., Ottawa.
316 Wood, Chas. O., Ottawa.
317 Seton, B. W., Montreal.
318 Drought, F. A., Ottawa.
319 Cumming, A. L., Cornwall.
320 Monture, G. C., Kingston.
321 Mills, A. M., L'Orignal, Ont.
322 Dion, A. A., Ottawa.
323 Marshall, J. H. G., Ottawa.
324 Sargent, C. D., Cornwall.
325 Lee, R. B., Ottawa.
326 Symes, J. A., Ottawa.
327 Davy, R. Adams, Ottawa.
328 Fraser, D. J., Ottawa.
329 Blanchet, G. H., Ottawa.
330 Dodge, G. B., Ottawa.
331 McRae, J. B., Ottawa.
332 Bourget, P. B., Ottawa.
333 Connell, C., Ottawa.
334 Hereford, Harry, Ottawa.
335 Montgomery, R. H., Ottawa.
336 Ferrier, A., Ottawa.
337 Durley, R. J., Ottawa.
338 Dunlap, H. J., Ottawa.
339 Peek, R. L., Ottawa.
340 Locke, T. J., Ottawa.
341 Challies, J. B., Ottawa.
342 Jackson, L. W., Montreal.
343 Kitto, F. H., Ottawa.
344 Coutlee, W. F., Ottawa.
345 Ewart, H. E., Ottawa.
346 Brabazon, C. H., Ottawa.
347 Smith, N. H., Ottawa.
348 Steers, F. P., Ottawa.
349 Swan, A. D., Montreal.
350 Macphail, J. G., Ottawa.
351 Cochrane, J. B., Ottawa.
352 Henry, R. A. C., Montreal.
353 Goudge, M. F., Ottawa.
354 Williamson, D. A., Ottawa.
355 Macdonald, J. A., Ottawa.
356 Pratt, F. M., Ottawa.
357 Boyd, W. H., Ottawa.
358 Crain, G. E., Ottawa.
359 Prittie, L. C., Ottawa.
360 Grindlay, T., Ottawa.
361 Narraway, A. M., Ottawa.
362 Balfour, R. H., Montreal.
363 Disney, Chas. P., Toronto.
364 Barnes, H. T., Montreal.
365 Westland, C. R., Ottawa.
366 Hardouin, J., Ottawa.
367 Bennett, G. A., Ottawa.
368 Magrath, C. A., Ottawa.
369 Carroll, J., Ottawa.
370 Kennedy, Howard, Ottawa.
371 Butterworth, J. V., Ottawa.
372 Ross, J. E. R., Ottawa.
373 Murdie, W. C., Ottawa.
374 Brown, L., Ottawa.
375 Whittier, A. R., Ottawa.
376 Peaker, W. J., Ottawa.
377 Foreman, J. L., Ottawa.
378 Van Scoyoc, H. S., Montreal.
379 Barber, H. G., Ottawa.
380 Acres, H. G., Niagara Falls.
381 Miles, E. L., Lindsay, Ont.
382 Traill, J. J., Toronto.
383 Grant, A. M., Ottawa.
384 Fawcett, S. D., Ottawa.
385 Taggart, C. H., Kamloops, B.C.
386 Shanks, Thos., Ottawa.
387 Murphy, John, Ottawa.
388 Riddell, J. M., Ottawa.
389 Medlen, E. M., Ottawa.
390 Stalker, A. D., Ottawa.
391 Erskine, C. S., Ottawa.
392 Hoolihan, H. D., Ottawa.
393 Waugh, B. W., Ottawa.
394 Rinfret, C., Ottawa.
395 Forbes, H. L., Ottawa.
396 Sinclair, G. E. B., Ottawa.
397 MacDonald, W. E., Ottawa.
398 LeBlanc, P. M. H., Ottawa.
399 Dennis, T. C., Ottawa.
400 Anderson, F., Ottawa.
401 Bowes, LeRoy T., Ottawa.
402 Moran, John F., Ottawa.
403 Moulton, H. P., Ottawa.
404 Dennis, E. M., Ottawa.
405 Lawson, J. T., Ottawa.
406 Armstrong, C. J., Montreal.
407 Bell, J. J., Ottawa.
408 Gaby, F. A., Toronto.
409 GrandMont, B., Trois Rivieres.
410 Palmer, P. E., Ottawa.
411 Bruce, R. F. H., Ottawa.
412 Ewart, J. A., Ottawa.
413 Wrong, F. H., Westboro, Ont.
414 Slinn, W. H., Billing's Bridge, Ont.
415 Weldensinger, A., Zurich, Switzerland.
416 Lavine, H. A., Montreal.
417 Doane, M., Ottawa.
418 Von, Louis, Montreal.
419 Ogilvie, Noel

Ladies' Registration at Ottawa

1 Chapleau, Mrs. Jefferson, Ottawa.
2 Ogilvie, Mrs. Noel, Ottawa.
3 Craig, Mrs. J. D., Ottawa.
4 Corriveau, Madame R., Ottawa.
5 Cameron, Mrs. K. M., Ottawa.
6 Barton, Mrs. H. M., Ottawa.
7 Grant, Mrs. A. M., Ottawa.
8 Sherwood, Mrs. Luman, Ottawa.
9 Grant, Mrs. Gordon, Ottawa.
10 Edwards, Mrs. C. P., Ottawa.
11 Odell, Mrs. R. K., Ottawa.
12 Chaloner, Mrs. C. F., Ottawa.
13 Swan, Mrs. A. D., Montreal.
14 Dawson, Mrs. W. Bell, Ottawa.
15 Stephen, Mrs. C., Montreal.
16 Keith, Mrs. Fraser, Montreal.
17 Norrish, Mrs. Ben, Montreal.
18 Jones, Mrs. H. W., Montreal.
19 Desbarats, Mrs. G. J., Ottawa.
20 Hervey, Mrs. C. L., Montreal.
21 Rannie, Mrs. J. L., Ottawa.
22 Forbes, Mrs. J. M., Ottawa.
23 MacLachlan, Mrs. D. W., Ottawa.
24 Clark, Mrs. G. T., Toronto.
25 McCallum, Mrs. G. H., Ottawa.
26 Westland, Mrs. Clarence, Ottawa.
27 Camseli, Mrs. Charles, Ottawa.
28 Parkinson, Mrs. N. F., Ottawa.
29 Pinhey, Miss Y. E., Ottawa.
30 Pinhey, Miss A. H., Ottawa.
31 Cochrane, Mrs. Farrer, Ottawa.
32 Sherrin, Mrs. Philip, Ottawa.
33 Ferrier, Mrs. Alan, Ottawa.
34 Beattie, Mrs. Wm. C., Ottawa.
35 Simmons, Mrs. T. L., Ottawa.
36 Busfield, Mrs. J. L., Montreal.
37 Bell, Mrs. A. Netlam, Montreal.
38 Warnock, Mrs. Chas., Montreal.
39 Byrne, Mrs. J. H., Ottawa.
40 Jost, Mrs. E. B., Ottawa.
41 Nelles, Mrs. D. H., Ottawa.
42 Grant, Mrs. Alex. J., St. Catharines.
43 Miller, Mrs. F. F., Napanee.
44 Henderson, Mrs. J. H., Ottawa.
45 Byers, Mrs. R. P., Toronto.
46 Delahey, Mrs. W. A., Ottawa.
47 Dickie, Mrs. Vivian, Ottawa.
48 Murphy, Mrs. J. J., Ottawa.
49 Peaker, Mrs. W. J., Ottawa.
50 McCallum, Mrs. H. A., Ottawa.
51 Mountain, Miss, Ottawa.
52 Delaute, Mrs. F. J., Ottawa.
53 Browne, Mrs. G. A., Ottawa.
54 King, Mrs. R. P., Ottawa.
55 Melville, Mrs. Jas. L., Ottawa.
56 Trudel, Mrs. A. P., Ottawa.
57 Bélanger, Mme A. A., Ottawa.
58 Lamb, Mrs. H. J., Toronto.
59 Stewart, Mrs. W. J., Ottawa.
60 Walsh, Mrs. E. J., Ottawa.
61 Fawcett, Mrs. S. D., Ottawa.
62 Shaver, Mrs. P. A., Ottawa.
63 Macdonald, Mrs. J. A., Ottawa.
64 Ellis, Mrs. J. F., Ottawa.
65 Pierce, Mrs. J. W., Ottawa.
66 King, Mrs. R. P., Ottawa.
67 Richards, Mrs. W. A., Ottawa.
68 Nagle, Mrs. Chas. E., Ottawa.
69 Bartley, Mrs. T. H., Ottawa.
70 Mountain, Mrs. Geo. A., Ottawa.
71 Mountain, Miss Edna, Ottawa.
72 Byers, Mrs. R. R., Toronto.
73 Barber, Mrs. H. G., Ottawa.
74 Dunn, Mrs. Thos. H., Ottawa.
75 Oxley, Mrs. J. Morrow, Toronto.
76 Lawson, Mrs. Wilfrid, Ottawa.
77 Wicksteed, Mrs. L. C., Ottawa.
78 Wicksteed, Miss Winnifred, Ottawa.
79 Connell, Mrs. Charles, Ottawa.
80 Gale, Mrs. Gordon, Ottawa.
81 Keefer, Mrs. T. C., Ottawa.
82 Knight, Virginia Coyne, Toronto.
83 Massey, Mrs. A. W. K., Montreal.
84 Richan, Mrs. G. F., Ottawa.
85 Seymour, Mrs. Horace L., Toronto.
86 Seens, Mrs. John W., Montreal.
87 Seton, Mrs. B. W., Montreal.
88 Uniacke, Mrs. R. F., Ottawa.

World Power Conference Committee Meeting

At a meeting held on January 23rd, of the Canadian committee arranging for this country's participation in the world power conference to be held in London next July, it was decided that if the French committee were agreeable to such a proposition, the Canadian body would have no objection to inviting Germany to be represented. A reply to this effect will be sent to London, following an inquiry from the British committee. It was also decided that the Canadian delegation would sail by the Empress of France on June 18th, on which vessel reservations have been made, and that the invitation of the American delegation which will number 300, that the Canadians join them and sail from Boston on an American vessel, be not accepted.

Dr. Charles Camsell, M.E.I.C., deputy minister of mines, presided over the meeting of the committee which will report to Hon. Charles Stewart, minister of the interior. Those attending were: A. Monro Grier, K.C., Toronto; General C. H. Mitchell, C.M.G., M.E.I.C., University of Toronto; J. G. Glassco, M.E.I.C., of Winnipeg: K. H. Smith, M.E.I.C., of Halifax; Arthur Surveyer, M.E.I.C., Montreal; O. Lefevre, M.E.I.C., Quebec; A. A. Dion, M.E.I.C., of Ottawa; Fraser S. Keith, M.E.I.C.; President Walter J. Francis, M.E.I.C., of *The Engineering Institute of Canada;* Prof. Christie, A.M.E.I.C., of McGill University; Ormond Higman, M.E.I.C., B. F. Haanel, M.E.I.C., of the Dominion Fuel Board; and J. B. Challies, M.E.I.C., director of the Water Power Branch of the Department of the Interior, Ottawa.

The Banff-Windermere Highway

J. M. Wardle, A.M.E.I.C.,
Chief Engineer, Canadian National Parks Branch, Dept. of the Interior.

No motor highway in the west has aroused so much interest or been given so much publicity as the Banff-Windermere highway, which was opened for motor traffic on June 30th, 1923. The new highway extends from the town of Banff in Banff National Park, Alberta, to the Windermere district which is in the Columbia River valley, some seventy miles south of the main line of the Canadian Pacific Railway.

This highway was constructed under the direction of J. M. Wardle, A.M.E.I.C., chief engineer, Canadian National Parks, engineering service, while C. A. Davidson, now acting Highway Commissioner of the Province of Alberta, was resident engineer on the west end of the work with A. G. Wilkins as superintendent of construction. To Mr. Wilkins is also chiefly due the credit for the excellent work on the east section of the highway.

This road provides a direct highway connection to the Kootenay and Banff National Parks from the great western tourist centres of Los Angeles, Portland, San Francisco and other cities of the Pacific coast, and by means of existing highways east of Banff gives a much needed central connection to the prairie provinces. It provides a much needed road between Alberta and British Columbia, and in addition is the last link in the California-Banff B-line highway and in the Banff-Grand Canyon road, which two routes constitute the greatest scenic loops of the west.

While the construction of the Banff-Windermere road was first conceived as a scenic and commercial coach road in 1905, it was not until 1911 that construction of the British Columbia section was commenced by the British Columbia government with financial assistance from the Canadian Pacific Railway Company. In 1913 work was stopped through lack of funds, and was not resumed until 1919, when its construction was taken over by the Canadian National Parks Branch of the Department of the Interior of the Canadian government. Realizing the importance of the road from the tourists' standpoint, the Dominion government agreed in 1919 to complete the road by January 1924, in return for which the province of British Columbia was to transfer to the Dominion a ten mile strip of land adjacent to the road in British Columbia for park purposes, and which is now known as Kootenay Park.

The total length of the road between Banff and the Windermere valley is ninety-three miles; of this amount thirty miles had been constructed by the Parks Branch prior to 1915, and which extended westerly to the British Columbia boundary. When the latter Branch began construction operations on the British Columbia section in the fall of 1919, some fifty-three miles of road were uncompleted.

Throughout the summer of 1919 location surveys were made, and a great amount of reconnaissance work was done to insure the best route. While the general route of the road was limited to the Vermilion River and Kootenay River valleys, there was considerable choice in certain sections as to what benches should be followed by the road, having in view grades, depth of snow fall, southern exposure, character of material encountered and alignment. The river flats, while affording good gravel deposits, might be subject to flooding in extreme high water. The final location, which was often influenced by bridge sites at the crossing of various tributaries to the main stream, was a result of careful consideration of the various points involved, and the general success of construction and operation amply justified the care taken. The maximum grade on the road is found on a 300-foot section in the Sinclair pass where the grade is 9 per cent. Location was run on the basis of a maximum of 6 per cent, and in view of the mountainous country traversed, remarkably easy grades were obtained. From Castle to the summit of the Vermilion pass, the road climbs 710 feet in five miles with a maximum of 6 per cent, and motor cars take this stretch of road generally in high gear. From Sinclair canyon on the west end of the road to Sinclair pass, the road climbs 2,000 feet in eight miles with the one short maximum noted above and with an average of 5 per cent.

Figure No. 1.—Banff-Windermere Road and Valley of Vermilion River, sixty-one miles west of Banff.

Figure No. 2.—Banff-Windermere Road. Along Vermilion River Valley near Kootenay River bridge, sixty-four miles west of Banff.

Figure No. 3.—Heavy grading along the Vermilion River, four miles east of the Kootenay Valley.

Construction Problems

Some interesting construction problems presented themselves. The main body of the work averaged some thirty miles from the nearest railway head at either end of the road. The greatest part of the work also lay between the Vermilion Pass summit and the Sinclair Pass summit of the Rocky mountains, two distinct mountain passes of 5,660 feet and 4,950 feet, respectively, through which the road was located, and which, by their altitude and early weather conditions, materially affected construction. Practically the entire fifty-three miles lay through virgin forest country, traversed, when construction began, by an Indian trail that was almost impassable during the high water months of June and July. In clearing this length of right-of-way, the greatest care was necessary to avoid disastrous forest fires that would, if started, do immense damage. Clearing and burning operations were, consequently, undertaken during the winter months, winter camps being established at suitable points along the right-of-way. Considerable difficulty was experienced in keeping open the sixty miles of winter tote road necessary in view of the snow fall on the Vermilion and Sinclair summits, which averaged 5 feet and 3 feet, respectively. Practically all bridge work was also done during the winter months of 1920-21 and 1921-22. These winter operations were not only carried on at a time when labour was plentiful, but appreciably relieved unemployment in the west at that time.

For construction operations proper, the road was divided into two sections, the western section being approximately thirty-two miles in length and the eastern section twenty-one miles in length. In charge of each section was a resident engineer. Each engineer's organization consisted of two or three gangs under a competent foreman and stationed at suitable intervals, each gang having a certain amount of work to do. As soon as any one section was completed by a grading gang, the latter was jumped ahead to another section, and as the work progressed a very keen rivalry developed between the various gangs. A grading gang consisted of from ten to twelve teams, a road grader, four or five timber men for culvert and crib construction and some thirty-five labourers and teamsters. In the last year of con-

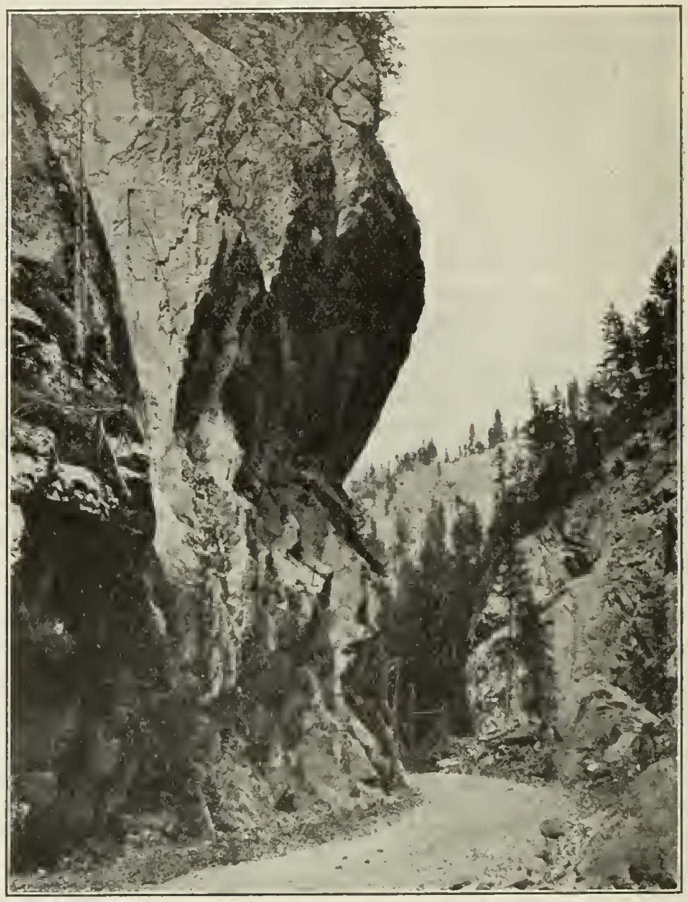


Figure No. 4—Banff-Windermere Road, heavy rock work in Sinclair Pass. Final surfacing not done.

struction, namely 1922, a surfacing gang was added to the force of each resident engineer, to surface with gravel the grading completed in the previous year. A surfacing gang consisted of some ten surfacing units consisting of trucks, traillers or dump waggons, a gasoline bucket loader for the gravel pits and a gasoline road roller. The transport of equipment, explosives and subsistence supplies was handled by six light Reo trucks, three being detailed to each resident engineer. These trucks made regular scheduled trips from the eastern and western railway heads to the various camps, their average one-way haul being about thirty-five miles. Each of these trucks ran about one hundred miles daily. All trucks and mechanical equipment were kept in good repair by the drivers, and their work was supervised by a first class motor mechanic who had his headquarters in the field at a convenient camp.

Owing to the location of the work in the heart of the Canadian Rockies, only a short season of about four and a half months was available for grading operations. Consequently, the latter work had to be carefully planned and vigourously carried on. The grading work on a large scale was commenced in June 1921, and the schedule proposed at that time called for the construction of 1,000 feet of new road daily. This rate of progress was more than maintained, new road being built at the rate of from five to eight miles per month. In the seasons of 1921 and 1922 nine months were available for grading operations, and in this time forty-three miles of new road was graded, and in addition some twenty-five miles of road were surfaced. While a good proportion of the above mileage was comparatively easy, there was also a good percentage of sidehill cuts ranging from 15 feet to 40 feet in depth.

Several features in connection with the construction of the road might be worthy of mention. In the first place, special care was taken to see that all roots and other growth was removed within the limits of the road grade. Various vegetable matter on the forest floor was also removed by means of graders and slips so that no such material would be incorporated in the road grade. The original surface of the ground was not broken by a plough until it was as clean as it was reasonably possible to make it.

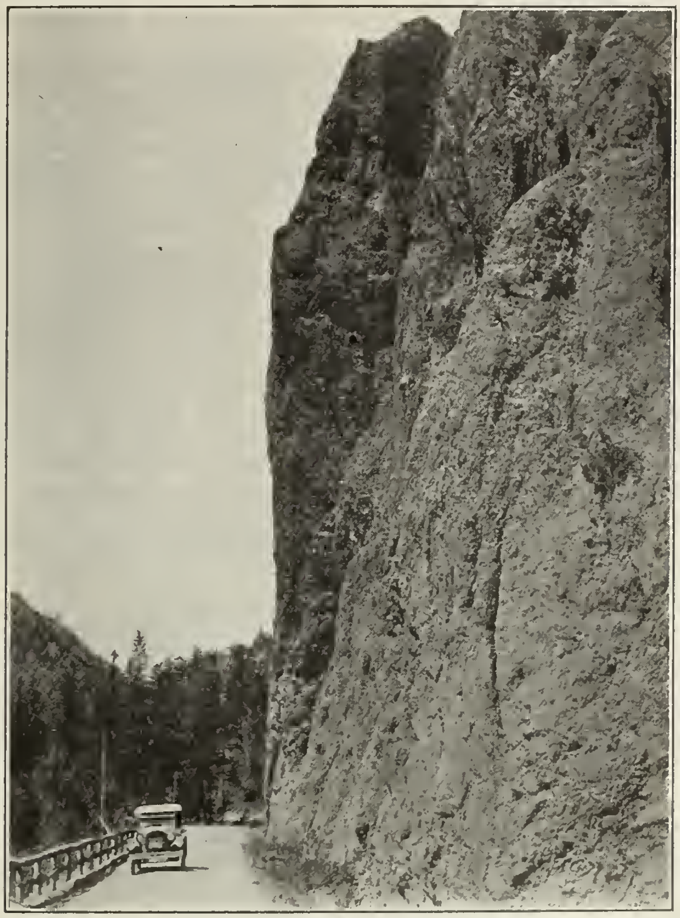


Figure No. 5.—Banff-Windermere Road. Red Rock Bluff, in Sinclair Creek Valley, two and one-half miles from Windermere Valley.

Crowning and Ditching

Particular attention was paid to crowning and ditching. An interesting fact brought out in the construction of the road was that not only did different classes of material require a different crowning, but that weather conditions on different sections of the road also require consideration when deciding on the height of crown. The western slopes of the Vermilion valley, where more moisture fell than on the other sections, required greater drainage provision than the more westerly sections of the road. In the valley of the Kootenay river, there is considerably less precipitation than in the valley of the Vermilion river, as was very evident when the first rains fell on newly constructed grades in both localities. Particular attention was paid to drainage facilities. Not only were culverts placed wherever there was indication of stream flow in the spring or fall, but the road was patrolled from time to time during heavy storms, and culverts were placed at points where any amount of water accumulated under such conditions in the side ditches. Both resident engineers made frequent trips over their sections on the transport trucks so that they would personally experienced the effect of the finished road surface on motorists. Frequently, sections of road that to the eye seemed very satisfactory were found to be decidedly irregular when traversed by a truck at twenty-five miles per hour.

Another feature of construction was the strict provision of superelevation on all curves. After the first season, the different foremen became very adept in giving the proper superelevation to each curve, and probably no construction feature has been as much appreciated by motorists travelling the Banff-Windermere highway during the 1923 season. The width of the road cross-section is on tangents 20 feet, which, with a 2-foot ditch on either side, gives a clear available wheelway of 16 feet. The ditches and road crown, however, are continuous, so that passing traffic has available 20 feet of safe roadway if required. Additional width, varying from 2 feet to 10 feet is given on all sharp curves or on curves where vision may be obstructed. Specially

Figure No. 6.—Banff-Windermere Road. A one-mile tangent in the Kootenay Valley.

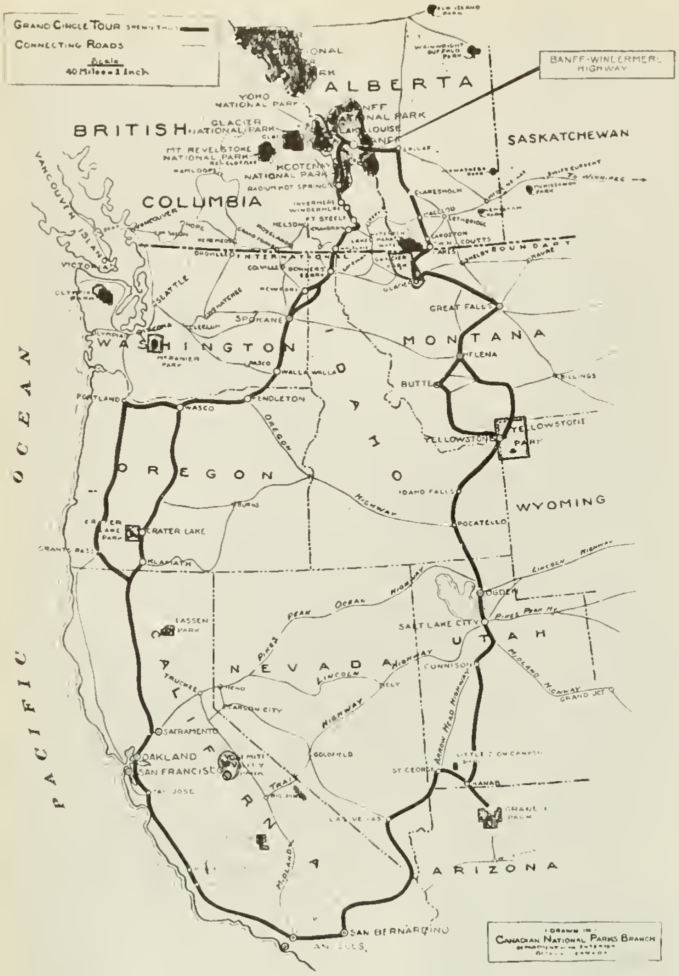


Figure No. 7.—Grand Circle Motor Tour.

designed traffic signs were erected along the road prior to its being open to traffic, an effort being made to limit such signs to points where actual caution is necessary, so that a motorist would realize that the signs were not placed promiscuously and that each sign should be heeded. Numerous motorists were consulted after they had traversed the road as to suggestions regarding the placing of traffic signs, guard rails, etc., and some very valuable opinions from the motorists' point of view were obtained.

The road was completed on September 30th, 1922, or about eighteen months before the time set under the agreement between the federal and provincial governments. The cost per mile of the road, including clearing, grubbing, grading, bridges, culverts, etc., ranged from \$3,500 per mile to \$25,000 per mile, while the average cost for the fifty-three miles built from 1919 to 1922 inclusive by the Parks Branch was \$7,600 per mile.

Engineering Drawing

By H. H. Jordan and R. P. Hoelscher.
Reviewed by Alexander Peden, A.M.E.I.C.,
Chief Draftsman, Dominion Bridge Co. Ltd., Montreal.

"Engineering Drawing" by H. H. Jordan and R. P. Hoelscher has just been placed in the Engineering Institute library. This volume collects under one cover all types of engineering drawing and general information referring thereto.

Its chapters on lettering and working tools are thorough and treat this subject from a new aspect, while it explains clearly how to prepare and arrange work before placing it upon a drawing. You will here find specific information regarding mechanical, architectural, plate, map and patent office drawing. It is quite up-to-date in that it mentions tracing reproductions and photostat work, without which a modern office could not handle its work economically and successfully.

The book is published by John Wiley & Sons, Incorporated.

OBITUARIES

H. W. H. Bruce, A.M.E.I.C.

On Saturday, January 19th, 1924, H. W. H. Bruce, A.M.E.I.C., died suddenly at Welland, Ontario. The late Mr. Bruce was born in Ottawa on February 27th, 1881, and was the son of the late Mr. H. B. D. Bruce, well known civil servant, who died in Ottawa fifteen years ago.

Mr. Bruce commenced his career as a civil engineer in 1898 and worked continually on railroad construction up to the outbreak of war. In 1914 he went overseas with the Borden Motor Machine Gun Battery. Coming out of the trenches after his first tour he broke his leg and was invalided to England, where he spent a year. He then returned to France and was badly wounded at the battle of Vimy Ridge, where he was awarded the M.M. He had several opportunities of obtaining a commission, but preferred to remain in the ranks with the friends with whom he enlisted. He returned to Ottawa in 1918 and was appointed senior assistant chief engineer of the Welland Ship Canal, which post he retained up to the time of his death.

During his career as railroad engineer, the late Mr. Bruce was engaged on many important surveys of new lines all over the eastern provinces. In 1898 he worked on the Canada Atlantic extension at Lacolle, Quebec. In 1899 he was engaged on the Manitoba South extension. In 1900 he surveyed the Great Northern line from St. Jerome to Hawkesbury. During 1901 and 1902 he was engaged in a topographical survey of Chats Falls. Then for two years he worked along the line of the Bobcaygeon and Pontopool railway. During the next four years, 1906 to 1909, Mr. Bruce was employed by the Canadian Northern Railway. In 1910 he was surveying along the Little Nation river, after which, from 1911 to the date of his enlistment for overseas, he was engaged on the Quebec and Saguenay railway. He leaves one sister, Mrs. C. E. Bleakney, of 750 Echo Drive, Ottawa, and an uncle, Robert F. H. Bruce, M.E.I.C., of 40 Henderson Avenue, Ottawa.

Mr. Bruce was elected an Associate Member of *The Institute* on August 12th, 1921.

J. P. Burnyeat, M.E.I.C.

Although ill for some time, the sudden death of J. P. Burnyeat, M.E.I.C., at his home in Vernon, B.C., on Sunday, September 2nd, 1923, in his sixty-eighth year, came as a great shock to his many friends. The late Mr. Burnyeat was born at Truro, N.S., August 24th, 1855.

Prior to going to British Columbia in the early 80's, he was engaged on location and construction of the Intercolonial Railway in Nova Scotia and New Brunswick. His first work in the west commenced in June, 1881, when he was assistant engineer on the revision of surveys and construction of the Canadian Pacific Railway in British Columbia, on which work he was engaged until the end of 1888. In 1889, he was inspector of buildings under construction for provincial and dominion governments at Kamloops, among the many other buildings, in the design and construction of which he was engaged, was the Masonic Temple at Kamloops. In 1891, he first moved to Vernon, B.C., when he laid out that town site and where he resided until the time of his death. He is survived by two sons and two daughters. Mr. Burnyeat was elected a Member of *The Institute* on December 20th, 1894.

PERSONALS

S. R. Frost, A.M.E.I.C., Chairman of the Niagara Peninsula branch, has been elected to represent the city of Niagara Falls, Ont. as alderman for the year 1924.

Geo. A. Walkem, M.E.I.C., vice-president of *The Institute*, was recently returned by acclamation to the office of reeve of the municipality of Point Grey, B.C.

Andrew J. Riddell, A.M.E.I.C., architect and engineer of Sandwich, Ont., has moved his offices to the King Building, Windsor, Ont.

J. B. Holdcroft, A.M.E.I.C., is hydraulic engineer with the Pacific Coast Pipe Company, Limited, 1551 Granville Street, Vancouver, B.C.

P. E. Bauman, S.E.I.C., is with the engineering department, camp 60, S. California Edison Company, Big Creek, California.

E. Ibbotson Leonard, M.E.I.C., was elected to the board of directors of the Canada Trust Company to fill the vacancy caused by the death of his father.

H. F. McDonald, M.E.I.C., has been appointed representative of Nesbitt, Thomson and Company, Limited, on the Pacific coast, with offices at Vancouver, B.C.

W. F. Angus, M.E.I.C., of the Canadian Car and Foundry Company, Limited, Montreal, was elected representative fellow in science on the Corporation of McGill University.

J. P. Watson, A.M.E.I.C., formerly with the mechanical department of the Canadian Pacific Railway, Montreal, has resigned to accept a position in the same department of the Dominion Bridge Company, Limited, of Montreal.

T. W. Fairhurst, A.M.E.I.C., of Vancouver, B.C., has resigned from the position of sales engineer with the Vancouver Machinery Depot, Limited, to join the staff of the Marion Steam Shovel Company of Marion, Ohio.

Kennington Hague, A.M.E.I.C., of Montreal, has joined the staff of the Ferranti Meter and Transformer Manufacturing Company, Limited, and will be located in Toronto.

G. C. Monture, S.E.I.C., formerly in charge of the employment service at Queen's University, Kingston, is now with the Department of Mines of the federal government, at Ottawa, Ont.

B. A. Culpeper, S.E.I.C., of the class of '23 in civil engineering, McGill University, has received the appointment of draughtsman with C. D. Howe and Company, consulting engineers, of Port Arthur, Ontario.

I. P. MacNab, M.E.I.C., was recently selected to act as chairman of a board of arbitration authorized to settle a dispute of longstanding between the junior and senior street railway employees of the city of Calgary.

A. S. Chapman, A.M.E.I.C., is being congratulated on his official appointment as city engineer, Calgary. Mr. Chapman has proved himself a very interested and active member of *The Institute* and is at present on the executive of the Calgary branch.

J. S. Johns, Jr.E.I.C., has resigned from the staff of the Nova Scotia Steel and Coal Company, Limited at Wabana,Newfoundland, to accept a position with the Newfoundland Power and Paper Company, Limited, at Deer Lake, Newfoundland.

A. H. Bowyer, S.E.I.C., is at present on railroad location and construction at Allco, B.C., for the Abernethy-Lougheed Logging Company. Mr. Bowyer was previously assistant to the municipal engineer of the Corporation of Burnaby, B.C.

E. C. Gaines, M.E.I.C., who has been associated with the Coal and Bunkering Company of Sydney, Australia, for the past two years has resigned to accept a position with the Mead-Morrison Manufacturing Company of Chicago, Ill. Mr. Gaines graduated from the University of Missouri in 1900.

Clarke J. Madgett, A.M.E.I.C., has resigned as director of the Standard Steel Construction Company, Limited, of Welland, Ont., and managing director of the London Bridge Works, Limited, to assume the position of contracting engineer with the Sarnia Bridge Company, of Sarnia, Ont.

J. B. Nelson, A.M.E.I.C., formerly designer and checker in the structural steel and bridge departments of the Canadian Allis-Chalmers, Limited, Toronto, has resigned to accept the position of checker with the Standard Steel Construction Company, Limited, of Welland, Ont.

Gordon McIntyre, Jr.E.I.C., is now located at Sarnia, Ont., with the Imperial Oil Refineries, Limited. Mr. McIntyre is a graduate of McGill University with the class of 1921 in chemical engineering, and has been chemist on testing, research and efficiency work with the Imperial Oil Company at Regina, Sask.

Arthur G. Pedder, A.M.E.I.C., of Ottawa, has left for Nickleton, Ont., where he has accepted a position of chief engineer, power house, of the British-America Nickel Corporation, Limited. Mr. Pedder was formerly assistant engineer of the steam power house of the Ottawa Electric Company.

John Murphy, M.E.I.C., of the Ottawa Branch, recently addressed a large audience of civil, electrical, mechanical and chemical engineers at a meeting of the Technology Club of Syracuse, Inc., and affiliated societies. The subject of Mr. Murphy's address was, "The Prevention of Ice in Canals and Other Waterways" and was illustrated by motion pictures and slides.

F. H. Hibbard, A.M.E.I.C., has received the appointment of engineer, Maintenance of Way, by the Quebec Central Railway Company. Mr. Hibbard's connection with this railway dates back to 1913 when he was engineer in charge of construction. In 1916 he was promoted to assistant engineer which position he held until his recent appointment.

David B. McLay, M.E.I.C., is at present sewerage engineer with the municipal engineer of Singapore, S.S. Mr. McLay was located in Vancouver, B.C., for several years prior to the war, having come to Canada in 1911 from Uddingston, Lanarkshire, Scotland. He was recently been spending some time at Uddingston before leaving for Singapore.

J. S. Kingston, A.M.E.I.C., of Ottawa, who has been connected with the Department of Public Works for some years, expects to leave Canada shortly and will take up his residence in England. Mr. Kingston was born in London, England, in 1862, and upon coming to Canada he became attached to the Chief Architect's Branch of the Department of Public Works where he was engaged as heating and ventilating engineer.

H. G. Thompson, Jr.E.I.C., formerly sales engineer with the Canadian Sirocco Company, Limited, at Montreal, and for the past six months on the engineering staff of the Riordon Company, Limited, at Temiskaming, Que., has resigned to accept a position with the Combustion Engineering Corporation, Limited, as manager of their Vancouver office. Mr. Thompson is at the present time in Toronto and will leave shortly for Vancouver to assume his new duties.

Major J. R. Cosgrove, M.E.I.C., has been appointed British Columbia Lumber Commissioner in Eastern Canada in succession to A. Edward Roberts who has entered the industrial field. Major Cosgrove has had considerable experience both in the logging, manufacture, and handling of British Columbia lumber, as well as in its use in engineering and building structures. He was formerly with the Vancouver Lumber Company, Ltd., and the Pacific Coast Lumber Inspection Bureau and later city engineer of Trail, B.C.

Lt.-Col. J. McI. Gibson, A.M.E.I.C., has formed a partnership with J. E. Walker under the name of Walker and Gibson, architects and engineers, with offices at 82 King Street, East, Toronto. Prior to and immediately following graduation from the University of Toronto in 1910, Mr. Gibson was engaged in land surveying in Ontario and the west. In 1911, he was on road construction in British Columbia and for the next few years his work included waterworks engineering with Messrs. Chipman and Power, designing of reinforced concrete bridges, retaining walls and buildings for C. W. Noble, and design and construction of concrete works with I. S. Osborn. While overseas, he was Major and chief engineer officer, 127th Bn. C.E.F., afterwards 2nd Bn. Canadian Railway Troops.

Verne Leroy Havens, M.E.I.C., until recently editor of *Ingenieria Internacional* of the McGraw-Hill Company, and now engaged in private practice, in New York City, has been awarded a gold medal and diploma by the Brazilian government in recognition of his successful efforts in organizing the International Engineering Congress which took place in Rio de Janeiro last year. Besides his task as the active organizer of the congress he was delegated to represent the American Society of Civil Engineers and *The Engineering Institute of Canada*, of which societies he is a member, and also the Federated American Engineering Societies and the American Electric Railway Engineering Association. While in Rio de Janeiro he was also made an honorary member of the Club de Engenharia de Brazil, the leading technical body of that country.

Friends of Geo. H. Burnett, A.M.E.I.C., will regret to learn of the death of his wife, as the result of an accident on November, 12th, 1923. Mr. Burnett is employed by the Warren Construction Co., Lock Box 1186, Portland, Oregon, as construction superintendent on a twenty-two mile section of the Roosevelt highway, with headquarters at Taft, Oregon. The accident occurred at the camp, where he was residing with his family. Mr. Burnett himself sustained painful though not serious injuries, from which he has practically recovered. He expects to resume his occupation in the near future, while his two children, a boy and a girl, remain at school in Vancouver, B.C.

A Gillies, A.M.E.I.C., who has been associated with Messrs. Sutcliffe and Neelands of New Liskeard, during the past summer on town engineering and waterworks plant layout for the townships of Tisdale and Swastika, has entered private practice with an office in Timmins, Ont. Mr. Gillies is a graduate of the University of Toronto, receiving his diploma from the S.P.S., in 1907 and his B.A.Sc., degree in 1909. During 1909-10 he was resident engineer on the Cobalt Power and later engineer on the Minnedosa Power. He was appointed contractor's engineer on bridge foundations at Fort William and during 1912 he became associated with the Canadian Northern Railway as bridge engineer. After receiving his discharge from the army, where he served for two years with the 7th Canadian Railway Troops, he was engineer with the St. Marys Cement Company where he remained until last year.

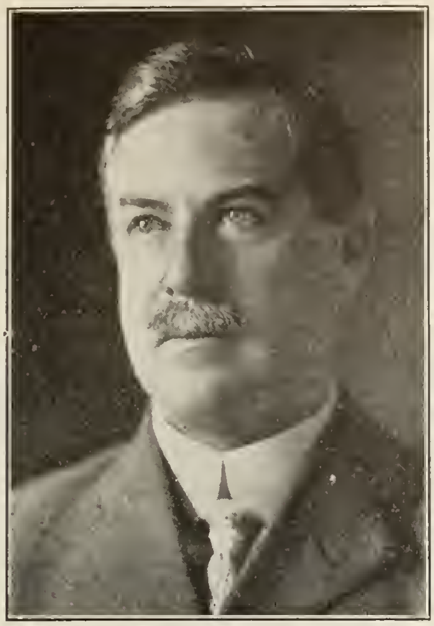
Chairman of Victoria Branch for 1924

F. C. Green, M.E.I.C., the recently elected chairman of the Victoria Branch, is a native of St. John, N.B., where he was gold medalist at the St. John Grammar School. After graduation in 1893 from the University of New Brunswick with the degrees of B.A., and C.E., Mr. Green spent some years as resident engineer on railway construction in New Brunswick, and the state of Maine, coming to British Columbia in 1897, where as senior partner in the firm of Green Bros. Burden and Company, he has since been engaged in a general engineering and surveying practice.

Wm. H. Sullivan, M.E.I.C., resigns from Federal Service

W. H. Sullivan M.E.I.C., whose resignation from the staff of the Welland Ship Canal, terminates, for the time being at least, a long and active career with the Department of Railways and Canals, entered the federal service on September 19th, 1892, when he became an employee of the department on the Ontario-St. Lawrence canal survey. In 1894 he was engaged on the Cornwall canal enlargement, where, three years later, he was promoted to assistant engineer.

F. C. GREEN, M.E.I.C.



W. H. SULLIVAN, M.E.I.C.

He was appointed principal assistant engineer on the Hillsboro and Murray Harbour branch of the Prince Edward Island Railway in 1900. From assistant engineer on the Welland canal in 1905, he became in 1912 the superintending engineer of that system, and in 1913 he was appointed to the position from which he has just resigned, that of principal assistant engineer, Welland ship canal, under Alex. J. Grant, M.E.I.C., engineer-in-charge.

Mr. Sullivan graduated from the Royal Military College in 1892, was elected Associate Member of the Canadian Society of Civil Engineers in October 1899, and was advanced to the rank of Member in *The Institute* in May 1920.

The staff of the Welland ship canal presented to Mr. Sullivan, on his resignation, a handsome gold watch and chain, as a token of the esteem and affection in which he was held by all with whom he came in contact. His wide circle of friends, on the staff of the canal, in the Niagara Peninsula Branch, and elsewhere, feel keen regret at Mr. Sullivan's retirement, particularly as ill health which forced the step.

Chairman of Ottawa Branch for 1924

J. L. Rannie, B.A.Sc., D.T.S., M.E.I.C., the new chairman for 1924 of the Ottawa Branch, was born in Newmarket, Ont., May 27th, 1886. He secured his preliminary education in the public and high schools of that place and graduated from Toronto University with honours as bachelor of applied science in civil engineering in 1908. In 1909 he secured his commission as Dominion Land Surveyor and a certificate as Dominion Topographical Surveyor in 1914. He entered *The Engineering Institute* during his college course, was elected Associate Member in 1918 and Member in 1922. His engineering experience was gained with the Canadian Northern Railway in the west, with the International Joint Commission on the Lake of the Woods watershed, with the International Boundary Commission and with the Geodetic Survey of Canada, Department of the Interior. He entered the service of the department in 1907 and was promoted to the post of supervisor of triangulation in 1918.

ELECTIONS AND TRANSFERS

At the meeting of Council held on January 24th, 1924, the following elections and transfers were effected:—

Members

CARPENTER, Edward Emery, B.S. (C.E.), (Stanford Univ.), consltg. engr., B.C. Electric Railway Co. Ltd., Vancouver, B.C.

MARTHELEUR, Elie Louis, mining and elec. engr. (Louvain Univ.), elec'l. engr., all coal operations, British Empire Steel Corporation, Sydney, N.S.

Associate Members

APPLETON, Albert Thomas, supt. of stations, City of Winnipeg Hydro-Electric System, Winnipeg, Man.

DUNCAN, John Moyle, B.A.Sc. (Hons.), (Univ. of Tor.), consulting engr., of 26 Prince Arthur Avenue, Toronto, Ont.

HUGHES, James Wenceslaus, elec. engr., east lines, C.P.R., Montreal.

JAMES, Harold H., engrg. dftsman., office of mtce. engr., Montreal Locomotive Works, Montreal.

McDONALD, Frederick Charles, plant engr., Dominion Bridge Company, Montreal.

MORRISON, George, (City and Guilds of London Tech. Coll.), district manager, Maritime Provinces, English Electric Co. of Canada, Limited, 200 Brookland Street, Sydney, N.S.

WARD, Herbert James, res. engr. on constrn. of experimental turbine testing station at Shawinigan Falls, etc., for Shawinigan Water & Power Company, Shawinigan Falls, Que.

YOST, Winfield Hancock, mech. engr., Hart-Otis Car Co. of Montreal, 376 Marlowe Avenue, Montreal, Que.

Juniors

BURGESS, Bert Ira, B.Sc. (Univ. of N.B.), junior asst. switchboard engr., Can. Gen. Elec. Co., Peterborough, Ont.

CANNING, Dow Vernon, B.Sc. (McGill Univ.), junior asst. switchboard engr., Can. Gen. Elec. Co., Peterborough, Ont.

GORDON, Harold Cowan Morton, B.Sc. (McGill Univ.), Dominion Coal Company, Glace Bay, N.S.

HAY, Marshall Neil, B.Sc. (Queen's Univ.), mech. engr., fabrication dept., Northern Aluminum Company, Shawinigan Falls, Que.

Affiliate

LESLIE, James, inspr. munic. waterworks and fire preventive appliances, Canadian Fire Underwriters' Assn., Montreal.

Transferred from the class of Junior to that of Associate Member

BENNET, William Herbert, B.Sc. (Queen's Univ.), res. engr., supervising constrn. of three Lake Kenogami dams, for the Quebec Streams Commission, Montreal.

CHALMERS, George Haddon, B.Sc. (Queen's Univ.), engr., Jas. A. Bell & Son, St. Thomas, Ont.

SMITH, Neville Herbert Francis, D.L.S., supervision over party doing precise levelling etc., Geodetic Survey of Canada, Ottawa, Ont.

WEIBEL, Emil Edwin, B.Sc. (McGill Univ.), designing and estimating, Dominion Bridge Company, Lachine, Que.

Transferred from the class of Student to that of Junior

DAVIS, Sydney Herbert, B.Sc. (McGill Univ.), Apt. 1, 604 Union Avenue, Montreal, Que.

MONTURE, Gilbert Clarence, B.Sc. (Queen's Univ.), office manager, engineering society employment service, manager students' book and supply store, and editor for publications of above depts., Queen's University, Kingston, Ont.

ROSS, James Hargrave Drummond, B.Sc. (McGill Univ.), with Gugenhein Bros., New York, N.Y.

EMPLOYMENT BUREAU AND MEMBERS' EXCHANGE

The Institute's Employment Service

It is encouraging to note that during the past few weeks there has been a renewed demand for the services of trained men in the various branches of engineering. This demand, following a period of inactivity and coming at a time of the year when by reason of the climatic conditions there is usually a cessation of investigations and construction work, is taken as foreshadowing an early resumption of active development. Repeated reports of extensions to industrial plants, proposed hydro-electric power developments, programmes of road construction, investigation of the country's natural resources, and other works, in the carrying out of which the engineer must take the leading part, all lend colour to the anticipated renewed activity at an early date.

The Institute has been most fortunate in being able to secure appointments for many of its members during the past year when conditions were barely normal. The success attending its efforts is due to the co-operation received from the many organizations throughout Canada who have from time to time advised headquarters of their requirements. It is hoped that during the present year even greater service may be rendered to the members of *The Institute* along this line. To this end the co-operation of the members interested in securing positions is essential. Such members should keep in mind three points which would be of great assistance in keeping the employment records up-to-date.

(1) Full particulars of qualifications and experience should be forwarded for filling, preferably in duplicate in order that they may be submitted to prospective employers on short notice.

(2) They should, from time to time, advise headquarters if they have not secured suitable appointments.

(3) They should advise headquarters immediately upon receiving an appointement, supplying the information as to where the appointment has been received and the nature of the work undertaken.

To assist the members in submitting the fullest possible details of experience in a uniform manner, a form had been prepared and will be supplied upon request. This form contains the following headings:—

Name; address; telephone number
Academic Qualifications (Name of college, date of graduation, degree, branch of engineering, etc.)
Class of work desired
Salary expected
When available
References, (Give names and addresses of past employers from whom references may be secured, if required).
Experience (Give dates, names of employers, details of work).

Situations Vacant

Electrical Engineer

Two electrical engineers. One as assistant to the superintendent of the city stations and one as assistant to the superintendent of distribution. Apply box No. 80-V.

Electrical Engineer

Competent designer several years experience on the electrical design of high voltage water stations, well fitted to act as checker or squad leader and work on the design if the main features were explained. Location Toronto. Apply box No. 83-V.

Electrical Engineer

Competent electrical engineer to act as resident engineer in charge of the installation of electrical and mechanical equipment for a 24,000 H.P. water power station in Northern Ontario. Apply box No. 84-V.

Chemical and Mechanical Engineer

Engineer with some five years experience in chemical and mechanical engineering required by a pulp and paper company near Montreal to undertake special investigations in the mill. Apply box No. 85-V.

Hydraulic Engineer

A firm of Montreal consulting engineers require the services of a young hydraulic engineer for general office and field work. The applicant must be a graduate of some recognized engineering school and must be able to speak French and English fluently. Write giving references and stating salary desired. All communications will be treated as confidential. Apply box No. 86-V.

Situations Wanted

Construction and Sales Engineer

Civil engineer, B.Sc., F.R.S.A., A.M.E.I.C., Ontario professional engineer; 31 years of age, desires position immediately. Experience covers railway construction, roads, bridge construction, hydro-electric development, also sales engineer. Will go anywhere. Now in Toronto. Apply box No. 133-W.

Sales Engineer

Sales engineer, graduate, age 32, four years sales experience also, experienced in construction work, seeks position in building material or equipment line. At present employed, but looking for larger field. Apply box No. 134-W.

Electrical Engineer

Graduate of Toronto, 1923, desires to locate with a hydro-electric or central station organization. On G.E. test since graduation. Familiar with high voltage, generating and transformer stations. Construction and operating experience on such. Position must have first class opportunity to develop engineering and executive abilities. Energetic and industrious. Age 26. Ontario and Quebec preferred. Apply box No. 135-W.

Civil Engineer

Civil engineer, A.M.E.I.C., desires position with a firm of contractors, engineers or on the staff of a city engineer. Seven years experience, highway construction, pavements, concrete structures, office practice and surveying. Competent field or office man. Apply box No. 136-W.

Members' Exchange

Institute Transactions

A member of The Institute wishes to dispose of a set of the Transactions of The Engineering Institute of Canada, including volumes three to thirty-three with the exception of volumes 27, 28 and 30, together with a complete set of The Engineering Journal. Further particulars regarding the same may be secured upon application to box No. 5-E.

For Sale

One new buff engineer's transit. Exceptional bargain. Apply box No. 6-E.

British Columbia Lumber Publications

A number of valuable publications have been issued under the authority of the government of British Columbia, and forwarded to this office by Major John R. Cosgrove, M.E.I.C., British Columbia Lumber Commissioner, Toronto.

Two of these are pocket size, the first being Standard Classification, Grading and Dressing Rules for Douglas Fir, Western Hemlock, Western Spruce, and Western Red Cedar, and the other, Rules for Grading Western White Pine, Spruce, Fir, Larch, Hemlock, Cedar, and Idaho White Pine.

There is also a British Columbia catalogue of standard mouldings as adopted by the manufacturers and dealers in British Columbia.

Two of the publications are issued by the Forest Branch, Department of Lands, Victoria. One of these is a booklet on the uses, strengths and working stresses of British Columbia timber, and the other, instructions how to finish British Columbia woods.

These publications are available to all members of *The Institute* through Major John R. Cosgrove, M.E.I.C., B.C. Lumber Commissioner, 51 Yonge Street, Toronto.

Proceedings of the American Society for Testing Materials

The library of *The Institute* has been presented with a copy of the 1923 proceedings, volume 23, of the A.S.T.M. which has just been issued. This volume is issued in two parts:

Part I (1,006 pp.) contains the annual report of 32 of the standing committees of the society, together with the discussion thereon at the annual meeting, and 103 tentative standards which have either been revised or are published for the first time; the annual address of the president and the annual report of the executive committee. Part II (683 pp.) contains 50 technical papers with discussion.

The technical papers contain valuable information on results of investigations by experts in the field of engineering materials and the reports of the committees cover ferrous and non-ferrous metals, cement, ceramics, concrete, gypsum, lime, preservative, coatings, petroleum products, road materials, coal and coke, waterproofing materials, electrical insulating materials, shipping container, rubber products, textile materials, methods of testing, and nomenclature and definitions. Each part is available at the following prices: $6.00 in paper, $6.50 in cloth and $8.00 in half-leather binding.

BRANCH NEWS

Moncton Branch

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

The regular monthly meeting of the Moncton Branch was held at Moncton, on December 18th, 1923. After supper had been served, Mrs. Harold Price rendered a solo, immediately followed by one from Mr. Metzler, — encored. Major McKie accompanied both singers.

The Telephone

F. O. Condon, M.E.I.C., addressing the meeting, introduced W. R. Pearce, M.E.I.C., of the New Brunswick Telephone Company, who immediately took the platform, reading a paper on "The Telephone", illustrating by lantern slides the different phases of telephone construction, operation, maintenance and improvements. In the course of his address, Mr. Pearce likened the telephone as now used and depended upon, to the solar plexus of a giant; the giant representing the business and social world of to-day; remarking that if the different utilities other than the telephone were temporarily crippled, there were other things which could be called upon to take their place. Not so with the telephone, if disabled, there was nothing that could supplant it, and for example he took the skyscraper, robbed of the telephone; he stated that messengers could not take its place, nor letters take the place of long distance three-minute conversation over a telephone.

With the assistance of lantern slides, maps and charts, Mr. Pearce then went into the problem the telephone companies have in installing their systems so as to take care of all probable calls upon them for telephone service from any direction, describing minutely the development study, the probable demands for several years to come in order to adequately take care of the community to be served. Mr. Pearce then dealt with the cable study, describing how the company arrived at the different number of pairs of wires carried to each sector of the community, so as to take care of all requests for service well in advance of the requirements at the time of installation; how the most practical methods were employed in order to ascertain the probable requirements as far as eighteen years in advance; this forecast being made by extending a curve based on the growth of that community during a certain number of years previously. This portion of Mr. Pearce's paper was most complete, and was clearly impressed upon the members through the assistance of the lantern slides, describing the ways and means in detail.

It was shown how, by means of a wrongly located telephone exchange in a city, the expenditure and upkeep would be greatly increased, over one that had been properly located. Mr. Pearce at this time showed how much more difficult it was to serve some cities than others, due to street lay-outs, etc., the ideal lay-out being a city with a back alley running lengthwise the streets. Mr. Pearce told of the development in telephone cable as used to-day; of the placing of the cables underground instead of carrying them on poles, of the advantages derived from the method of transmission, and describing how this main artery is carried out from the exchange through the streets of the city that will give the most efficient and economic distribution of service wires to that section of the city. At this point in the lecture Mr. Pearce passed several samples of cable around for the inspection of the members. In conclusion, Mr. Pearce explained most clearly the construction of two types of pole terminals, which drew from several members questions which were readily and satisfactorily answered.

Lethbridge Branch

Geo. S. Brown, A.M.E.I.C., Secretary-Treasurer.

Another successful and well attended meeting of the Lethbridge Branch was held at the Y.M.C.A. on December 15th, C. D. MacKintosh, M.E.I.C., occupied the chair and presided over the meeting in his usual genial and happy manner.

E. G. Sterndale Bennett contributed two well rendered songs and E. B. Sloan presided at the piano, and the thanks of the branch are due these gentlemen for helping to make the musical part of the programme a success.

Foundations and Steel Structures

C. F. Draper, M.E.I.C., bridge engineer of the C.P.R., gave a paper on "Foundations and Steel Structures", with special reference to the Cowley bridge. Mr. Draper said: The washout caused by the tremendous floods which is now a matter of history occurred about June 8th and resulted in three of the concrete piers of the Cowley bridge being displaced and four piers had to be reinforced and reconditioned.

The geological formation of the rock around the bridge sight and the formation of the bed of the river presented unusual difficulties in cofferdaming around the piers. The piers were jacketted with reinforced concrete and link walls were built between the upstream and downstream piers. When the piers were moved by the floods they did not settle directly downward but took different angles which caused the steelwork to become distorted and this had to be forced back into position for which purpose four fifty-ton jacks were used. A ten-day stop in traffic was all that was considered necessary and even during that time certain transferring across the bridge was done. Traffic was then resumed and carried on with certain limitations. The work is now completed and all operating restrictions removed.

The speaker paid a tribute to the late James Finley who took a prominent part in putting the bridge in shape for the resumption of traffic immediately after the flood. Mr. Finley paid a visit to the scenes of his labours in November and was taken sick there and died, and thus, said the speaker, passed away a real genius as a bridge erector.

Sam Porter, M.E.I.C., and Major Muckleston, M.E.I.C., made fitting reference to the recent death of Lord Shaughnessy and Sir Wm. McKenzie, both of whom had done much to build up Canada and particularly western Canada, and both had for nearly all their lives been closely affiliated with engineers.

A Real Irish Night

It was a real Irish night for the local branch on Saturday night January 12th. The community singing ran to Irish songs. Mr. Teague obliged the members by giving Irish solos and the main speaker of the evening, it was said by many, if his wit and humour was any criterion, must have been an Irishman. It was a splendid evening and the large attendance of members and affiliates enjoyed every minute of it.

The ladies of the Y.M.C.A., Auxiliary excelled themselves with the dinner they served and with the orchestra of members kindly assisted by Mrs. Dunning and Mr. Ludgate those assembled were put in good humour from the word "GO". John Dow, M.E.I.C., who has succeeded Colin MacKintosh, M.E.I.C., as chairman of the branch kept the ball rolling. He announced that Fraser S. Keith, M.E.I.C., the secretary of *The Institute* would pay this branch a visit in the spring. He read a letter from Lord Shaughnessy acknowledging letter of condolence from the branch on the death of the late Lord Shaughnessy; made fitting reference to the departure of two valued members in Major Muckleston and C. D. MacKintosh, M.E.I.C., and stated that Roy Miles, M.E.I.C., has been appointed a member of the executive.

The chairman took the opportunity of congratulating Mr. Miles on having a brother who had just had the distinction of being made a Fellow of Royal Society of Arts of London, England, and also P. M. Sauder, M.E.I.C., on his becoming manager of the Lethbridge Northern Irrigation System. Two new members were introduced, namely, D. Jones of the Chinook Coal Company, and J. B. de Hart, district inspector of mines for the provincial government.

The chairmen of the various committees reported the various activities of the branch which showed that the Lethbridge engineers are fully alive to their responsibilities. Mr. Broderick produced a letter which he, as secretary of the Lethbridge Irrigation Council, has received. Mr. Broderick said: "Among the mail which we receive from all parts of the world concerning farming opportunities, we get many strange requests, but strangest of all these, is one that we received a few days ago from a German in the Rhur Occupied Zone. He presents an interesting problem in engineering.

> " 'If the Canadian Government,' he says, 'is interested in the prosperity of the country, I have a special proposal which will bring industry and agriculture, a whole new modern town! It would only be necessary for Canada to give us autonomy for ten years and permit us to print our own postage stamps and give us ten years free of taxes. Canada would get a new town with industries and agriculture. These desired rights are our capital which brings money for building and buying machinery. After ten years all buildings and machines belong to the government, and all profits made by these privileges will come in the hands of the government. The desire is not to make money, but to get money for the work. Without money nothing can be done.
>
> " 'It would perhaps be necessary to make a great gate in the Rocky mountains. It would cost millions! Then we could warm the air from the Pacific and the whole climate could be changed for the better. If we had such a gate we could also make a Pacific channel to Winnipeg and Quebec! For these ideas we need one hundred years. Not one generation can finish such ideas, but in the interests of the country we start and the tenth generation finishes.
>
> " 'I do not wish to make profits. No, I wish to work for the fascination of it and for the honour of my name and my new fatherland. *If I can eat three times daily I am satisfied.*
>
> " 'Please advise me what you think.' "

This proved too much for the local branch, and the members gasped for breath and allowed the matter to remain for others to tackle.

Fire Protection

After a short social intermission, Chairman Dow introduced Chief Hardy, the speaker of the evening, whom he described as one of the best fire chiefs in Canada and had recently been the recipient of a cup in recognition of his services which was well deserved. The Chief said in part: "I can assure you that it gives me great pleasure to appear before you this evening, and although I am rather timid as this is the first time I have ever had anything like this to do, I will do my best to say something of interest to you all. Of course I would sooner be in a smokey building fighting fire than doing a job like this, however, I am getting a start.

"While my whole life has been given up to fire fighting and which is first on the list, I will make it second. For several years now my aim has been fire protection before the fire starts, in fact I must say that this should be the aim of every fire chief in Canada, and I am glad to say that it is becoming more and more their theme every day.

"Fire protection costs money, and this is one of the reasons why it is not looked upon with favour in villages, towns and cities, it is counted a waste of money by those building new property.

"The municipalities are guilty of the same violation in neglecting to have proper apparatus by which good protection could be given to surrounding property when a fire does break out, and generally after the fire has done great havoc, the people are willing to spend three times the amount of money needed before the fire to purchase the necessary apparatus, that would have probably prevented the great damage done had it been purchased before the fire had occurred.

"I am glad to say to the credit of our city commissioners that Lethbridge does not stand in that light, for during the last twelve years when I have asked the city council for what was considered necessary, it has always been purchased and has proved to be good business, in fact if we had not the apparatus we now have on several occasions, I venture to state that there would have been a large portion of this city laying desolate through fire.

"Fire waste is a national problem, and we do not realize the great waste in Canada yearly from fire, and it is increasing year after year until in 1922 it reached the enormous figures of $54,390,600 or $6.20 per capita, and this did not include forest fires.

In 1898 the loss was $ 7,978,300. or $1.53 per capita.
In 1908 the loss was $18,922,100. or $2.91 per capita.
In 1918 the loss was $33,870,000. or $4.13 per capita.

"As I have already stated in the year 1922 the loss caused by fire reached the highest point in the history of Canada and represents the largest comparative fire loss ever recorded in any country of the world, and 1923 seems to be running a close second, for in the first six months the losses amounted to $26,674,330.

"Taking the whole loss from 1898 to 1922 inclusive, we have a grand total, or I might say the disgraceful total, of $517,776,604. or some one hundred and a half millions more than the whole public debt of Canada before the Great War began." Chief Hardy then discussed at length the false impression that these losses are met by insurance companies, and that this waste is reduced.

In dealing with fire prevention in the home, he said, "The attic, cellar, storeroom, closets, yard and outhouses should be cleaned at least twice a year and all useless material removed or burned. Then examine your furnaces and stove pipes. Then don't smoke in bed. Perhaps those guilty of the practice may be too green to burn but the beds are not. Just a few figures before closing the prevention part:—

	Canada	*United States*	*Gt. Britain*
Estimated population........	8,799,400	11,600,000	46,080,000
Total fire loss for 1922.......	54,390,600	521,860,000	30,812,000
Property value per capita....	1,588	2,527	2,130
Loss per thousand of property value..................	3.96	1.86	0.31

Chief Hardy then closed his remarks with a reference to modern methods of fire fighting and to the importance of a general knowledge of the principles of first aid.

A lively discussion, in which Messrs. Porter, Freeman, Broderick, Meech and others took part and out of which grew some very important ideas of which more will be heard later, brought a splendid evening to a close.

Kingston Branch

A. Jackson, A.M.E.I.C., Secretary-Treasurer.

Bacteriology as Applied to Sanitation

At the regular meeting of the Branch, held November 26th, Doctor Reid, professor of bacteriology, Queen's University, gave a most interesting lecture on bacteriology as applied to sanitation. Doctor Reid stated that the diseases generally arising from polluted water were typhoid, dysentry, cholera and anthrax. The first being the most common in this country. The trouble with an epidemic of typhoid, frequently lay in the difficulty of tracing it. That is a number of people may have contracted it, but by the time the disease has been diagnosed as typhoid, the cause may have disappeared. Such a condition arose in an eastern Ontario city a few years ago and was generally traced to ice-cream, but the examination of five hundred samples, failed to show any typhoid bacilli.

In some rural areas, the water supplied contains so much typhoid bacilli from sewage drainage into it, that the average city dweller would contract typhoid should he continue to drink it, whereas a resident of the area who has been drinking it all his life is apparently immune.

The life of the typhoid bacilli in cold water is generally limited from two to three days, but in the earth they would live a couple of weeks, or under more favorable conditions would live a year. The Niagara river, where it empties into lake Ontario, has a fairly high bacteria content, but beyond a radius of eighteen miles of this point, intestinal bacteria have all disappeared, and it is fit to drink. This disappearance being due to dilution and also lack of food for the bacteria. The preceding applies generally where a river enters into a large body of water.

A couple of slides of the map of Europe showed by varied degrees of shading, the number of cases of intestinal diseases. Eastern Europe shows a considerable percentage more of these diseases than western, where the water supply is regulated along scientific lines. A number of slides were shown of the different bacteria, and the method explained as to how they were made.

London Branch

E. A. Gray, Jr. E.I.C., Secretary-Treasurer.
R. I. Olmsted, A.M.E.I.C., Branch News Editor.

A special meeting of the London Branch was held on Wednesday, December 12th, in the Board room of the Public Utilities Commission. In the absence of the chairman and vice-chairman, J. R. Rostron, A.M.E.I.C., presided.

A most interesting paper was presented by W. M.Veitch A.M.E.I.C., sewer engineer of London, and A. J. Stevens, M.E.I.C., presented the report of the Coal Committee. Mr. Veitch's paper dealt with the essential features of sewer design and his brief treatment of this important subject contained a number of important facts which were presented in a very interesting manner.

Sewage Disposal

The branch was fortunate in having E. B. Besselievre, sanitary engineer of the engineering firm, The Door Company, New York, who gave an inpromptu address on "Sewage Disposal."

Mr. Besselievre gave a brief resume of the different systems of sewage treatment from the first method, that of dilution to the latest mechanical devices in operation, in connection with the activated sludge process of treatment.

The first method of sewage treatment by dilution in streams had been largely abandoned owing to pollution, the next method was broad irrigation, this method has become too costly, due to the high price of land, in close proximity to a city. Then came sedimentation tanks, sedimentation and filters. This also covers a wide expanse of valuable land. The modern trend of sewage disposal seems to be towards the least initial and operating cost to produce an effluent which will satisfy the health officials.

The old methods were by no means inefficient. In the majority of cases they have gone out of commission due to mis-use and lack of proper attention. A simple design usually entails manual control which in many cases is difficult to obtain. The principle of the activated sludge process was carefully explained, together with the latest developments in American practice. The present-day engineers are trying to simplify the design by cutting down in aeration tank depth and the installation of mechanical devices to free the sewage from extraneous matter before treatment, and also by the adoption of devices for the rapid production and collection of sludge.

At the conclusion of Mr. Besselievre's address, the coal report was presented, following which the papers presented called forth a considerable amount of discussion, all present participating.

A Joint Meeting

An open meeting at which some three hundred interested members of the combined clubs were present, was held on December 19th, in the auditorium of the Collegiate Institute under the joint auspices of the London Branch, the Canadian Club, the Women's Canadian Club and the Chamber of Commerce. The programme consisted of moving pictures covering the interesting points of the voyage of the C. G. S. Arctic during 1922 and 1923, and enlarged on by the officer in command, Capt. J. D. Craig, D.L.S., M.E.I.C., who was the speaker of the evening.

Prior to the meeting , the executives of the clubs entertained Capt. Craig at a dinner in the Blue Dragon Tea Rooms, with E. V. Buchanan, M.E.I.C., presiding.

Annual Meeting

The annual meeting and dinner of the London Branch was held on Januara 16th, at the Tecumseh hotel at 6.30 p.m. The Branch was unusually fortunate in having as guests Walter J. Francis, C.E., M.E.I.C., president of *The Institute*, Willis Chipman, B.A.Sc., M.E.I.C., president of the Association of Professional Engineers of Ontario, F. S. Lazier, B.Sc., M.E.I.C., divisional engineer, Welland ship canal, representing the Niagara Peninsula Branch. Invitations were extended to J. B. Challies, C.E., M.E.I.C., and several others who could not be present.

The annual financial report was presented by E. A. Gray, Jr.E.I.C., secretary-treasurer, and was adopted. Following the annual report the elections were held with the following results:—

Chairman..........E. V. Buchanan, M.E.I.C., general manager, Public Utilities Commission.
Vice-Chairman......W. C. Miller, B.A.Sc., A.M.E.I.C., city engineer, St. Thomas.
Executive Committee.W. P. Near, B.A.Sc., M.E.I.C., city engineer, London; H. A. Brazier, M.E.I.C., of the construction firm of Boss & Brazier; R. S. Olmsted, A.M.E.I.C., J. R. Rostron, A.M.E.I.C., city engineer's department, London; Chas. Talbot, A.M.E.I.C., county engineer, county of Middlesex.
Ex-Officio...........Major W. J. Forbes-Mitchell, D.S.O., M.E.I.C., Department of Public Works of Canada.
Secretary-Treasurer..E. A. Gray, Jr.E.I.C., Public Utilities Commission.

The following resolution was passed: — That the secretary write the past-chairman, W. J. Forbes-Mitchell expressing the regret of the members that the retiring chairman was unable to be present and extending to him the best wishes for a speedy recovery in health.

E. V. BUCHANAN, M.E.I.C.
Chaiman, London Branch

In the absence of the retiring chairman, E. V. Buchanan, M.E.I.C., the incoming chairman presided, and gave the following address:

Address by Newly-elected Chairman

Gentlemen:

I wish to thank you for the honour you have done me in electing me chairman of the London Branch of *The Engineering Institute of Canada.* I think I realize the responsibilities placed upon me. The position will be hard to fill because of the men who have preceded me—Mr. H. A. Brazier during the organization year and Mr. Forbes-Mitchell last year. Permit me to express my regret at this time that Mr. Forbes-Mitchell was unable to complete his term of office on account of the condition of his health. With your permission the secretary will write Mr. Forbes-Mitchell regretting that he was not with us this evening, and wishing him a speedy recovery.

In assuming an office of this kind it is natural, first, to consider the aims of the organization, then take stock to see if these objectives are being reached. The aims of *The Engineering Institute of Canada* are stated thus:—

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

Let us give this statement our consideration for a few moments. There is no doubt in my mind that the branch has well and ably fulfilled the first requirement that is, "To facilitate the interchange of professional knowledge". The papers presented before the branch have been of a high standard and discussions have shown a keen interest by the membership. In the second place we have done much to promote the professional interests of the members. We have lent our aid to the formation of the Association of Professional Engineers of Ontario, which is now well on its way to success and of which we will hear more this evening.

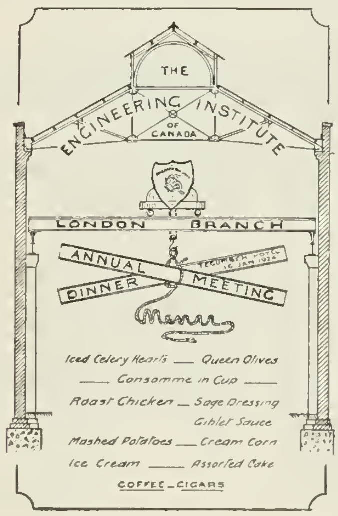
Again in the promotion of research, we can take to our credit the report of our Fuel Committee and its recommendations to the parent body. I believe, however, that the promotion of research should always be kept before us. The great dependency of the world upon its industrial organization not alone for comforts but for the very vitals of life, dictates that haphazards be replaced by knowledge, and more knowledge can only be obtained by research.

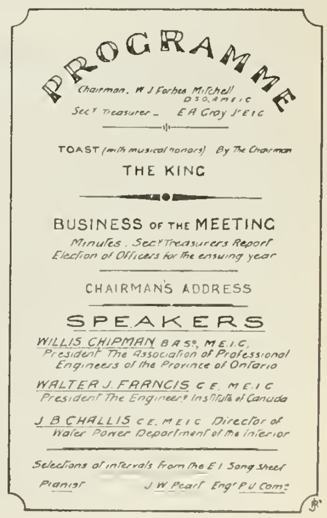
The cause of research always obtains impetus when a great discovery is proclaimed. London claims Dr. Banting, and so, locally, we have heard a great deal about research in the sphere of medical science. Let us hope London will be as fortunate in the realm of engineering. While we may only hope for such an honour for London we feel confident that Canada must some day have the eyes of the world directed towards her by the accomplishment of one of her engineers.

Well may we have confidence in Canada to bear her part in speeding the progress of humanity through scientific achievement, when we note the magnificent progress made by our technical colleges and universities and the calibre of the men which they are turning out, and who are members of our *Institute.* To-day in some western Ontario town another Edison may be maturing his genius as Edison did in the obscurity of a railway telegrapher's job in Sarnia and Stratford, — another budding scientist to follow in the footsteps of the Brantford hobbyist who emerged from his study of a bit of charred paper to give the world the telephone and the name and fame of Alexander Graham Bell.

The final objective which I mention is to my mind the most important one that is to enhance the usefulness of the profession to the public.

Lord Bacon has truly said that there are three things which make a nation great and prosperous, fertile soil, busy workshops, and easy conveyance for men and commodities from one place to another. Canada has been blessed with fertile soil in abundance, but we must not forget the thousands of acres which have been made useful by irrigation projects and other engineering feats. Within the memory of nearly all of us, and who are all young, Canada has turned from a land of scattered agriculturists to a country of industrial production. The change has come through engineers who have provided the means of communication. What country in the world can boast of such a magnificent railway system as Canada? What country, when its youth and population is considered can boast of such good roads and bridges? Its telephone and telegraph system is as good as the best.





The engineers have put machinery not only to do the work in the factory, but have turned it to remove the drudgery of detail in the store, the office, the home and the farm. They have put methods into management and knowledge where ignorance has taken toll. Have not then the engineers proved their usefulness to the public? We emphatically answer, YES. But do we not hide our light under a bushel?

The world knows that Henry Ford is the master of low production costs, of industrial efficiency. The world is scarcely aware that Ford's true genius is in his recognition of the limitless possibilities of science in industry, or that his low priced car is more a product of his laboratories than of his workshops.

Humanity, though scarcely conscious of the fact, is learning to lean upon the engineer. The passenger who trusts himself to the express speeding 75 miles an hour, to the bridge across the Thames, the elevator in the office building or the ship that puts to sea, places his life in the hands of the authority who tells him that is a safe thing to do. This is not courage, but confidence. Courage is the attribute of the designers who stake their irreparable reputations in telling the capitalist that the enterprise is safe for his money, and the patron that it is safe for his life. It is the scientist in his laboratory, the engineer at his desk, who tests and delves with positive calculation to tell the world. "That's right. Go ahead".

Sir James Barry said recently, "The man of science," and I suppose he included the man of practical science, "is the only man who has anything to say to-day, but he is the only man who does not know how to say it". This is probably one of the chief factors for want of recognition of the engineer. Let us, therefore, with these facts in mind take an interest in public affairs and in commerce, not for any selfish reason, not for any vain glorification, but because we know that we have a mission to fulfill, because we know that our training fits us to see clearly the reason for many of our economic troubles, and, therefore, help to solve them.

Rudyard Kipling in his rectorial address delivered recently at St. Andrews University, said, men who have been taught not to waste or muddle material under their hand, are less given to muddle, or mis-handle, moral, intellectual and emotional issues, than the men whose wastage has never been checked, or who look to have their wastage made good by others. The proof is plain.

There is an opportunity in this situation for our London Branch. Let us make our united capacity for handling the larger problems of London and western Ontario, available for the guidance of the public in public enterprises where expert knowledgement is a special need.

Should not each of our members bring the larger problems of his own experience and practice before our meetings for discussion, not as a substitute for professional consultation, but as a means of keeping the members of *The Institute* and the public abreast of progress, and availing ourselves of the strength that will flow from such co-operation.

Willis Chipman, M.E.I.C., reviews the History of the Provincial Association

The chairman then called on Mr. Chipman for a few words.

Mr. Chipman stated that in 1891 he had been called to London to assist in solving the sewer problems that faced the city at that time, and that he had made a recommendation that was just now being adopted, that of metering the water. He detailed the history of the Ontario Association of Professional Engineers, relating how the assent of the legislature was gained to the bill incorporating it. That was slightly more than a year ago, and there were now more than 1,000 members.

President Francis gratified at Progress of Branch

Mentioning that Mr. Francis, in 1923, had travelled some 78,000 miles, and that therefore he had honoured London in being present, Mr. Buchanan introduced the president of *The Institute.*

Mr. Francis stated that he was gratified at the progress London was making in engineering. There were now over 5,000 members of the E.I.C., a representative body of the profession in Canada, with 24 branches. Originally formed in 1887 as the Canadian Society of Engineers, it stretched from coast to coast.

Stating that there were 118 branches of engineering, Mr. Francis said it was difficult for the public to understand the engineer's position in public life. There had been great advancements in engineering in the past twenty years, and still greater were coming, but with it all, the engineer must take his place as a citizen of the community and more interest in public affairs. Referring to Quebec, he said that the public there were beginning to ask questions regarding the work of the profession in that province, where it was now being made illegal for any incompetent person to practise without showing his credentials to the association of engineers. This protected the public.

"The engineer is entitled to stand shoulder to shoulder with the other professions," he declared, "but we must stop cutting fees and seeking jobs."

One of the greatest things *The Institute* was doing for the engineer was the cultivating of friendship and the mutual confidence it inspired. The aim of the engineer should be that perfection of character developed by service to his fellow-man, this being the greatest asset obtainable. An engineer must have a sound head, heart and physique to render that service that brings happiness. He that rendered service would obtain happiness, which consisted of love of fellow-man, a clear conscience, and enough money.

A vote of thanks was also extended to J. W. Peart for officiating at the piano, and to J. R. Rostron, A.M.E.I.C., for the preparation of the attractive programme in the form of a blueprint embodying some design of structural drafting, together with a fine sample of lettering.

The vote of thanks to them was moved by H. Craig, A.M.E.I.C., and seconded by Major P. de L. De Passy, Jr.E.I.C.

The meeting proved most enthusiastic and the incoming officers are assured most hearty co-operation during their term of office.

A toast to the King was proposed by the chairman. Many selections were enjoyed from *The Engineering Institute* song sheet, including a special interpretation of Alouette by the genial president. The meeting closed with the singing of the national anthem.

Montreal Branch

E. A. Ryan, A.M.E.I.C., Secretary-Treasurer.
W. H. Abbott, A.M.E.I.C., Branch News Editor.

The annual meeting of the Montreal Branch was held on December 20th, 1923, and notwithstanding very inclement weather, was well attended. The retiring chairman of the branch, John T. Farmer, M.E.I.C., presided.

The proceedings were opened by the chairman calling upon the Papers and Meetings Committee to present their report, following which the chairman presented an address covering the activities of the Montreal Branch during the year 1923. This address forms part of the annual report of the branch published elsewhere.

The chairman presented the report of the scrutineers and announced that the following members had been duly elected:—

Chairman, O. O. Lefebvre, M.E.I.C.
Vice-Chairman, J. L. Busfield, M.E.I.C.
To Executive Committee:—W. C. Adams, M.E.I.C.
C. V. Christie, A.M.E.I.C.
P. S. Gregory, A.M.E.I.C.

Following a few words of welcome to the new members of the Executive Committee, and short replies thereto, votes of thanks were passed to the retiring chairman, to the retiring executive and different committees. A vote of thanks to the press was also unanimously carried, and a reply thereto was made in eloquent terms by Tom Passingham of the Montreal Gazette.

The meeting concluded with a standing vote of sympathy to the relatives of the late Sir Wm. McKenzie in their recent bereavement.

O. O. Lefebvre, M.E.I.C., the new chairman of the Montreal Branch, was elected a student of *The Institute* in 1903, an Associate Member in 1912, and a Member in 1920. He has continuously displayed an active interest in the affairs of the branch, and has been on the Executive Committee almost continuously since its inception. Outside of *The Institute,* Mr Lefebvre is well known owing to his official position as chief engineer of the Quebec Streams' Commission, in which position he has been responsible for carrying out very large engineering works in the province of Quebec, which have been described from time to time in the pages of *The Engineering Journal.*

J. L. Busfield, M.E.I.C., the newly elected vice-chairman of the branch, has been actively connected with the branch organization for a number of years. His activities as secretary during the years 1920-1921 and 1922 have been largely contributory to the success of the branch. Mr. Busfield is in private practice as a consulting engineer, being a member of the firm of Beaubien, Busfield and Company.

The three new elected committeemen are all members of the branch who took an active interest in its affairs through being members of the Papers and Meetings Committee during the past year. W. C. Adams, M.E.I.C., is chief engineer of the Northern Electric Company, Ltd.; C. V. Christie, A.M.E.I.C., is professor of electrical engineering, McGill University; P. S. Gregory, A.M.E.I.C., is assistant to the vice-president of the Shawinigan Water and Power Company, Ltd., Montreal.

At the first meeting of the new Executive Committee for the year 1924, a number of appointments were made to the various committees, as follows:—

Chairman, Papers and Meetings Committee, W. C. Adams, M.E.I.C.
Chairman, Civil Section, H. Massue, A.M.E.I.C.
Chairman, Electrical Section, L. H. Marrotte, M.E.I.C.
Chairman, Mechanical Section, J. D. Alder, M.E.I.C.
Chairman, Industrial Section, A. F. Hanley, A.M.E.I.C.

W. H. Abbott, A.M.E.I.C., was appointed chairman of Publicity Committee and Branch News Editor.

G. R. MacLeod, M.E.I.C., and J. L. Busfield, M.E.I.C., were appointed an Examining Committee to report on all applicants for admission to the Montreal Branch to the Executive Committee, and J. L. Busfield, M.E.I.C., was appointed chairman of the Reception Committee.

A committee comprising O. O. Lefebvre, M.E.I.C., J. A. Duchastel, M.E.I.C., and P. B. Motley, M.E.I.C., was appointed to follow the proceedings with regard to the projected Montreal-South Shore bridge. This committee will keep in touch with those interested in the project.

The first meeting of the branch for the year 1924 was held on January 10th. At this meeting, F. P. Shearwood, M.E.I.C., presided and Professor H. M. Mackay, M.E.I.C., presented a paper on "Some Secondary and Impact Effects in Pony Truss Railway Bridges". This paper, which was of a technical nature, dealt with observations made by Prof. Mackay on low truss bridges under train loads, with diagrams illustrating his arguments. It was illustrated by a series of lantern slides, and proved of interest to engineers engaged in such work.

Following the paper, Messrs. Motley, Tennant and Pratley took part in the discussion, and the general feeling appeared to be one of satisfaction that the stresses as found by Professor Mackay agreed so closely with the calculated stresses.

Niagara Peninsula Branch

R. W. Downie, A.M.E.I.C., Secretary-Treasurer.
R. Hogg, Jr. E.I.C., Branch News Editor.

Electrical Night

The January meeting took place on Wednesday evening, January 9th, at the hotel Reeta, Welland, when those members who attended were amply repaid for their zeal in facing the rather inclement weather, by the very interesting addresses provided by the various speakers.

The previous day had witnessed the ceremonial switching on of power from the new 55,000 kv.a., generator No. 6., at the Queenston plant of the Hydro-Electric Power Commission of Ontario. F. H. Farmer, A.M.E.I.C., representing the Canadian Westinghouse Company, described in detail the work leading up to this event, from the day when the commission made the contract with his company, until the unit was turned over to the commission as complete.

Some of the matter contained in Mr. Farmer's address was included in a paper read before the Hamilton Branch in March, 1922, and again at Montreal last session, so that a bare synopsis should suffice for this account.

The demand for electric energy from the Queenston power plant was such, that the output from the first four units was absorbed almost as soon as it was available. No. 5 machine was under way at the end of 1922, and it became apparent that in order to keep pace with requirements the installation of No. 6 should not be delayed. On January 10th, 1923, a contract was concluded with the Canadian Westinghouse Company, for the supply of one vertical 55,000-kv.a., generator, 12,000-v., to be installed and in operation by January 10th, 1924. A penalty was imposed, on a per diem basis, for any delay beyond this time, and a corresponding bonus for completion before this date, both to be operative for a maximum period of thirty days.

With the bonus as incentive, and with a relatively short time at their disposal, the company's engineers were called upon to practise many novel methods of time saving. Contrary to the usual proceedure of assembling and winding generators in position, it was necessary to attempt the assembly of the stator and rotar at chosen positions on the floor of the power house, and than to move them bodily to their final location on the bed-plate. In making this attempt, the features to be considered were as follows:—Selection of a suitable location on the floor of the power house capable of carrying the load of the completed stator. The feasibility of building up the stator on supports instead of on a continuous and level bed-plate. The feasibility of lifting the completed stator and carrying it along the power house to its final position.

A delay in installation of the turbine presented another problem. It became necessary to bridge over the turbine pit with steel beams, so that the work of placing the generator could proceed above. These and other difficulties were surmounted in a manner which reflects the greatest credit of the company's engineers, and permitted the company to secure the full amount of bonus allowed by their agreement. On December 10th, last, the commission were advised that the machine was ready for operation.

Mr. Farmer's address was illustrated by a series of lantern slides depicting the various stages of assembly and erection in the power house. One of these, of more than usual interest, showed the mighty stator, supported in mid-air by two powerful cranes, as it moved down the power house, from the place of assembly to the bed-plate, During this movement, there was a clearance of only three inches between it and the rails of the other generators on the one side, and the power house columns on the other. The movement was accomplished without mishap.

Insulators

E. B. Snyder, of the Dominion Insulator and Manufacturing Company Ltd., of Niagara Falls, Ont., followed Mr. Farmer with a talk on insulators, and some of the problems involved in the transmission of power on lines of great length or with limited clearances.

During the address samples were displayed of the high and low voltage, heavy duty bus insulators, also one of the 3,000 ampere disconnect switches installed in the Queenston power station. Details were given of the design and method of manufacture of these insulators, and the special features incorporated to handle the electrical and mechanical stress for maximum reliability and life.

The latter part of the address was illustrated by lantern slides and dealt with the manufacture and selection of the line insulator for power transmission. Interesting views of tests made in the company's high voltage laboratory showed some of the startling results obtained in a most important line of research.

Street Illumination

Street illumination was the subject of an illustrated address by R. M. Love, of the Canadian General Electric Company, Mr. Love sketched the history of street lighting, from its inception, when, in 1558, the inhabitants of Paris were ordered to place lighted candle lanterns in front of their houses, down to the present time, with the powerful electric lights which adorn the modern city streets.

"It is recognized" said the speaker, "that an adequate system of street lighting is required to promote safety from attack and burglary, to prevent stumbling and collision, to enable one to recognize the passer-by, to create a sense of security, and to eliminate eye fatigue caused from continual passing from dark to light, while glare striking the eye directly from the source of light must be eliminated or reduced to a minimum".

How these various objects were attained, and how at the same time the down-town lights of a city were made to be not only objects of beauty in themselves, but means of illuminating the beauties of the surrounding buildings and the windows of the merchants, was well brought out by word and lantern pictures.

A description was also given of the batteries of powerful search lights in use at Niagara Falls, to illuminate the cataract and the tumbling rapids at its crest. The combined rays from these lights equal those of 1,115,000,000 candles.

Trip over Queenston Power House

About fifty members of the Niagara Peninsula Branch meet at Niagara Falls on Saturday afternoon, December 8th, motoring from there to the Queenston power house. The afternoon was spent in a thorough inspection of the business end of the Chippawa power canal.

Dinner was served at the Lafayette hotel, Niagara Falls. A new song sheeet was on the menu, and served by Mr. Blanchard on the piano, with Mr. Frost as chorous leader; the viands tasted delicious.

The business meeting opened with S. R. Frost, A.M.E.I.C., in the chair.

The chairman called for the report of the By-law Committee. The by-laws, as drawn up for approval, had already been placed in the hands of all corporate members by mail. On behalf of the committee of which he was chairman, F. S. Lazier M.E.I.C., requested that the by-laws be discussed, amended if necessary, and approved at this meeting. He then moved that the report be adopted. The motion was seconded by A. C. D. Blanchard M.E.I.C., and carried.

Symposium on Fuel

The symposium on fuel, scheduled as the main item in the programme for the evening, was then introduced by the chairman. He referred to a letter received from the president of *The Institute*, some time before, in which the need of discussion on Ontario's fuel supply was urged on the branch. The letter had been written early in the summer, when a strike in the anthracite fields was imminent. This danger has passed, said the chairman, but the relief is only of a temporary nature. The needs of the province for an assured and permanent fuel supply for domestic use, was a problem worthy of close study, a problem which, as engineers, the members of the branch should discuss. From the time that the coal left the mine, till it was consumed in the combustion chamber, it's transportation by rail or water, to its economic use in the furnace of the consumer, it required the skill of the engineer.

After these introductory remarks, the chairman requested A. J. Grant, M.E.I.C., to take the chair during the ensueing discussion, so that he himself might be free to deliver his paper on Coke.

The subject was divided into seven sections, covering a wide range of possible sources of heat, and was delivered by the following,—

Pennsylvania Anthracite,	by F. S. Lazier, M.E.I.C.
American Bituminous,	" L. B. McDonald, Branch Affiliate
Welsh Coals,	" E. P. Johnson, A.M.E.I.C.
Canadian Coals,	" T. S. Scott, M.E.I.C.
Coke,	" S. R. Frost, A.M.E.I.C.
Oil,	" J. R. Bond, A.M.E.I.C.
Secondary Fuels	" Walter Jackson, M.E.I.C.

Quebec Branch

Hector Cimon, A.M.E.I.C., Secretary-Treasurer.

Forty members attended the monthly luncheon-meeting of the Quebec Branch, held at the Chateau Frontenac on Monday, December 17th.

Chairman A. R. Décary, M.E.I.C., in an introductory speech said that the members present would all regret the unavoidable absence of Sir Georges Garneau who was to have spoken but was being detained home through illness. It is understood, however, that Sir Georges Garneau who, besides being an engineer, is a prominent citizen and business-man, will address the members of the branch at one of the next meetings. Fortunately, Mayor Samson and Mr. Ed. Tanguay, the popular president of the Board of Trade, were the guests of the branch and upon being introduced in very able terms by the chairman, delivered some most interesting talks.

Mayor Samson said that it was a great, although unexpected, pleasure for him to address a gathering of men who did so much for the country and for the city of Quebec. He was an optimist and he believed that the province of Quebec was only at the beginning of its development They had but to look around them and they saw at once the natural wealth of the country, natural wealth that could only be won by the work of engineers.

The speaker referred to a recent visit he paid to the Grande Décharge of lake St. John where, he said, one cannot believe without seeing it what huge and wonderful development is taking place. It will be a triumph of modern engineering and the source of great prosperity for this district.

He incidentally called the attention of the audience to the necessity of a highway between the city of Quebec and lake St. John,which must be built in the near future. Good roads, he said, attracted tourists and during the summer months tourists were invaluable. The finest advertisement they wanted was a first hand knowledge on the part of outsiders and this knowledge meant the realization of the resources of the province. As soon as that knowledge was fully grasped by visitors, capital would quickly flow into the country.

The second speaker, Mr. Ed. Tanguay, said that he would make no apology for speaking about the Board of Trade, since he was the president of that body. He said that during the week a drive was in progress to secure new members for the Board and he hoped that many engineers would see their way clear to join forces with an organization that was endeavouring to advance the good of the city. It was a mistake to assume that the Board was merely attempting to achieve good for the business community and that it only needed the support of the business men. As a matter of fact they needed the help of other as well. There were many occasions when the advice of engineers was a decided advantage. Fortunately, they already had some engineers among their members and their technical training, the speaker was pleased to recognize, made them fit for discussing and quickly solving problems which would appear most intricate to ordinary business men.

Mr. Tanguay pointed out the advantage of co-operative efforts. He said that combinations of men were usually able to obtain results that were denied to the individual. The very fact that they were united carried weight with those they were dealing with. The Board of Trade, concluded the speaker, was striving towards the well-being of the city and it behooved everyone with the good of the city at heart to join up.

The luncheon was concluded by a few words from A. E. Doucet, M.E.I.C., who thanked the speakers for their interesting addresses. Speaking on behalf of the engineers, he said that they were all anxious to do their best for the province and their city.

St. John Branch

W. J. Johnston, A.M.E.I.C., Secretary-Treasurer.

A meeting of the St. John Branch was held on December 20th, in the New Brunswick Telephone Company's building, with H. F. Bennett, A.M.E.I.C., chairman of the branch, presiding. An address well illustrated with lantern slides, was given by B. E. Claridge, Ph. B., M.F., on the development and scope of forest engineering.

The Development and Scope of Forest Engineering

When timber was abundant and easily reached there was no difficulty in having it transported to the mill for manufacture. In time the more accessible timber areas became depleted and it was necessary to bring timber greater distances, The planning and construction of works in the forest for the transportation of this timber is the work of the forest engineer.

Forest engineering is one of the newer branches of the profession, being little used and hardly necessary until the twentieth century. It requires in particular a working knowledge of civil, mechanical and electrical engineering, and in America has reached its greatest development on the Pacific coast. A forest engineer often has to combine with his duties those of a forester. True forestry is the art of growing timber as a crop, whereas forest engineering deals with works for the conveyance of timber from stump to mill.

The present difficulty of bringing timber long distances over rough country requires serious economic study for its mode of transportation. After stumpage charges, the average cost of an unmanufactured log is 25 per cent for cutting and blocking, and 75 per cent for transportation to mill. Lumber transportation systems vary with the country and type of timber. On the Pacific slope on America where the timber is large-sized, logging railways and power skidding are employed; in the central and eastern sections, log-haulers on large operations and stream-driving is employed; in tropical countries the logs are carried by aerial cable over the flat swampy ground and dense undergrowth.

The first duty of a forest engineer planning the cutting of an area is the preparation of a map showing contour, type and density of stand of timber, and such other detail as may be required. Actual maps have varied in cost from $27.00 per square mile for area surveyed, to a maximum of $851.50 per square mile in the case of a large American lumber company. Some firms execute all lumbering operations from detail maps. From the map is decided the primary and secondary systems of transportation. This depends on topography, size of timber, size of operation. The construction programme, and its order of procedure must be decided on.

A proper amortization scheme of accounting must provide the writing off a large depreciation over a comparatively short term of years. The usual logging operation requires low initial cost with high operating and maintenance charges over a period of from twenty to thirty years.

The first logging railway was built in Michigan in 1876. At present the standard of construction is an intensitive study and is based on the unit cost of traffic per ton-mile. With some exceptions, grades are limited to 5 per cent and curves to 18 degrees. Equipment used includes air-brake and standard coupling. On secondary roads the geared-type locomotive is used, while the light rod-connected locomotive gives good results on better-class roads. In Washington, these logging railways have trestles up to 125 feet high, all piles in single length, while Howe-truss bridges up to 110-foot span are used. All trestles and bridges are of wood.

Flumes, from one to seventy miles long, sometimes carried in tunnels through mountains, and occasionally also serving irrigation purposes, are used to transport timber. A knowledge of water supply and leakage is most important. The speaker mentioned several cases where completed works proved a failure through lack of water. When logs are floated to the mill a knowledge of earth and timber dam consstruction is necessary. These dams are built at headwaters of streams to ensure water for log-driving.

The protection of forests requires the construction of trails, roads, telephone lines and look-out towers, and this work falls to the forest engineer. At times he constructs ditches in swampy country or breast-works on plains of shifting sand, and by combining with his duties those of a forester helps to reclaim waste areas by planting grass and trees.

A common method of moving logs is by the slide or chute. Two logs are placed side by side and cut V-shaped on the inside and the depression between the logs kept greased in summer and iced, where possible, in winter.

The speaker who is professor of forest engineering at the University of New Brunswick, Fredericton, mentioned the method of handling the 3,600-acre wood lot on the grounds of the provincial university. A re-forestation policy is proposed for all waste areas by planting spruce and pine. The seed will be obtained from the seed-extraction plant now under construction by the N. B. Government at Fredericton. A definite policy of cutting on this wood-lot has been decided on which will maintain the supply of wood and in time be a better revenue-producer.

Referring briefly to forestry practice the speaker declared that any forestry policy should perpetuate the stand of the forest and not be exhaustive as mining.

Edmonton Branch

W. R. Mount, A.M.E.I.C., Secretary-Treasurer.

At 8.15 p.m., on the evening of December 13th, R. S. L. Wilson, A.M.E.I.C., (chairman) called the second regular meeting of the season to order. After the reading of minutes of the previous meeting, Mr. Wilson introduced Professor Kleven, of the Department of Law, University of Alberta, as the speaker of the evening, whose subject was "Some Applications of Law to Engineering." The speaker commenced his remarks by showing how the law of the present has been built up from the codes of the past, and how decisions handed down by the courts of the past served as guiding principles for the lawyers to-day. He went on to show how many apparent irregularities of the law and apparently unreasonable decisions where based on well established and clearly defined precedents and were not so unreasonable as appeared. The laws of Canada were derived largely from the laws of England, which laws had attained higher standards than in any other country. It was then shown how respect and observance of the law was more highly developed in England than elsewhere.

Professor Kleven also dealt briefly with the relations of an engineer to corporations and other public bodies. Many instances of court dealings with contractors were cited and after his paper, discussion took place chiefly in connection with incompleted contracts and contracts made invalid for various reasons.

On January 16th, in the Board of Trade rooms, the members of the Edmonton Branch combined with the Northern Alberta Branch of the C.I.M. & M., in entertaining the engineering students of the University of Alberta.

The entertainment took the form of a social evening and smoker and was the means of returning hospitality received from the students a year ago.

Howard Stutchbury, provincial trade commissioner, presided, and was supported by Norman Fraser, of the Mining Institute and A. G. Stewart, A.M.E.I.C., in the absence of R. L. S. Wilson, A.M.E.I.C., chairman of the Edmonton Branch, who was confined to bed.

Light refreshments were served and an excellent programme of solos, stunts, yarns and choruses was provided, about 100 students and members being present.

Short speeches of welcome by the presiding officers and of thanks by representatives of the students commenced and terminated the evening. The success of the entertainment was assured by the efforts of Messrs. Stansfield and Haddow on behalf of the E.I.C. Branch, and Messrs. Jones and Stevens of the C.I.M. & M.

Peterborough Branch

R. C. Flitton, A.M.E.I.C., Secretary.

The age-old quest for gold that from earliest times has challenged the spirit of hardihood and adventure in man was the subject of a very interesting talk in the Chamber of Commerce on December 14th, by A. F. Brigham, general manager of the Hollinger Consolidated Gold Mines. The meeting was under the auspices of the Peterborough Branch, and was featured by the presence of a great many visitors. R. B. Rogers, M.E.I.C., presided.

Gold Mining in Northern Ontario

In the course of his explanatory talk, Mr. Brigham described in detail, but in easily comprehensible language, the processes involved in bringing gold from its lair in the quartz veins to the bullion boxes.

In 1909, he said, a man named Wilson, grubstaked by a Chicago man, found the dome mine, so-called because the quartz protruded from the ground like a dome. A vein of gold discovered there was 2 feet by 5 inches, and there have been no spectacular discoveries of gold in the Porcupine district since.

A couple of million dollars in gold ore were taken from the Porcupine Crown mine, he said, but this is now idle. Just over the hill a man put in his pegs in what is now Hollinger mine territory.

One of the difficulties in mining in this country is the general nearly vertical dip of the veins. This means that if valuable ore is found the doubtful quantity is the depth to which it extends. The most wonderful mines in the world are those where the veins run horizontally, and it is easy, by following the vein, to estimate the value. The value of the property is an indefinite problem in the Hollinger field, but there is a strong probability from present indications that gold will persist in paying quantities farther than it can be followed. A test showed a value of $150,000 per vertical foot to the 425-foot level and a further test to the 800-foot level ran a little higher. "We have plans completed to carry the shaft to the 3,000-foot level and that, at $150,000 a foot, would return $450,000,000 in gold on a property of twenty acres. Of this $220,000,000 will be spent in winning the gold."

"With the exception of a few inported chemicals and certain licenses for American patents," said Mr. Brigham, amid applauses, "this $220,-000,000 will be spent in the Dominion of Canada."

Describing the methods of drilling, sinking shafts, and hauling the ore, Mr. Brigham said there are 13,000 tons of ore coming out of that district every day, with an average value of $8. a ton. In the mines the ore is hauled by electric locomotives, about 75 tons of ore being hauled on one train. The round trip of a locomotive in the mine from the loading point and back averages 6,000 feet. In connection with the operation of the locomotives, the speaker remarked that the development of the mines is inseparably linked up with hydro-electric development, as they could not operate on a paying business without electric power.

The output of tailings, or waste material, from the Hollinger mine, would fill a coal train over a mile long every day. The disposition of this 5,000 tons of debris daily is a difficult problem, Mr. Brigham said.

Sixteen hundred assays are made every day to ascertain the exact quality of the ore being mined. A research department is maintained to examine the history of the rocks, about which nothing is known yet.

The same rocks are found in the Rocky Mountains, in Labrador and at Lake of the Woods, showing the possibility of development in other fields quite as rich as the Porcupine district of Ontario. What is required, Mr. Brigham said, is belief in the project and energy and intelligence to guide in the development work.

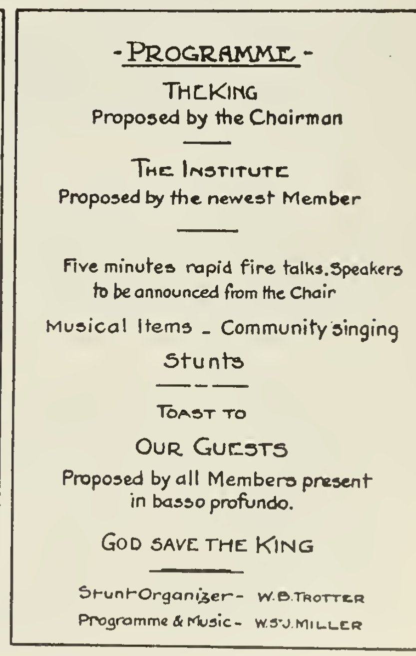
Among the constructive suggestions offered by the speaker, he advocated the allowance by the government of the entire royalty collected from mining operations to the towns connected with the mines until they are sanitary and provided with schools. A very large element of the population of these towns is technically trained and desirous of living decently. The mines to-day are paying for men with brains rather than for men with brawn, and a good type of town should be built.

The lecture was concluded with the exhibition of four government films depicting the mining industry and processes from the staking of the claim to the boxing of the bullion.

Calgary Branch

J. A. Spreckley, A.M.E.I.C., Secretary.
W. St. J. Miller, A.M.E.I.C., Branch Editor.

One of the most important E.I.C., events of the year, at least from a social standpoint, is the annual dinner of the Calgary Branch. This was held in the Board of Trade rooms on Monday, January 7th. The occasion was such that a gala feast of good edibles gave place to revelry



by night — in moderation. Seldom has an evening passed with so much concerted (not concentrated) spirit. Talking of the latter, opinions were voiced regarding a certain branch being much envied for its close proximity to a certain province, and the toughtful manner in which entertainment across the border was arranged! Jealousy, that's all.

The chair was very ably occupied by P. J. Jennings, M.E.I.C., in the absence of Chairman V. Meek, A.M.E.I.C., who was detained in Ottawa on business. Vice-Chairman Emery was also out of town on business. Mr. Jennings handled the various affairs throughout the evening in a commendable manner, not a detail being overlooked. It was mainly due to his thoughtfully drawn up agenda that everything went without a hitch.

Some seventy-five members and guests took their seats, and the first thing to strike the eye was a suitably designed programme and menu. It was after the incisors had incised and limbs were stretched in comfort that one began to realize the sincerity of the quotation:—

"Snatch gaily the joys which the moment shall bring,
And away every care and perplexity fling".

Several stunts were pulled off under the direction of W. B. Trotter A.M.E.I.C., and V. A. Newhall, A.M.E.I.C., to the mortification of selected victims. Following "The King" R. M. Dingwall, A.M.E.I.C., the youngest member present, was called upon to propose the toast to *The Institute* which he did in a very pleasing manner. A varied musical programme, under the direction of W. St. J. Miller, A.M.E.I.C., was presented, which included some of our best local talent, and was much enjoyed. Between the various items five minute rapid fire talks were interspersed from members on subjects of particular interest.

A Review of Conditions in Alberta

D. W. Hays, M.E.I.C., struck an optimistic note in his reference to the prospects for 1924 and advised his hearers to "pack up your troubles in your old Kit Bag", as had just been sung at the dinner table. He however acknowledged that a song just concluded "It is quiet down here", appropriately suited the occasion so far as the past year was concerned. The subject of tax reduction was touched on, and he backed up his optimistic attidude with a reference to the extensive undeveloped resources in the province of Alberta.

A. S. Dawson, M.E.I.C., referred to the cessation of construction work in the province, intimating that he saw little promise of any improvement in this line for some years. He advised members to give greater attention to national and community affairs, and eulogized the engineering profession while pointing out the high esteem in which its members are in general held to-day. Referring to irrigation he advocated the introduction of some different class of farming, if the greatest success was to be attained.

Progress in Telegraph System

L. A. B. Hutton, A.M.E.I.C., was the next speaker, and outlined the progressive programme followed furing the year by the C.P.R., telegraph department. He stated that 17,000 miles of telegraph line were in use by the company, 25 miles having been laid in the year. His statistics showed 46,000 cars of 1923, crop had been shipped out of the province during December, as compared with 24,000 during the same month a year ago. 10,500,000 bushels had been shipped via Panama to Great Britain up to December 1st.

B. Russell, A.M.E.I.C., of the reclamation service, Department of the Interior, said that out of 1,000,000 acres surveyed for irrigation, only 30 per cent was settled, the remainder awaiting settlement.

A. L. Ford, M.E.I.C., referred to the matter of protection against flood damages, stating that the Dominion Water Power Branch would do everything possible to give the necessary service during the coming year.

P. L. Philpots, speaking for F. J. Robertson, A.M.E.I.C., in connection with Calgary Power Company pole lines, stated that 150 tons of copper had been used, necessitating 50 carloads of freight on the new power line during the last year, the estimates being placed at $250,000.

B. L. Thorne, M.E.I.C., estimated 7,000,000 tons of coal had been mined and shipped from Alberta during 1923, thereby establishing a record for this province. He enlarged upon the extraordinary difficulties encountered by coal engineers in the extraction of this valuable product, especially as regards surveying of the faulted seams so common in our fields.

The doctors' and lawyers' professions were very ably represented by Dr. D. S. MacNab and P. A. Carson respectively , each one speaking in glowing terms concerning the brother profession of engineering.

Community singing and athletic stunts added a get-together-go-as-you-please atmosphere, and a jolly evening was brought to a close by singing a special adaptation of a popular song:—

"We are nearing the end of a *perfect day*,
A day that we'll never forget.
Every Member and Guest should go away
With thoughts that bring no regret.
For an engineer smiles during work or play,
And makes friendships that never fade.
So we'll grasp, at the end of this perfect day,
The hands of the friends we've made."

At the annual meeting of the Calgary branch of the Professional Institute of Civil Service of Canada the following members of the E.I.C., were elected amongst others, as officers for the ensuing year — Chairman A. G. Wilson, A.M.E.I.C., C. J. McGavin, A.M.E.I.C., representing the Dominion Water Power Branch and W. St. J. Miller, A.M.E.I.C., representing the Irrigation Division, Reclamation Service.

Ottawa Branch

F. C. C. Lynch, Affiliate E.I.C., Secretary-Treasurer.

A new method of treating the cheapest grades of slack coal by which many by-products are secured and huge savings affected was discussed before a meeting of the Ottawa Branch on the evening of January 3rd, in the Victoria Memorial Museum, by A. J. Taylor, of Toronto, president of the Combustion Engineering Corporation, Limited. His subject was, "Powdered coal as an industrial fuel and the relation of low temperature distillation to powdered coal".

Powdered Coal as an Industrial Fuel

Descriptions were given of the two largest pulverized coal installations in Canada, one of the Ford Motor Company at Walkerville, consisting of three 1,300-h.p. boiler units, which are the largest boilers in Canada, and which plant is the first in the world to be operated in combination with a complete low temperature coal distillation plant. Engineers all over the world are watching with great interest its development.

The second plant touched on was the new central heating and steam standby station for the Winnipeg Hydro-Electric in which the lower grade coals of western Canada will be burned. Direct unit pulverized fuel plants offer the solution to the successful burning of lignite coals in the smaller boiler plants, it was said.

The plant being installed for the Ford Motor Company at Walkerville was a wonderful engineering achievement. It has a capacity of 600 tons of raw coal treated in 24 hours and is the first plant of its kind. Built at a cost of nearly a million dollars, requiring 2,300 yards of concrete, 2,000 tons of refractories, 700,000 pounds of conveyor equipment and apparatus, and for its operation, 250,000 pounds of molten lead it is believed that this system will operate at a thermal efficiency of 95.2 per cent.

If the plant being installed at Walkerville gives the results that the inventors and their associate engineers believe it will, it means that any large industrial plant operating on raw coal costing, for example, say $2. a ton, could by treating this coal obtain from the by-products of gas, gasoline, fertilizer and fuel oil a net value sufficient that would leave them coke to be burnt in pulverized form equivalent in value to the two dollars raw coal that it would replace, and the net cost of this coke would be less than five cents a ton.

The significance of this statement is apparent when it is recalled that there are millions of tons of slack coal in western Canada, available at $2. a ton, and less, and that central steam stations could be located close to these supplies of cheap coal and operated in conjunction with low temperature distillation plants so as to produce cheap electrical energy for industrial and railway purposes. There would also be a possibility that these central stations could combine with the production of electrical power the manufacture of gas for domestic purposes, and as well the manufacture of briquettes as domestic fuel.

Western Canada will undoubtedly have a series of steam plants producing and distributing cheap electrical energy, through those areas that are outside the field of possible hydro-electrical developments.

Low temperature coke which is one of the products from the distillation process can be combined with suitable coals and then treated in the ordinary coke ovens to produce a very high grade of metallurgical coke, and this is a possible combination that is of importance to British Columbia whenever an iron and steel industry is established there.

Sentiment, except under wartime conditions, will not influence any but a very small section of the public to use Canadian coals instead of imported coals, unless the saving to be affected is in plain sight, said the speaker. The use of pulverized coal in locomotives has possibilities of saving that are as great as in industrial power plants, he said.

There were more than eighty members present at the annual general meeting of the Ottawa Branch held on January 10th, in the Daffodil tea rooms. Reports covering the activities of the various committees were submitted and showed a very flourishing condition. Membership increased during the year and a substantial increase was made to the financial balance on hand. The luncheons have become increasingly popular and the practice of securing distinguished visitors as the guests of honour and speakers at these functions has proved exceedingly successful.

Officers for 1924 were elected. The new chairman is J. L. Rannie, M.E.I.C., of the Geodetic Survey. F. C. C. Lynch, Affiliate E.I.C., superintendent of the Natural Resources Branch, Department of the Interior, was re-elected secretary, and the following members were added to the managing committee: R. J. Durley, M.E.I.C, R. L. Peek, M.E.I.C., and Brigadier-General A. G. L. McNaughton, A.M.E.I.C.

Following the routine business, four films of an entertaining nature were shown and much enjoyed. Whilst supper was being served the retiring chairman, O. S. Finnie, M.E.I.C., rendered a vocal solo.

Special reference was made during the evening to the loss which *The Institute* had suffered in the deaths of Messrs. A. St. Laurent, M.E.I.C., C. A. Biggar, A.M.E.I.C., and G. L. Rainboth, A.M.E.I.C.

Halifax Branch

K. L. Dawson, A.M.E.I.C., Secretary-Treasurer.

Annual Meeting

The fifth annual meeting of the Halifax Branch was held in the St. Julien room of the Halifax hotel at 6.30 p.m., on December 20th, 1923.

Special preparations had been made by a committee composed of F. A. Bowman, M.E.I.C., C. H. Wright, M.E.I.C., Professor W. F. McKnight, A.M.E.I.C., and H. W. L. Doane, M.E.I.C., to have it different to the ordinary run of our meetings. Before our chairman Professor F. R. Faulkner, M.E.I.C., called the meeting to order those present had the pleasure of partaking of a fine dinner. There were favours at each plate, a package of playing cards from the Canadian General Electric Company, Ltd., and a deskpad from the Northern Electric Company, Ltd. The tables had been very tastefully decorated by Mrs. F. W. W. Doane and Mrs. H. W. L. Doane. Under the exuberant direction of K. H. Smith, M.E.I.C., a good volume of joyful noise was produced by the members to the accompaniment of a three-piece orchestra having H. H. Schurman, S.E.I.C., at the piano with W. H. Bachman and W. E. Davison playing banjos. These three prospective members were students at Nova Scotia Technical College. Specially artistic menu-cards had been prepared by Professor W. F. McKnight, A.M.E.I.C.

After the toast to the king the chairman introduced R. T. MacIlreith, L.L.B., member of the Board of Commissioners of Public Utilities of Nova Scotia by saying that he was so well advertised that he needed no verbal send-off. He stated that there was a very general opinion that Mr. MacIlreith was the right man in the right place, doing his best for the mutual interests of all. He suggested that it was the opinion of most engineers that the Public Utility Board was guiding itself admirably through very difficult situations.

Mr. MacIlreith expressed pleasure and gratification on hearing this expression of confidence in the board, and said that with the help of engineers they are exerting their best efforts. He admitted that they received a lot of free advertising but that it was chiefly in the form of criticism. Criticism is a good thing and does not worry anyone who is doing what he thinks is right. His connection with engineers began at the Halifax city hall. At that time he thought that the ministers in the city pulpits were not succeeding in making the people as honest as they should be. The city engineer being of the same opinion they joined forces and began a campaign to make people pay for what they received. There was a great fight in which he found that engineers were loyal companions. This was some years ago. Many former foes admit the correctness of the stand he took. He went on to explain how a great deal of the trouble which engineers experience is caused by themselves, and in wishing the branch every success, he praised the work of engineers in connection with the board.

Address by Chairman of Highway Board

In introducing A. S. McMillan, chairman of the provincial highways board, the chairman suggested that he might perhaps be considered as a man who was continually between "the devil and the deep sea" because everyone wanted good roads and no one wanted them to cost anything.

Mr. McMillan suggested that the reference to the devil and the deep sea was very apt but not perhaps in the way that the chairman had used it. In his position he was very often the arbiter between an engineer and a contractor. He left it to the audience to decide which one of the contending parties was the devil. The engineers' work lives on and on as a monument to his skill or his failure. Therefore if he goes down he may have to stay down for he cannot conceal his weaknesses like members of some other professions. When a lawyer fails his opponent reaps the benefit and the laugh about it in private afterwards. The doctor may sew up a sponge or a hatchet inside his patient. The operation is posted as successful but the patient dies of shock. The clergyman may slip from the paths of recognized theology and assert his independence of it. He is not now posted as a heretic but is heralded as a modernist. He said that the provincial highways' board was paying its engineers' salaries which compare favourably with those of the other provinces of Canada and are higher than some. While the professions may recognize that our engineers do not receive the salaries they merit it is hard to convince the general public that they should be paid more than is being paid by other provinces for similar work. The average cost of the roads which are being built in our province is about $6,000.00 per mile. Such roads cannot stand much engineering expense; therefore, a great deal of the work done on them by engineers must be done by eye. Good judgment on the part of the engineer is essential. We are just starting our highways and we need engineers who have good common sense and sound judgment. We need constructive engineers with executive ability. They are not as plentiful as they should be. Any young man who can acquire the ability to handle large bodies of men successfully will find a demand for his services. The provincial highways' board has a fine group of engineers and will try to retain them.

Guests from the Garrison

Colonel Benoit and Major Henshaw, our guests from the garrison spoke briefly. Colonel Benoit said that military engineers have a brotherly interest in the practitioners of the civil branches and come into touch with all. In times of stress they call on their civil brethren to help them. Therefore it is to the mutual interest of all that they work as closely together in times of peace as is possible.

Major Henshaw spoke of his present work in the garrison and called the attention of the members to the fact that a company of militia engineers was being organized to look after the searchlights, etc., in the fortress. Officers were needed as well as men. He thanked the branch for the privilege of attending and wished us a prosperous year.

Reports of Committees

Prof. F. R. Faulkner, M.E.I.C., reported for the committee on the published classification and remuneration for engineers that it had sent a questionnaire to 140 members of whom only forty had replied. The fact that less than thirty per cent of the membership of the branch had answered would indicate that very little interest was being taken in this vital and pressing matter. The work of the committee was being hindered and to a certain extent made useless by the tardiness in answering the questions. He urged that those who have not written consider it their duty to do so quickly.

C. A. Fowler, M.E.I.C., reported that the Papers Committee had arranged for four papers in as many months.

K. H. Smith, M.E.I.C., will give a paper on the "Chippewa Power Development". It will be elaborately illustrated by papers and slides. (As a special attraction for this meeting Mr. Fowler announced that he had persuaded Mr. Smith to include a short talk on his scheme for the re-establishment of the population of Nova Scotia.)

F. A. Bowman, M.E.I.C., will read a paper on the "Depreciation of Public Utility Equipment".

G. S. Stairs, A.M.E.I.C., will read a paper on "Town Management".

C. H. Wright, M.E.I.C., will arrange for a suitable paper on the "Wireless Telephone".

Report of Scrutineers

C. A. Fowler, M.E.I.C., reported for the scrutineers that the change in the by-laws of the branch had passed unanimously; that C. H. Wright, M.E.I.C., had been unanimously elected to the post of chairman; that Professor W. F. McKnight, A.M.E.I.C., R. W. McColough, A.M.E.I.C. and J. F. Lumsden, A.M.E.I.C., had been elected to as members of the executive committee for two years to represent the part of the branch district included in the circle of twenty-five miles radius from Halifax; that Professor D. W. Munn, A.M.E.I.C., had been elected as member of the executive committee to fill out the unexpired year of the term of C. H. Wright, M.E.I.C., who was elected chairman; and that G. S. Stairs, A.M.E.I.C., and A. R. Chambers, M.E.I.C., had been elected as members of the executive committee for two years, and J. G. W. Campbell, A.M.E.I.C., and J. W. Millar, M.E.I.C., had been elected as members of the executive committee for one year, to represent the territory of the branch which is more than twenty-five miles from the city of Halifax. The election of the last four men was made legal by the passing of the changes in the new by-laws.

After thanking the various special and standing committees for their services, the members of the executive committee and the secretary for their loyal assistance and support, the Chairman Faulkner gave his retiring address as follows:—

Retiring Chairman's Address

"For a few minutes, because it is fashionable to be brief this evening, I desire to direct your thoughts to a problem which is of the utmost importance to our profession, a problem which has filled the minds of some of us for many years but a problem which can never be completely solved. I do so because of its importance, — *The Institute* has a committee on it now, — and because a successful solution will require your individual and collective advice, sympathy and co-operation.

Our general secretary, in a recent address before the Montreal Branch, is reported to have made the statement that there are too many engineers in Canada to-day and that this condition will become worse in the spring when the engineering colleges pour forth a large number of graduates. I do not intend to discuss this statement, although one might profitably do so as there is much to be said on both sides, but will call your attention to a suggestion made by the same speaker, that the engineering course be lengthened to six years. This suggestion, as I interpret it, was made primarily to point out a way to curtail the supply but I mention it because it leads to the problem of which I have spoken, that of engineering education.

In Canada, the length of the engineering course at, I think, all universities is now four years so that Mr. Keith's suggestion means an increase of fifty per cent in the time that must be spent after matriculation before a student receives a degree. In the July and August numbers of *The Journal* you will have noticed a most excellent paper by Professor McKiel, M.E.I.C., of Mount Allison University on "Modern Tendencies in Engineering Education". This paper was well worth reading and reading again. I also call your attention to a letter from Professor E. O. Temple Piers, A.M.E.I.C., of MacKenzie College, Sao Paulo, Brazil, in the December issue of *The Journal,* interesting paaticularly as showing the conditions that prevail in that South American country.

Professor McKiel's paper examines the chief criticisms directed at our present system and mentions some of the proposed remedies. He stresses the statement that the average graduate in engineering is weak in the ability to use the English language, this may seem surprising to some and it must be remembered that this statement applies not only to Nova Scotia but to other provinces and the States as well, but with it I am forced to agree. It is certainly deplorable and is possibly one reason why the engineering profession has not been sooner recognized by the public. It seems to me that the fault is not so much in the colleges but goes back to the public schools. Surely the time to teach a future citizen to write and speak correctly is at the time when the said future citizen is being taught these subjects and it should not be put off until after matriculation. I do not mean that we should delve into the treasure house of literature in our schools but I mean that a student on entering college should be able to speak correctly and coherently and write so that one can clearly understand what he is trying to convey. It must be admitted also that many of the bad habits of speech are acquired in the home but that again throws us back into the public schools. The fact remains, however, and will remain until our schools, whether in the city, town or country are willing to employ teachers with the necessary qualifications for teaching these subjects.

If we admit this lack of training in a fundamental subject before a student enters a university, an effort must be made to overcome it and more time be allowed in the engineering curriculum for the study of English. In addition the engineer is criticized as being lacking in other subjects. commonly known as the humanities, and these too must be provided for. The need of such subjects has for long been recognized in all colleges and efforts made to satisfy this need, but if they are introduced in their proper proportions, just how can they be inserted into an already crowded four year course. The answer is that they can't unless some of the professional subjects are eliminated; this suggestion at once meets with opposition from some who contend that the young graduate is already deficient in professional training and that he should have more rather than less. If that be the case, there seems only one solution, the extension of the engineering course to five or six years. But here comes opposition from other sources; from the universities and the students. The universities contend, and rightly, that this suggestion will involve a heavy additional drain on resources already strained; the student will contend, and it will be true in many cases, that he already has enough difficulty in financing himself and may have to abandon the idea of studying engineering altogether, especially if the low scale of salaries received immediately after graduation continues to prevail.

So there you are; on one hand a demand for a broader, more thorough or more highly specialized training, and on the other, the increased cost to the universities and students. I have faith, however, that if a five or six year course is found necessary, both the universities and students will find a way to meet the additional expense and the fact that a number of engineering institutions in the United States already have such courses, confirms this opinion. Therefore it is the first point in this problem, the desirability of a longer course, to which I hope you will direct your thoughts. If there is a definite demand for a longer period of training, if the practising members of the profession feel that the graduate is not as thoroughly or as broadly prepared as he should be, then the universities will have to fall into line and the students follow with them. But, if you make this demand, remember that you are very likely to be called upon to do your share. If the courses are increased in length by co-operation between industries or practising engineers and the universities, as is now the case at some of the American institutions, would you be willing to take one or more students into your plant or into your office and teach what is required, not merely have him work there, but really teach him, for it will require time and energy on your part and proper teaching is most exhausting work, and further what can you offer him as an incentive. If on the other hand the course is lengthened by giving all the instruction in the class rooms, drafting rooms or laboratories of a college, will not the graduate demand that you should recognize this in employing him. Referring again to Professor Piers' letter, you will notice his statement that in Brazil the graduate in engineering is regarded as a professional man at the start and given responsible work. Would you do the same under the proposed new conditions, or would you still expect him to act as rodman or chainman or in some other equally minor capacity. If on the other hand you will be willing to give him a position of professional responsibility will you also be willing to reward him adequately or would he still be expected to take a salary which, in many cases skill labour would reject with scorn. In short and in conclusion, it is useless to talk of extending the usual period of instruction unles, we are willing to pay the price."

Toronto Branch

J. A. Knight, A.M.E.I.C., Secretary-Treasurer.
L. W. Wynne-Roberts, A.M.E.I.C., Branch News Editor.

The second half of the winter session of the Toronto Branch opened on Thursday, January 10th, when an address was given by Dr. J. A. Amyot, deputy minister of health, Canada, on "Public Health Machinery of Canada". Invitations had been extended to the Canadian Academy of Medicine, the provincial and municipal departments of health, and there was a representative audience present, including a number of lady public health workers.

Public Health Machinery in Canada

In introducing the speaker, Prof. C. R. Young, M.E.I.C., chairman, remarked that Dr. Amyot had been professor of hygiene at the University of Toronto, provincial bacteriologist, and had overseas service to his credit. Dr. Amyot on rising to speak stated that there had been a great advancement in public health work in 20 years, and that now the federal, provincial and municipal departments of health, aided by universities and others outside, were doing much work for the prevention of disease. He then outlined briefly the organization and work of the federal department, describing the facilities for the proper quarantine and examination of immigrants, the inspection of food stuffs, and the supervision of the manufacture of patent medicines.

The speaker stated that fifty nations belonging to the League of Nations were in general agreement on the opium and narcotic drug act in force in Canada. In conclusion, Dr. Amyot said that the department had no powers inside the provinces, but there was a Dominion Council of Health, which comprised the chief officer of health of each province, the deputy minister of health, and five other men such as farmers, citizens, who were changed every three years. This council met twice each year and were trying for unification and co-ordination of work, which resulted from carrying out principles adopted by common consent at the meetings.

Prof. C. R. Young, M.E.I.C., in opening the discussion thought control in the interest of public health was fully justified and society must be protected by such departments. F. A. Dallyn, M.E.I.C., referred to the Cochrane epidemic and instanced it as an example where prompt measures were well applied and the effect of the epidemic was nullified.

Public Speaking and the Engineer

In view of the oft repeated statement that engineers find it difficult to express themselves in public, the executive committee invited Prof. W. H. Greaves, Victoria University, to address the meeting of January 17th on "Public Speaking and the Engineer". In his opening remarks, to a large audience, the speaker stated that engineers needed the same training in the fundamentals of public speaking as a preacher or any other orator. The problems usually confronting the engineer were first, that of making his ideas plain and secondly filling his audience with enthusiasm so that his hearers were willing to act upon his advice. The problem might be called that of salesmanship. Three agents are employed in public speaking, those of mind, voice, and body, or words, tone and action, and the engineer is most interested in those of tone and body. The great essential in speaking effectually must be an intense, sympathetic appreciation of what one is saying while one is saying it. Tone and action are natural languages and each in itself is capable of expressing thought and feeling. By the use of different modulations of the voice and body the number of expressions is illimitable.

Prof. Greaves thought that one of the most important fundamentals was the stream of tone, and the modulations of this stream constitute the greater part of the study of the spoken word. Describing and illustrating the many modulations, the speaker cited two as being of practical importance, those of change of pitch between words, and inflection, which is a change of pitch on a sustained vowel. Falling inflection indicated positiveness, agressiveness, whilst a rising inflection suggested questioning, lack of thought, thoughtlessness. Rapid change showed nervousness, excitement, will to dominate, whilst the employment of a gradual change indicated poise, calmness, self control. Inflection and change of pitch always go together and are used to make ideas plain, to place them in logical sequence and to emphasize. The absence of these modulations produced what is commonly known as the "ministerial" or speaker's tone.

Imaginative and emotional elements were signified by "tone colour", and intensity of conviction was indicated by movement, or rhythmic pulsation. All modulations should be used merely as a means to an end, which end is the expression of truth as simply, sincerely, and as effectively as possible.

The following members took part in the discussion, A. C. Oxley, A.M.E.I.C., S. W. Winckler, M.E.I.C., R. B. Evans, A.M.E.I.C., A. Crumpton, M.E.I.C., R. O. Wynne-Roberts, M.E.I.C., who moved a vote of thanks which was seconded by Peter Gillespie, M.E.I.C.

ANNOUNCEMENT OF MEETINGS

Further information may be secured from the secretaries of the various branches, whose addresses will be found under "Officers of Branches" on page 50 of *The Journal.*

Niagara Peninsula Branch:—

Secretary-Treasurer, R. W. Downie, A.M.E.I.C.

Feb. 1st. Annual dance at Niagara Falls.

Feb. 12th. Dinner-meeting at the Welland Inn, St. Catharines, "Asphalt Paving," by Germain P. Graham, of the Asphalt Association.

Peterborough Branch:—

Secretary, R. C. Flitton, A.M.E.I.C.

Feb. 6th. Address on "Asphalt and its Uses in Highway Construction", by G. P. Graham, district engineer, The Asphalt Association.

Feb. 28th. Address on "The Testing and Inspection Work of the Hydro-Electric Power Commission of Ontario", by W. P. Dobson, M.E.I.C., laboratory engineer, H.E.P.C. Toronto.

Saskatchewan Branch:—

Secretary-Treasurer, D. A. R. McCannel, A.M.E.I.C.

Feb. 7th. Address on "The Coal Fields of Saskatchewan, the Advantages and Disadvantages of Generating Power at Pit Head", by J. B. Hamilton, A.M.E.I.C., town engineer, Estevan, Sask.

Feb. 21st. Short addresses by several members.

Mar. 12th. Annual meeting and social evening.

Mar. 28th. Address being arranged for.

St. John Branch:—

Secretary-Treasurer, W. J. Johnston, A.M.E.I.C.

Feb. 21st. Address on "Construction of St. John Hydro-Electric Distribution System", by Barry Wilson, A.M.E.I.C., of St. John Power Commission.

Mar. 20th. Address on "Electric Transmission Economics and their Relation to Rate Fixation", by Budleigh Faraday, Comm. Manager. N.B. Power Co.

Winnipeg Branch:—

Secretary-Treasurer, P. Burke-Gaffney, A.M.E.I.C.

Feb. 7th. Address on "Electric Steam Boilers", by Mr. De Kermor.

Feb. 21st. Address on "Mechanical Equipment of Packing Houses", by W. J. Cummings.

Mar. 6th. Address on "Corrosion of Metals", by Professor J. W. Shipley, Ph.D.

Mar. 20th. Address on "Forestry", by Colonel Stevenson.

Hamilton Branch:—

Secretary-Treasurer, W. F. McLaren, M.E.I.C.

Feb. 14th. Address on "Asphalt".

Toronto Branch:—

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

Feb. 7th. Address on "The Transportation Situation in Toronto", by H. H. Couzens, general manager, Toronto Transportation Commission.

Feb. 14th. Three prize papers by winners of Toronto Branch competition for engineering students of the University of Toronto. Subjects and speakers will be announced later.

Feb. 21st. Illustrated address on "The St. Lawrence Deep Waterways Project, with special reference to the Ice Problem", by D. W. McLachlan, M.E.I.C., engineer in charge, St. Lawrence Ship Canal, Department of Railways and Canals, Canada.

Feb. 27th. Joint meeting with Ontario section A.S.M.E., addressed by C. F. Kettering, vice-president, chief engineer and head of the research division, General Motors Corporation of the United States on "Research and Automobile Development".

Halifax Branch:—

Secretary-Treasurer, K. L. Dawson, A.M.E.I.C.

Feb. 7th. Supper-meeting in Green Lantern, 6.15 p.m. to be addressed by F. A. Bowman, M.E.I.C., on "Depreciation as it Affects the Engineer".

Victoria Branch:—

Secretary-Treasurer, E. P. Girdwood, M.E.I.C.

Feb. 14th. Address on "Roads", by P. Philip, M.E.I.C., chief engineer, Public Works Department, Victoria, B.C.

Feb. 16th. Luncheon.

Mar. 12th. Address on "Johnson Street Bridge", by F. M. Preston, A.M.E.I.C., city engineer, Victoria, B.C.

Mar. 15th. Luncheon.

Mar. 26th. Address on "Moveable Bridges", by E. E. Brydone-Jack, M.E.I.C., supervising district engineer, Public Works Department, Canada, Victoria, B.C.

Current Wages in the Building Trades in Canadian Centres, October, 1923

Rates per hour, as reported to the Association of Canadian Building and Construction Industries, 44 Central Chambers, Elgin Street, Ottawa, Canada.

	Bricklayers	Masons	Marble and Tile Setters	Cement finishers	Stone Cutters	Plasterers	Carpenters	Lathers	Painters	Electricians	Sheet Metal Workers	Slate and Tile Roofers	Struct'l Steel Workers	Plumbers and Steamfitters	Hoisting Engineers	Hod Carriers	Laborers
Nova Scotia																	
HALIFAX	.90-1.00	.90-1.00	....	.75	.64	.90-1.00	.57	.57	.57	.60	.60	.57	.60	.60	.64	.35	.25–.35
New Brunswick																	
ST. JOHN	.90-1.10	.90-1.10	.80	.90-1.10	.80	.90-1.10	.50–.60	30c. per 100	.60–.75	.40–.60	.60	....	.60	.55–.75	.45	.30	.30
Quebec																	
MONTREAL	up to 1.00	up to 1.00	.70–.75	.65-.70	.75-1.00	.80-1.00	.50–.75	.50–.65	.45–.60	.65–.80	.48–.70	.55–.65	.60–.90	.65–.75	up to $30 per week	.40	.35
QUEBEC	.90-1.00	.75	.80	.50	.50	.70–.85	.45–.60	$3.00 per 1,000	.40–.65	.45–.55	.45–.55	.45–.55	.65	.45–.55	.45	.40	.35–.40
SHERBROOKE	.90-1.00	.60–.80	....	.45–.50	1.00	.60–.85	.45–.50	.45–.50	.40–.60	.50–.75	.50	....	....	.45–.75	.70	.35	.30
Ontario																	
BELLEVILLE	1.10	1.10	....	1.00	1.00	.80	.65	.65	.70	....	....	....	....	.90	.50	.40	.40
BRANTFORD	1.00	1.00	1.00	.50–.70	1.00	.90-1.00	.80	.80-1.00	.50–.65	.75	.50–.75	.50–.75	....	.60–.80	.50–.60	.45	.40
BROCKVILLE	.90	.90	....	.90	.90	.90	.75	.60	.65	.80	....	....	....	.80	....	.50	.35–.40
CHATHAM	1.00	1.00	....	1.00	1.00	1.00	.60–.70	....	.60	.60–.80	.60	.60	....	.60	....	.50	.40
GUELPH	$1–1.10	$1–1.10	....	.60	$1–1.10	$1–1.10	.80	.60	.60	.65	.65	....	....	.65–.75	....	.50	.40–.45
HAMILTON	1.00	1.00	1.00	.65	1.00	1.12½	.80	.75-.87½	.70	.75	.80	.80	.70	.85	.65–.75	.50	.40
KINGSTON	.85-1.00	.85-1.00	.85–.90	.85–.90	.75–.90	.85-1.00	.75	.75–.90	.65	.65–.70	.80–.85	.80	.80	.80–.85	....	.40	.35
LONDON	1.00	1.00	1.00	.65–.80	1.00	1.00	.60–.80	.85	.65	.75–.90	.75–.85	.50	....	.75-$1.00	....	.50–.60	.40–.45
NIAGARA FALLS	1.25	1.25	1.25	.60	1.25	1.25	.80–.90	.85	.75–.80	.80	.80	.80	....	.90	.75	.60	.50
OTTAWA	1.00	1.00	1.00	.50	.85	.85	.75	.75	.65–.80	.80	.75	.75	....	.80	.75	.45–.50	.45
PORT ARTHUR AND FORT WILLIAM	1.00	1.00	....	.60–.65	....	.90-1.00	.60–.70	Pc.Wk.	.60–.65	.65–.70	.70	....	.90	.85	.80–.85	.50	.40
ST. CATHARINES	1.00	1.00	....	....	....	1.00	.85	....	....	....	....	....	....	....	....	.50	.40–.50
ST. THOMAS	$1–1.10	$1–1.10	1.00	.55–.65	.85	.90-1.00	.55–.75	.85	.50–.60	.65–.75	.50–.65	.65–.70	.70–.80	.65	.75	.50	.40–.45
SARNIA	.95-1.00	.90-1.00	.90-1.00	.75–.85	.65–.70	.80-1.00	.60–.70	7c to 11c per yd.	.60–.70	.60–.95	.60	....	.50–.60	.65–.75	.50–.70	.50	.40–.50
STRATFORD	1.00	1.00	....	.55	1.00	1.00	.55–.65	.60	.50–.60	.60–.70	.60	.60	.50–.60	.50–.70	....	.50–.55	.30–.50
TORONTO	1.00	1.00	1.05	.70–.75	1.00	1.25	.90	$1-1.12½	.75	.80	.80	.75–.90	75–.85	.90	.85	.60–.75	.45–.55
WINDSOR (Border Cities)	1.15-1.25	1.15-1.25	1.37-1.40	.90-1.00	1.25	1.50	1.00	1.25	.85-1.15	1.00-1.25	.90-1.00	1.00-1.25	.90	$1-1.12½	.90-1.00	.60–.65	.50–.60
Manitoba																	
WINNIPEG	1.10	1.10	1.00-1.05	.70	.95-1.07½	1.07½	.85	.80	.75	77½c-85c	.80	....	.90	.90-1.00	.85-1.00	.50	.32½-.42½
Saskatchewan																	
MOOSE JAW	1.25-1.35	1.25	1.00	.75	1.25	1.25	.75	8c to 10c per yd.	.70–.80	.85	.85	....	....	.90	.70	.50	.40
REGINA	1.25	1.25	1.25	1.20	1.00	1.20	.75	7c to 9c per yd.	.75	.85	.80	....	....	.90	.75	....	.40–.50
SASKATOON	1.15	1.15	1.15	.55-1.00	1.00	1.10-1.15	.70–.75	6½c to 7c per yd.	.60–.75	.70	.70–.75	.70–.75	.72½	.90	.70-1.00	.50	.45–.50
Alberta																	
CALGARY	1.15	1.15	1.15	1.15	1.15	1.15	.80	.80	.70–.80	.90	.80–.90	....	....	.90-1.00	....	.50–.65	.35–.50
EDMONTON	1.10	1.10	1.10	.75-1.00	1.00	1.15	.75–.80	7c. yd.	.75–.80	.85	.85	....	.90	.90	.75-1.00	.45	.45
British Columbia																	
VANCOUVER	1.06¼	1.06¼	1.00	.75–.85	.75-1.06¼	1.06¼	.81¼	7c. yd.	.75	.90	1.00	....	1.12½	1.00	.85-1.00	.75	.45–.50
VICTORIA	1.00	1.00	1.00	.60	1.00	1.00	.62½	1.00	.62½	.87½	.80	1.00	1.12½	.80	.62½	.56¼	.50

CORRESPONDENCE

An Invitation from the Institution of Civil Engineers

Great George St., Westminster, S.W.I.,
December 21, 1923.

The Secretary,
The Engineering Institute of Canada,
My dear Sir,

I am desired by the Council to ask you to convey to those of your members who may be in London next Summer in connection with various functions that are then to take place, the very cordial invitation of this Institution to make use of its premises, and of any services which the Institution office may be able to render to them personally. It is intended to have a room set apart for our Engineering Visitors from Overseas in which they may be able to meet friends and conduct correspondence; and further, if it will be a convenience to them, the Institution will be pleased for them to use this postal address and will arrange to forward letters to individual members to any temporary addresses they may advise from time to time during their stay on this side.

Believe me to be, with kind regards,
Yours very faithfully,
H. H. JEFFCOTT, *Secretary.*

Work of Zirphaea Crispata

A rock-boring Bivale, Mollusc or Clam

Halifax, N.S., January, 9, 1924.

The Editor:—
The Engineering Journal.

Enclosed, I am sending you a photograph of a piece of rock, (an argillaceous limestone) showing the holes, presumably bored by Zirphaea Crispata, a rock-boring bivale, Mollusc or clam, found in the coastal waters of the Atlantic seaboard of the maritime provinces of Canada, and a few other localities.

The specimen shown was dredged near the west side of the harbour of Sydney, Cape Breton, Nova Scotia (N. lat. 46° 11′ 10″. W. lon. 60° 13′ 10″) from near the top (a few inches below the surface) of an approximately horizontal bed of rock about ten feet below low water of ordinary spring tides. It is 5½ by 3½ inches by about 1¼ inches thick and in it are nineteen complete or partial, holes which would indicate that at this particular place there was a large colony of the borers. In the specimen the holes taper from 5½ to 7½ tenths of inche in the thickness of 1¼ inche.

Evidence is not lacking that the borers, when very small, (⅜ of an inch and less) enter the rock for purposes of domicile, at the upper or smaller ends of the holes, taking their nourishment, like other Molluscs, from the sea water that constantly circulates through their bodies, and that they live and die in their bores, because by their growth they effectually cut off their retreat.

I attach hereto a copy of an extract from "The Economic Mollusca of Acadia." Also a copy of a report that I have just had from one of my assistant engineers, who with excellent powers and opportunities of observation, took an interest in the subject.

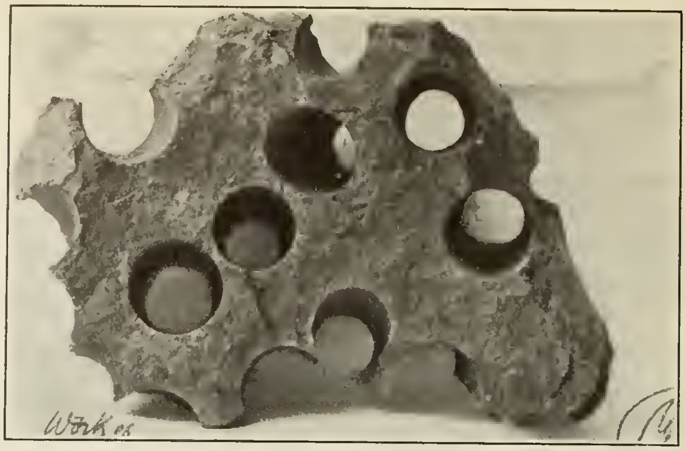
Yours truly,
C. E. W. DODWELL, Hon. M.E.I.C.,
Supervising District Engineer,
Maritime Provinces.
Department of Public Works.

ZIRPHAEA CRISPATA (Linn.) Mörch.
(Zirphaea,-(?); crispata, wrinkled.)
Date-fish.

Distribution. (a) General;—Shallow water to seventy fathoms. Connecticut to gulf of St. Lawrence. Iceland. northern Europe to Great Britain and France. West coast of America, south to California.

(b) *In Acadia:*—(In N.B.) Grand Manan, very rare, Stimpson. Bay of Fundy, eight to seventy fathoms, in hard clay, Verrill. L'Etang Harbour. (in N.S.) Sable Island, large specimens, Jones (On authority of Willis). Prince Edward Island, boring in red sandstone reefs. Dawson. Probably to be found in suitable localities all around our coast.

Habits. This is a well-marked shell and not like any other yet found on our coast. It is a bivalve, each valve of which is somewhat like that of the clam. Across the middle runs a furrow, in front of which the lines of growth rise in regular teeth, which are entirely wanting behind that line. The shell gapes very widely open both before and behind, and the dorsal margin in front of the furrow is folded over outwards. It does not exceed four inches in length in our waters, but grows much larger to the south and on the west coast. It is a burrowing Mollusc, and lives in hard clay, soft stone or even submerged wood.



Specimen of rock showing holes bored by Zirphaea Crispata, found in Sydney Harbour, N.S.

Economics. On the coast of California this species is extensively eaten. It is, however, much larger than with us, and is regularly exposed in the markets under the name of "Date-fish." It is not abundant enough in Acadia to be of any value. It appears to do no injury in its burrowing, to any of man's works.

Notes from "The Economic Mollusca of Acadia." by W. F. Ganong. reprinted from Bulletin No. VIII. of the Natural History Society of New Brunswick.

See Also, "Report of the Invertebrata of Massachusetts, published agreeably to "an order of the Legislature, Second Edition, comprising the Mollusca, by Augustus "A. Gould, M.D. Edited by W. G. Binney, Boston, Wright and Potter, State "Printers, 79 Milk Street, (corner of Federal Street). 1870."

Rural Road Construction in Ontario

Toronto, October 26th, 1923.

The Editor,
The Engineering Journal.

If, in the province of Ontario, we are going to spend millions in an endeavour to eliminate heavy yearly maintenance charges on our main lanes of traffic we must spend it in a type of paving that will support a rapidly increasing motor traffic and will wear sufficiently long to warrant the outlay.

Numerous types of roads have been constructed: gravel, macadam, tar penetrated, concrete and the asphaltic top; the latter sometimes on a resilent base, (water bound macadam), and sometimes on a rigid base of six or eight inches of concrete.

In the case of the first three types, no doubt, at the time they were laid down it was felt that they would be economical, but with the rapidly increasing tonnage moving over them it is found that they are anything but economical, taking into consideration their initial cost and excessive maintenance. The gravel road I have in mind is about seventy miles from Toronto. It was constructed two seasons since and next year, if continued as a gravel road, will require re-gravelling. This will cost in the neighbourhood of twenty-five hundred dollars per mile. Of course in the case of a new road it is advisable to treat the surface first for a season with some kind of material before laying on the permanent top.

The tar penetrated road, I have thought of, is a portion about thirty miles from Toronto which was laid on a good wide macadam road some five years since, at a cost, I have heard, of some seventeen thousand dollars per mile, but it has, with the increased traffic gone to pieces in several places. This was however caused in a great measure by the road having no side ditches and was consequently undermined by moisture and frost action.

Macadam roads have been found to go to pieces very quickly, after first being broken into, on our main travelled roads, on account of fast and heavy motor vehicular traffic, aggravated by the use of chains, especially the large ones on heavy trucks. Macadam on roads should only be used as a base course for permanent pavement. Macadam, unlike good road gravel cannot be dragged or economically surfaced.

In the exposed concrete road that has been laid down in this country we have the greatest problem and greatest loss in the event of failure, and we have had many cases of partial and a few of total failure in this type of permanent roadway. A pavement of this nature, to be permanent must be waterproof, free from cracks and contain few expansion joints, as, if not waterproof, severe and uneven frost action sets up underneath, that under very severe frost and at the same time vibration from heavy travel the pavement soon cracks in various directions and these cracks letting through the moisture, though filled yearly and sometimes two or three times per year, (creating a heavy maintenance charge), gradually widen and eventually the paving has to be replaced.

Up to about fifteen years ago it seemed desirable to lay steel on railways with a slightly open joint to admit of expansion. However, I have seen a distance of ten miles laid up tight with the eighty-five pound section of rail and it gave no trouble from the time it was laid, and I have also laid down for a continuous distance of two miles a concrete base for a roadway, six inches thick and twenty feet wide without any expansion joints. This was filled in to flush with the curb with an asphaltic blanket two an a half inches thick. Of course the asphalt is to a great extent a non-conductor of frost and acts to a great extent as a medium in minimizing the effect on the concrete of sudden changes of temperature, especially in the early or late winter. This road, although carrying heavy traffic is one of the best in Ontario to-day. This method of construction is, I think, being followed on all roads of this type under construction at the present time.

However none of the before mentioned types of roads will stand up unless the bed of the road is thoroughly drained and the water taken clear of the side ditches by means [of offtake drains. Thus, in the case of porous roads, such as macadam or gravel where the evaporation through them is considerable continually drawing any moisture in the bed to the surface, if the water is drained away from the side ditches, even in wet weather there will be a hard bottom but this will entirely disappear in wet weather if water is allowed to stand in the side ditches in dry weather.

In the case of a permanent waterproof pavement, where this evaporation is checked, if the bed is thoroughly drained and the side ditches put down deep enough there will gradually be created a strata of dry material under the pavement that will not take the frost, will add to the strength of the pavement and greatly eliminate vibration.

In the roadbed that is wet and springy it has been and is the custom to underdrain with agricultural tile. This is rarely efficatious unless laid deep, (too deep to function properly), as the road rollers when going over it when rolling out the base of the road, crack the tile and, under the vibration from traffic it falls to pieces thus creating voids under the pavement. The better methods is, I find, to trench through the road base about ten inches wide and from eighteen inches to two feet deep with a grade of not less than two tenths in ten feet carried out to the side ditches, and the trench so made filled with four-inch crushed rock and rolled along with the road base. This enables any water forming in the roadbed to find its way to the side ditches and also allows a circulation of air which will *eventually dry out the road base.*

There is some doubt in my mind, irrespective of costs, as to the relative merits of the resilent or rigid base for asphaltic pavements. On a level or nearly level roadbed the resilent base, used by not too heavy trucks and cars, will apparently roll to a very smooth surface, whereas, if a roll appears on the surface over a rigid base it generally remains there. There are streets in the city of Toronto where the asphaltic surface has been laid on a resilent base that have been in service for as long as fifteen years with practically no maintenance expense. No doubt the rigid base is necessary in undulating country, however the drainage must be perfect.

A well drained road is always a good road and no matter how much money is spent on a road, if it is not properly drained and the water given exit from the side ditches it cannot last without continual repairing and renewals.

F. S. Drummond, A.M.E.I.C.

Appraisal Report Recently Issued

The report of the appraisal of the Union National Gas Company which was prepared by a committee including R. B. Harkness, A.M.E.I.C., Natural Gas Commissioner of the Province of Ontario, and R. O. Wynne-Roberts, M.E.I.C., consulting engineer, of Toronto, has been recently issued by the Department of Mines of the Province of Ontario and has been presented to *The Institute* Library by Mr. Wynne-Roberts.

Recent Visitors to Headquarters.

R. H. Wood, M.E.I.C., Halifax, N.S., A. J. M. Bowman, A.M.E.I.C., Windsor, Ont., R. B. Young, M.E.I.C., Toronto, Ont., J. P. Hodgson, M.E.I.C., Vancouver, B.C., J. P. Forde, M.E.I.C., Victoria, B.C., A. F. Dyer, A.M.E.I.C., Halifax, N.S., H. H. Donnelly, A.M.E.I.C., St. Vincent de Paul, Que., C. E. W. Dodwell, Hon.M.E.I.C., Halifax, N.S., Frank P. Vaughan, M.E.I.C., St. John, N.B., Wm. Smaill, M.E.I.C., Vancouver, B.C., L. B. Copeland, A.M.E.I.C., Rouses Point, N.Y., R. W. Leonard, M.E.I.C., St. Catharines, Ont., Geoffrey Stead, M.E.I.C., St. John, N.B.

Formal Opening of the New Aerodynamic Laboratory of the University of Toronto

The new aerodynamic laboratory in the Department of Mechanical Engineering of the University of Toronto, Toronto, Canada, is to be formally opened on Friday February eight, at 4.00 p.m. Major General J. H. MacBrien, C.B., C.M.G., D.S.O., chief of staff, Department of National Defence, and Brigadier General C. H. Mitchell, C. B., C.M.G., D.S.O., C.E., LL.D., M.E.I.C., D.Eng., dean of the Faculty of Applied Science. of the University, will officiate. The opening of this excellent building, which will now house the wind channel, will permit research in aerodynamics and allied subjects the whole year round instead of during the summer months only. The channel which was fromerly housed in the hydraulic laboratory, has been altered, and now permits speeds up to ninety feet per second in the working section. This is the only equipment of its kind in Canada, and is frequently made use of by the Royal Canadian Air Force to provide data on proposed designs which could not be obtained in any other way, and by manufacturers for various test work.

1924 Marks Centennial of Cement Industry

Old records on file in the British patent office show that in 1824, just one hundred years ago, an English bricklayer named Joseph Aspdin was awarded a patent for a material he called "Portland cement". At that time a number of men were engaged in experiments in an effort to produce a cement superior to the natural cements then in use. As far back as 1756 an English contractor named John Smeaton had discovered that an impure limestone containing a certain amount of clayey matter possessed decided hydraulic properties when burned. Aspdin's contribution was his discovery of the value of taking proper proportions of different ingredients and then pulverizing and thoroughly mixing them before they were burned into clinker, which later was finely ground. He called his material "Portland" cement because when it hardened it resembled a building stone quarried on the Isle of Portland.

Although Aspdin's invention was brought out in 1824, it was not until 1872 that the Portland cement industry started on this side of the Atlantic. Of course natural cements had been in use for years, and in the late sixties imported portland cement was gaining a strong foothold in the American markets. In 1872 David O. Saylor established a plant for the manufacture of Portland cement at Coplay, Pennsylvania and so far as can be ascertained this is the first plant of its kind to be started in this hemisphere.

Many interesting stories are told in connection with the early efforts to produce portland cement. One man used a cookstove in which to burn rock while conducting his experiments. Another used a piece of sewer pipe as a kiln, and ground his materials in a coffee mill. Still another pressed a bent car-axle into service as a part of a grinding machine. For a number of years the reputation of imported cements was so strong that American manufacturers had a difficult time in securing a market for their product. It was not until the late nineties that the home product took its place on an equal footing with imported cement, and eventually won the market. To-day, there are more than a score of Canadian plants distributing their products from Nova Scotia to British Columbia.

The great development of the industry has necessitated the revolutionizing of methods of manufacture. Where the early pioneers used crude dome-like kilns for burning their raw materials a modern plant contains huge rotary kilns—steel brick-lined cylinders that may weigh as much as eight Pullman cars each. One of these great modern kilns will produce as much clinker in a day as one of the old kilns could turn out in a year. The old fashioned grinding machinery has been supplanted by a variety of crushers and centrifugal, hammer and ball mills, in which the raw materials and clinker are reduced to a powder finer than flour.

The centennial of the invention of Portland cement is an important date in industrial history, and as such will be fittingly observed by various organizations in the building field.

Association of Canadian Building and Construction Industries

Joseph M. Pigott, Hamilton, was re-elected president of the Association of Canadian Building and Construction Industries at the final general session of the sixth annual convention of that organization at Windsor, Ont., on January 26th, 1924.

Montreal was chosen as the place for the seventh annual convention of the association. Other officers elected for 1924 were: Eastern vice-president, K. D. Church, Montreal; western vice-president, Wm. Wilson, Regina; honorary secretary, E. G. Brosseau, Quebec; honorary treasurer, Fred. B. McFarren, Toronto; representative from general contractors' section, Samuel E. Dinsmore, Windsor; representative from trade contractors' section, R. J. Fitzsimmons, Hamilton; representative from manufacturing and supply section, Harry J. Mero, Walkerville.

OTHER SOCIETIES NEWS

Golden Jubilee of l'Ecole Polytechnique

Graduates of l'Ecole Polytechnique, old and young, including three who were members of the first class to leave the halls of that institution in 1877, besides a large contingent of undergraduates, and their friends and mentors in civil and religious life, gathered on Friday and Saturday, January 25th and 26th, to commemorate the fiftieth anniversary of the foundation of their Alma Mater. The celebration, which lasted for two days, and provided every means for a real reunion, commenced on Friday at 4 p.m. with the annual meeting of the Old Students' Association followed at seven o'clock by an informal dinner at Cercle Universitaire, the day's programme concluding with a concert. On Saturday the programme included Requiem Mass at nine o'clock in the morning, a visit to the school work shops at ten o'clock, lunch at the Cercle Universitaire at one o'clock, a reception at the school and a visit to the laboratories at three o'clock and a banquet in the Windsor Hotel, commencing at 7.30 p.m.

At the banquet the guest of honour was the lieutenant-governor of the province, the Hon. Narcisse Perodeau, while among others who addressed the gathering were the Hon. J. L. Perron, Senator Dandurand, Mgr. Piette, rector of the University of Montreal, and Mgr. Gariepy, rector of Laval University, Quebec.

Those of the class of '77, present at the banquet were. Emile Vanier, A.M.E.I.C., Gustave Papineau, A.M.E.I.C., and L. S. Pariseau, A.M.E.I.C.

A. Boyer, A.M.E.I.C., principal of the school, presided, introducing the speakers.

The toast to the Dominion, which followed the toast to the King, was answered by Senator Dandurand.

Walter J. Francis, M.E.I.C., president of *The Engineering Institute of Canada*, replying to the toast to the engineering profession, brought the greetings of *The Institute*, and also its congratulations to the school on having attained its fiftieth anniversary.

He paid a glowing tribute to the success of graduates of the Polytechnique, and said that they had taken an outstanding part in the up-building of *The Institute*, which now had a membership of well over 5,000, throughout the Dominion.

Dr. Frank D. Adams, Hon.M.E.I.C., dean of the faculty of science, at McGill University, responded to the toast to the sister faculties, speaking in French and English.

Dean Adams was long applauded, and at the conclusion of his address, Mgr. Piette asked the guests to drink a toast to the bonne entente which exists between McGill and the University of Montreal. The McGill yell was then given.

Canadian Pulp and Paper Association Hold Annual Meeting

The Annual Convention of the Canadian Pulp and Paper Association was held at the Ritz-Carlton Hotel in Montreal, Wednesday, Thursday, and Friday, January 23rd, 24th and 25th, 1924. The programme included many interesting addresses at the luncheons and annual dinner in addition to the special papers before the sections of the association.

The technical section opened its meetings on Wednesday, and among the papers presented and discussed were: — "Pulp Testing", by C. V. S. Hawkings, chief chemist for Price Bros. and Company, Ltd., Kenogami, Que.; "The Use of Canadian Talc in Papermaking," by William C. Lodge of the Forest Products Laboratories, Montreal; "Ball and Roller Bearings as Applied to Paper Machines," by R. H. DeMott, manager pulp and paper division SKF Company, Montreal; "Recent Developments in the Use of Canadian Fuels," by B. F. C. Haanel, M.E.I.C., chief division of fuels and fuel testing, Mines Branch, Department of Mines, Ottawa; "Felts and the Mechanism of Water-Removal," by Dr. E. A. Rees, director of research, F. C. Huyck and Sons, Albany, N.Y., and Arnprior, Ont.; "The Effect of the Rate of Growth on the density of the Wood and Fibre Characteristics," by J. D. Hale, Division of Timber Physics, Forest Products Laboratories, Montreal; "Improved Floors for Paper Mills," by Charles A. Mullen, M.E.I.C., of the Milton Hersey Company, Montreal.

At the luncheon on Thursday, January 24th, which was addressed by Sir William Price, George Mead, George Chahoon, Dr. Hugh P. Baker, W. G. MacNaughton, A.M.E.I.C., and Ellwood Wilson, M.E.I.C., the speakers emphasized the importance of co-operation between the practical and technical men in the pulp and paper industry and more than one speaker emphasized the necessity of having men of technical training at the head of our industries.

A joint meeting of the technical and woodlands sections was held on Thursday afternoon at which the principal topic of discussion was "Treatment of Decayed Wood In and Outside the Mill".

The Luncheon on Friday was addressed by the Hon. James Lyons, Minister of Mines and Forests for Ontario.

The annual business meeting took place on Friday morning when George Carruthers, president of the Interlake Tissue Mills, Limited, Toronto, and vice-president of the Association was elected president for 1924. At this meeting, H. F. E. Kent, retiring president of the association, presented his report. The reports of the various sections of the association were also presented, including among others, those of O. F. Bryant, chairman of the technical section, and Ellwood Wilson, M.E.I.C., for the woodlands' section.

The annual meeting closed with a banquet at the Ritz-Carlton Hotel at which the principal speaker was the Hon. Thomas A. Low, Minister of trade and commerce. In the course of his speech, which was a remarkable review of the history and development of the pulp and paper industry in Canada, the minister quoted statistics of production which would lead to the prediction that Canada will soon take her place as the greatest newsprint producer in the world.

Association of Professional Engineers of the Province of British Columbia

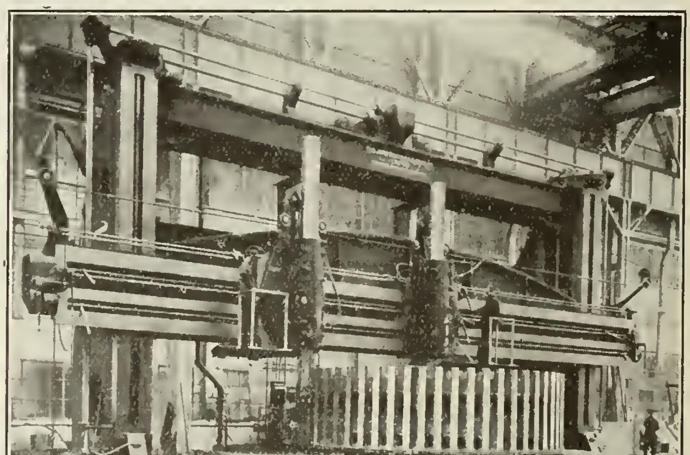
The fourth annual meeting of the Association of Professional Engineers of the Province of British Columbia, was held on December first, nineteen hundred and twenty-three, and on that occasion E. E. Brydone-Jack, M.E.I.C., was appointed president, Patrick Philip, M.E.I.C., vice-president, and A. G. Langley, H. Rindal, M.E.I.C., G. S. Eldridge, and Frank Sawford, were appointed members of Council. In accordance with the constitution, A. E. Foreman, M.E.I.C., as last past-president, automatically becomes a member of the 1924 council.

Subsequently, the Lieut.-Governor-in-Council appointed the following to the executive council of the association for the year 1924:— James Muirhead, M.E.I.C., electrical; E. G. Matheson, M.E.I.C., civil; Thos. Graham, mining; F. W. Guernsey, mining.

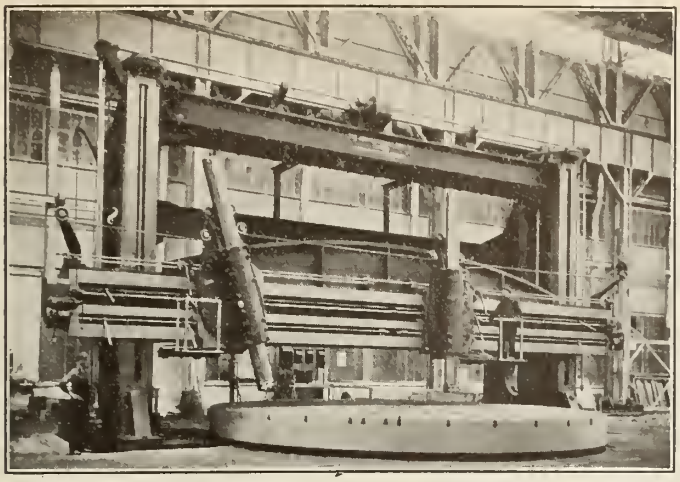
On January 23rd, Professor W. L. Uglow, of the University of British Columbia, was appointed to the executive council of the association for the year 1924, in place of Thos. Graham, who had resigned.

Canadian Section American Waterworks Association

The annual convention of the Canadian Section of the American Waterworks Association will be held at the Royal Connaught hotel, Hamilton, on Wednesday, Thursday and Friday, February 27th, 28th, and 29th.



Bertram's Giant boring mill in operation.



Bertram's 36-foot boring and turning mill completed.

Large Boring Mill for Electric Generator Manufacture

John Bertram and Sons, Dundas, have just completed and shipped to the Canadian Westinghouse Company, a boring mill having an 28-foot table and capable of swinging work 36 feet in diameter and 12 feet high. The cross rail is 47 feet long, weighs about 80 tons and requires a 30-h.p. motor to raise it.

The revolving table weighs about 100 tons and is driven by a 60-h.p. motor, while 10 h.p. is required to operate the rapid traverse for the heads and bars. Control of the mammoth machine will be in the hands of two men who will ride on the platforms attached to the tool saddles.

The mill will be used on the large hydro-electric generators now being built for the Quebec Development Company and the St. Maurice Power Company.

Building Construction

The Insurance Institute of America has issued an interesting pamphlet on building construction, which has been prepared by a sub-committee of the Educational Committee of that Institute. This is the second edition of the pamphlet and may be secured at a nominal fee from The Insurance Institute of America, 110 William Street, New York City.

Progress on the Grande Decharge Power Development

Late in December, 1922, the Quebec Development Company decided to commence construction of the Isle Maligne hydro-electric development on the Saguenay river, near St. Joseph D'Alma, province of Quebec, Canada, and began at once assembling materials and forces for the preliminary work. Owing to the holidays the first start of actual work was delayed until January 8th, 1923.

The Isle Maligne development is designed for a power house of 480,000 horse power installation in the left channel of the Grande Decharge at Isle Maligne, three spillways along the crest of the island, a spillway in the left channel of the Grande Decharge at Isle Maligne, an earth dam across a ravine or old channel opposite Isle Maligne and three spillways in the same number of channels of the Petite Decharge.

The first work to be done was the building of a coffer dam across the left channel of the Grande Decharge at the head of Isle Maligne, for the purpose of unwatering the power house site, and the building of an eleven mile railway from Hebertville, on the Canadian National Railway, to the power house site, for the purpose of bringing in equipment, material, etc. Both of these pieces of work were started on January 8th, 1923.

Along the line of the railway trestles were erected over all the gulches and concrete piers and abutments built at all the steel bridge sites between January 8th, and April 1st, 1923. The last of these bridges was that over the right channel of the Grande Decharge. This bridge is also the largest and of the most interest.

Bridge over Right Channel of Grande Decharge

At the point of crossing, the channel is narrow and the entire crossing is effected with two ninety-foot approach spans and a channel span of two hundred and twenty feet.

The spans are double track bridges, with trusses 31 feet 6 inches apart centres; they are proportioned for E-40 loading under the specifications, recently adopted, of the Canadian Engineering Standards Association. On each side of the bridge there is a walkway two feet six inches in the clear.

The weight of the main span is 955,000 lbs., of which less than ten tons is added to take care of the erection stresses. The flanking span, which is used as a simple span, weighs 268,000 lbs., while the span from which the long span is cantilevered, weighs 333,000 lbs.

Work on the 220-foot span started on Sunday, September 15th, and the bent was not completed until the 16th. This was due chiefly to the difficulties of landing it properly and securing it in place, against the rush of waters coming just over the sill of the bent. The first steel in the main span was placed on the 17th of September and the span was landed on Sunday, October 14th. At this time practically all the riveting was completed, the exceptions being a few rivets in the connections of the interior floor beam next to the far end and of the stringers in the end panel.

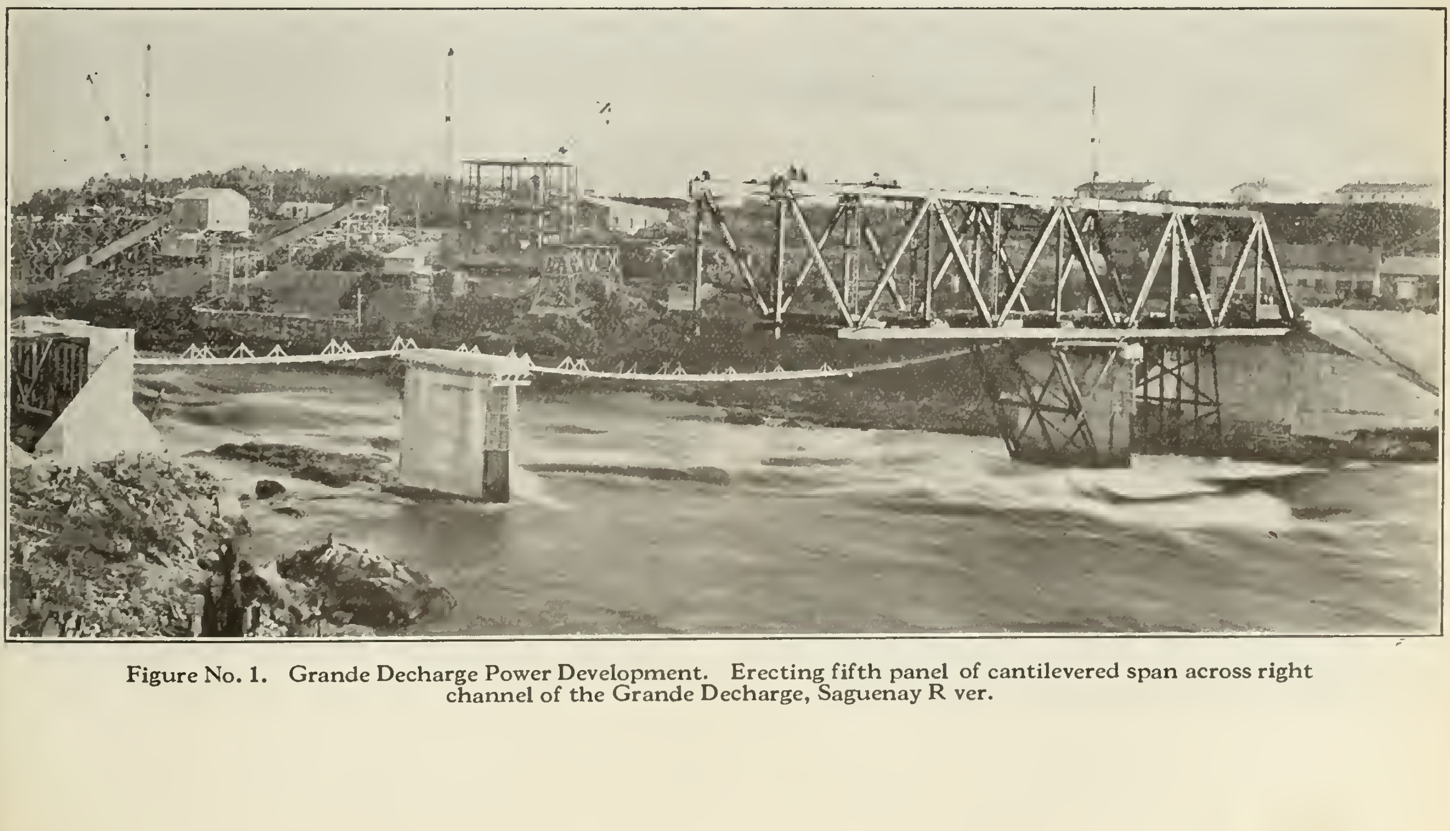


Figure No. 1. Grande Decharge Power Development. Erecting fifth panel of cantilevered span across right channel of the Grande Decharge, Saguenay R ver.

RECENT PUBLICATIONS RECEIVED

Transactions, Proceedings, Etc.

Presented by the Societies:

Proceedings Tenth Annual Convention, Canadian Good Roads Association, June 1923.
Proceedings, The New Zealand Society of Civil Engineers 1922-1923, Volume No. IX.
The Royal Engineers Journal, Volume XXXVII, No. 4. December, 1923.
75th Anniversary of the Society of Civil Engineers of France, 1848-1923. Bulletin of June 1923.
Proceedings of the Society of Civil Engineers of France, Bulletin of July-September 1923.
Proceedings of the Twenty-Sixth Annual Meeting of the American Society for Testing Materials, Volume 23, Parts 1 and 2. June 26-29, 1923.
Transactions of the Institution of Mining and Metallurgy, Thirty-First Session, 1921-1922, Volume XXXI.
The Institution of Mechanical Engineers, List of Members, May 1st, 1923.

Reports and General Publications.

Presented by Dominion Water Power Branch, Department of the Interior, Canada.

Atlantic Drainage (South of St. Lawrence River), New Brunswick, Nova Scotia, Prince Edward Island. Climatic Years 1920-21 and 1921-22. Water Resources Paper No. 37.
Pacific Drainage, British Columbia and Yukon Territory. Climatic year 1921-22. Water Resources Paper No. 39.

Presented by Department of Mines, Canada.

Report of the Department of Mines for the fiscal year ending March 31st, 1923.

Presented by Department of Mines, Province of Ontario.

Appraisal of plant and property of the Union Natural Gas Company of Canada, Limited.

Presented by North West Territories and Yukon Branch, Department of the Interior.

Canada's Arctic Islands, Log of Canadian Expedition, 1922.

Presented by Geological Survey, Department of Mines, Canada.

Geology of Fraser River Delta Map-area, by W. A. Johnston. Memoir 135.

Presented by Purdue University, Lafayette, Indiana.

Bulletin of Purdue University, July 1923, No. 7. "Emergency Braking on Electric Cars", by D. D. Ewing.

Presented by Bureau of Mines, Department of the Interior, Washington.

Recovery of Gasoline from Uncondensed Still Vapors. Uses of Water in the Oil-Shale Industry with particular reference to engineering requirements with a chapter on The Sanitation of Oil-Shale Camps.
Analyses of Ohio Coals.
Production and Briquetting of Carbonized Lignite.

Presented by Geological Survey, Department of the Interior, U.S.

Forty-Fourth Annual Report of the Director of the United States Geological Survey to the Secretary of the Interior, for the fiscal year ended June 30th, 1923.
Surface Water Supply of the United States, 1919 and 1920. Part II South Atlantic Slope and Eastern Gulf of Mexico Basins. Water-Supply Paper 502.
Surface Water Supply of the United States, 1921, Part IV, St. Lawrence River Basin. Water-Supply Paper 524.
Surface Water Supply of the United States, 1921, Part VIII. Western Gulf of Mexico Basins. Water-Supply Paper 528.
Surface Water Supply of the United States, 1919 and 1920. Part V. Hudson Bay and Upper Mississippi River Basins. Water-Supply Paper 505.
Variation in Annual Run-off in the Rocky Mountain Region, Water-Supply Paper 520-A.
Geology of the Tullock Creek Coal field, Rosebud and Big Horn Counties, Montana. Bulletin 749.
Reports for 1922 on lime; gold, silver, copper, and lead in South Dakota and Wyoming; mica; slate; silica; barytes and barium products; secondary metals; sulphur and pyrites; abrasive materials; sand and gravel; mineral waters; gold, silver, copper, lead and zinc in New Mexico and Texas; gold, silver, copper, lead and zinc in Idaho and Washington.
Pedestal Rocks in the Arid Southwest. Bulletin 760-A.

Plane Trigonometry

By Paul R. Rider, Ph., and Alfred Davies, M.A.

Reviewed by G. J. Dodd, M.Sc., A.M.E.I.C.,
Lecturer in Mathematics and C.E. McGill University, Montreal.

The authors have set out to give to secondary and technical schools and colleges a suitable textbook in plane trigonometry and they certainly have accomplished their purpose. They have developed the subject very fully from the beginning and have finished it with an interesting chapter on analytic trigonometry. The book should prove very useful to engineering students and is recommended especially to students studying the subject with very little outside help.

The use of the subject to surveying, mechanics and the solution of equations is brought out by the help of numerous examples. The subject of logarithms is rightfully stressed and their use, and calculation from the exponential series, are given. There are also portraits of men, such as Euler and Napier, with short biographies of historical interest, showing their connection in the development of this important mathematical subject.

The book is published by D. Van Nostrand and Company, New York.

Elementary Surveying

By Breed and Hosmer.

Reviewed by D. H. Nelles, M.E.I.C.,
Supervisor of Topography, Geodetic Survey of Canada, Ottawa, Ont.

This treatise on the principles and practice of surveying was first issued by John Wiley & Sons, in 1906. Since then five additions have been printed, making a total of 72,000 copies. The present edition is bound in a soft red leather cover, five by seven and a half inches, small enough to go comfortably into a coat pocket. The type is large and widely spaced so as to be easily read. Part 1 covers the use, adjustments and care of instruments in an easily understood and comprehensive manner. Part 2 deals with surveying methods, part 3 with computations, part 4 with plotting and part 5 comprises a very complete list of mathematical tables.

In the present edition Chapter VIII on Observations for Meridian and Latitude, Chapter X on City Surveying and Chapter XIV on Calculations of Traverses have been completely revised. In Chapter VIII the tables and methods for observing Polaris have been improved. Chapter X has been entirely re-arranged, the principles of City Planning have been re-written, and several common city surveying problems have been added. The subject matter is arranged in an orderly manner and covers the ground thoroughly, while the large type, and the phraseology which gives it a personal touch makes it easy and interesting to read. The student of engineering will find it a valuable addition to his library.

The book is published by John Wiley & Sons, Incorporated.

Petroleum Resources of the World

By Valentin R. Garfias.

Reviewed by F. C. Mechin, A.M.E.I.C.,
Superintendent, Imperial Oil Refineries, Limited, Montreal, Que.

With the increasing demand for petroleum and its products the question of future supply is of vital importance. The time at which the producing fields may become exhausted and the potentialities of the prospective fields is the subject of considerable current literature. This book is devoted to the geographical distribution of petroleum throughout the world. It contains short historical records and physical descriptions of producing fields, a survey of the promising prospective fields, and a review of the salient facts of interest in regard to the petroleum producing countries with criticisms on their petroleum laws. The author concisely but yet thoroughly reviews all the petroleum resources of the world and concludes that there need be no alarm as to the future supply of petroleum for some time to come.

The work is well presented and includes several maps and statistical tables of interest. It should hold considerable information for those interested in the petroleum industry.

The book is published by John Wiley & Sons, Incorporated, New York, U.S.A.

Preliminary Notice

of Applications for Admission and for Transfer

January 17th, 1924.

The By-laws now provide that the Council of the Institute shall approve, classify and elect candidates to membership and transfer from one grade of membership to a higher.

It is also provided that there shall be issued to all corporate members a list of the new applicants for admission and for transfer, containing a concise statement of the record of each applicant and the names of his references.

In order that the Council may determine justly the eligibility of each candidate, every member is asked to read carefully the list submitted herewith and to report promptly to the Secretary any facts which may affect the classification and election of any of the candidates. In cases where the professional career of an applicant is known to any member, such member is specially invited to make a definite recommendation as to the proper classification of the candidate.*

If to your knowledge facts exist which are derogatory to the personal reputation of any applicant, should be promptly communicated.

Communications relating to applicants are considered by the Council as strictly confidential.

The Council will consider the applications herein described in February, 1924.

FRASER S. KEITH, Secretary.

*The professional requirements are as follows:—

A Member shall be at least thirty-five years of age, and shall have been engaged in some branch of engineering for at least twelve years, which period may include apprenticeship or pupilage in a qualified engineer's office, or a term of instruction in a school of engineering recognized by the council. The term of twelve years may, at the discretion of the council, be reduced to ten years in the case of a candidate for election who has graduated from a school of engineering recognized by the council. In every case the candidate shall have held a position in which he had responsible charge for at least five years as an engineer qualified to design, direct or report on engineering projects. The occupancy of a chair as a professor in a faculty of applied science or engineering, after the candidate has attained the age of thirty years, shall be considered as responsible charge.

An Associate Member shall be at least twenty-seven years of age, and shall have been engaged in some branch of engineering for at least six years, which period may include apprenticeship or pupilage in a qualified engineer's office or a term of instruction in a school of engineering recognized by the council. In every case a candidate for election shall have held a position of professional responsibility, in charge of work as principal or assistant, for at least two years. The occupancy of a chair as an assistant professor or associate professor in a faculty of applied science of engineering, after the candidate has attained the age of twenty-seven years, shall be considered as professional responsibility.

Every candidate who has not graduated from a school of engineering recognized by the council, shall be required to pass an examination before a board of examiners appointed by the council. The candidate shall be examined on the theory and practice of engineering with special reference to the branch of engineering in which he has been engaged. This examination may be waived at the discretion of the council if the candidate has held a position of professional responsibility for five or more years.

A Junior shall be at least twenty-one years of age, and shall have been engaged in some branch of engineering for at least four years. This period may be reduced to one year, at the discretion of the council, if the candidate for election has graduated from a school of engineering recognized by the council. He shall not remain in the class of Junior after he has attained the age of thirty-three years.

Every candidate who has not graduated from a school of engineering recognized by the council, or has not passed the examinations of the first year in such a course, shall be required to pass an examination in the following subjects: geography, history (that of Canada in particular), arithmetic, geometry, euclid (books I, IV and VI), trigonometry, algebra up to and including quadratic equations.

A Student shall be at least seventeen years of age, and shall present a certificate of having passed successfully an examination equivalent to the final examination of a high school or the matriculation of an arts or science course. He shall either be pursuing a course of instruction in a school of engineering recognized by the council, in which case he shall not remain in the class of student for more than two years after graduation; or he shall be receiving a practical training in the profession, in which case he shall pass an examination equal to that prescribed for admission to the grade of Junior in the foregoing section and he shall not remain in the class of Student after he has attained the age of twenty-seven years.

An Affiliate shall be one who is not an engineer by profession but whose pursuits, scientific attainments or practical experience, qualify him to co-operate with engineers in the advancement of professional knowledge.

The fact that candidates give the names of certain member as references does not necessarily mean that their applications are endorsed by such members.

FOR ADMISSION

BOYLE—ROBERT WILLIAM, of Edmonton, Alta. Born at Carbonear, Nfld., Oct. 2nd. 1883; Educ., B.Sc. McGill Univ. 1905. M.Sc. (for research in physics) 1906. Ph.D. 1909. 1851 Exhibition Research Scholarship, Manchester Univ., England, 1909-11; 1912, asst. professor of physics, McGill Univ.; 1912, professor of physics, Univ. of Alberta; 1916-19, in charge of experimental work, and later consultant on equipment of ships with "Asdies" for the Admiralty Board of Inventions and Research and Admiralty Anti-Submarine Divisions; Fall 1919 resumed professorship of physics and of electrical engineering, University of Alberta. Oct. 1921 appointed dean of faculty of applied science, Univ. of Alberta, Edmonton, Alta.

References: F. S. Keith, L. A. Herdt, E. P. Fetherstonhaugh, W. J. Dick, H. M. MacKay, E. Stansfield, R. S. L. Wilson.

CONNELL—CHARLES, of Ottawa, Ont. Born at Cork, Ireland, Dec. 14th, 1880; Educ., Kelvin Tech. Sch. Dublin and tech. instruction Canadian National Railway; 1899-1904, served aptice'ship with the Great Southern and Western Rly. of Ireland at the Inchicove Locomotive Works, Dublin; then appointed outdoor asst. to the running supt. in chge. of runs. tests and reports re train wrecks, etc.; 1909, in charge of the motive power dept. at Tuam Co., Galway; 1912-14, in charge of the Kerry dist.; 1914, joined the G.T.R. in charge of the tech. instrn. for motive power apprentices at evening engrg. classes at Belleville, Ont.; 1915, transferred to Ottawa and took over the work of tech. instrn. in mechanics and dfting. for the apprentices there; For last six years have been dfting. instr. at the Ottawa Tech. Sch. eveng. classes and also tech. instructor for C.N. Rly.

References: G. A. Mountain, H. Etches, M. S. Blaiklock, A. B. Lambe, P. Sherrin, W. J. Peaker.

FORREST—EDWARD BRYDGES, of 18 Melrose Avenue, Montreal, Que. Born at Montreal, Nov. 30th, 1885; Educ., civil engrg. course, Amer. Sch. Corr.; 1902, rodman, Portland and Rumford Falls Rld.; 1903-06, dftsman. and instr'man., C.P.R.; 1906-08, dftsman and asst. Jos. Rielle, P.L.S.; 1908-15, with Nat. Transcon. Rly. as follows: 1908-10, dftsman., 1910-13, chief dftsman., mech. dept., 1913-15, engr. in charge of erection of St. Malo locomotive and car shops; 1915-18, production engr., shell components, Imperial Munitions Board; 1918-21, sec. treas., Sheffield Engineering and Supplies Ltd.; Two years to date, tech. service dept., public works, City of Montreal.

References: G. Grant, A. Ferguson, G. R. MacLeod, S. Howard, H. R. Lordly, L. Laferme, J. G. Caron.

FURLONG—HENRY WALTER, of 24 Winthrop Ave., Wollaston, Mass. Born at Guildford, England, June 16th, 1888;Educ., B. Sc. Univ. of London, England, 1908; Assoc. City and Guilds Inst. London, 1908; 1908-09, with G. H. Williams & Son, sewerage engrs., London; 1909, with Messrs. Unwin, Murphy & Esten, surveyors, Toronto; 1909-15, with Dominion Bridge Co., Montreal as follows: 1909, dftsman., 1910-11, estimator and designer, 1911, asst. to Toronto mgr., 1912, asst. to contracting engr., Lachine, 1912-14, local engr., Ottawa branch, 1914-15, dftsman, estimator and designer; 1915-20, asst. engr., Can. Govt. Rlys, Moncton, (designer and checker under bridge engr.); 1920 to date, asst. engr. with Stone & Webster, Inc., Industrial Engrs., Boston, as follows: 1920-23, designer of all type of steel and concrete constrn., specializing in power plant constrn.; 1922, responsible charge of design and res. engr. in connection with boiler plant installation for New York Steam Corpn., New York City, and 1923-24, responsible charge of struct'l. steel design and dfting. at Boston office.

References: F. P. Shearwood, P. L. Pratley, D. C. Tennant, W. A. Duff, R. O. Stewart, F. R. Faulkner, C. M. Barnes.

GELINAS—CHARLES EDOUARD, of Three Rivers, Que. Born at Three Rivers, Que., June 10th, 1887; Educ., B.A.Sc., Laval Univ. 1911; 1908-09, (summers) Pub. Works of Canada; 1910, (summer), D. and N.H. Coal Mines; 1911-13, Trussed Concrete Steel Co., on design, plans, etc., 1914, spring, supt. of constr'n. for Archambault and Conway, contractors and fall of the same year with T. Pringle and Son as checker on reinforced concrete; 1915-19, city engr. Grand'Mere and mgr. Municipal Power Co.; 1919-22, engr. with Laurentian Pulp and Paper Company in charge of constr'n. of new water works sewerage for Grand'Mere, also mechanical work; 1922 to date, city engr. Three Rivers, Que.

References: A. Surveyer, W. S. Lea, E. A. Ryan, A. R. Decary, C. S. Saunders, C. R. Lindsey.

GILBERT—FREDERICK ARTHUR, of Mimico, Ont. Born at Toronto, Ont., Jan. 5th, 1893; Educ., Grad. Tech. High Sch., Toronto. Matric. and post grad. course of one year, 1908; O.L.S. 1921; 1909-10, with Speight & VanNostrand; 1910-11, dftsman., roadways dept., City of Toronto; 1911-16, instr'man. with city surveyor, Toronto; 1916-19, overseas; June 1919, articled as surveyor with Mr. LeMay, city surveyor, Toronto. Graduated as O.L.S. Feb. 1921; 1921-23, asst. to Mr. LeMay on town planning work; Feb. 1923 to date, chief surveyor for Frank Barber & Associates, Ltd., Toronto, Ont.

References: F. Barber, J. A. Knight, O. M. Falls, J. McAdam, W. C. Lumbers, G. L. Berkeley, T. D. LeMay, G. Rankin.

GOUDGE—MONSON FRASER, of Ottawa, Ont. Born at Windsor, N.S., Apr. 15th, 1895; Educ., B.A. Kings Univ. May 1917, B.Sc., in mining engrg. N.S. Tech. Coll. May 1921; 1913-14 (summers), rodman, Nova Scotia Govt. road surveys; 1916-18, overseas with 8th Can. Siege Battery, serving in France as battery commander's asst. and as observer; 1920 (summer), asst. on geological survey field party under Dr. Faribault in Nova Scotia; 1921 (summer) senior asst. on geological survey party under Dr. Tanton, in Thunder Bay Dist., Ontario; Jan. 1922-June 1923, engaged in experimental and research work with the Imperial Oil Refineries Limited, Halifax, N.S.; At present, engr. Grade 11, Mines Branch, Dept. of Mines, Ottawa, engaged in the investigation of alkali deposits in western Canada.

References: L. H. Cole, F. R. Faulkner, F. C. Mechin, I. P. MacNab, R. L. Nixon, K. L. Dawson, C. H. F. Donkin, C. O. Whitman.

LEGER—OSWALD ERNEST, of 670 Sherbrooke Street West, Montreal, Que. Born at Lachine, Que., Dec. 19th, 1889; Educ., first year, McGill Univ. 1911-12; 1907-14, dftsman., designer, and asst. contracting engr., Dominion Bridge Company; 1914-19, overseas, Capt., Can. Engrs.; 1919-20, designer, Dominion Bridge Company; 1920-23, asst. chief engr., International Paper Company. Design and constrn. 300 ton paper mill at Three Rivers. Constrn. 40,000 H.P. hydro-electric development on Hudson River at Sherman Island; At present, sales engr., Canadian Vickers, Limited, Montreal.

References: F. P. Shearwood, D. C. Tennant, P. L. Pratley, A. Macphail, E. S. Mattice, A. H. White.

MOFFATT—ROBERT ROY, of 55 Ankerville Street, Sydney, N.S. Born at Mayfield, P.E.I., Oct. 18th, 1887; mech. engrg. course, Amer. Sch. of Corr.; 1906-08, pattern maker, Robb Engineering Works, Amherst, N.S.; 1908-10, pattern maker, Dominion Iron & Steel Co., Sydney, N.S.; 1910-12, dftsman., Dominion Iron & Steel Co., Sydney; 1916, dftsman., Robb Engineering Co. Ltd., Amherst; 1917-19, squad leader, engrg. dept., Dominion Iron & Steel Co., Sydney; 1919 to date, chief dftsman., Dominion Iron & Steel Co., Sydney, N.S.

References: A. P. Theuerkauf, W. S. Wilson, R. J. Fisher, A. W. McMaster. K. G. Cameron, K. H. Marsh.

MURRIN—WILLIAM GEORGE, of 1289 Balfour Ave., Shaughnessy Hts., Vancouver, B.C. Born at London, Eng., Aug. 27th, 1875; Educ., Roy. Naval School, Greenwich and Finsbury Tech. College, London, Eng.; 1893-99, City of London Electric Lighting Company shops and central station; 1899-1900, Stockton and Middlesboro Electric Tramway Co., England; 1901-13, works mgr. and elec. engr. London United Tramway Co., England; 1913, mech. supt., later gen. supt., asst. gen. mgr., and at present vice-pres. British Columbia Elec. Rly., Vancouver, B.C.

References: W. G. Swan, W. Smaill, P. Philip, G. A. Walkem, C. Brakenridge, A. C. Eddy.

ROACH—CHARLES LAWRENCE, of St. John, N.B. Born at Windsor, N.S., April 25th, 1902; Educ., B.Sc. (E.E.), N.S. Tech. Coll. 1923. Engrg. cert. Acadia Univ.; 1922, tech. adviser, with small radio firm in N.S.; 1922-23, electrician, during course at N.S. Tech. Coll.; At present, plant dept., N.B. Telephone Co., St. John, N.B.

References: F. R. Faulkner, W. R. Pearce, W. F. McKnight, A. Sutherland, D. W. Munn.

SANGDAHL—GEORGE STANLEY, P.E.Q., of 824 Grosvenor Avenue, Montreal. Born at Milwaukee, Wis., May 13th, 1889; Educ., B.S. Univ. of Ill. 1913; 1909-10 and summers up to 1913, detailer (struct'l. steel), and from 1913-15, designer (struct'l. steel and concrete), Purdy & Henderson, Engineers, Chicago; 1915-20 (except 18 mos. army service), engr. (design and sales), Chicago Bridge & Iron Works, Chicago and New York; 1st Lieut. U.S.A. engrg. ordnance dept., 1 year overseas with First American Army; 1920 to date, district manager, Horton Steel Works, Ltd. (of Bridgeburg), Montreal, Que.

References: W. J. Francis, F. B. Brown, J. L. Busfield, C. H. Scheman, A. Surveyer, deGaspe Beaubien.

SMYTHIES—REGINALD ERIC, of 207 Albertus Avenue, Toronto, Ont. Born at Portsea, Hampshire, England, Sept. 18th, 1888; Educ., Seven years at Christ Church College, Worsham, Sussex, England; 1904-09, served ap'ticeship with Messrs. Day, Summers & Co. Ltd., Southampton, England, Engrs. and Shipbldrs.; 1909-11, served two years at sea as engr. in charge of a watch. 1911 obtained British Board of Trade 2nd engr's. cert.; 1921, joined staff of Chapman & Walker Ltd., engrs. and contractors, Toronto, becoming manager of the electric motor dept.; 1914, associated with Melville Bertram, Esq., Toronto, in starting the Lincoln Electric Co. of Canada, Limited; 1916-19, with R.N.V.R. Lieut. and in 1918 in command of a flotilla of trawlers and drifters; Jan. 1919 to date, vice-president and chief engr., Lincoln Electric Co. of Canada, Ltd., Toronto.

References: J. M. Oxley, W. P. Dobson, H. G. Acres, A. B. Cooper, M. V. Sauer, F. R. Ewart.

WILFORD—HAROLD JAMES DEACON, of Lindsay, Ont. Born at Iroquois, Ont., May 15th, 1900; Educ., B.A.Sc. Univ. of Toronto, 1923; (Degree withheld pending completion of shop work); 1920-21 (summers), on constrn. of dam at Lakefield, Ont.; 1922 (summer), on highway constrn., Whitby to Lindsay, dept. of public highways, and from May 1923 to date, asstng. in suptce. of contract works and the engrg. pertaining thereto, on contracts with the Dept. of Railways and Canals, and Dept. of Public Highways, Ontario. All of the above mentioned work with F. R. Wilford & Co. Ltd., Engrs. and Contractors.

References: R. W. Angus, C. R. Young, E. L. Miles, A. H. Munro, A. L. Killaly, W. E. Blue, F. R. Wilford.

FOR TRANSFER FROM CLASS OF ASSOCIATE MEMBER TO THAT OF MEMBER

d'ABBADIE d'ARRART—CAMILLE ARNAULD, of Jonquiere, Que. Born at Paris, France, May 10th, 1873; Educ., B.S. Poitiers Univ., France; 1896-1902, rodman, leveller and transitman on C.P.R., and C.N.R., surveys west of Winnipeg and res. engr. on constr'n. C.P.R. lac du Bonnet branch and C.N. main line; 1902-10, loc. engr. on National Transcontinental Rly. dist. B. and div. engr. on constr'n. of same section of this line; 1910-11, supt. engr. reconstruction North Pier of Quebec Bridge for Messrs. M. P. and J. T. Davis; 1911-14, asst. engr. C.P.R. constr'n. dept. on location and constr'n. C.L.O. and W. branch and double tracking Lake Superior div.; 1914-19, overseas; 1919-23, asst. engr. Cie des Chemins de fer du Nord (France) on reconstruction of bridges in devastated regions. At present, res. engr. on constr'n. of Kenogami dam, for Quebec Streams Commission.

References: A. E. Doucet, H. E. Huestis, C. L. Hervey, C. W. P. Ramsey, D. Hillman, J. E. N. Cauchon, G. Grant, D. A. Ross.

D'AETH—JOHN BANCROFT, of Montreal, Que. Born at Montego Bay, Jamaica, B.W.I., Nov. 29th, 1885; Educ., B.Sc. McGill Univ. 1908; 1908-09, foreman on constrn., Walker-Fyshe Constrn. Co.; in Jamaica; 1909, transitman on location Narrow Gauge Rlys., Jamaica; 1910-11, res. engr. for Ambursen Hydraulic Constrn. Co. on Barnet Shoales Dam, Athens, Ga.; 1911-12, private contracting and house building; 1912-13, field engr. on constrn. Saskatoon Street Rly. for Stone & Webster Engrg. Corpn., and later with the city of Saskatoon in same capacity; 1913-14, engr. on constrn., Shawinigan Falls log chute; 1914 (Mar.-May), engr. in charge of survey for W. I. Bishop; 1914-15, asst. engr. Quebec Streams Commission; 1915-18, res. engr. in charge of constrn. on the Gouin dam for Quebec Streams Commission; 1918-20, constrn. engr. on Big Eddy dam, Spanish River, Ont., and from Oct.-Dec. 1920, supt. of constrn. on hydro-electric plant on Whitefish River, Ont., for Fraser Brace & Co.; Oct. 1921 to Sept. 1923, engr. of constrn. and asst. supt. with Fraser Brace Ltd. on the Great Falls hydro-electric power plant, Manitoba, for the Manitoba Power Co.; At present, gen. constrn. and designing engr., Fraser Brace, Ltd., Montreal.

References: J. H. Brace, C. E. Fraser, R. S. Lea, H. Holgate, G. R. MacLeod, O. O. Lefebvre, W. I. Bishop, F. S. Keith.

STOWE—GEORGE NORMAN, of New Westminster, B.C. Born at Leeds, Eng., Jan. 23rd, 1885; Educ., Leeds School of Art; 1903, land survey; 1904-07, railway location and constr'n.; 1907-12, instrumentman, Grand Trunk Pacific Rly.; 1912-13, res. engr. and 1913-14, locating engr. Edmonton, Dunvegan and British Columbia Rly.; 1916, field engr. attached to M.D. 13, Calgary; 1917, Lieut. 7th Can. Rly. troops in France; 1918, Lieut. and Adjutant, No. 13, engrg. depot, Calgary; 1919, locating engr. of highways, Dominion Parks Branch, Ottawa; 1920, asst. engr. and 1921 to date, asst. dist. engr. Public Works Dept. of British Columbia.

References: J. Callaghan, C. Ewart, W. G. Swan, A. E. Foreman, P. Philip, E. H. Verner.

FOR TRANSFER FROM CLASS OF JUNIOR TO HIGHER GRADE

McCAMMON—JOHN WHYTE, of 1368 Greene Avenue, Westmount, Que. Born at Inverness, Que., July 13th, 1888; Educ., B.Sc., McGill Univ. 1912; Aptice'ship. course with Can. Westinghouse Co., Hamilton, Ont.; 1½ yrs. asst. to mech. and elec. engr. Mackenzie Mann & Co., Mount Royal Tunnel; 9 yrs. mgr. pump and elec. depts. of Can. Fairbanks-Morse Co., Montreal; At present, sales manager, Chas. Walmsley & Co. (Canada) Ltd.

References: E. A. Ryan, L. A. Herdt, J. A. Shaw, C. F. Medbury, H. Kay.

NASH—ABRAM LELAND STANLEY, of Brantford, Ont. Born at South Cayuga, Ont., July 6th, 1894; Educ., B.A.Sc., Univ. of Toronto, 1922; member, Ont. Land Surveyors' Assn. 1915; 1912-15, ap'tice and asst. to A. M. Jackson, O.L.S., in municipal work and gen. practice; 1915 (summer), responsible asst. as O.L.S. in charge of party and in office and munic. engrg. work; 1915-19, overseas. Sgt. Awarded M.M.; 1919 (summer), asst. with Messrs. Jackson & Lee, Brantford, Ont.; 1919 to date, partner in the general engrg. firm, Messrs. Lee & Nash (formerly Jackson & Lee), During this period, summer 1921, asst. to the city engr. of Kitchener, and winters 1919-22, at S.P.S. Univ. of Toronto.

References: A. M. Jackson, S. Shupe, F. P. Adams, G. R. Marston, R. W. Angus, F. H. Midgley, D. T. Black.

NESHAM—LIONEL CHARLES, of 139 Mansfield St., Montreal, Que. Born at Torquay, Eng., Nov. 5th, 1892; Educ., B.Sc., McGill Univ. 1916; 1911-12, Geodetic Survey of Canada; 1913-16, International Boundary Surveys; 1916-17, Montreal Tramways Co.; 1917-18, Port Nelson Terminals, Dept. of Rlys. and Canals; 1918-20, St. Lawrence River Improvement Surveys, Dept. of Rlys. and Canals; May-Aug. 1920, Bonnot Co., Canton, Ohio, pulverized coal plant design; Sept.-Nov. 1920, Ford Motor Co., River Rouge, Mich., blast furnace and foundry design; Dec. 1920-21, St. Lawrence River Improvement, Dept. of Rlys. and Canals; 1922-23, Port Nelson Terminals, Dept. of Rlys. and Canals; May-Oct. 1923, Canadian Johns-Mansville Co. Asbestos, Que.; At present, res. engr. on hydro-elec. development for Beaubien, Busfield & Co.

References: deGaspe Beaubien, J. L. Busfield, D. W. McLachlan, J. J. McArthur, E. Brown, H. M. MacKay.

FOR TRANSFER FROM CLASS OF STUDENT TO HIGHER GRADE

BURPEE—C. MILES, of 1200 Sycamore Street, Milwaukee, Wis.; Born at Edmundston, N.B., Aug. 18th, 1900; Educ., B.Sc., in C.E. Univ. of N.B. May 1923; 1918 (summer), bldg. inspr. and 1919 (summer) rodman, C.N.R.; 1920 (summer), instr'man. C.N.R., and also asst. mgr. town of Edmundston, N.B.; 1921-23, (summers), res. highway engr. with Dept. of Public Works of New Brunswick. At present, instructor in charge of the dept. of dfting. and descriptive geometry, college of engrg., Marquette Univ., Milwaukee, Wis., U.S.A.

References: B. M. Hill, D. W. Burpee, L. L. Theriault, E. O. Turner, C. McN. Steeves, A. F. Baird.

FOUNTAIN—GEORGE FREDERICK, of 2862–38th Avenue West, Vancouver, B.C. Born at Grimsby, Eng., Jan. 30th, 1898; Educ., B.A.Sc., Univ. of British Columbia, 1922; 1916-19, overseas; 1920 (summer), instr'man. on D.L.S. survey; 1920 and 1922 (summers), instr'man. on water storage development for city of Vancouver, B.C.; 1922 to date, asst. city surveyor, Corporation of City of Vancouver, B.C.

References: W. H. Powell, W. B. Young, J. N. Anderson, Wm. Anderson, A. Lighthall.

GAGE—CHARLES EDWIN, of 152 Hillsdale Avenue, Toronto, Ont. Born at Deloraine, Man., June 18th, 1888; Educ., B.A.Sc., Univ. of Tor. 1918; 1906-07, logging and road building in British Columbia; 1908, carpenter for Campbell Bros. at Hamilton; 1909, in charge of locomotive boiler and machinery in Regal Shirt Works at Hamilton; 1910-11, various kinds of submarine work as diver for Miller, Cunning and Robertson; 1912-14, work on Toronto Intake consisting of pile driving of a special nature, laying pipe and concrete work; 1914-18, overseas; 1919-20, Baldwins Canadian Steel Corp.; 1920-21, Dept. of Pub. Works for Roger Miller & Sons, on crib building and superstructure for Toronto break-water, in charge of overhauling the plant which consists of locomotive cranes, compressors, hoisting engines, scows, tugs, etc.; 1921-22, with Toronto Transportation Comm., in charge of design of machinery for constr'n. work and also constr'n. engr. for all branches of the work. At present member of the firm of general contractors, The Toronto Contracting and Haulage Company, 505 Lumsden Bldg., Toronto, Ont.

References: C. R. Young, T. R. Loudon, P. Gillespie, A. W. Sinnamon, D. W. Harvey.

McFARLANE—MAYNARD LESLIE DEEDEO, of London, England. Born at London, England, Aug. 12th, 1895; Educ., 2 years towards B.Sc. (Eng.), McGill Univ. Did not grad. owing to outbreak of war; Passed P.D.L.S. exam., Montreal, 1914; 1913-14 (summers), survey work in West Indies; 1914-20, military service. 1914-15, with the Infantry and observer, R.F.C., France. Casualty — afterwards employed on technical duties as follows: 1915-16, in charge tech. equipment (including aeroplanes and engines), 22 squadron, R.F.C., England and France; 1916-17, tech. officer, 3rd Wing, R.F.C., supervising four squadrons as above (France); 1917-18, tech. asst., Depot R.F.C., supplying aircraft parts (England); 1918, on tech. staff, G.H.Q., R.F.C., France; 1918, in charge from Havre of equipment on formation of Royal Air Force, England; 1918, chief tech. officer, group hqrs. in charge of supply of aircraft, engines and equipment to the fleet, (England); 1920, editor, technical journal on shop management and methods. Also technical translator, foreign journals; 1921 to date, experimental and research work.

References: H. Holgate, H. L. Trotter, C. Cate, C. M. McKergow, J. O. Twinberrow.

PINEL—WILLIAM GORDON, of 121 Havelock Street, Toronto, Ont. Born at Toronto, Ont., July 29th, 1896; Educ., B.A.Sc., Univ. of Tor. 1921; 1920 (summer) instrumentman, on railroad surveys under Canadian Light Railways Co., near Kirkland Lake, Ont.; 1921, in charge of survey for Colonization Roads Dept., Ontario; 1922, Dept. of Public Highways on constr'n. of concrete pavement for town of Merritton, Ont., constr'n. of bridges at Erindale and Waterdown and drainage work at Aurora; 1923, insp'r. with Dept. of Public Highways of Ontario on road constr'n. at Dundas, Ont.

References: P. Gillespie, C. R. Young, A. W. Connor, R. M. Smith, F. N. Rutherford, C. H. Fullerton.

ROSE—HUGH GRANT, of 90 Fourth Avenue, Ottawa, Ont. Born at Ottawa, Ont., Jan. 25th, 1898; Educ., M.A. Queen's Univ. 1920, D.L.S. 1921, B.A.Sc. Univ. of Tor. 1923; 1916-17, (summers) recorder on observing party of Geodetic Survey of Canada; 1918-19-20, (summers), asst. on reconnaissance; 1921 (summer) in chge. of observing party of Geodetic Survey in western Ontario; 1922 (summer) in chge. of reconnaissance; 1923 (summer) in chge. of observing party for Geodetic Survey of Canada on Lower St. Lawrence. At present with the Geodetic Survey of Canada in charge of party, (during seasons).

References: N. J. Ogilvie, J. L. Rannie, W. C. Murdie, J. W. Menzies, C. R. Young, P. Gillespie, E. S. Smyth.

WINTER—THOMAS HINSON, of Deer Lake, Nfld. Born at St. John's, Nfld., Feb. 17th, 1895; Educ., B.A. Univ. of Kings Coll. 1921. B.Sc. (C.E.), N.S. Tech. Coll. 1923; 1917 and 1919 (summers), asst. to civil engr. with Dominion Iron & Steel Co., Wabana, Nfld.; 1920 (summer), instr'man. and asst. constrn. engr., N.S. Prov. Highways Board; 1921 (summer), levelman and chief asst. on contour location for water storages with the Donnacona Paper Co., Quebec; Six months to date, chief asst. to engr. in charge of pipe line and forebay constrn. with the Sir W. G. Armstrong Whitworth & Co. Ltd., Deer Lake, Nfld.

References: F. R. Faulkner, D. W. Munn, W. F. McKnight, W. G. Hardy, S. C. Mifflen, R. W. McColough, R. L. Nixon, D. A. Evans, L. H. Wheaton.

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A

ABRASIVE WHEELS

Bond Tenacity. Grinding Wheel Bond Tenacity, Robert J. Spence. Abrasive Industry, vol. 4, no. 12, Dec. 1923, pp. 351 and 355. Function of bonding material and effects of varying work and wheel speeds.

ACOUSTICS

Auditoriums, The Acoustics of the Auditorium, G. A. Sutherland. Roy. Inst. British Architects—Jl., vol. 30, nos. 19 and 20, Sept. 22, and Oct. 20. 1923 pp. 608-620 and 637-645, 10 figs. Nature and propagation of sound, and their application to acoustics of an auditorium.

AERONAUTICAL INSTRUMENTS

Height of Aircraft from Ground. The Measurement of True Height by Aneroid. L. N. G. Filon. Jl. of Sci. Instruments, vol. 1, no. 1, Oct. 1923, pp. 1-8, 3 figs. Deals with devices for obtaining approximately true height, of aircraft from ground, on assumption that law of temperature is approximately known, of class which retains present mechanism but enables pointer to read correct height (without a calculating device) on a special type of dial; describes two types of dial which give a direct reading of "lapserate" height with considerable accuracy.

AERONAUTICS

Bibliography. Bibliography of Aeronautics 1917-1919, Paul Brockett. Nat. Advisory Committee for Aeronautics, 1923, 494 pp. Covers literature published from Jan. 1, 1917, to Dec. 31, 1919, and continues work of Smithsonian Miscellaneous Collections covering material published prior to June 30, 1909, and work of Nat. Advisory Committee published in Bibliography of Aeronautics for years 1909 to 1916.

AIR COMPRESSORS

Automatic Electric Drive. Automatic Electric Drive of Medium-Size Piston Compressors (Selbsttätiger elektrischer Betrieb mittlerer Kolbenkompressoren), R. Rückert. Fördertechnik u. Frachtverkehr, vol. 16, nos. 21 and 22, Nov. 3 and 18, 1923, pp. 242-243 and 249-252, 11 figs. Describes automatic device for starting without load developed by German Gen. Elec. Co. (AEG), and its field of application; it is shown that highest degree of efficiency is obtained from compressed-air plant with use of this device.

Multitubular Isothermal. Multitubular Isothermal Compressors (Les compresseurs multitubulaires isothermiques et leurs applications), L. Neu. Revue de l'Industrie Minérale (Comptes Rendus), no. 66, Sept. 15, 1923, pp. 189-196, 2 figs. Points out that isothermal compression involves expenditure of much less energy than is required for diabatic compression, and avoids practical difficulties associated w th temperature rise; by substituting multitubular cylinders and pistons for those of ordinary compressor, output can be increased 20 per cent for same power consumption.

AIR PUMPS

Water-Jet. Adaptability of Water-Jet Air Pumps for the Removal of Air from Surface Condensers (Eigenschaften der Wasserstrahl-Luftpumpen für das Entlüften von Oberflächenkondensatoren), Fritz L. Richter. Zeit. des Vereines deutscher Ingenieure, vol. 67, no. 45, Nov. 10, 1923, pp. 1042-1045, 7 figs. Results of experiments made with water-jet apparatus driven by pressure water to determine absorption of dry as well as moisture-containing air; based on these experimental results and well as those of Höfer with steam-jet apparatus, it is shown how both apparatus behave when removing air from surface condensers; utilization of exhaust steam from both apparatus.

AIRPLANE PROPELLERS

Tests, Analysis of. Analysis of W. F. Durand's and E. P. Lesley's Propeller Tests, Max M. Munk. Nat. Advisory Committee for Aeronautics—Report, no. 175, 1923, 14 pp. 22 figs. Critical study of propeller model tests with view of obtaining clear insight into mechanism of propeller action and of examining soundness of physical explanation generally given.

AIRPLANES

Internally Braced. Design of Internally Braced Biplane Wings. A. S. Niles. Air Service Information Circular, vol. 5, no. 440, May 1, 1923, 31 pp., 15 figs. Describes properties of internally braced biplanes and indicates proper method of design.

Light. Gliders and Light Planes. A. Ogilvie. Roy. Aeronautical Soc.—Jl., vol. 27, no. 155, Nov. 1923, pp. 524-528 and (discussion) 528-534. Author discusses results which may be looked for from light plane; he believes it should be possible to develop propeller system which would enable full power of engine to be effectively used from time it is opened up. give steep angle to climb, be efficient at top speed and at same time act as air brake when gliding down without engine.

Stability. The Problem of the Stability of Airplanes (Le problème de la stabilité des avions), L. Breguet and R. Devillers. Technique Moderne, vol. 15, no. 19, Oct. 1, 1923, pp. 577-582, 6 figs. Clarifying discussion of fundamental principles involved.

Wind-Tunnel Tests. Wind Tunnel Tests of Five Strut Sections in Yaw, Edward P. Warner. Nat. Advisory Committee for Aeronautics—Tech. Notes, no. 167, Nov. 1923, 13 pp. 6 figs. Models were made at McCook Field and tested in old wind tunnel of Mass. Inst. of Technology.

AIRSHIPS

Metal- vs. Fabric-Clad. Metal-Clad versus Fabric-Covered Rigid Airships, R. Upson. Aviation, vol. 15, no. 24, Dec. 10, 1923, pp. 702-703. Points out that metal envelope has advantage of fire-resisting quality, greater gas tightness, durability and lesser weight.

Photoelastic Tests. Photoelastic Method Applied to Rigid-Airship Research, Thos. H. Frost. Soc. Automotive Engrs.—Jl., vol. 13, no. 6, Dec. 1923, pp. 497-498, 2 figs. Account of photoelastic tests carried out at Mass. Inst. of Technology on model of ZR1, to determine stress distributien with ship in flight.

ALIGNMENT CHARTS

Graphic Utilization. Simple Methods for Graphic Utilization of Alignment Charts Without Calculation (Einfaches Verfahren zur zeichnerischen Auswertung von Liniendiagrammen ohne Rechnung), Paul Ertl. Zeit. für das Berg. Hütten- u. Salinenwesen, vol. 71, no. 2, 1923, pp. 175-179, 2 figs. Describes method developed by author for determination of derived values from basic values.

ALLOYS STEELS

Automobile Construction. Steels for Automobile Construction (Kraftwagen-Baustähle). Motor u. Auto. vol. 20, no. 18, Sept. 25, 1923, pp. 156-159. Describes special steels manufactures by Böhler Bros. & Co., with special reference to nickel and chromenickel steels.

Fracture. Faults in Alloy Steel (Ueber Fehlstellen in legiertem Stahl), A. Schleicher. Stahl u. Eisen, vol. 43, no. 47, Nov. 22, 1923, pp. 1449-1452. It is shown that fractures known as flasks are due to presence of solid oxidic slag enclosures.

ALLOYS

Aluminum. *See Aluminum Alloys.*
Bearing Metals. *See Bearing Metals.*
Brass. *See Brass.*

Cast The Use of Cast Alloys for the Working Parts of Machinery, Pisek. Foundry Trade Jl., vol. 28, nos. 374, 375 and 376, Oct. 18, 25 and Nov. 1, 1923, pp. 325-329, 349-351 and 369-376, 61 figs. Physical properties of alloys; cooling considerations; influence of impurities and overheating; liquation; physical changes by alloying; how metals solidify; deoxidizers; contraction; piping and blowholes; alloys of copper; deoxidizing copper alloys; brasses; aluminum bronzes; anti-friction alloys; aluminum alloys. From paper presented to Paris Int. Foundry conference.

Chrome-Molybdenum. Chrome-Molybdenum and Chrome-Molybdenum-Copper Alloys (Ueber Chrom-Molybdän- und Chrom-Molybdän-Kupfer-Legierungen), E. Siedschlag. Zeit. für anorganische u. allgemeine Chemie, vol. 131, no. 2, Oct. 1923, pp. 191-202, 3 figs. Results of investigations.

Ferro-alloys. *See Ferro-alloys.*

Solid Solutions. The Modern Concept of Solid Solutions, Zay Jefferies and R. S. Archer. Chem. & Met. Eng., vol. 29, nos. 21 and 22, Nov. 19 and 26, 1923, pp. 923-926 and 966-969, 4 figs. How they are visualized by metallurgist; presentation of working information regarding constitution and properties of alloys.

ALUMINUM ALLOYS

Constitution and Age Hardening. The Constitution and Age-Hardening of the Quaternary Alloys of Aluminum, Copper, Magnesium, and Magnesium Silicide, Marie L. V. Gayler. Inst. Metals—advance paper, no. 6, for meeting Sept. 10-13, 1923, 28 pp. 22 figs. Constitution of ternary alloys at 400 deg. cent., and of quaternary alloys of aluminum with magnesium silicide and copper and magnesium in definite ratio; age hardening of quaternary alloys.

Transformations and Thermal Treatment. A Dilatometric Study of the Transformations and Thermal Treatment of Light Alloys of Aluminum, A. M. Portevin and Pierre Chevenard. Inst. Metals—advance paper, no. 12, for meeting Sept. 10-13, 1923, 19 pp., 12 figs. Application of dilatometric methods, judiciously using recording differential dilatometer, permits of study of transformations and mechanism of heat treatment of light alloys of aluminum-magnesium-silicon, and in general of alloys containing two-phase, unvarient transformations, a study which had not been carried out up to present.

ALUMINUM BRONZE

PROPERTIES AND USES. Aluminum-Bronze. Meta lIndustry (Lond.), vol. 23, no. 23, Dec. 7, 1923, pp. 505-508, 3 figs. Surveys essential features in general constitution and properties and deals with practical problems in founding and working of principal alloys of series; industrial uses.

SPECIAL. Special Aluminum Bronzes (Les bronzes d'aluminium spéciaux), Léon Guillet., Revue de Métallurgie, vol. 20, nos. 2 and 4, Feb. and Apr. 1923, pp. 130-138 and 257-261, 27 figs. Microscopic study; mechanical properties; critical points; heat treatment variation of mechanical properties as a function of temperature; determination of resistance, density, elongation and other physical properties. Feb.; Copper-aluminum-nickel alloys. Apr.: Phosphor-magnesium-and cobalt-aluminum bronzes.

ASBESTOS

CANADA. Canada's Great Asbestos Industry, Norman R. Fisher. Compressed Air Mag., vol. 28, no. 11, Nov. 1923, pp. 679-674, 14 figs. Dominion now supplies fully 80 per cent of all asbestos consumed in world. Description of the various deposits, and mining methods and equipment used.

AUTOMOBILE ENGINES

CARBURATORS. *See Carburetors.*

TORSIONAL OSCILLATIONS IN. Torsional Oscillations in Automotive Engines and Their Experimental Investigation (Drehschwingungen bei Fahrzeugmotoren und deren experimentelle Untersuchung), J. Geiger. Zeit. des Vereines deutscher Ingenieure, vol. 67, nos. 47-48, Nov. 24, 1923, pp. 1077-78, 14 figs. Rotational oscillations as causes of fracture in crankshafts; report on mechanical recording of extremely rapid oscillations up to 60,000 per min.; pressure fluctuations in mixture inlet as cause of slow torsional fluctuations of shaft.

AUTOMOBILE FUELS

GASOLINE. *See Gasoline.*

LATENT HEAT. Equilibrium Boiling-point and Latent Heat of Vaporisation of Motor Fuels, W. R. Ormandy and E. C. Craven. Instn. Petroleum Technologists—Jl., vol. 9, no. 39, Oct. 1923, pp. 368-379, 1 fig. Results of investigations; calculations of latent heats for various mixtures.

MIXED. The National Motor Fuel: Study of the Possible Constitution (Le carburant national: Etude sur sa constitution possible), C. Legrand. Chimie & Industrie, vol. 10, no. 3, Sept. 1923, pp. 411-428, 12 figs. Study of an extensive series of binary, ternary and quaternary mixtures of alcohol, benzol, gasoline and ether, with reference to their stability and satisfactory functioning as internal-combustion engine fuels.

VOLATILITY. Economic Motor-Fuel Volatility, S. W. Sparrow. Am. Petroleum Inst.—advance paper, for meeting Dec. 11-13, 1923, 16 pp. Deals with fuel investigation being conducted by Bur. of Standards in co-operation with Soc. Automotive Engrs., Nat. Automobile Chamber of Commerce, and Am. Petroleum Inst.; results obtained since Dec. 1922.

AUTOMOBILES

BRAKES. Bureau of Standards Makes Definite Checks on Brake Performance, Herbert Chase. Automotive Industries, vol. 49, no. 22, Nov. 29, 1923, pp. 1092-1096, 8 figs. Relative effectiveness of various arrangements and operating means are graphically recorded; use of front-wheel type does not double rate of deceleration; surprising values for friction coefficient between tire and road obtained.

LIGHTING AND STARTING SYSTEMS. Electric Lighting and Starting Systems. Autocar, vol. 51, no. 1464, Nov. 9, 1923, pp. 987-991, 12 figs. Descriptions of exhibits at Olympia (Lond.) annual automobile exhibition, Nov. 2-10, 1923.

SPRING ACTION AND VIBRATION. Spring-Movement and Vibration Study of Cars in Action, T. J. Litle, Jr. Soc. Automotive Engrs.—Jl., vol. 13, no. 6, Dec. 1923, pp. 445-449, 5 figs. Describes device that combines recording seismograph and spring-action recorder, which is essential in conducting investigations; methods governing use of device when studying spring action and chassis vibration.

WHEEL ALIGNMENT. Motor-Vehicle Wheel-Alignment, J. F. Duby. Soc. Automotive Engrs.—Jl., vol. 13, no. 6, Dec. 1923, pp. 453-458 and (discussion) 458-460, 4 figs. Explains method for obtaining correct alignment that will insure easy steering and cause least amount of tire wear; front-wheel and rearwheel alignment requirements; analysis of "toe-in" "camber" and manner of determining them; axle tilt and wheel wabble.

AVIATION

ENGINEERING WORK, EMPLOYMENT. The Aeroplane in Engineering, L. D. Huntoon. Min. & Metallurgy, vol. 4, no. 204, Dec. 1923, pp. 607-611, 3 figs. Air mapping for geological reconnaissance; air reconnaissance for railroads; air-location of metallurgical works; accuracy of aerial traverse tested; applications to forestry; air transportation.

B

BALANCING MACHINES

EÖTVOS TORSION. The Eötvos Torsion Balance and Its Application to the Finding of Mineral Deposits, Stephen Rybar. Economic Geology, vol. 18, no. 7, Oct.-Nov. 1923, pp. 639-662, 15 figs. Discusses method developed by Eötvos by means of potential theory; describes variometer and its application to determination of subterranean disturbances. Bibliography on publications of Eötvos on subject.

BEARING METALS

NICKEL IN, EFFECT OF. The Effect of Small Quantities of Nickel upon High-Grade Bearing Metal, A. H. Mundey and C. C. Bissett. Inst. Metals—advance paper, no. 9, for meeting Sept. 10-13, 1923, 5 pp., 5 figs. Result of practical investigation into mechanical and wearing properties of bearing metal of well-known grade, after addition of small but increasing amounts of nickel.

BEARINGS, ROLLER

BRIDGE. Recommendation for a Standard Bridge Bearing (Vorschlag für ein einheitliches Brückenlager), J. Karig. Bautechnik, vol. 1, nos. 38, 40-41 and 43, Sept. 7, 21 and Oct. 5, 1923, pp. 357-360, 416-420 and 429-433, 32 figs. Based on years of experience author makes recommendation for an economical roller bearing; discusses basic form of bearing; permissible stresses; bearing pressures; calculation of rollers; roller base and cover plate; head plate; recommendation for sizes of bearings; special forms; calculation.

BLAST FURNACES

BUCKET-TYPE CHARGER. Completes New British Furnace, Jos. Horton. Iron Trade Rev., vol. 73, no. 22, Nov. 29, 1923, pp. 1480-1481, 1 fig. New 400-ton stack built at Middlesbrough is equipped with bucket-type charging apparatus; electric power is generated from waste heat; bell is raised and lowered hydraulically.

BOILER FEEDWATER

DEAERATING. Lowering Oxygen in Water Reduces Corrosion, Chas. E. Colborn. Power Plant Eng., vol. 27, no. 24, Dec. 15, 1923, pp. 1225-1226, 1 fig. Laws governing amount of gas water will dissolve and means of deaerating water.

FEED METERS. The Testing of Boiler-Feed Meters. Power Engr., vol. 18, no. 213, Dec. 1923, pp. 457-459, 5 figs. General methods adopted by Glenfield & Kennedy.

TREATMENT. Cost Analysis of Feed Water Softening, Allen F. Brewer. Elec. Light & Power, vol. 1, no. 11, Nov. 1923, pp. 17-19 and 75-77, 10 figs. Water-softening methods; discusses items of expense in plant operation which would be affected by installation of feedwater purifying system; other determining factors.

Internal Treatment of Boiler Water—Proper and Improper, D. K. French. Indus. & Eng. Chem., vol. 15, no. 12, Dec. 1923, pp. 1239-1243. Study of internal treatment applied directly in boiler for correction of difficulties encountered in steam production; reactions in boiler; principles on which treatments act; discusses proprietary compounds which have done so much to discredit this method of treatment.

BOILER FURNACES

AIR-SUPPLY REGULATION. The Expediency of Regulated Air Supply for Fuel Economy (Nutzen geregelter Verbrennungsluftzufuhr für sparsame Brennstoffwirtschaft), H. Schwarz. Archiv für Wärmewirtschaft, vol. 4, no. 9, Sept. 1923, pp. 172-173, 1 fig. Describes automatic apparatus for regulating air supply for combustion.

COMBUSTION SYSTEMS. Factors in the Choice of a Combustion System, E. B. Ricketts. Power Plant Eng., vol. 27, no. 23, Dec. 1, 1923, pp. 1194-1196. Points out that future selection of firing methods will lie between stoker, pulverized fuel and low-temperature coal distillation.

LOW-GRADE ANTHRACITE. Investigations of Furnaces with Special Regard to Low-Grade Anthracite (Feuerungsuntersuchungen mit besonderer Berücksichtigung minderwertiger Steinkohle), H. Ebel. Wärme, vol. 46, nos. 40, 41, 42 and 43, Oct. 5, 12, 19 and 26, 1923, pp. 439-442, 451-454, 462-465 and 472-474, 15 figs. Sources of losses with low-grade anthracite; principles of combustion; hydrogen losses; apparent and actual excess of air; heat generated per cu. m. flue gas; producable heat, carbon losses, quality and calorific efficiency of furnaces; heat balance, flue-gas volume and chimney losses.

BOILER HOUSES

EFFICIENCY. The Importance of the Boiler House, David Brownlie. Eng. & Boiler House Rev., vol. 37, no. 4, Oct.-Nov. 1923, pp. 93-94. Discusses present inefficiency due to design and equipment of plant and methods of controlling working of plant, and gives suggestions for improvements.

BOILERS

COAL MINES. Advance in Steam-Boiler Practice in Anthracite Region, M. M. Rice. Coal Age, vol. 24, no. 21, Nov. 22, 1923, pp. 767-772, 4 figs. Importance of burning small sizes of coal at mines; changes in boiler and furnace design to obtain efficient combustion; benefits of high stacks.

GAS PASSAGES, CHART FOR. Chart for the Design of Gas Passages, M. E. Yeager. Power Plant Eng., vol. 27, no. 24, Dec. 15, 1923, pp. 1226-1228, 1 fig. Explanation of chart for reading areas of gas passages in boilers and furnaces.

HYDROSTATIC TEST. What is the Value of the Hydrostatic Test? Thos. H. Fenner. Power, vol. 58, no. 22, Nov. 27, 1923, pp. 851-853. Shows where hydrostatic test can be of great assistance in determining condition of object under examination, and also other cases where it may be detriment to safety which it seeks to insure.

LOADING. The Economical Limits of Boiler Loading, Chas. F. Wade. Elec. Rev., vol. 93, no. 2398, Nov. 9, 1923, pp. 687-688. Discusses factors determining upper limits of economical loading of any given plant, namely, available draft power, draft system, labor costs, class and quality of fuel used.

LOCOMOTIVE. *See Locomotive Boilers.*

WATER-TUBE. *See Boilers, Water-Tube.*

BOILERS, WATER-TUBE

DEFORMATIONS. Deformations in Vertical-Tube Boilers While Heating (Formänderungen von Steilrohrkesseln beim Ahheizen), Wilhelm Otte. Zeit. des Vereines deutscher Ingenieure, vol. 67, no. 44, Nov. 3, 1923, pp. 1021-1023, 12 figs. General discussion; results of measurements and conclusions.

SPEARING. The Spearing Boiler. Eng. & Boiler House Rev., vol. 37, no. 4, Oct.-Nov. 1923, pp. 99-100, 3 figs. Principal features of Spearing water-tube boiler.

WATER-CIRCULATION AND EFFICIENCY TESTS. Water Circulation and Increasing Efficiency of Water-Tube Boilers (Wasserumlauf und Leistungssteigerung der Wasserrohrkessel), H. Maas. Zeit. des Bayerischen Revisions-Vereins, vol. 27, nos. 19 and 20, Oct. 15 and 21, 1923, pp. 145-148 and 156-158, 11 figs. Discusses observations made in operation of highly stressed water-tube boilers and reports on water-surface measurements, water-circulation and efficiency tests on different types of boilers; conclusions and recommendations for design of high-power boilers, based on tests.

BRASS

CORROSION. Corrosion of Brass as Affected by Grain Size, Rob. J. Anderson and Geo. M. Enos. Am. Inst. Min. & Met. Engrs.—Trans., no. 1282-N, Dec. 1923, 11 pp., 6 figs.; also (abstract) in Min. & Metallurgy, vol. 4, no. 204, Dec. 1923, p. 624, 1 fig. Describes series of tests using accelerated electrolytic corrosion test developed by writers in Bur. of Mines: results show that, for brass tested and corrosive solutious used, effect of grain size (from 0.01 to 0.10 mm. diam.) on corrosion loss is very small and probably can be ignored for practical purposes; in general, however, brass with smaller grain size tends to corrode less than that with larger grain size.

BRASS FOUNDRIES

CRUCIBLES. The Care of Brass Foundry Crucibles, C. F. Hopkins. Metal Industry (Lond.), vol. 23, no. 21, Nov. 23, 1923, pp. 459-460, 7 figs. Points out importance of proper annealing; treatment of crucibles in furnace; handling crucibles. (Abstract.) Address before Phila. Foundrymen's Assn.

BRIDGES, CONCRETE

PREDETERMINED STRENGTH OF. A Notable Structure Built by New Methods. Ry. Rev., vol. 73, no. 20, Nov. 17, 1923, pp. 711-719, 14 figs. Bridge of concrete of predetermined strength built over Great Miami River by C.C.C. & St. L. Ry.

PRECAST FERRO-CONCRETE. A Pre-Cast Ferro-Concrete Footbridge, W. H. Shortt. Ry. Gaz., vol. 39, no. 19, Nov. 9, 1923, pp. 580-582, 6 figs. Describes reconstruction of a footbridge at a station on Southern Ry. which marks distinct advance in ferro-concrete construction as applied to railway bridge work.

BRIDGES, HIGHWAY

CONCRETE. Reinforced Concrete Road Bridges. Concrete & Constructional Eng., vol. 18, no. 11, Nov. 1923, pp. 720-733, 19 figs. Consideration of new road bridges which will be required in connection with the various schemes which are now being promoted for construction of new roads in England.

BRIDGES, LIFT

BASCULE. Bascule Bridges on the Oise River at Chauny and on the Canal of the Haute-Deule, Near Douai (Ponts basculants sur l'Oise, à Chauny, et sur le canal de la Haute-Deule, près de Douai). Génie Civil, vol. 83, no. 13, Sept. 29, 1923, pp. 289-291, 6 figs. Details of two bridges recently constructed by Etablissements Schneider, replacing swing bridges destroyed during war.

BRIDGES, STEEL

STRESSES IN. Auxiliary Stresses due to Riveted Joint Connections of Steel Truss Bridges (Nebenspannungen infolge vernieteter Knotenpunktverbindungen eiserner Fachwerkbrücken), H. Müllenhof. Bauingenieur, vol. 4, no. 19220, Oct. 15, 1923, pp. 564-570, 8 figs. Discussion of report of the Tech. Committee of Assn. Swiss Bridge and Steel Building Concerns.

BUILDINGS

EARTHQUAKE RESISTING, JAPAN. Modern Steel and Reinforced-Concrete Structures Survive Japanese Earthquake, John W. Doty and W. W. Johnston. Eng. News-Rec., vol. 91, no. 17, Oct. 25, 1923, pp. 678-681, 3 figs. Results of survey in Yokohama and Tokyo after disaster of September 1. (Abstract.) Report to Secretary of State, Washington.

C

CALORIMETERS

BOYS. A General-Purpose Recording Drum, C. V. Boys. Jl. of Sci. Instruments, vol. 1, no. 1, Oct. 1923, pp. 26-28, 3 figs. Describes a convenient auxiliary of recording drum for recording continuously volume of a certain quantity of air at the temperature and pressure at the time and saturated with water vapor; developed in connection with integrating and recording gas calorimeter, but modified to be of general application.

CANALS

CANADA. Present Status of Welland Ship Canal. Can. Engr., vol. 45, no. 21, Nov. 20, 1923, pp. 502-508, 7 figs. Progress of construction during last three years of unit in a large scheme for navigation of large ships between Atlantic seaboard and Great Lakes; historical review of canal projects; twin lift locks a notable engineering work; section 8 relocated.

CARBURETORS

DESIGN THEORY. Explains Theory Governing Carburetor with Intake Throttle, P. S. Tice. Automotive Industries, vol. 49, no. 22, Nov. 29, 1923. pp. 1099-1101, 7 figs. Mixture required to give minimum consumption varies only with inlet pressure due to corresponding dilution of charge with burned products; design of Stewart-Warner instrument is based on this fact, not on proportioning fuel to air drawn through.

CAR LIGHTING

SYSTEMS. Principal Systems of Individual Electric Lighting Applied to Railway Cars (Les principaux systèmes d'éclairage électrique individuel appliqués aux voitures de chemins de fer), M. Bougrier. Electricien, vol. 37, nos. 1287 and 1288, Nov. 1 and 15, 1921, vol. 38, nos. 1304 and 1310, July 15 and Oct. 15, 1922, and vol. 39, no. 1318, Feb. 15, 1923, pp. 481-488, 505-513, 313-320, 457-464, 75-81, 40 figs. Lighting by candles, oil, electricity and acetylene; systems of individual and of collective electric lighting; voltage of lights and regulation of voltage; dynamos and batteries; Stone, Vicarino and other systems; Rosenberg system and its application to French state railways.

CARS

DRAFT-GEAR CLOSURES. A Mathematical Law of Impact Between Cars, E. M. Richards. Ry. Mech. Engr., vol. 97, nos. 11 and 12, Nov. and Dec. 1923, pp. 760-762 and 817-819, 3 figs. Study of time of partial and full-draft gear closures, checked by test results of U. S. R. R. Administration.

CARS, PASSENGER

BUILDING METHODS. Production Methods in British Passenger Car Building, D. R. Lamb. Ry. Rev., vol. 73, no. 22, Dec. 1, 1923, pp. 782-786, 12 figs. Modern production methods in wooden passenger-car building introduced at Derby Works of Lond. Midland & Scottish Ry.; departure in woodworking involves machining to size within extremely close limits.

CAST IRON

DEFECTIVE, EXAMINATION OF. The Examination of Defective Ferrous Materials in an Engineering Works, T. Henry Turner. Engineering, vol. 116, no. 3022, Nov. 30, 1923, pp. 698-700, 3 figs. Considers abnormalities which appear from time to time in machine shops of large modern engineering works; deals with cast and wrought materials and methods of overcoming evil effects of defects; laboratory work which discovery of defects entails. Paper read before Birmingham Met. Soc.

ELECTRIC-FURNACE PRODUCTION. Grey Cast Iron from the Point of View of the Electric Furnace, G. K. Elliott. Foundry Trade Jl., vol. 28, no. 378, Nov. 15, 1923, pp. 419-420. Main features of acid and basic electric furnaces, and effects of each upon principal elements of cast iron in comparison with effects obtained through cupola; problems of cast iron that have arisen through introduction of electric furnace for treating cast iron. Paper read before Am. Foundrymen's Assn.

HIGH-GRADE LOW-CARBON. German Views on Semi-Steel and other High-Grade Low-Carbon Cast-Irons, F. Wust and P. Bardenhener. Foundry Trade Jl., vol. 28, no. 378, Nov. 15, 1923, pp. 410-412. Melting in a crucible; mixing of liquid steel and liquid pig iron; melting in an open hearth furnace; melts made in electric furnace; casts made in cupola. Translated from Die Giesserei.

PEARLITIC. Tells of Pearlitic Cast Iron, Carl Sipp. Foundry, vol. 51, no. 24, Dec. 15, 1923, pp. 986-987. Structure of pearlite secured in iron by pouring low-silicon metal into heated molds; claim made for improved physical properties of metal, especially under dynamic tests.

STRENGTH AT HIGH TEMPERATURES. The Strength of Cast Iron (Semi-Steel Mixtures) at High Temperatures, Arthur Marks. Foundry Trade Jl., vol. 28, no. 378, Nov. 15, 1923, pp. 421-422, 2 figs. Results of research carried out with a view to investigating cause of failure at high temperatures and upper limiting temperature at which cast iron may be safely used, and to determine temperature at which cast iron mixtures, when heated showed a rapid drop in strength.

TESTS. A Consideration of Some Mechanical Tests on Cast Iron, E. Siegle. Foundry Trade Jl., vol. 28, nos. 379 and 380. Nov. 22 and 29, 1923, pp. 433-436 and 467. 10 figs. Results of shear and transverse tests carried out by author; mechanical properties of hematite and semi-phosphorus irons. Translated from paper presented before Paris Int. Congress.

CELLULOSE

CHLORINE MANUFACTURING PROCESS. Use of Chlorine in the Production of Cellulose (Applications du chlore à la fabrication de la cellulose) A. De Perdiguier. Chimie et Industrie, vol. 10, no. 3, Sept. 1923, pp. 429-436, 8 figs. Methods of producing cellulose for papermaking from vegetable fibers.

CEMENT, PORTLAND

SETTING TIME. Regulating Setting Time of Portland Cement. Can. Engr., vol. 45, no. 20, Nov. 13, 1923, pp. 485-487. Investigation of methods for regulations and causes of changes in setting time, and results of experiments conducted by British Portland Cement Research Assn.

CENTRAL STATIONS

CONTROL AND CHECKING SYSTEM. Control and Checking Systems for Automatic Stations, R. J. Wensley. Elec. World, vol. 82, no. 21, Nov. 1923, pp. 1062-1064, 5 figs. Apparatus developed for use of system dispatcher in controlling and checking operations in distant automatic generating stations and substations.

REMOTE INDICATOR. The Cambridge Remote Indicator. Elec. Rev., vol. 93, no. 2396, Oct. 26, 1923, pp. 608-609, 3 figs. By suitable modifications, voltage, current power, or power factor can be indicated many miles away, at small cost; system has been in successful operation for five years between two power stations 8 mi. apart. See also Electn., vol. 91, no. 2371, Oct. 26, 1923, pp. 458-459, 6 figs.

VENTILATION. Ventilation of Electrical Stations. Contract Rec. & Eng. Rev., vol. 37, no. 47, Nov. 21, 1923, pp. 1104-1106, 3 figs. Difficulties of adequately ventilating some types of substation buildings; apparatus necessary; means of exhausting stale air.

CHARTS

ENGINEERING AND BUSINESS. Engineering and Business Charts, A. W. Swan. Eng. Production, vol. 6, no. 135, Dec. 1923, pp. 496-500, 12 figs. Classes of chart users; squared paper chart; laying out horizontal and vertical scales; correct use of scales; ratio charts; straight-line and its uses; special slide rules and alignment charts.

CIRCUIT BREAKERS

AIR-BREAK GATE-END. Air-Break Gate-End. Circuit-Breaker. Engineering, vol. 116, no. 3019, Nov. 9, 1923, pp. 591, 1 fig. New design for use underground in coal mines; is used at gate ends and controls circuit of trailing cable leading, for instance, to coal cutter.

COAL

ANALYSIS. Methods of Coal Analysis. Colliery Guardian, vol. 126, no. 3281, Nov. 16, 1923, pp. 1229-1231. Proximate and ultimate analysis; determination of phosphorus in ash, caking index, and calorific value; low- and high-temperature assay of coal; method of reporting analysis. Interim report of Fuel Research Board.

B.T.U. VALUE. Practical Value of B.t.u. in Coal, G. A. Rosetti. Pratical Engr., vol. 68, no. 1917, Nov. 22, 1923, pp. 289-291.x Discusses following point: assuming that facts of test are known and agreed, as to quantity and quality of fuel used, quantity and conditions of evaporation produced, conditions of combustion, etc., what is correct figure for efficiency.

DRYING. A Standardized Method for Air-Drying Coal, E. Stansfield. Can. Inst. Min. & Metallurgy, no. 139, Nov. 1923, pp. 615-620, 2 figs. Describes method and apparatus adopted by author.

DISTILLATION. Carbonizing Coal by the Sensible Heat of Producer Gas, C.H.S. Tupholme. Chem. & Met. Eng., vol. 29, no. 23, Dec. 3, 1923, pp. 1008-1012, 6 figs. British process which utilizes otherwise waste heat of producer gas for distilling various fuels, producer being fed with residue from distillation retort.

SPECIFIC HEAT. The Specific Heat of Coal and Its Relation to Composition, G. Coles. Chem. & Industry, vol. 42, no. 46, Nov. 16, 1923, pp. 435T-439T, 4 figs. Determinations of specific heat made by means of Bunsen ice calorimeter; results and conclusions.

COAL MINES

AIR SHAFT. New Air Shaft Reduces Ventilation Costs, S. S. Tescher. Coal Industry. vol. 6, no. 11, Nov. 1923, pp. 473-474, 1 fig. New air shaft and fan installation at Aguilar Colo., double ventilation with increase in power consumption of only 50 per cent.

POWER IN. Power in Colliery Working, J. Kirsopp. Power Engr., vol., 18, no. 212, Nov. 1923, pp. 428-436. Describes typical plant for ventilation of coal mines; problem of haulage.

SCREENING PLANT. New Screening Plant and Head Frame at Barnsley Main Collieries, Iron & Coal Trades Rev., vol., 107, no. 2908, Nov. 23, 1923, pp. 765-766, 6 figs. New screening plant consists of four units, each comprising tippler, jigging screen and picking belt with cross conveyors for nuts and slack.

VENTILATION. The Humidification of Mine Air. M. J. Lide. Coal Mine Management vol. 2, no. 11, Nov. 1923, pp. 38-50, 6 figs. Deals with air conditioning, showing futility of half-way measures and plans for securing effective humidification.

COAL MINING

BLASTING. Practical Pointers on Blasting Coal, W. J. German. Coal Industry, vol, 6, no. 11, Nov. 1923, pp. 470-472, 5 figs. Avoidance of improper practices prevents accidents, increases production and reduces cost of mining.

COAL WASHING

RHEOLAVEUR PROCESS. Washer That Removes Refuse in Coal as It Travels, J. Kersten. Coal Age, vol. 24, no. 23, Dec. 6, 1923, pp. 847-850, 8 figs. Describes Rheolaveur or flow-washer, devised by A. France-Focquet, of Liege, Belgium; raw coal is swept by water along troughs; slate and bone stratify out and are trapped in slots which by an upward current of water, are kept from admitting coal.

COILS

PETERSEN. Operating Performance of a Petersen Earth Coil, J. M. Oliver and W. W. Eberhardt. Am. Inst. Elec. Engrs.—Jl., vol. 42, no. 9, Sept. 1923, pp. 804-914, 8 figs. Report on Alabama Power Co.'s operating experience with Petersen coil installed between neutral and ground of 120-mi., 44,000-volt, 3-phase, star-connected, 60-cycle system.

COMBUSTION

VOLUMETRIC REPRESENTATION. The Volumetric Representation of Combustion Phenomena (Zur räumlichen Darstellung von Verbrennungsvorgängen), Georg Szende. Feuerungstechnik, vol. 12, nos. 1 and 2. Oct. 1 and 15, 1923, pp. 1-4 and 9-13, 7 figs. Relation between three given components of flue gases is expressed by so-called flue-gas planes, simple construction of which is shown; flue-gas planes of different fuels are shown to bear very simple geometrical relations to one another, and their total forms what is known as flue-gas body, which gives very clear representation of combustion phenomena.

COMPRESSED AIR

PNEUMATIC MAIL TUBES. Continental Pneumatic Postal Tube Installation. Indus. Management (Lond.), vol. 10, no. 10, Nov. 15, 1923, pp. 283-285, 5 figs. Latest developments of pneumatic appliances employed for postal purposes in city of Munich, Germany. Translated from Zeit. des Vereines deutscher Indenicure.

CONCRETE

IMPERMEABILITY. Rammed versus Cast Concrete. (Stampfbeton oder Gussbeton), Robert Otzen. Bauingenieur, vol, 4, no. 16, Aug. 31, 1923, pp. 466-472, 6 figs. Study of problem of impermeability.

AGGREGATE FROM LOCAL DEPOSIT. Concrete Aggregate Produced from Local Deposit, J. A. Garrod. Eng. News-Rec., vol. 91, no. 25, Dec. 20, 1923, pp. 1012-1015, 1 fig. High cost if imported stone and sand, and uncertainty of transportation, lead contractor to screen gravel on job. cu.-yd. cost far below cost from outside sources.

SAND. What Makes a Good Concrete Sand? Edmund Shaw. Rock Products, vol. 26, no. 23, Nov. 17, 1923, pp. 42-43. Explains characteristics of a good fine aggregate according to theories of different authorities.

EXCESS WATER, EFFECT OF. Effect of Excess Water on Concrete. Can. Engr., vol. 45, no. 23, Dec. 4, 1923, pp. 553-554, 3 figs. Control of mixing just as important as regulation of quantity of cement; too much water tends to weaken concrete; method of conducting slump test for measuring consistency. From Concrete Data for Engrs. & Architects.

CONCRETE CONSTRUCTION, REINFORCED

MUNICIPAL WORKS. Reinforced Concrete in Municipal Engineering Works, G. W. Palethorpe. Contract Rec. & Eng. Rev., vol. 37, no. 46, Nov. 14, 1923, pp. 1086-1087. Advantages and disadvantages of use of reinforced concrete; list of municipal works upon which it has been used; notes on actual handling of the material in construction of works.

CONCRETING

COLD-WEATHER. Concrete Work Done in Very Cold Winter Weather, M. A. Burbank. Ry. Rev., vol., 73, no. 21, Nov. 24, 1923, pp. 735-736, 3 figs. Describes building of reinforced-concrete culvert in November and December 1922 in British Columbia, with temperature ranging from 20 deg. above zero to 53 deg. below.

CONDENSERS, STEAM

SPECIFICATIONS. Condenser Specifications and Bids for Detroit Municipal Plant Power, vol. 58, no. 24, Dec. 11, 1923, pp. 934-936. Presents initial tabulation of condenser bids, illustrating methods employed.

CONVEYORS

BAND. Conveyors. Sci. & Art of Min., vol. 34, no. 7, Oct. 27, 1923, pp. 102-103, 4 figs. Describes band, its advantages and disadvantages; Sutcliffe belt conveyor; suspended rough conveyor.

CHAIN SYSTEM. Conveyor System in Continuous Motion. Iron Age, vol. 112, no. 24, Dec. 13, 1923, pp. 1594-1595, 4 figs. Handles windshields frames into tanks and through ovens without pause; capacity 3000 pieces in 9 hr.; installed in plant of Ternstedt Mfg. Co., Detroit.

CHEMICAL WORKS. The Use of Conveyors in Chemical Works, H. Seymour. Chem. Age (Lond.), vol. 9, no. 232, Nov. 24, 1923, pp. 565-566. Discusses continuous and pneumatic conveyors.

COLLAPSIBLE, FOR CARGO HANDLING. Telescopic Power Conveyor for Ship Cargo Handling, G. F. Nicholson. Belting, vol. 23, no. 5, Nov. 1923, pp. 31-32, 1 fig. Collapsible conveyor, it is claimed will revolutionize vessel freight handling; designer describes epuipment capacity 125 tons per hr.

SHAKING. The Operation of Shaking Conveyors with the Aid of Auxiliary Cylinders Der Rutschenbetrieb mit Hilfszylindern) J. Soballa. Glückauf, vol. 59, no. 44, Nov. 3, 1923, pp. 1005-1009, 8 figs. Describes design and operation of auxiliary cylinders and arrangement and operation of a conveyor with such cylinders; advantages.

CORES

COREBOX CONSTRUCTION. Large Core Box Construction, Jas. Edgar. Metal Industry, (Lond.) vol. 23, no. 22, Nov. 30, 1923, pp. 491-492, 4 figs. Methods of construction.

CORROSION

MINE WATERS, IN. Corrosion in Mine Waters, and Recent Investigations of it by the U.S. Bureau of Mines, Robert J. Anderson and George M. Enos. Am. Soc. Steel Treating—Trans., vol. 6, no. 5, Nov. 1923, pp. 587-610 and 647, 20 figs. Discusses problem of corrosion in general way, especially as applied to corrosion of metals and alloys in acid mine waters; results and photomicrographs of long-time immersion tests on 45 metals and alloys; describes accelerated electrolytic corrosion test apparatus. Bibliography.

COUPLINGS

SELECTION AND APPLICATION. Factors Affecting Use of Rigid and Compression Couplings When Employed in Connecting Line Shafting in the Mechanical Transmission of Power in Industrial Works, Frank E. Gooding. Indus. Engr., vol. 81, nos. 10, 11, and 12, Oct., Nov. and Dec. 1923, pp. 499-501 and 517-518; 529-533 and 564; and 579-583 and 590, 37 figs. Oct.; Use of rigid, sleeve, clamp and compression couplings. Nov.: Various types of flexible couplings, their characteristics and applications in connecting shafts of two machines in a direct line or of a driven machine to its driving mechanism. Dec.: Possible sources of trouble in operation attributed to flexbile couplings, and considerations to be observed when installing them.

COST ACCOUNTING

AERIAL TRANSPORTATION. Cost Accounting in Aerial Transportation, Earl D. Osborn. Aviation, vol. 15, no. 21, Nov. 19, 1923, pp. 628-630. Problem of accountant is so to group elements of expense that directors may have clear mental picture of cost; maintenance ledger account; depreciation; miscellaneous accounts; cost records.

INVENTORY METHODS. Making Short Work of Inventory Taking. Factory, vol. 31, no. 6, Dec. 1923, pp. 764-766, 4 figs. Plans and ideas used successfully by manufacturers in making inventory period a part of well-managed routine rather than cost confusion once or twice a year.

CRANES

BRIDGE-ERECTING. Large Bridge-erecting Cranes for India. Engineer vol. 136, no. 3543, Nov. 23, 1923, pp. 566-567, 4 figs. To be used on North-Western Ry. of India for purpose of reconstructing and strengthening number of bridges on that system total weight is 136 tons.

CULVERTS

TESTS. Flow Tests for Clay and Metal Culvert Pipe. Eng. Wld., vol. 23, no. 5, Nov. 1923, pp. 287-290, 8 figs. Describes tests carried out by U.S. Bur. Public Roads at hydraulic laboratory of State Univ. of Iowa, to determine accurately effect of friction on flow of water through culverts and entrance losses at culverts inlet.

CUPOLAS

IRON MELTING IN. Describes Cupola Reactions, Jaime Coll. Foundry, vol. 51, no. 23, Dec. 1, 1923, pp. 961-962. Reference to and conclusions from contemporary literature on many phases incident to process of melting iron in cupola furnace. (Absrtact.) Paper presented before Int. Foundry Congress, Paris.

Observes Melting in Cupola, John Grennan. Foundry, vol. 51, no. 22, Nov. 15, 1923, pp. 908-910, 1 fig. Conditions during heat observed through holes in cupola steel indicate melting takes place over extended length depending on variation of sections of stocks. Paper presented before Am. Foundrymen's Assn.

CURVES

FITTING. Method of Least Squares and Curve Fitting, H. S. Uhler. Optical Soc. Am.—Jl., vol. 7 no. 11, Nov. 1923, pp. 1043-1046. Author exposes certain tacit insidious potential sources of confusion permeating many writings on method of least squares and deduces compact rigorous formulas for all important cases that can arise in adjusting straight line to set of observed points in two dimensions.

D

DAMS

STAVE LAKE, B.C. Blind Slough Dam at Stave Lake, B.C., A. F. Tredcroft. Can. Engr., vol. 45, no. 23, Dec. 4, 1923, pp. 541-544, 6 figs. Describes sluice dam which is one of an important series of hydro-electric developments being undertaken by British Columbia Elec. Ry. Co., in Stave and Alouette Lakes Region; details of construction methods employed; 640 ft. in length and consists of 10 bays of stop logs and 4 bays in which Tainter gates are installed with concrete approaches, parapets, etc.

EARTH. Damaged Earth Dam Repaired by Hydraulic Fill, M. E. Bunger. Eng. News-Rec., vol. 91, no. 17, Oct. 25, 1923, pp. 674-676, 4 figs. Over 300,000 cu. yd. pumped into embankment, reduced by settlement and wave action; pump fed by drag bucket.

DIE CASTING

MACHINES. Develop Die Casting Machine, E. B. Kreutzberg. Foundry, vol. 51, no. 24, Dec. 15, 1923, pp. 1000-1001, 2 figs. Device patented by E. N. Dollin, interesting feature of which is valve control apparatus by which air from high-pressure system exhausts into low-pressure system.

Interesting Die Casting Machine. Brass World, vol. 19, no. 11, Nov. 1923, pp. 365-366, 2 figs. Describes high-producing machines, developed by E. N. Dollin, running over 200 operations per hr. on many long-run jobs.

DIESEL ENGINES

CENTRAL-STATION. The Economical Operation of Diesel Engine, C. Mendelsohn. Elec. World, vol. 82, no. 19, Nov. 10, 1923, pp. 970-971, 2 figs. Results obtained from Diesel-engine generating plant of two units in Arizona belonging to Old Dominion Co.; each unit, comprises vertical 5-cylinder, 2-stroke-cycle Nordberg-Carels Diesel engine, with directly connected 850-kva., 2300-volt, 3-phase, 60-cycle a.c. generator.

COMPRESSORLESS. Compressorless Diesel Engines (Kompressollose Dieselmotoren), Otto Günther Motorwagen, vol. 26, nos. 26, 28 and 29-30, Sept. 20, Oct. 10 and 20-31, 1923, pp. 387-392, 423-427 and 437-440, 12 figs. Modern development of Diesel engines with compressor for small and medium-size, slow- and high-speed machines: thermotechnical and economic conditions; recent theories on working process in Diesel engines, ignition-point testing. and combustion; influence of eliminating air of injection; description of principal German and foreign compressorless U-boat engines.

DRAWINGS

SCHEDULING AND PROGRESS-RECORDING. Scheduling and Progress-Recording of Drawings, Irwin Hoffman, Machy. (N.Y.), vol. 30, no. 4, Dec. 1923, pp. 296-297, 4 figs. Describes system followed out and developed by writer which has proved successful in drafting rooms of large contracting company.

DREDGES

LARGE. Some Great Dredges, J. F. Springer. Sci. Am. vol. 129, no. 6, Dec. 1923, pp. 394-395, 4 figs. Details of monster grab buckets that are able to take 50 tons of mud and rock at single bite.

E

ECONOMIZERS

DESIGN. Status of Economizer Construction and Its Future Development (Stand des Ekonomiserbaues und seine künftige Entwicklung), H. Seeberger. Wärme, vol. 46, nos, 42 and 44, Oct. 19 and Nov. 2, 1923, pp. 459-461 and 483-484, 1 fig. Investigation of purpose of economizer; designs and adjustment; injurious effect on strength of economizer through chemical influences, mechanical action and other operative influences; requirements of design to offset these injurious effects.

ELECTRICAL APPARATUS

HIGH-TENSION. Electrical Apparatus for High-Tension Power Transmission, Stephen Q. Hayes. Elec. Jl., vol. 20, nos. 11 and 12, Nov. and Dec. 1923, pp. 401-407 and 466-474, 36 figs. Deals with transformers for developing and using high tension; bushings suitable for high-tension apparatus; oil circuit breakers for switching high-tension circuits; disconnecting switches for isolating oil breakers; lightning arresters; arrangements of transformers and switchgear suitable for high-tension on installations.

ELECTRIC CURRENTS

SHORT-CIRCUITS. Short Circuit Phenomena, G. L. E. Metz. Electrician, vol. 91, no. 2375, Nov. 23, 1923, pp. 568-570, 3 figs. A complex subject; importance of transient currents; influence of effective field flux and synchronous reactance.

ELECTRICAL EQUIPMENT

PROTECTION. Protection of Electrical Equipment, Victor H. Todd. Power Plant Eng., vol. 27, no. 21, Nov. 1, 1923, pp. 1083-1087, 10 figs. Protection of generators; guarding against overloads; mechanical troubles; failure of lubricating system.

ELECTRIC LAMPS, INCANDESCENT

MACHINES FOR. Incandescent Lamp Machinery. Machy. (N.Y.), vol. 30, no. 4, Dec. 1923, pp. 257-258, 2 figs. Describes machines employed for forming tube in end of lead wires, and for welding filament and lead wires together.

ELECTRIC-FURNACES

ALLOY-MELTING. Improved Electric Melting Furnace for Alloys, T. F. Bailey. Chem. & Met. Eng. vol. 29, no. 24, Dec. 10, 1923, pp. 1062-1063, 3 figs. New type of radiant dome electric furnace installed in plant of Miller Industries, Canton, O.

SEALING METALS THROUGH GLASS. The Art of Sealing Base Metals Through Glass, William G. Houskeeper. Am. Inst. Elec. Engrs.—Jl., vol. 42, no. 9, Sept. 1923, pp. 954-960, 16 figs. Describes methods by which base metals may be sealed to and through glass, even though metal and glass have different coefficients of thermal expansion; discusses four different types of seals.

DEVELOPMENTS. The Development of the Electric Incandescent Lamp, Bernard P. Dudding and Colin J. Smithells. Beama, vol. 13, nos. 66 and 67, Oct. and Dec. 1923, pp. 221-229 and 342-349, 21 figs. Oct.: Laws and luminosity value of radiation; platinum and carbon filament lamps; Nernst lamp; tungsten filaments; gas-filled lamps. Dec.: Lamps manufacture; testing; leading-in-wires.

ELECTRIC LOCOMOTIVES

GEN. ELEC. CO. Electric Locomotives for the Paris-Orleans Railway and the Mexican Railway. Ry. & Locomotive Eng., vol. 36, no. 12, Dec. 1923, pp. 380-381, 3 figs. Results of speed tests and description of new type built by Gen. Elec. Co. and Am. Locomotive Co. for French railways; also gives details and test results of new locomotive for Mexican Ry. Co.

INDUSTRIAL PLANTS. Saving upon Internal Transport, C. S. Darling. Power Engr., vol. 18, nos. 211 and 212, Oct. and Nov. 1923, pp. 370-374 and 414-416, 10 figs. Survey of requirements to be met by satisfactory locomotives for works use and description of typical suitable electric locomotives for this purposes; actes on costs.

Passenger. Electric Locomotives Tested at Erie. Elec. Ry. Jl., vol. 62, no. 23. Dec. 8, 1923, pp. 986-970, 2 figs. Dimensions and data of 120-ton Paris-Orleans locomotive designed for high-speed passenger service, and of 150-ton Mexican Railway freight locomotive; Paris-Orleans locomotive developed 105 m. p.h. in preliminary tests; 150-ton locomotive has "tug-of-war" with Mikado-type steam engine.

Twin-Motor Drive. Individual-Axle Drive by Twin Motors for Electric Locomotive J. Werz. Elecn., vol. 91, no. 2372, Nov. 2, 1923, p. 488, 2 figs. Advantages of twin motor over single machine are said to be: smaller weight, smaller space occupied, better power factor, smaller inertia in rotating masses, series connection of two armatures (lighter apparatus), and simpler construction; disadvantages: more numerous bearings, limitations in lengths of motor axes, and inaccessibility of commutators. (Abstract.) Translated from Elektrotechnische Zeit.

ELECTRIC MOTORS, A.C.

Synchronous. An Analysis of the Synchronous Motor, A. Dawes Du Bois. West. Soc. Engrs.—Jl., vol. 28, no. 11, Nov. 1923, pp. 512-529, 11 figs. Fundamental principles of synchronous motor operation; analysis by vector diagrams of phenomena occurring in synchronous motor under conditions of varying field excitation with method for plotting "V" or excitation curves for different loads, so as to determine power-factor corrections to be expected.

Induction. Induction Motors for Medium and Large Outputs. Beama, vol. 13, no. 68, Dec. 1923, pp. 377-381, 11 figs. New line of machines constructed by English Elec. Co. covers outputs ranging from 100 to 10,000 hp., and are intented for use on 3-phase, 50-cycle circuits at pressures from 2200 to 6600 volts.

ELECTRIC MOTORS

Series, Single-Phase. Single-Phase Series Motors, G. Fox. Southern Engr., vol. 40, no. 4, Dec. 1923, pp. 40-45, 8 figs. Deals with simple, neutralized, and inductively-neutralized series motors, single-phase series induction motors, series induction motor with rotor excitation, and commutation.

ELECTRIC RAILWAYS

London, England. The Golders Green-Hendon Extension, London Electric Railway. Ry. Gaz., vol. 39, no. 21, Nov. 23, 1923, pp. 645-647, 9 figs. partly on pp. 650-651. Engineering features; notes on stations and signaling, traffic facilities and cost of new works, new rolling stock, train services and fares.

ELECTRIC SWITCHES

High-Voltage. High-Voltage Switches, Bushings, Lightning Arresters, Ha Michener. Am. Inst. Elec. Engrs.—Jl., vol. 42, no. 12, Dec. 1923, pp. 1251-1254, 3 figs. Experiences of Southern Cal. Edison Co. on its 60,000, 150,000 and 220,000 volt system.

ELECTRIC TRANSMISSION LINES

Long-Distance. Calculation of Long-Distance Transmission Lines (Calcul des lignes de transmission à grande distance) Darrieus. Societé Française des Electriciens Bul., vol. 3, no. 28, Aug.-Oct. 1923, pp. 534-572, 7 figs. Shows that a line provided with "flat" regulation can be considered as constituting an arrangement free from a return wave and of optimum efficiency according to point of view developed by Boucherot.

Costs. Line and Substation Costs. Elec. World, vol. 82, no. 23, Dec. 8, 1923, pp. 1159-1163, 3 figs. Comparison of costs of 66-kv., 110-kv. and 132-kv., lines and substations; recommended construction of substations and lines; detailed unit costs and discussion of overhead costs. (Abstract.) Report of transmission line committee presented before Empire State Gas & Elec. Assn.

Rural. Economical Design for Rural Lines, Howard P. Seelye. Elec. Light & Power, vol. 1, no. 11, Nov. 1923, pp. 13-16 and 56, 6 figs. Discusses question of building most economical line possible to provide quality of service which is demanded by farmer.

Grounding. Present Day Practices in Grounding of Transmission Systems. Am. Inst. Elec. Engrs.—Jl., vol. 42, no. 9, Sept. 1923, pp. 928-946, 7 figs. First report of subcommittee on grounding of protective devices.

110-Kv. 110-Kv. Transmission Line for Oak Grove Development of Portland Railway, Light and Power Company, H. R. Wakeman and W. H. Lines. Am. Inst. Elec. Engrs.—Jl., vol. 42, no. 9, Sept. 1923, pp. 891-893. Deals with design of line to transmit energy from new Oak Grove development to city of Portland, Ore., distance of 54 mi.

Insulation of Anchors and Tower Supports. Insulation Design of Anchors and Tower Supports for 110,000-Volt 4427-Foot Span Over Carquinex Straits, L. J. Carbett. Am. Inst. Elec. Engrs.—Jl., vol. 42, no. 9, Sept. 1923, pp. 887-890, 7 figs. Compression type of insulation has been adhered to in work carried out during 1922, making crossing unique among long high-voltage spans; methods by which problems were solved, hinged anchor structure, sturdy insulated support for towers, moveable top for middle tower support, are described.

ELECTRIC WELDING

Locomotive Repair Shop. Electric Welding in a German Locomotive Repair Shop (Das elektrische Schweissen bei der Werkstatteninspektion Ingolstadt), H. Vollmayr. Organ für die Fortschritte des Eisenbarnwesens, vol. 78, no. 5, May 15 1923, pp. 85-91, 10 figs. Describes methods employed; points out advantages of cold over hot welding.

ELECTRIC WELDING, ARC

Rail Bonds, Copper. Use of Mold Successful in Arc Welding Copper Rail Bonds, Chester F. Gailor. Elec. Ry. Jl., vol. 62, no. 24, Dec. 15, 1923, pp. 1001-1003, 4 figs. Describes two methods of arc welding first employing a carbon electrode and second a copper alloy rod; figures of numerous bond tests.

Tanks. Arc Welding of Fuel Oil Tanks, Pliny P. Pipes. Am. Welding Soc.—Jl., vol. 2, no. 11, Nov. 1923, pp. 20-30. Brief description of construction, entirely by electric-arc-welding process, of four large fuel oil tanks in Equitable Building, New York City.

ELECTRICAL MACHINERY

Commutators, Repair. Successful Repair of Commutators, A. R. Knapp. Power Plant Eng., vol. 27, no. 23, Dec. 1, 1923, pp. 1189-1190, 1 fig. Describes method employed; repairing bars and mica rings.

EMPLOYEES, TRAINING OF

Delco Instruction Course. Business Economics Taught to Workers at Delco Plant, Harry Tipper. Automotive Industries, vol. 49, no. 24, Dec. 13, 1923, pp. 1194-1195. Purpose of new course is to give employees clear conception of structure of industry and to develop individual thought.

Disabled. Training and Employment of Disabled Workmen in the Ford Plant. Monthly Labor Rev., vol. 17, no. 5, Nov. 1923, pp. 173-174. How disabled employees are placed so that their maximum ability can be realized.

EVAPORATION

Multiple-Effect. Fundamental Principles of Multiple Effect Evaporation, Hugh K. Moore. Chem. & Met. Eng., vol. 29, no. 25, Dec. 17, 1923, pp. 1102-1105, 3 figs. Deals with fundamentals of process; evaporator design and operation; problem of evaporating waste sulphite liquor.

Pulp Industry. Some Evaporator Problems Met in the Paper Pulp Industry, George K. Spence. Chem. & Met. Eng., vol. 29, no. 22, Nov. 26, 1923, pp. 972-973. Critical review of process and equipment from operator's viewpoint, both in soda and sulphate pulp mill and in sulphite mill.

The Case for the Multiple Effect Evaporator in the Pulp Mill, H. Austin. Chem. & Met. Eng., vol. 29, no. 22, Nov. 26, 1923, pp. 974-975, 1 fig. Recovery of black liquor important bearing on problems of evaporator designs and operation.

EXPLOSIVES

Detonation. The Detonation of Explosives. Ariz. Min. Jl., vol. 7, no. 10,, Nov. 15, 1923, pp. 7 and 37-38. Theory of detonation; elements of explosives action: characteristics of explosives.

F

FERRO-ALLOYS

Manufacture. The Manufacture of Ferro-Alloys, J. A. Holden. Foundry Trade Jl., vol. 28, nos. 375, 378, 380 and 381, Oct. 25, Nov. 15, 29 and Dec. 6, 1923, pp. 359-360, 418, 461-462 and 485. Oct. 25: Ferro-chrome. Nov. 15: Ferrosilicon. Nov. 29: Thermit ferro-tungsten, Dec. 6: Electric-furnace ferro-tungsten.

FIRE EXTINGUISHERS

Fireproofing Agents, and. Fireproofing and Fire-Extinguishing Agents. Chem. Trade Jl., & Chem. Engr., vol. 73, no. 1904, Nov. 16, 1923, pp. 573-575. Summary of modern developments. Use of ammonium compounds, boric acid compounds, magnesium compounds, compounds of zinc and aluminum, tin and antimony compounds, and compounds of tungsten and zirconium; fireproofing with water glass; organic fire-profing agents; methods of application and testing, etc.

FIRE PROTECTION

Sprinkler Tanks. Heating Elevated Steel Springler Tanks. C. D. Abbott. Nat. Fire Protection Assn.—Quaterly, vol. 16 no. 2, Oct. 1922, pp. 186-194, 3 figs. Describes tests carried out to determine heat losses from steel sprinkler tanks and performances of steam-heated water circulating tank heaters, and results obtained; tables giving recommended sizes of acceptable heaters for tanks of various sizes.

FILTERS

Sewage, Surface Ponding of. Surface Ponding of Sewage Filter Beds and its Elimination, F. W. Harris. Surveyor, vol. 64, no. 1659, Nov. 2, 1923, pp. 327-328. Points out that as method of inoculation and as means of augmenting reserve of colonized media, infiltration of small insects has proved most successful; descriptive notes on filters and their previous and present condition.

FIRE FIGHTING

Sprinklers Tests. Automatic Sprinkler Tests. Nat. Fire Protection Assn.—Quarterly, vol. 17, no. 2, Oct. 1923, pp. 159-161, 2 figs. Tests carried out by Tennessee Inspection Bur. on 8-head sprinkler branch line to determine pressure and discharge from each sprinkler head with line installed in accordance with present standards.

FIRECLAYS

Brick. New Fire Clay Brick. Iron Age, vol. 112, no. 23, Dec. 6, 1923, p. 1508, 2 figs. Uniformity in size claimed as feature; advantages for blast-furnace linings.

FLIGHT

Ceiling. Note on the Graphical Resolution of the Equations of Horizontal Flight and the Determination of Ceiling (Note sur la résolution graphique des équations du vol horizontal et la détermination du plafond), M. Alayrac. Bul. Technique du Bureau Veritas, vol. 5, no. 9, Sept. 1923, pp. 184-186, 7 figs. Deduces graphical method from general conclusions on influence of various elements in conditions of flight, and indicates new method of determining ceiling which necessitates only construction of two curves.

Two-Dimensional Motion of Lamina. The Two-Dimensional Motion of a Lamina in a Resisting Medium under the Action of a Propeller Thrust, S. Lister. Lond. Edinburgh, and Dublin Philosophical Mag. & Jl., Sci., vol. 46, no. 275, Nov. 1923, pp. 819-827, 3 figs. Refers to investigation by Lanchester and Brodetsky of "phugoids" or flight curves" of lamina moving in resisting medium under no external forces other than its own weight; present paper extends investigation by introduction of propeller thrust.

FLOORS

Concrete. Self-Supporting Reinforcement for Concrete Floor. Eng. News-Rec., vol. 91, no. 23, Dec. 6, 1923, pp. 921-922, 3 figs. I-beams with flanges slit and bent to provide integral shear members carry steel forms; rods and wire mesh.

Concrete Floor Hints for Contractors. Eng. & Contracting (Bldgs.), vol. 60, no. 3, Sept. 26, 1923, pp. 662-665. Useful notes and information from Portland Cement Assn. on heavy-duty floors, terazzo floors, colored floor finish, floor treatment and concrete floor coverings.

FORESTRY

Fire Protection. Forest Fire Control Problems and Progress, Roy Headley, Nat. Fire Protection Assn.—Quarterly, vol. 17, no. 2, Oct. 1923, pp. 108-117, 3 figs. Discusses speed in reaching fires; mountain lookout stations; airplanes for forest fire detection; fire-fighting methods. See also article on Protection of Forest Lands. pp. 118-120, 1 map.

FLOW OF WATER

Resistance of Structures in Rivers. The Resistance of Structures in Rivers and Other Open Channels against the Flowing Water (Der Widerstand von Einbauten in Flüssen und anderen offenen Gerinnen auf des strömende Wasser), H. Krey. Bautechnik, vol. 1, nos. 40-41, Sept. 21, 1923, pp. 415-416, 3 figs. Describes method of calculation.

FLUE-GAS ANALYSIS

Duplex-Mono Recorder. The "Duplex-Mono" Flue Gas Recorder. Eng. & Boiler House Rev., vol. 37, no. 4, Oct.-Nov. 1923, pp. 108-110, 4 figs. Describes practical way of determining critical point in composition of flue gases where a furnace is working at its highest efficiency; describes Duplex-Mono instrument which automatically records both CO_2 and CO content.

Gas Sampling. Sampling of Boiler Flue Gases, T. G. Otley. S. African Instn. Engrs.—Jl., vol. 22, no. 3, Oct. 1923, pp. 37-40 (includes discussion), 1 fig. Note stressing difficulty of obtaining really reliable gas samples and explaining why such divergent results are sometines obtained by different observers on same test; gives results of experiments made showing variation of CO_2 percentage in products of combustion at various points across width of boiler uptake before entering economizer and across economizer uptake between economizer and chimney.

FOUNDRIES

Problems. The Present Position of Some Debatable Points in Foundry Practice, V. C. Faulkner, Foundry Trade Jl., vol. 28, no. 377, Nov. 8, 1923, pp. 390-392 and (discussion) 392-395. Discusses technical instruction, semi-steel, pearlitic cast iron and semi-steel sulphur in cast steel, separating charges in cupola, and long-life molds.

FREIGHT HANDLING

Claim Prevention. Less Damage to Freight by Rough Handling, C. F. Polzin. Ry. Age, vol. 75, no. 23, Dec. 8, 1923, pp. 1057-1059, 2 figs. What locomotive engineer can do to help reduce claim and damage cause; timely and proper use of brake valves can help. Abstract of article which won prize offreed by C. & N. W. Ry. for best paper on prevention of freight damage caused by rough handling.

Terminal Service. A Study in L. C. L. Freight Terminal Service. Ry. Rev., vol. 73, no. 21 Nov. 24, 1923, pp. 747-750, 6 figs. Chicago junction railway files new inbound less-than-carload freight service supplementing previous similar arrangement for outbound less-than-carload freight which has been operating successfully; describes complete freight service, particularly in its aspect of affording terminal service in its combination with warehousing.

FUELS

Coal-Slime Utilization. Utilization of Coal Slimes of High Ash and Low Volatile Content (Utilisation des schlamms cendreux et pauvres en matières volatiles), Ch. Hanot. Revue Universelle des Mines, vol. 19, no. 2, Oct. 15, 1923, pp. 79-114, 15 figs. Recovery and washing of slimes; combustion in hand-and stoker-fired furnaces; possible efficiencies and costs; consumption in gas producers or in pulverized form.

Low-Grade, Utilization of. Utilization of Low-Grade Fuels (Utilisation des combustibles inférieurs), A. Verbrugghen. Awsociation des Ingénieurs Sortis des Ecoles Spéciales de Gand — Annales, vol. 13, no. 3, 1923, pp. 183-196. Discusses their utilization in pulverized form and without grinding in special furnaces.

Research. Some Aspects of the Fuel Problem C. H. Lander. Chem. & Industry, vol. 42, no. 44, Nov. 2, 1923, pp. 1052-1056. Results of recent work carried out by Fuel Research Board, dealing with coal survey, methods of sampling and analysis, gas standards, steaming in vertical retorts, low-temperature carbonization and power alcohol.

See also Coal; Oil Fuel; Pulverized Coal.

FURNACES, ANNEALING

Testing. Practical Points on Testing Annealing Stoves. Foundary Trade Jl., vol. 28, no. 381, Dec. 6, 1923, p. 474. Points out advantages gained by employing draft gages.

FURNACES, HEAT-TREATING

Selection. Some Observations on Furnaces and Fuels Including the Electric Furnace for Heat Treating, E. F. Collins. Am. Soc. Steel Treating—Trans., vol. 4, no. 6, Dec. 1923, pp. 709-724 and (discussion) 724-726. Points out that furnaces should be fitted to processes rather than attempting to fit special processes to standard furnaces; adaptability of electric heat-treating furnace of metallic resistor type for carbon-steel heat treatment.

FURNACES, INDUSTRIAL

Hydraulic Theory of. Critical Study of Industrial Furnaces from the Standpoint of the Author's Theory Based on the Laws of Hydraulics (Etude critique des foyers industriels d'après la théorie de l'auteur basée sur les lois de l'hydraulique), W.-E. Groume-Grjimailo. Revue de Métallurgie, vol. 20, no. 10, Oct. 1923, pp. 687-693, 7 figs. Examination of Schurmann cupola, a steam boiler with preheated-air supply and an open-hearth furnace with divided flame.

G

GAGES

Pitch Measurement. The Mechanical Measurement of Pitch, H. T. Wright. Machy. (Lond.), vol. 23, no. 582, Nov. 22, 1923, pp. 236-239, 8 figs. Method of recording and analysis of test results; describes pitch-measuring machines.

GALVANIZING

Crystallization Effects on Galvanized Iron. Crystallization Effects on Galvanized Iron. J. W. Hannah and E. L. Rhead. Inst. Metals—advance paper, no. 14, for meeting Sept. 10-13, 1923, 15 pp., 6 figs. Results of investigations show that spangle is independent of nature of steel sheet; pure zinc alone is incapable of producing spangle.

Welding Galvanized Vessels. How to Prevent Melting Off and Evaporation of the Galvanized Deposit in Welding Galvanized Iron Vessels (Wie ist das beim Schweissen verzinkter Eisenfässer auftretende Abschmelzen und Verdampfen der Verzinkung zu Behindern), B. Haas. Zeit. für die gesamte Giessereiprazis, vol. 44, nos. 37-38, Sept. 22, 1923, pp. 77-78. Points out that only means of combating effect of high welding heat is to cover welding surfaces and surrounding highly heated metal surfaces with such metal coatings as will at least retard development of vaporous zinc oxide and melting of galvanized deposit.

GAS MAINS

Cast-Iron, Brazed Joint for. Brased Joints for Cast-Iron Gas Mains, A. F. Bridge and M. R. Thompson. Gas Age-Rec., vol. 52, no. 23, Dec. 8, 1923, pp. 699-703, 8 figs. Describes new joint consisting of a Tobin bronze collar applied to plain-end cast-iron pipe by means of an oxy-acetylene torch; strength of brazed joint; De Lavaud centrifugally cast pipe; results of tests and observations of cast-iron pipe joints; comparative costs of pipe joints; results of tensile strength tests with new joint.

GAS PRODUCERS

Ash-Fusion. Investigations on the Operation of Ash-Fusion Gas Producers (Untersuchungen über den Betrieb des Abstichgaserzeugers), A. Wilhelmi. Stahl u. Eisen vol. 43, no. 46, Nov. 15, 1923, pp. 1419-1437, 3 figs. Notes on design and operation; metallurgical phenomena; ash-fusion producer as blast furnace; maximum permissible ash content of fuel; economical features.

GASES

Air Entertainment by Jet. The Entertainment of Air by a Jet of Gas issuing from a Small Orifice in a Thin Plate, J. S. G. Thomas and E. V. Evans. Lond., Edinburgh, and Dublin Philosophical Mag. & Jl. Sci., vol. 46, no. 275, Nov. 1923, pp. 785-801, 5 figs. Consideration of dependence of air enterainment by jet of gas upon density of gas in jet and upon density of air into which jet issues; experiments were confined to hydrogen, coal gas, air, and carbon dioxide.

Compressibility. On the Compressibility at 0 Deg. Cent. and Below 1 Atmos. and the Deviation from the Avogadro Law of Oxygen, Hydrogen and CO_2 (Sur la compressibilité à 0o et au-dessous de 1 atmosphère et l'écart à la loi d'Avogadro de plusieurs gaz. I—Oxygène, hydrogène et anhydride carbonique), P. A. Guye and T. Batuecas. Journal de Chimie Physique, vol. 20, no. 3, Oct. 1, 1923, pp. 308-336, 4 figs. Results of extended experiments at laborarory of physical chemistry, Univ. of Geneva.

Volume Changes Under High Pressures. The Volume Changes of Five Gases Under High Pressures, P. W. Bridgman. Nat. Acad. Sciences—Proc., vol. 9, no. 11, Nov. 1923, pp. 370-372. Summarizes most important numerical results of a recent investigation on effect of pressure on volume of hydrogen, helium, ammonia, nitrogen and argon.

GASOLINE

Vapor Pressure of. The Vapor Pressures of Gasolines and Light Petroleum Naphthas, F. H. Rhodes and E. B. McConnell. Indus. & Eng. Chem., vol. 15, no. 12, Dec. 1923, pp. 1273-1275, 5 figs. Method for exact determination of vapor pressures of gasoline; measurement of vapor pressures of several different types of gasolines and naphthas; it is shown that no general relation exists between vapor pressure of gasoline and its average distillation temperature or its density.

GEARS

Chucking for Grinding. Chucking Gears for Grinding. Eng. Production, vol. 6, no. 135, Dec. 1923, pp. 487-489, 14 figs. Details of number of efficient methods.

Design. New Applications of Involute Forms Developed in Recent Years, E. W. Miller. Automotive Industries, vol. 49, no. 22, Nov. 29, 1923, pp. 1108-1110, 7 figs. It is claimed that many toothed wheels are being made which cannot receive approval of engineers; close study of minute errors. (Abstract.) Paper read before Am. Gear Mfrs. Assn.

Development of industry. Development of the Gear Industry. E. W. Miller. Machy. (N. Y.), vol. 30, no. 4, Dec. 1923, pp. 265-269, 13 figs. Importance of finding new uses for gearing, and examples illustrating possibilities. (Abstract.) Paper read before Am. Mfrs.' Assn.

Manufacture. Attain Success Specializing in Gear Service, G. L. Ord. Can. Machy., vol. 30, no. 22, Nov. 29, 1923, pp. 13-17, 12 figs. Design and manufacture of gears at plant of Hamilton Gear and Machine Co., Toronto.

Milled, Analysis of. Analysis of Milled Gears, E. Wildhaber and E. Buckingham. Am. Mach., vol. 59, no. 21, Nov. 22, 1923, pp. 757-759. Determination of error in using cutter of wrong number; modification of cutting depth; excess depth of cut for backlash.

Testing. Modern Problems in Gear Testing and a Proposed Testing Machine, Wilfred Lewis. Am. Mach., vol. 59, no. 24, Dec. 13, 1923, pp. 875-881, 8 figs. Purpose of proposed tests will be determination of effect varying degrees of tooth accuracy and varying velocities on strength of gear teeth. Paper read before Am. Gear Mfrs'. Assn.

GEOLOGY

Engineering, Application to. Modern Geology and Its Contribution to Engineering, Morris M. Leighton. West Soc. Engrs.—Jl., vol. 28, no. 11, Nov. 1923, pp. 491-506, 5 figs. Explains theory of formation of earth now most generally accepted by geologists; advances new beliefs regarding structure of earth; experiments indicated that it is more rigid than if it had been constructed of solid steel; practical application of fundamentals of geological knowledge to engineering.

GRAVEL PLANTS

Electrically Operated. The Forreston Gravel Plant, W. A. Gelbach. West Soc. Engrs.—Jl., vol. 28, no. 11, Nov. 1923, pp. 507-511. Describes newly completed gravel washing plant erected for purpose of furnishing clean ballast for railway tracks; it is entirely electrically operated, requiring crew of only 13 men for production of 50 cars of gravel per day of 10 hr.

GRINDING MACHINES

Central-European Types. European Abrasive Equipment, B. Scrapira. Abrasive Industry, vol. 4, nos. 10, 11 and 12, Oct. Nov. and Dec. 1923, pp. 283-285, 321-322 and 356-357, 9 figs. Describes precision grinding machines of various types made by prominent Central-European machine-tool builders; three types of German grinding machines, vertical-spindle and disk-wheel-type surface grinders are in common use.

Gear. Automatic Gear Grinder. Iron Age, vol. 112, no. 25. Dec. 20, 1923, pp. 1649-1650, 3 figs. New unit, marketed by Fellows Gear Sharper Co., with adjustable involute control; separate instrument for detecting errors.

H

HANDLING MATERIALS

Barrel-Stacking Machine. A New Barrel-Stacking Machine. Indus. Management (Lond.), vol. 10, no. 10, Nov. 15, 1923, pp. 280-281, 1 fig. Device for handling barrels and objects of similar form, such as newsprint reels, drums, hogsheads of tobacco, etc.

Cost Accounting. Profit or Loss in Material Handling, Jas. A. Shepard. Management & Administration, vol. 6, no. 6, Dec. 1923, pp. 739-742. False burden figures are said to hide truth in most plants; economy of efficient handling methods.

Open-Ground-Stored Materials. Storage of Minerals on Open Ground. Considered in Relation to Reclaiming Requirements, Herbert Blyth. Chem. Age (Lond.), vol. 9, no. 232, Nov. 24, 1923, pp. 562-564, 7 figs. Problems of storing minerals on large open spaces considered in relation to necessity for frequent and complete recovery of material from stock heap without hand labor. Describes four systems which provide for double duty of dumping and reclaiming, viz., conveyor method, simple transporter system with fixed track, transporter operating on rotating gantry, and travelling telpher bridge switched to telpher track.

Warehouses. Materials Handling in the Warehouse, M. W. Potts. Indus. Management (N. Y.), vol. 66, no. 6, Dec. 1923, pp. 337-343, 12 figs. How mechanical equipment increases capacity.

HARDNESS

Brinell Numbers. Brinell Hardness Numbers, H. W. Brownsden. Inst. Metals—advance paper, no. 2, for meeting Sept. 10-13, 1923, 2 pp. Points out desirability of expressing Brinell hardness numbers for non-ferrous metals on some rational basis, so that figures quoted by different authors may be comparable.

HEAT

Conservation of. Progress in the Development of Heat Conservation (Fortschritte in der Entwicklung der Wärmewirtschaft), H. Hilliger. Zeit des Vereines deutscher Ingenieure, vol. 67, nos. 42 and 45, Oct. 20 and Nov. 10, 1923, pp. 981-984 and 1045-1048, 12 figs. Deals with recent tendencies in construction of grates in their relation to design of furnace; importance of pulverized-coal firing in fuel economy; discusses problems of boiler technique, with special reference to heat storage.

HEAT STORAGE

Methods. Thermal Storage, C. E. Stromeyer. Engineer, vol. 136, no. 3544, Nov. 30, 1923, pp. 582-583. Notes on how to supply hot water required in bleaching and similar works and how to supply steam for peak loads in power stations.

HEAT TRANSMISSION

Box Testing Method. Box Method for Detremining Heat Transmission, Arthur J. Wood. Refrig. Eng., vol. 10, no. 5, Nov. 1923, pp. 172-179, 12 figs. Term "box method" applies to various types of calorimeters for determining constants of heat transmission; types of test boxes; advantages and disadvantages; apparatus and method of testing. Report of Insulation Committee.

CONVECTION. Free and Forced Convection of Heat in Gases and Liquids, Chester W. Rice. Am. Inst. Elec. Engrs.—Jl., vol. 42, no. 12, Dec. 1923, pp. 1288-1289 and (discussion) 1289-1293, 4 figs. Discusses methods of attacking problem. (Abridged.)

NUSSELT'S INVESTIGATIONS. The Most Important Researches of W. Nusselt for the Determination of Heat Transmission (Die wichtigsten Forschungsarbeiten von W. Nusselt zur Bestimmung des Wärmeübergangs), H. Schmolke. Dinglers polytechnisches Jl., vol. 338, nos. 17-18, Sept. 15, 1923, pp. 173-176, Review of works based on Nusselt's investigations.

SURFACE TRANSFER. Surface Transfer of Heat, T. S. Taylor. Refrig. Eng., vol. 10, no. 5, Nov. 1923, pp. 179-193, 9 figs. Discusses all factors involved in connection with transfer of heat from surface by all methods of heat flow. Report of Insulation Committee.

HEATING, ELECTRIC

RESIDENCE. Residence Heating by Electricity, E. A. Loew. Elec. World, vol. 82, no. 19, Nov. 10, 1923, pp. 958-962, 6 figs. Field data of energy requirements; temperature and humidity affect results; costs, rates and classified uses.

TUBULAR SYSTEM. A Tubular Electric Heating System. Engineer, vol. 136, no. 3545, Dec. 7, 1923, p. 614, 2 figs. Lightfoot tubular electric heating system originally devised for heating of explosives factories, where low-temperature heat, widely distributed, is required; now being further developed for industrial, commercial and domestic uses.

HEATING, HOUSE

OIL BURNER FOR. The Heating of Houses with Oil, C. H. Chalmers. Am. Petroleum Inst.—advance paper, for meeting, Dec. 11-13, 1923, 8 pp. Notes on domestic oil burner and how it operates.

HIGHWAYS

INVISIBLE-TRACK TYPE. "Invisible Track" Type of Highway. Eng. & Contracting (Roads & Streets), vol. 60, no. 5, Nov. 7, 1923, pp. 956-957, 1 fig. Experimental section being constructed in Kentucky; two reinforced-concrete beams are constructed at approximately 5 ft. from centre to centre, and 18 in. wide, and are covered with 1½ in. of rock asphalt; to assist traffic in following trackways a rise of 3 in. is made between tracks, just enough to indicate where they are.

HOUSING

GARDEN-CITY SCHEME, LONDON. The Garden Cities of Letchworth and Welwyn Near London (Les cités-jardins de Letchworth et de Welwyn, près de Londres), G. B. Lévy. Génie Civil, vol. 83, no. 19, Nov. 10, 1923, pp. 449-453, 6 figs. Details regarding two English model villages, their organization and financing, and advantages they offer to manufacturers.

HYDRAULIC TURBINES

CHARACTERISTIC CURVES. The Characteristic Curves of Reaction and Impulse Turbines and of Centrifugal Pumps, H. W. Coultas. Beama, vol. 13, nos. 67 and 68, Nov. and Dec. 1923, pp. 304-312 and 370-374, 8 figs. Construction and application. Curves for a centrifugal pump.

CHEMICAL MEASUREMENTS. Recent Applications of Chemical Measureing Methods in Hydro-electric Plants in Dutch East Indies (Over eenige recente toepassingen der chemische debietmeetmethode bij den dienst voor waterkracht en electricieit in Nederlandsch-Indië), C. G. J. Vreedenburgh. Waterstaats Ingenieur, vol. 11, no. 5, May 1923, pp. 135-145, 21 figs. on supp. plates. Chemical measurement on one of the newly erected turbine sets in hydro-electric station at Bengkok for control of useful effect guaranteed by makers.

DESIGN AND DEVELOPMENT. Waterwheel Construction and Governing, E. M. Breed. Am. Inst. Elec. Engrs.—Jl., vol. 42, no. 12, Dec. 1923, pp. 1261-1263. Review of developments; problems of design; advantages gained by use of propeller-type runner.

DRAFT TUBES. On the Dynamic Similarity of a Draft Tube and Its Model (Sur la similitude dynamique d'un tube d'aspiration et de son modèle). A. Foch Académie des Sciences—Comptes Rendus. vol. 177, no. 19, Nov. 5, 1923, pp. 868-869. Shows how efficiency of a draft tube can be determined from tests of a small model.

GOVERNORS. Governors for Hydraulic Turbines, R. M. White. Power Plant Eng., vol. 27, no. 23, Dec. 1, 1923, pp. 1178-1182, 11 figs. Recent improvements in design have consisted in simplification of details.

SELECTION. Choice of Turbines for Hydro-electric Stations (Criteri per l'impiego delle turbine nelle centrali idrolettriche), G. Gambardella. Elettrotecnica, vol. 10, no. 28, Oct. 5, 1923, pp. 669-672, 2 figs. Determination of type and fundamental characteristics of turbines to be installed, according to height of fall, quantity of available water and most convenient r.p.m. at which machines will run, necessary to get best efficiency; considers different types of turbines.

HYDRO-ELECTRIC DEVELOPMENTS

BAVARIA. Water Power in Bavaria. Times Trade & Eng. Supp., vol. 13, no. 279, Nov. 10, 1923, p. 217. Account of big development scheme begun in 1919, including laying of 1154 mi. of 110,000-volt transmission lines and building of 43 power stations and 11 large transformer stations; program of construction.

SWITZERLAND. Construction Work in Connection With Conducting of Water of Lake Arnon to the Grade Eau (Les travaux d'amener dans la Grande Eau des eaux du lac d'Arnon), P. Schmidhauser. Bul. Technique de la Suisse Romande, vol. 49, nos. 9, 11, 12, 13, 14, 15, 16, 18 and 19, Apr. 28, May 26, June 9, 23, July 7, 21, Aug. 4, Sept. 1 and 15, 1923, ppl 102-106, 125-129, 142-146, 154-157, 161-163, 173-178, 185-188, 213-216 and 225-228, 59 figs. Utilization of waters of Lake Arnon; describes hydro-electric system of Société Romande d'Electricité, and the Grande Eau concession; hydrographic data of Lake Arnou: details of construction and tunneling work; equipment; etc.

HYDRO-ELECTRIC PLANTS

GLEN FALLS, N.Y. The Sherman Island Hydro-electric Development of the International Paper Company, B. R. Connell and W. T. O'Connell. Gen. Elec. Rev., vol. 26, no. 12. Dec. 1923, pp. 804-817, 14 figs. Describes problem of design and details of construction.

NIAGARA. Recent Hydro-electric Installations at Niagara (Les récentes installations hydroélectriques du Niagara), Firket. Association des Ingénieurs Electriciens Sortis de l'Institut Electrotechnique Montefiore, no. 6, Nov-Dec. 1922 and no. 1, Jan. 1923, pp. 267-320 and 3-28, 21 figs. Describes works of Niagara Falls Power Co., Toronto Power Co. and Hydro-electric Power Commission of Ontario; new 100,000-hp. plant of Niagara Falls Power Co.; Queenston-Chippawa Development.

OFF-PEAK LOAD UTILIZATION. Electrochemistry and Electrometallurgy of Surplus Electric Energy (L'Electro-chimie et l'electrométallurgie de l'energie électrique disponible), Curtel-Hulin. Revue d'Electrochimie et d'Electrométallurgie, vol. 17, nos. 2 and 3, Feb. and Mar. 1923, pp. 25-27 and 45-48. Discusses use of surplus hydro-electric energy in generating stations, and proposes electrochemical utilization, i.e., electrothermic by heating effect of current and electrolytic by transformation of electric energy into chemical energy; application to electric furnaces.

I

ICE MANUFACTURE

ELECTRIC POWER IN. Ice Making with Electric Power. Elec. World, vol, 82, no. 24, Dec. 15, 1923, pp. 1215-1218, 8 figs. Use of different types of motors, controls and switchboard layouts; typical high-speed and low-speed plants.

ICE PLANTS

RAW-WATER. New Raw-Water Ice Plant of Pittmans & Dean Co., Detroit. Ice & Refrigeration, vol. 65, no. 5, Nov. 1923, pp. 245-250, 10 figs. Description of a modern electrically-driven plant, including general arrangement, machine room, refrigeration and mechanical equipment, ice-making system, ice-storage room, and electrical equipment; power consumption.

IMPACT TESTING

NOTCHED-BAR TESTS. The Significance of the Notched-Bar Test (Was haben wir an der Kerbschlagprobe?), P. Ludwik. Stahl u. Eisen, vol. 43, no. 46, Nov. 15, 1923, pp. 1427-1428. Author seeks to show that decrease in notched-bar toughness occurring when limit impact velocity is exceeded is attributable to too little cohesion in relation to internal friction.

INDUSTRIAL MANAGEMENT

STORES MANAGEMENT. Modern Practice in Stores Management, William D. Gordon. Indus. Management (N. Y.), vol. 56, nos. 5, 6 and vol. 66, nos. 3 and 6, May, June, Sept. and Dec. 1923, pp. 274-278, 375-378, 1 fig., 163-169, 7 figs. and 320-326, 6 figs. May: Effects of poor stores system; Dewey decimal and Pnemonic symbol systems for classification. June: Location and physical arrangement. Sept.: Planned production and storeroom operation. Dec.: Stores accounting.

INDUSTRIAL PLANTS

MAINTENANCE AND EQUIPMENT. Modern Maintenance of Plant and Equipment, Wm. G. Ziegler. Indus. Management (N. Y.), vol. 66, nos. 5 and 6, Nov. and Dec. 1923, pp. 267-276, 14 figs.; and 374, 353, 11 figs. Nov.: Structure and its appurtenances. Dec.: Work of millwright department.

INSTRUMENTS

MECHANICAL LIFE TESTING OF. Life Testing of Mechanical Instruments. Frederick J. Schlink. Optical Soc. Am.—Jl., vol. 7, no. 11, Nov. 1923, pp. 1031-1042. Selection of specimens for tests; preparation for test; maintenance during test; nature of mechanical wear; limitations and special features of forced test. Part of report of Am. Soc. Mech. Engrs.' special research committee on permanency and accuracy of engineering instruments.

INTERNAL-COMBUSTION ENGINES

ADMISSION AND EXHAUST ELEMENTS. Study of Admission and Exhaust Elements of Internal-Combustion Engines (Etudes des Organes d'alimentation des moteurs à combustion interne), O. Lepersonne. Technique Automobile et Aérienne, vol. 14, no. 122, 1923, pp. 83-93, 13 figs. Calculation of dimensions of admission and exhaust pipes, of angles of opening and closing of admission and exhaust valves, and of pressure in cylinder at end of suction stroke.

DEVELOPMENT. History and Development of the Internal-Combustion Engine and the Motor Ship, John H. Narbeth. Steamship, vol. 34, nos. 403, 404, 405, 406, 408, 409, 410, 411, 412, 413 and 414, Jan. Feb., Mar., Apr., June. July, Aug., Sept., Oct., Nov. and Dec. 1923, pp. 208-214, 251-258, 279-286, 311-318, 374-380, 9-15, 44-53, 80-83, 108-114, 140-142 and 172-174, 51 figs. Jan.; Diesel's position, work and early engines: first British-built Diesel engine; solid-injection engines. Feb.: Russia's start i 1902; Noble 2- and 4-stroke engines. Mar.: Early discussions in United Kingdom. Apr.: Sulzer Bros.; Atlas Diesel Co.—polar engines; early M. A. N., Carels-Diesel, Krupp, Junkers and Burmeister & Wain engines. June: Gasoline and Diesel-driven submarines; Vickers' engines, works and improvements; Fullagar engines. July: Doxford and North British Diesel engines. Aug.: Still engine. Sept. and Oct.: General European progress, 1912-20. Nov. and Dec.: United States progress—notable ships.

MANIFOLDS, HOT-SPOT. Temperature Requirements of Hot Spot Manifolds, C. S. Kegerreis and O. C. Berry. Purdue Univ.—Bul., vol. 7, no. 10, Sept. 1923, 42 pp. 29 figs. Details of investigations to determine temperatures required for vaporization of different fuels at high rates, and temperatures available in exhaust under different running conditions, and results obtained.

VIBRATIONS. Effects Produced by Vibrations in Internal-Combustion Engines, J. Geiger, Power, vol. 58, no. 24, Dec. 11, 1923, pp. 964-965. Vibrations felt a mile away; preventive measures that have proved successful. Translated from paper read before Assn. German Engineers (V. d. I.).

See also Automobile Engines; Diesel Engines; Oil Engines.

IRON AND STEEL

STRENGTH PROPERTIES. Strength Properties of Iron and Steel at High and Low Temperatures (Festigkeitseigenschaften von Eisen und Stahl in der Kälte und Wärme), W. Oertel. Stahl u. Eisen vol. 43, no. 45, Nov. 8, 1923, pp. 1395-1404, 14 figs. Review of literature on this subject published since 1900 up to and including 1922, including a few references of earlier date. Bibliography.

IRON CASTING

CORE REMOVAL WITH VIBRATOR. Remove Cores with Vibrator, Foundry, vol. 51, no. 24, Dec. 15, 1923, pp. 984-985, 2 figs. Four special machines equipped with powerful vibrators at plant of Ferro Machine & Foundry Co., Cleveland, O., serve to remove cores and adhering sand from automobile cylinder castings at rate of 200 per hr.

TEST BARS. Making and Testing Test Bars, J. S. Glen Primrose. Foundry Trade Jl., vol. 28, no. 380, Nov. 29, 1923, pp. 463-465 and (discussion) 465-466, Test bars for steel; testing wire and cast iron; position of cast-on bar; non-ferrous test bars; runners as test bars; tensile, transverse, compression, hardness, impact and torsion testing.

Test Bars, Rob. Buchanan. Foundry Trade Jl., vol. 28, no. 379, Nov. 22, 1923, pp. 440-442. Importance of grain size in test bar and castings; tensile test bars; tentative specifications for gray-iron castings; proposed specifications. Discussion.

IRON METALLURGY

CONCENTRATION. Experiments in Dewatering Iron Ore Pulp (Fran tysklands elemtrokemiska industri), Gösta Angel. Teknisk Tidskrift, vol. 53, nos. 23 and 28, June 9 and July 14, 1923, pp. 33-36 and 38-40 (Kemi). Desirable water content in pulp or railway transportation is 2½ percent; describes apparatus for dewatering; pulp extractors and filtering presses; etc.

K

KILNS

TUNNEL. Temperature Control of Dressler Tunnel Kiln, T. R. Harrison. Am. Ceramic Soc.—Jl., vol. 6, no. 11, Nov. 1923, pp. 1128-1133, 5 figs. Conditions to be considered in firing kiln of Champion Porcelain Co., including temperature at hottest section along tunnel, length of heat zone, and analyses of tunnel gases at various points; variation in quality of city gas used as fuel is most serious condition. Methods of control.

L

LABORATORIES

APPARATUS. STANDARDIZATION. Standardization and Limitation of Types and Sizes of Laboratory Apparatus, J. M. Roberts. Optical Soc. Am.—Jl., vol. 7, no. 11, Nov. 1923, pp. 973-981. Discusses what has been accomplished in standardization of chemical and physical apparatus.

RESEARCH. Research Laboratories at Maribyrnong, Victoria. Australasian Elec. Times, vol. 2, no. 10, Oct. 27, 1923, pp. 696 and 699-670, 6 figs. Describes electrical equipment of Physical and Chemical Research Laboratories, recently completed by Commonwealth Public Works Dept. for Munitions Supply Branch of Dept. of Defence, for carrying out research work connected with properties of materials, methods of manufacture, etc., and to act as checking authority for all gages, tools and finished products required in manufacture of munitions of war.

LATHES

BENCH. Recent Developments in Precision Bench Tools, B. A. Behrend. Am. Mach., vol. 59, nos. 17, 20 and 23, Oct. 25, Nov. 15 and Dec. 6, 1923, pp. 607-611, 719-722 and 829-831, 46 figs. Describes tools in use in author's mechanical laboratory.

COLLETS FOR MACHINING. How Rivett Makes Spring Collets. Am. Mach., vol. 73, no. 24, Dec. 13, 1923, pp. 865-867, 7 figs. Formed upon Gridley automatics; held upon centres in succeeding operations; final grinding.

LIGHTING

STREET. New Practices in Street Lighting, A. E. Bettis. Am. Inst. Elec. Engrs.—Jl., vol. 42, no. 9, Sept. 1923, pp. 985-987, 2 figs. Departures made in installation of new system in Kansas City, Mo., are in removal of all street-lighting equipment in each of seven substations, and placing of large part of lamp circuits underground.

LOCOMOTIVE BOILERS

OPERATION EFFICIENCY. An Efficient Heat Interchange Apparatus, L. H. Fry. Mich. Technic, vol. 37, no. 1, Nov. 1923, pp. 12-14 and 30, 1 fig. Illustrates efficiency with which a well designed locomotive boiler operates and indicates sources of this efficiency; determination of quantity of heat radiated to firebox; heat transfer in flues.

LOCOMOTIVES

MIKADO. Mikado Locomotives for the Lehigh Valley. Ry. Age, vol. 75, no. 21, Nov. 24, 1923, pp. 959-960, 2 figs. Particulars of 2-8-2 freight locomotives recently built for Lehigh Valley Ry., order of 30 having been divided equally between Baldwin Locomotive Works and Am. Locomotive Co.

MOUNTAIN TYPE. Mountain Type Locomotive for Great Northern. Ry. Age, vol. 75, no. 23, Dec. 8, 1923, pp. 1065-1066, 2 figs. Particulars of 4-8-2 type locomotives for heavy passenger traffic replacing Pacific type; weight in working order 365,600 lb.; 54,830 lb. tractive force.

OVERLOAD CAPACITY. The Overload Capacity of Steam Locomotives (Uever die Ueberlastungsfähigkeit der Dampflokomotiven), H. Severin. Organ für die Forstschritte des Eisenhahnwesens, vol 78, no. 5, May 15, 1923, pp. 92-93. It is shown that overload capacity of steam locomotive is at least equal to that of electric locomotive,if it does not exceed it, due to fact that overload capacity of latter is limited by heating of rotor.

PACIFIC TYPE. Canadian Pacific Standard 4-6-2 Locomotive. Ry. Mech. Engr., vol. 97, no. 12, Dec. 1923, pp. 803-808, 8 figs. Also Ry. Age, vol. 75, no. 24, Dec. 15, 1923, pp. 1107-1108, 1 fig. Heavy Pacific type with well-proportioned boiler; improvements in details.

REGULATORS. Multiple-Valve Locomotive Regulator. Engineering, vo. 116, no. 3021 Nov. 23, 1923, p. 648, 3 figs. Recently placed on market by Société Franco-Belge de Materiel de Chemins de Fer, La Croyère Belgium, and known as Lejeune regulator; it is of multiple-valve type and it is claimed that valve remains completely steam-tight for long periods in service; advantages.

STEAM-TURBINE. The Ramsay Condensing Turbine Electric Locomotive, Ry. & Locomotive Eng., vol. 36, no. 12, Dec. 1923, pp. 371-373, 2 figs. New adaptation of turbine to locomotive.

THREE-CYLINDER. Three-Cylinder Freight Locomotive on the New York Central. Ry. & Locomotive Eng., vol. 36, no. 12, Dec. 1923, pp. 373-374, 1 fig. First application of 3-cylinder principle to heavy freight engine.

LUBRICATING OILS

PROPERTIES. Physical and Chemical Properties of Lubricating Oils (Caractères physiques et chimiques des huiles de graissage) J. Levy. Technique Moderne vol. 15, no. 21, Nov. 1, 1923, pp. 695-703, 8 figs. Influence of the various properties, such as density, volatility, viscosity, acidity, evaporification, etc., on lubrication.

Some Physical Properties of Lubricants, E. A. Evans, Instn. Petroleum Technologists—Jl., vol. 9, no. 39, Oct. 1923, pp. 380-384, 6 figs. Relative efficiencies of several oils. See also article by same author, entitled, Asphalt in Lubrication Oils, pp. 384-388.

M

MACHINE SHOPS

IDLE CAPITAL IN. Idle Capital in the Machine Shop, A. Easthope. Eng. Production, vol. 6, no. 135, Dec. 1923, pp. 474-479 and (discussion) 479-481. Method of tabulating total weekly loss of capital occurring in non-use of machine tools, and necessary steps toward removing cause; trend of modern organization.

MALLEABLE CASTINGS

HARDENING. Tool Production from Hardened Malleable Iron, E. K. Smith. Can. Machy., vol. 30, no. 22, Nov. 29, 1923, pp. 21 and 38. Feasibility of hardening parts of malleable castings, nature of hardened products and processes best adapted to hardening advantages of malleable castings.

MAGNESIA

PRODUCTION FROM MAGNESITE. Tests of Caustic Magnesia Made From Magnesite From Several Sources, P. H. Bates, Roy N. Young P. Rapp. U.S. Bur. Standards Technologic Papers, No. 239, Sept. 14, 1923, pp. 529-558, 2 figs. Results of investigation to study variation in physical properties of caustic magnesia produced by burning magnesite at relative low temperatures (Under 1100 deg. cent.); burning temperatures required for magnesites from different deposits, to produce magnesia of same quality.

MANGANESE STEEL

CASTING. Specializes Manganese Sgeel, H. E. Diller. Foundry, vol. 51, no. 22, Nov. 15, 1923, pp. 891-897, 14 figs. Methods and equipment of foundry of Taylor-Wharton Iron & Steel Co., High Bridge, N.J., which turned from production of car wheels and axles to casting manganese steel; melts ferromanganese in cupola for converter steel.

CHARACTERISTICS. Characteristics of Some Manganese Steels, Jerome Strauss. Am. Soc. Steel Treating—Trans., vol. 4, no. 6, Dec. 1923, pp. 665-708, 17 figs. Review of previously published data and new metallographic survey, supplemented by mechanical tests, of portion of iron-carbon-manganese system; mechanical, electrical and magnetic properties of commercial manganese steels; constitution and possible improvements; directions in which manganese may prove useful as alloying element.

MAPPING

AERIAL PHOTOGRAPHY. Aerial Photography (Luftbildmessung), O. Koerner. Luftfahrt, vol. 27, no. 8, Aug. 5, 1923, pp. 86-89, 4 figs. Describes instruments employed for map drawing from aerial photographs.

MEASURING INSTRUMENTS

EXTENSOMETER AMPLIFIER. An Extensometer Amplifier, S. R. Williams. Optical Soc. Am.—Jl., vol. 7, no. 11, Nov. 1923, pp. 1011-1013, 3 figs. Details of device for multiplying effect of any linear displacemetn; outfit at present in use has multiplication factor of 65,000.

PRECISION. Modern Precision Measuring. Appliances for Mechanical Engineering. Eng. Progress, vol. 4, no. 10, Oct. 1923, pp. 201-212, 54 figs. Description is limited chiefly, but not exclusively, to instruments for measuring lengths deals with fixed, limited, standard, adjustable, inside, depth and thickness gages; minimeters, measuring dials and machines, seating gages, measuring implements for threads, angle meters, etc.

TORSIOMETER. Torsiometers for Measuring the Power of Steam Turbines (I torsiometri per la misura della potenza delle turbine a vapore), C. Bertella. Ingegneria, vol. 1, no. 6, Dec. 1, 1922 and vol. 2, no. 3, Mar. 1, 1923, pp. 146-151 and 69-75, 34 figs. Construction and operation of acoustic, mechanical, electrical and optical torsiometers.

METALS

CONDUCTIVITY, EFFECT OF TENSION ON. The Effect of Tension on the Thermal and Electrical Conductivity of Metals, P. W. Bridgman. Am. Acad. Arts & Sciences—Proc., vol. 59, no. 6, Nov. 1923, pp. 119-117, 2 figs. Develops improved method, and measures thermal conductivity under tension of seven metals and change of electrical conductivity under tension of same metals; theoretical discussion.

CORROSION PREVENTION. The Prevention of Corrosion. Chem. Age (Lond.), vol. 9, no. 232, Nov. 24, 1923, pp. 566-567. Review means which are now available for rendering metals non-corrodible; attention called in particular to use of stainless steels and quite recent progress which has been made with alloys of high nickel and chromium content.

DEFORMATION UNDER COMPRESSION. The Behaviour of Metals under Compressive Stresses, H. I. Coe. Inst. Metals—advance paper, no. 3, for meeting Sept. 10-13, 16 pp., 7 figs. Considerations of plastic deformation of tin under compressive stress; it is shown that tin becomes truly plastic at load corresponding to peak, then stiffens slightly, but subsequently becomes perfectly plastic again.

FAILURES. Metals in Engineering Service, Gordon Sproule. Eng. Jl., vol. 6, no. 12, Dec. 1923, pp. 523-530, 27 figs. Notes on design, choice of materials and inspection of failures.

FATIGUE. "Fatigue" of Metals and the Basic Assumptions of Mechanics of Materials. H. F. Moore. Mich. Technique, vol. 37, no. 1, Nov. 1923, pp. 17-18 and 30, 2 figs. Discusses breakdown of metals under repeated stress.

LACQUERING. Blushing, Hugo Zeller. Metal Industry (N. Y.), vol. 21, no. 11, Nov. 1923, pp. 444-445. Causes and methods of prevention of conditions variously termed blushing, clouding or white troubles. See also Metal Industry (Lond.), vol. 23, no. 22, Nov. 30, 1923, p. 489.

RATES OF COOLING EFFECT OF. Effects of Rate of Cooling on the Density and Composition of Metals and Alloys, R. C. Reader. Inst. Metals—advance paper, no. 13, for meeting Sept. 10-13, 1923, 5 pp. Numerical values are recorded showing effect upon density and composition throughout mass, of metals and alloys due to different rates of solidification.

REPEATED STRESSES. BEHAVIOR UNDER. The Behavior of Metals Subjected to Repeated Stresses, H. J. Gough. Roy. Soc.—Proc., vol. A-104, no. A-727, Nov. 1, 1923, pp. 538-655, 18 figs. partly on supp. plates. Review of previous work done; details of mechanical tests, and of study of microstructure of material when subjected to static tensile stresses and when subjected to reversed bending stresses.

VOLUME CHANGE DURING SOLIDIFICATION. On the Measurement of the Change of Volume in Metals during Solidification, Hikozô Endo. Inst. Metals—advance paper, no. 4, for meeting, Sept. 10-13, 17, pp., 2 figs. Results of measurements of change of volume during solidification or melting for number of metals having low melting points to 1100 deg. cent.

MILLING CUTTERS

HELICAL INVOLUTE TEETH. Selection of Milling Cutters for Helical Involute Teeth, E. Wildhaber. Am. Mach., vol. 59, no. 25, Dec. 20, 1923, pp. 909-911, 5 figs. New formula for tooth number of formed milling cutter to cut helical involute teeth; based on mathematical principles and easy to use; different results from old formula.

MINERAL INDUSTRY

CANADA. A Review of Canada's Mineral Industry. Can. Min. Jl., vol. 44, no. 50, Dec. 14, 1923, pp. 984-988. Prepared by Mines Branch of Can. Dept. Mines. for Nat. Resources Intelligence Service.

MINES

VENTILATION. Economy and Efficiency in Ventilation, J. Parker. Min. Inst. Scotland-Trans., vol. 44, Part, 3, Aug. 11, 1923, pp. 114-131, 6 figs. Rapid method of determining characteristics of a fan; advisability of endeavoring to increase efficiency of a fan by inserting a regulator in fan drift; tests to obtain characteristic of a Sirocco fan at Fife Ming. School; construction of evasee; duplicate and stand-by fans; power-saving arrangements; problems arising from excessive resistance of some splits; fan drives; surface leakage; etc.

MOLDING METHODS

GATING. Proper Gating an Important Factor in Molding, F. W. Best. Can. Foundryman, vol. 14, no. 11, Nov. 1923, pp. 15-16, 9 figs. Good metal poured into otherwise good molds may produce had castings if mold is improperly gated; examples of gates and their characteristics.

TUBES, SMALL-FLANGED. The Molding of Small Flanged Tubes, R. E. Search. Metal Industry (N. Y.), vol. 21, no. 11, Nov. 1923, pp. 435-437, 3 figs. Advantages and disadvantages of molding with flange above or below. Abstracted from Founderie Moderne, May 1923.

MOLDS

MULTIPLE MADE IN LOAM. Multiple Molds Made in Loam, J. H. Eastham. Foundry, vol. 51, no. 24, Dec. 15, 1923, pp. 1002-1003, 5 figs. This method, usually confined to production of small castings, may be adapted under certain conditions to large castings at saving in time and material.

MOTOR-TRUCK TRANSPORTATION

TERMINAL AREAS. The Automobile Truck Within the Terminal Area. Ry. Rev., vol. 73, no. 21, Nov. 24, 1923, pp. 767-770. Discusses organized cartage and substitution of motor service for interchange and intro-terminal movements. Part of report to U. S. Chamber of Commerce on relation of highways and motor transport to other transportation agencies.

TRAIN LOAD. A Highway Train Load (Der Müllerzug, ein Strassenlastzug), H. Werekke. Fördertechnik u. Frachtverkehr. vol. 16, no. 21, Nov. 3, 1923, pp. 239-242, 10 figs. Decribes Müller train which consists of an engine truck and (theoretically) unlimited number of trailers; the trailers are driven by electric power which they receive from engine truck, so that the latter does not pull the train in usual manner, but simply supplies the power for the other trucks or trailers.

MOTOR TRUCKS

ALL-WHEEL BRAKING. All-Wheel Braking for Business Vehicles, Richard Twelvetrees. Motor Transport (Lond.), vol. 37, nos. 975- 976 and 977, Nov. 5, 12 and 19, 1923, pp. 553-554, 589-590 and 644-645, 10 figs. Some considerations affecting use of multi-wheel brakes in commercial service.

N

NATURAL GAS

ENGINEERING PROBLEMS. Modern Natural-Gas Engineering, E. J. Stephany, Engrs. Soc. West. Pa.—Proc., col. 39, no. 8, Nov. 1923, pp. 267-275 and (discussion) 276-307. Early days and later development; the 1917 peak; modern tendencies; considerations of fuel cost; examples of fuel economies.

NICKEL METALLURGY

REFINING, ELECTROLYTIC. Electrolytic Refining Plays Part in Nickel Industry, J. L. McK. Yardlwy. Elec. News. vol. 32, no. 22, Nov. 15, 1923, pp. 83 and 85, 2 figs. Britisb American Nickel Co. uses process to separate metals from matter; flexibility prime requisite of electric equipment.

O

OIL ENGINES

ALLIS-CHALMERS. Operation and Care of the Allis-Chalmers Oil Engine. Southern Engr., vol. 40, nos. 3 and 4, Nov. and Dec. 1923, pp. 35-38 and 45-48, 9 figs. Engine operates on four-stroke-cycle. Diesel system. Pointers on startings, and shutting down, operation, care of main bearings, sbaftings, crank and piston pin adjustment, distribution of load to cylinders, handling air-injection valve, and care of fuel-oil pumps and of main inlet and exhaust valve.

COLD-STARTING HEAVY-OIL. An Innovation in Textile Mill Driving. Power Engr., vol. 18, no. 213, Dec. 1923, pp. 460-463, 6 figs. Describes Imperial-Keighley cold-starting beavy-oil engine and its advantages as prime mover in textile mill.

HIGH-COMPRESSION. Higb Compression Oil Engines in Theory and Practice. Power Engr., vol. 18, nos. 212 and 213, Nov. and Dec. 1923, pp. 411-413 and 445-447, 8 figs. Various points of importance in connection with this type of engine. Nov.: Moderate-capacity engines. Dec.: Mechanical parts are discussed severally and togetber.

OIL FUEL

ATOMIZATION. Mechanical Atomization of Fuel Oil, Claude C. Brown. Power Plant Eng., vol. 27, nos. 22, 23 and 24, Nov. 15, Dec. 1 and 15, 1923, pp. 1130-1132, 1192-1194 and 1238-1241, 5 figs. Nov. 15: Methods of atomization; types of atomizers. Dec. 1: Factors involved in correct operation of mecbanical atomizer type of oil burner. Dec. 15: Care and inspection of burners; relation of efficiency to capacity; draft requirements.

LOCOMOTIVES. The Burning of Fuel Oil in Railroad Locomotives, J. M. Johnston. Am. Petroleum Inst.—advance paper, for meeting Dec. 11-13,1923, 13 pp. Includes list of important roads using fuel oil; locomotive fuel and Mexican oil; dependability of supply; advantages of burning oil vs. coal; cost of coal and oil at source; cost of trasnportation—coal and oil; cost of handling, and other costs.

SOLID FUELS, PRODUCTION FROM. Coal and the Problem of Liquid Fuels (La houille et le problème des combustibles liquides), E. Audibert. Chimie & Industrie, vol. no. 4, Oct. 1923, pp. 613-631, 6 figs. Synthetic production of liquid fuels from solid fuels.

OXY-ACETYLENE WELDING

ALUMINUM. Welding Aluminum. Sbeet Metal Worker, vol. 14, no. 22, Nov. 23, 1923, 827-828. Difficulties to be overcome; fluxes to be used; explains preparations for work and welding operation.

CAST IRON. Accurate Cutting on Cast Iron. Welding Engr., vol. 8, no. 11, Nov. 1923, pp. 19-22, 9 figs. Describes cuts made by oxy-acetylene torch on cast-iron columns of a seven-story building, in order to move it.

COAL DRYERS. Huge Coal Dryer Oxy-Acetylene Welded, T. C. Fetherston. Am. Welding Soc.—Jl., vol. 2, no. 11, Nov. 1923, pp. 25-28, 4 figs. Describes oxy-acetylene welding as carried out in connection with construction of a coal dryer at a plant in southeastern Pennsylvania, for joining steel plates wbicb compose outer shell and internal flue and attaching circular bead permanently fitted in one end.

P

PAINTS

LITHOPONE. United States Governemet Specification for Gloss Interior Lithopone Paint, White and Ligbt Tints. U. S. Bur. Standards, Federal Specifications Board, Standard Specification No. 67, Sept. 19, 1923, 8 pp. Specification officially adopted by Federal Specifications Board on Sept. 1, 1923, for use of Departments and Independent Establishments of Government in purcbase of this paint, covering sampling, laboratory examination, analysis of pigment, and reagents.

PAPER MANUFACTURE

DYEING AND TINTING. Dyeing and Tinting of Paper, Julius Huebner. Paper, vol. 33, no. 3, Nov. 8, 1923, pp. 3-6 and 25. Describes dyestuff absorption experiments; more attention to paper dyeing necessary to establish standard.

RUBBER LATEX AS SIZE. Rubber Latex as Paper Size. A. van Rossem and W. Frenzyl. Paper, vol. 33, no. 4, Nov. 15, 1923, pp. 3-7, 4 figs. Details of investigation made to determine what effect, if any, addition of rubber latex had on properties of paper wbicb was made from a pulp that had been previously mixed with rubber milk in manner of a size, and results obtained; reach conclusions opposite to general opinion of paper experts.

FRENCH RAW MATERIAL SUPPLY. The Supply of Raw Material for the Paper Manufacture of France, L. Vidal. Jl., of Forestry, vol. 21, no. 6, Oct. 1923, pp. 604-613. Consideration of raw products for paper machines before during, and after tbe war; resourced in France, and colonial resources; processes of manufacture.

PULP MANUFACTURE. Proper Utilization of Waste Sulphite Liquor, R. H. McKee. Chem. Age (N.Y.), vol. 31, no. 11, Nov. 1923, pp. 483-485. Describes process wbich obviates stream pollution; liquor is utilized as alcohol and fuel; cost of plant and operation. Paper read before Am. Section Société de Chimie Industrielle, Oct. 2, 1923.

PAPER MILLS

WASTE HEAT UTILIZATION. Reduction of Paper Cost by Utilizing Waste Heat From the Paper Machine, J. O. Ross. Paper Trade, Jl., vol. 77, no. 21, Nov-22, 1923, pp. 48-50, 4 figs. Amount of air required and temperature of air; methods of utilizing waste heat.

SULPHUR BURNER OPERATION CONTROL. Graphical Control of Combustion Gases, R. Sieber. Paper, vol. 33, no. 5, Nov. 22, 1923, pp. 3-4 and 21. Rapid and convenient method for determining relation between gases formed in sulphur burning and for finding dioxide content of gas.

MACHINE-ROOM HEAT LOSSES. Heat Losses in Machine Room, E. P. Gleason and F. C. Stamm. Paper, vol. 33, no. 5, Nov. 22, 1923, pp. 6 and 9. Review of systems used in various mills and data showing results in use of open, hooded and closed systems; proof that open system is expensive.

STEAM TURBINE APPLICATION. Steam Turbine Application in Pulp and Paper Mills, A. G. Darling. Paper mill, vol. 47, no. 47, Nov. 24, 1923, pp. 12 and 46, 5 figs. Characteristics of steam; elements entering into cost of generating steam; methods available for obtaining low-pressure steam, viz., throttling, non-condensing turbines, extraction turbines, and combination of first three

PATTERN MAKING

GEARS. Pattern Making on Helical or Herring-bone Gear, Johsph Caslin. Can. Foundryman, vol. 14, no. 11, Nov. 1923, pp. 25 and 34, 1 fig. Purpose of this type of gear; laying out and locating teeth; necessity of each tooth being a segment of a perfect screw; stripping plate recommended.

PAVEMENTS

CITY. Present-Day Street and Pavement Practice for Cities. Eng. News-Rec., vol. 91, no. 22, Nov. 29, 1923, pp. 894-896, 3 figs. Contains abstracts of following papers presented before Am. Soc. Mun. Improvements: Report of Committee on Street and Highway Design; Curve Widening, G. A. Crayton; Some Details in Street Design, P. L. Brockway; Modern Construction of Brick Pavement Will P. Blair.

PETROLEUM

STORAGE AND TRANSPORTATION. Petroleum and tbe Marine Engineer, M. Deloise Curwen. Mar. Engrs. & Nav. Architect. vol. 46, no. 5504 Nov. 1923, pp 393-394. Notes on storage and transportation of petroleum; handling; danger of fire; tank cleaning; lubricating oils.

PIERS

REINFORCED-CONCRETE. Reinforced-Concrete Pier at tbe Naval Station. Guantanamo Bay, Cuba. Public Works of the Navy, U. S. Bur. Yards and Docks, Bul. No. 32, Apr. 1923, pp. 23-37, 11 figs. partly on supp. plates. Details of design and construction of new pier constructed adjacent to existing station pier; approximately 360 by 50 feet in general dimensions; supported by precast concrete piles, and designed to sustain superficial live load of 500 lb. per sq. ft. and concentrated wbeel loads of 46,000 lb. on 5-ft. 6-in. centres over track beams, including 10 per cent allowance for impact.

PIPE, CONCRETE

PRESSURE. Concrete Tubes for Internal Pressure, F. Emperger. Concrete & Constructional Eng., vol. 18, no. 11, Nov. 1923, pp. 701-708, 1 fig. Strengtb of concrete tubes subject to internal pressure; plain-concrete, reinforced-concrete, reinforced-concrete witb sbeet steel lining, and initially-stressed reinforced tubes.

PISTON RINGS

COMPOUND. A New Compound Piston Ring. English Mechanics, vol. 118, no. 3058, Nov. 2, 1923, p. 197, 1 fig. Account of Whidbourne ring, an original type which combines uniformity of wall pressure with gas-tightness even after mucb wear.

DESIGN AND PRACTICE. Modern Piston Ring Practice Involves Efficient Design and Production, P. M. Heldt. Automotive Industries, vol. 49, nos. 23 and 24, Dec. 6 and 13, 1923, pp. 1142-1146, 6 figs., and 1204-1208, 5 figs. Reviews development of modern piston-ring practice and gives constructive ideas about relative efficiency of various design features.

PLOWS

MANUFACTURE. Plow Grinding Practice Novel, F. B. Jacobs. Foundry, vol. 51, no. 23, Dec. 1, 1923, pp. 956-959, 7 figs. Chilled iron and steel plow parts first are surfaced with grinding wbeels and these are polished by abrasive grain; describes rigging.

POLES, WOODEN

STRENGTH CALCULATION. Graphic Solution for Wood-Pole Strength, E. Brokemyr. Elec. World, vol. 82, no. 19, Nov. 10, 1923, pp. 955-957. Using safety factors and chart of diameters gives convenient metbod for choosing poles; checking old poles for rot weakness made convenient; solution of taper problems.

POWER

COMBINED PURCHASED AND GENERATED. The Combined Use of Self-Generated and Purchased Power witb Simultaneous Waste-Heat Consumption (Ueber das Zusammenwirken von Eigenkrafterzeugung und Fremdstrombezug bei geichzeitigem Abwärmebedarf), M. Hirscb. Wärme, vol. 44, no. 43, Oct. 26, 1923, pp. 469-471, 5 figs. Power and heat conditions in leather factory using its own and purchased power; use of sufficient purchased current to insure a maximum utilization of exhaust steam, with and without waste-beat storage.

POWER FACTOR

CONTROL ON LONG LINES. Economic Considerations of the Power Factor Control of Long High-Voltage Lines, A. V. Joslin. Am. Inst. Elec. Engrs.—Jl., vol. 42, no. 12, Dec. 1923, pp. 1248-1250, 5 figs. Shows effect of power factor upon efficiency of transmission by few typical examples of transmission lines; most economical line power factor for any ordinary commercial transmission line varies by comparatively small per cent and is slightly less than unity.

RATE CLAUSES. Experience with Power-Factor Clauses. Elec. World. vol. 82, no. 22, Dec. 1923, pp. 1105-1109. Analysis of existing practices; opinions of some who have tried out power-factor clauses; administration and operation of typical provisions in existing contracts.

POWER PLANTS

ECONOMY. Power Plant Management, Robert June. Elec. Light & Power, vol. 1, nos. 8, 9, 10 and 12, Aug. Sept., Oct. and Dec. 1923, pp. 37-39 and 43-44; 22-24, 54 and 64; 31-32, 68-71 and 75; and 52, 71-72 and 78, 16 figs. Classification of coals; comparison of different ranks; moisture in coal; asb; influence of size on boiler efficiency; combustion space required for various coals; purchasing pointers; chemistry of combustion; air required for combustion; combustion losses; heat balance; draft for different fuels; control of draft, etc.

PROBLEMS. Power Plant Problems as Viewed by Designers, Operators and Manufacturers. Power, vol. 58, no. 23, Dec. 4, 1923, pp. 881-882. Discussion of problems confronting power-plant field by designers, operators and manufacturers; dealing with shortcomings and apparent difficulties of existing methods, machinery and material.

PRESSES

HYDRAULIC. What Can Be Done with High Pressures in the Chemical Engineering Industries, Chas. L. Mantell. Chem. & Met. Eng., vol. 29, no. 23, Dec. 3, 1923, pp. 1015-1018, 10 figs. How hydraulic press solves difficult production problems in mechanical separation of liquids and solids.

PRESSURE VESSELS

SAFETY PROBLEMS. Safety Problems of High Pressure Vessels, Samuel S. Caskey. Boiler Maker, vol. 23, no. 11, Nov. 1923, pp. 311-312. Deals with vessels employed in chemical and similar processes other than steam vessels. Problems met in construction; design of bolts; design data; details of pressure test. From paper read at Nat. Safety Council annual meeting.

PSYCHOLOGICAL TESTS

VOCATIONAL MEN AND REGULAR STUDENTS. The Performance of Vocational Men and Regular Students on Three Types of Psychological Test, John A. McGeoch. Wash. Univ. Studies, vol. 10, no. 2, Jan. 1923, pp. 67-85. Results of comparison show that, although scores on tests are uniformly higher for regular students, those of vocational men fall well within limits of normal performance on all tests. Bibliography.

PULVERIZED COAL

BOILER FIRING. Boiler Firing with Pulverized Coal at the Bruay Central Station [Chauffage des chaudières au charbon pulverisé (Centrale électrique de Bruay)]. M. Sohm. Revue de l'Industrie Minérale, no. 68, Oct. 15, 1923, pp. 561-586, 15 figs. Degree of inflammability of pulverized fuel in hoppers; cost of steam per ton; flexibility of vaporization; amount and nature of ash collected; etc.

Pulverized Fuel. Eng. & Boiler House Rev., vol. 37, no. 4, Oct. Nov. 1923, pp. 96 and 98, 1 fig. Brief description of huge installation being erected at Vitty power station in Paris, as illustrating remarkable developments in pulverized fuel firing made in United States during past two or three years.

FINENESS TESTING. Determination of the Fineness of Powdered Coal. W. A. Selvig and W. L. Parker. U. S. Bur. of Mines—Reports of Investigations, no. 2545, Nov. 1923, 14 pp. Results of sieving tests on two standard samples of pulverized coal; as result method for making fineness tests, by hand sieving, is recommended as standard method, while rapid method, by machine sieving, is given for routine tests.

POWER PLANTS. Notes on Pulverized Coal as a Fuel in Practice, A. E. Val Davies. S. A. Inst. Elec. Engrs.—Trans., vol. 14, part 9, Sept. 1923, pp. 162-170 and (discussion) 170-172. Résumé of present position of pulverized-coal and power-supply industry; notes on coal dryers, milling or grinding; conveying and feeding; present developments.

URBO-PULVERIZER. Development in Powdered Fuel Firing, J. S. Atkinson. Elec. Times, vol. 64, no. 1673, Nov. 8, 1923, pp. 475-477, 8 figs. Contrasts turbo-pulverizer unit with central system, and replies to criticisms of pulverized-fuel firing.

PUMPING

PNEUMATIC. Pneumatic Pumping Up to Date, John Oliphant. Am. Water Works Assn.—Jl., vol. 10, no. 6, Nov. 1923, pp. 1082-1087, 3 figs. Experience of several years' work in pumping water from wells with compressed air.

PUMPS

MINE, METALS FOR. Metals Must Resist Corrosion, G. A. Drysdale. Foundry, vol. 51, no. 23, Dec. 1, 1923, pp. 952-954. Points out that pumps in mines handling acidified waters require special metals; alloys should be free from zinc; tests under working conditions give different results from those made in laboratory.

PUMPS, CENTRIFUGAL

PUMP AND PAPER STOCK HANDLING. Centrifugal Pumps for Handling Pump and Paper Stocks at Various Consistencies, E. W. Pryor, Jr. Paper Trade Jl., vol. 77, no. 22, Nov. 29, 1923, pp. 43-45, 4 figs. Discusses essentials of a satisfactory pump to serve a paper maker, viz., dependability, accessibility, efficiency and interchangeability; description of Buffalo pump.

PYROMETERS

OPTICAL AND RADIATION. Optical and Radiation Pyrometry, R. S. Whipple. Birmingham Met. Soc.—Jl., vol. 8, no. 8, 1923, pp. 360-378 and (discussion) 378-381, 8 figs. Deals with types of pyrometers which have proved suitable for industrial use.

SMOKED GLASSES, USE IN MEASUREMENTS. The Use of Smoked Glasses in Optical-Pyrometrical Measurements (Ueber den Gebrauch von Rauchgläsern bei optisch-pyrometrischen Messungen), Fr. Hoffmann. Zeit. für Physik, vol. 17, no. 1, July 30, 1923, pp. 1-2, 6 figs. It is shown how pyrometrical weakening of smoked glasses when used on Holborn-Kurlbaum pyrometers can be calculated from spectral permeability of the smoked glass and the ocular filter employed, when light shining through pyrometer is no longer monochromatic.

R

RADIOTELEPHONY

SPEECH AND MUSIC TRANSMISSION. The Transmission and Reception of Speech and Music in Radio Telephony, N. W. McLachlan. Beama, vol. 13, nos. 67 and 68, Nov. and Dec. 1923, pp. 285-292 and 366-369, 9 figs. Microphones and allied apparatus; telephones and loud speakers; tramsmitter.

LOUD SPEAKERS. Electrical Loud Speakers, A. Nyman. Am. Inst. Elec. Engrs.—Jl., vol. 42, no. 9, Sept. 1923, pp. 921-927, 16 figs. Mechanical and electrical essentials of device applied to radiophone reproduction of speech and music; forms and methods used in developing and testing new types.

LONG-DISTANCE, EUROPEAN. European Long Distance Telephony. Elec. Communication, vol. 2, no. 2, Oct. 1923, pp. 61-80, 2 figs. Report of Preliminary Technical Committee for European Long Distance Telephony, Paris. Recommendations with respect to matters affecting transmission, including recommendations for aerial line, cables, and composite lines; specifications of a standard set with solid back microphone and Bell receiver, and points to be considered in drawing up standard specifications on Pupin coils for long international cables, international cables with combination pairs of wires, and amplifying relays; recommendations on matters relating to traffic. Translated from Annales des Postes, Télégraphes et Téléphones, Sept. 1923.

RAILWAY ELECTRIFICATION

ECONOMICS. Some Aspects of Railway Electrification, E. Marshall. West. Soc. Engrs.—Jl., vol. 28, no. 11, Nov. 1923, pp. 485-488 and (discussion) 488-490. Author raises question, as to why railroads have not further extended electrification of those projects that have been successful in past; discusses economics of question.

EUROPE. The Electrification of Foreign Railways, S. Parker Smith. Beama, vol. 13, nos. 63, 65 and 67, July, Sept, and Nov. 1923, pp. 20-29, 158-166 and 298-303, 7 figs. July: Switzerland: use of direct-current, 3-phase and single-phase systems. Sept. Italy; d.c. and 3-phase systems; locomotives; results. Nov.; Scandinavian countries.

FRANCE. Electrification of the Midi Railway (Note sur l'Electrification des Chemins de Fer du Midi), P. Leboucher and H. Ledoux. Revue Générale des Chemins de Fer, vol. 42 (1st Half), nos. 3, 5, 6 and vol. 42 (2d Half), nos. 1 and 2 Mar., May, June, July and Aug. 1923, pp. 181-225, 373-386, 461-481, 3-14 and 61-79, 106, figs. Program of electrification; power stations; high-tension lines, insulators, poles, protection against excess voltage, etc.; substations; electric locomotives; etc.

Electrification of the Midi Railway. Ry. Gaz. vol. 39, no. 22, Nov. 30, 1923, pp. 695-696. Summary of paper read to French Soc. Civ. Engrs., British Section, Nov. 22, 1923, by A. Pachellery, describing electrification work now in progress.

First Stage of the Program of Partial Electrification of the Paris, Lyons and Mediterranean System (Note sur la première étape du programme d'électrification partielle du réseau P. L. M.), M. Japiot. Revue Générale des Chemins de Fer, vol. 42, no. 5, Nov. 1923, pp. 291-321, 15 figs. Details regarding electrification of line from Culoz to Modane, and lines in vicinity of Nice.

SYSTEMS AND METHODS. Systems and Methods of Railway Electrification, H. M. Sayers. Elec. Times, vol. 44, no. 1674, Nov. 15, 1923, pp. 507-509, 4 figs. Discusses problems of electrification, with special regard to British conditions.

RAILWAY EQUIPMENT

TOOLS FOR MAINTENANCE. Tool Equipment for Bridge, Building and Water Service. Ry. Eng. & Maintenance. vol. 19, no. 12, Dec. 1923, pp. 495-497, 2 figs. Comprehensive lists of devices and appliances used by railway maintenance forces.

RAILWAY MANAGEMENT

STORES AND MECHANICAL DEPARTMENT, CO-OPERATION. Relation of Stores and Mechanical Departments, F. M. A'Hearn. Ry. Mech. Engr., vol. 97, no. 12, Dec. 1923, pp. 834-838, 9 figs. Describes practice of Bessemer & Lake Erie. Greenville, Pa., in handling certain stocks of material; method of handling firebox renewals; system for delivering material; disposal of scrap material.

RAILWAY MOTOR CARS

DIESEL-ELECTRIC. Ten Years' Diesel-Electric Railroad Experience. Thos. Orchard Lisle. Oil Engine Power, vol. 1, no. 11, Nov. 1923, pp. 529-537, 11 figs. Details of what has been done in Sweden on adoption of Diesel-electric cars for branch lines, since first car was put into operation ten years ago; 20 units of various sizes, from 75 hp. to 250 hp., now in service; advantages of Diesel-electric system; cost data.

DREWRY. Silent Chain Final Drive is Used on Drewry Railcars, M. W. Bourdon. Automotive Industries, vol. 49, no. 23, Dec. 6, 1923, pp. 1152-1154, 2 figs. 4- and 6-cylinder engines are of more rugged construction than those generally employed in truck service; gearset has two-parts of constant mesh gears; controls duplicated at each end.

GASOLINE. Gasoline Motor Train for the Mississippi Central Ry. Ry. Rev., vol. 73, no. 21, Nov. 24, 1923. pp. 761-763, 7 figs. Rail motor car and trailer which is to be operated at two-unit train in branch-line service.

STEAM. Steam Motor Coach on the Jersey Railways. Tramway & Ry. Jl., vol. 54 no. 24, Nov. 15, 1923, pp. 260-262, 5 figs. Design and operating data of car on system of Jersey Railways & Tramways, Ltd., runs a distance of four miles with six intermediate stops, with a scheduled timing for the single journey of 15 min.

TWO-CAR TRAINS. Two-Car Motor Train for Mississippi Central. Ry. Mech. Engr., vol. 97, no. 12, Dec. 1923, pp. 830-832, 7 figs. Chassis, of 4-wheel-drive type, and trailer provide baggage space and seats for 46 passengers.

RAILWAY OPERATION

FUEL ECONOMY. Fundamentals of Fuel Economy, W. L. Richards. Ry. Age, vol. 75, no. 22, Dec. 1, 1923, pp. 999-1003. Discusses the three elements entering into economical use of fuel, viz., operation, mechanical factors, and personnel.

TRAIN DESPATCHING. Recent Developments in Telephone Equipment for Train Despatching Circuits, Wm. H. Capen. Elec. Communication, vol. 2, no. 2, Oct. 1923, pp. 111-140, 22 figs. Outline of history up to present time; transmission requirements of despatching circuits as compared to those of ordinary telephone circuits; effect of electrical characteristics of line, number of sets, etc., on proper design for maximum efficiency; "standing waves;" diagrams of circuits for despatchers' and waystation sets; development of vacuum-tube amplifier with loud speaker for despatcher and waystation use; practical application and limitations of present train despatching apparatus; appendix giving development of mathematical formulas used in design of apparatus. From paper read at Am. Ry. Assn. convention.

RAILWAY TRACK

TRACK LAYING. Laying a Mile of Rail Per Hour Under Traffic. Ry. Age, vol. 75, no. 23, Dec. 8, 1923, pp. 1047-1050, 9 figs. Methods employed by Can. Pacific in laying over 100 mi. of 100 lb. rail under traffic; laid in units of two rails by double-tong gangs consistently at rate of 20 to 21 sec. per rail.

RAILWAYS

GOVERNMENT OWNERSHIP. Government Ownership of Railways, Robert S. Binkerd. New York, R. R. Club—Official Proc., vol. 33, no. 9, Oct. 19, 1923, pp. 7107-7113 and (discussion) 7114-7116. Author calls attention to growing opposition in Europe to continuation of government ownership.

REAMERS

TAPER. Piloted Machine Taper Reamers, Freceric Cooke. Machy. (Lond.), vol. 23, nos. 579 and 581, Nov. 1 and 15, 1923, pp. 139-142, and 202-204, 6 figs. Reamers are divided into their three main parts, namely, pilot, tooth, and shank, each of which is considered separately.

REACTORS

CURRENT-LIMITING. Operating Experience with Current-Limiting Reactors, N. L. Pollard. Am. Inst. Elec. Engrs.—Jl., vol 42, no. 9, Sept. 1923, pp. 915-920, 12 figs. Describes troubles experienced with different types of current-limiting reactors installed on Pub. Service Co.'s system; conclusion is reached that if present-day reactors are properly chosen with regard to thermal capacity they are very reliable.

RECTIFIERS

ELECTROLYTIC. Further Notes on Electrolytic Rectifiers, Mortimer A. Codd. Elec. Rev., vol. 93, no. 2398, Nov-9, 1923, pp. 683-684, 3 figs. From results of experiments it is concluded that for satisfactory operation of electrolytic rectifying cells two conditions are desirable, namely, method of preventing anode from polarizing and, arrangement of leak between two electrodes.

REFRACTORIES

STEEL INDUSTRY. Refractories in the Steel Industry, J. Spotts McDowell. Blast. Furnace & Steel Plant, vol. 11, nos. 10 and 11, Oct. and Nov. 1923, pp. 525-529 and 569-574, 10 figs. Clay, silica, firebrick, high-alumina and magnesite refractories; properties.

REFRIGERATING MACHINES

LUBRICATION. Lubrication of Refrigeration Machinery. Lubrication, vol. 9, no. 10, Oct. 1923, pp. 109-120, 20 figs. Discusses operating conditions of ammonia, carbonic anhydride and other refrigerants, as they involve lubrication.

REFRIGERATING PLANTS

AMMONIA COMPRESSORS. Compression Curves for Ammonia Compressors, Wm. D' Jack. Ice & Refrigeration, vol. 65, nos. 1, 2, 3, 4 and 5, July, Aug., Sept. Oct. and Nov. 1923, pp. 17-19, 79-81, 135-137, 198-200 and 262-264, 2 figs. Adiabatic, isothermal, saturation, and saturated-compression curves for ammonia machine; thermodynamic formulas; fundamental constants and relationships; mean effective pressure formulas.

Ammonia Condensers. Performance Tests on a Flooded Atmospheric Type Ammonia Condenser, H. J. MacIntire and Earl Beling. Refrig. Eng. vol. 10, no. 3, Sept. 1923, pp. 87-90 and (discussion) 90-91 and 93, 8 figs. Results of tests carried out to find out action of ammonia in a flooded condenser, coefficient of heat transfer and function of condensing water.

REFRIGERATION

Gas, Cooling with. Producing Cold With Gas, H. DeWitt Valentine. Am. Gas Jl., vol. 119, no. 28, Dec. 15, 1923, pp. 629-631 and 642-644, 4 figs. How gas is used in refrigeration. Read before Am. Gas. Assn.

RELAYS

Protective. A New Type of Overload Protective Relay, A. B. Campbell. Gen. Elec. Rev., vol. 26, no. 12, Dec. 1923, pp. 837-840, 2 figs. New types of temperature or thermal overload relays; general principles involved, construction and operation; important features.

RESEARCH

Scientific, Relation to Industry. Science and Industry in America. Walter Rosenhain. Engineer, vol. 136, nos. 3533, 3534, 3535, 3536, 3537, 3538, 3539, 3540, 3541 and 3542, Sept. 14, 21, 28, Oct. 5, 12, 19, 26 Nov. 2, 9, and 16, 1923, pp. 270-271, 298-299, 5 figs.; 330-331, 1 fig.; 358-359; 384-385; 412-413; 440-441; 468-469; 494-496, 5 figs.; and 522-524, 3 figs. Discusses attitude of industry toward scientific research and of scientific investigators towards industry. Applications of science and scientific methods in some typical, industrial and governmental establishments and work done in this connection in some American colleges and universities.

RESERVOIRS

Concrete. Reinforced Concrete in Reservoir Construction, F. R. Matthews. Concrete & Constructional Eng., vol. 18, no. 11, Nov. 1923, pp. 709-715, 4 figs. Watertightness of concrete; design of reinforced-concrete reservoirs.

RETAINING WALLS

Reinforced-Concrete. The Design of Reinforced Concrete Retaining Walls, A. C. Hughes. Surveyor, vol. 64, no. 1659, Nov. 2, 1923, pp. 323-325, 1 fig. Design of face wall; toe, and counterfort.

Reinforced-Concrete Relieving-Platform Sea Wall at the Navy Yard. Puget Sound, Wash., J. J. Gromfine and E. F. Bessey. Public Works of the Navy, U.S. Bur. Yards and Docks, Bul. No. 33, Oct. 1923, pp. 4-19, 19 figs.on supp. plates. Details of design and construction.

RHEOSTATS

Starting, Calculation of. A Universal Graphical Method for Calculating Starting Rheostats for D.C. Motors (Une méthode graphique universelle pour le calcul des rhéostats de démarrage des moteurs à courant continu). Industrie Electrique, vol. 32, nos. 751 and 752, Oct. 10 and 25, 1923, pp. 370-375 and 387-394, 11 figs. Diagrams and examples illustrating their use.

ROADS, ASPHALTIC CONCRETE

Construction. Asphaltic Concrete Construction in Fresno County, California, Chris P. Jensen. Eng. & Contracting (Roads and Streets), vol. 60, no. 5, Nov. 7, 1923 pp. 958-960. Materials, methods and results.

ROADS, CONCRETE

Vibrolithic Paving Process. Vibrolithic Paving Process Used on Parkway in Chicago. Highway Engr. & Contractor, vol. 9, no. 5, Nov. 1923, pp. 35-37, 6 figs. Describes vibrolithic process employed in paving concrete driveway in Lincoln Park, Chicago.

ROAD CONSTRUCTION

Scientific. Scientific Road Construction and Matters Relating Thereto, Humphrey P. H. Morgan. Surveyor, vol. 64, no. 1661, Nov. 16, 1923, pp. 365-369, 4 figs. Deals with lateral support, surfacing, gradients, camber, road widths, by-passes, avoidable corners, super-elevation, and highway bridges.

ROADS, TARRED

Maintenance. The Maintenance of Tar Pavements, John S. Crandell. Good Roads, vol. 65, no. 15, Nov. 7, 1923, pp. 145-148, 5 figs. Right and wrong methods of patching; surface treatment; suggestions for successful maintenance.

ROCK CRUSHING

Plants. Crushing 2,500 Tons of Rock Per Shift at Corona Calif, A. W. Allen. Eng. & Min. Jl.—Press, vol. 116, no. 21, Nov. 24, 1923, pp. 887-890, 11 figs. Describes rock-crushing plant operated by Blue Diamond Materials Co. of Los Angeles; screening and dust collection feature operations; storage capacity large.

ROLLING MILLS

Continuous. Rolling Mill Practice, T. Price, Metal Industry, (Lond.), vol. 23, nos. 22 and 23, Nov. 30 and Dec. 7, 1923, pp. 493-494 and 516-518. Details and advantages of Morgan continuous mill, which combines Acme and Morgan Skelp mills; action and design of rolls. Paper read before Staffordshire Iron & Steel Inst.

Plate. Scotch Build a New Plate Mill, Jos. Horton. Iron Trade Rev., vol. 73, no. 21, Nov. 22, 1923, pp. 1421-1423, 9 figs. New mill at plant of Dav. Colville & Sons, Glasgow, has capacity of 3000 tons weekly; furnace and rolls reflect departures from conventional design.

Practice. Rolling-Mill Practice, T. Price. Iron & Coal Trades Rev., vol. 107, no. 2907, Nov. 16, 1923, pp. 727-728. Cogging and finishing mills; need for correctly designed rolls; effect of rolling on material; designing of rolls; points to watch in designing rolls; diagonal designing. (Abstract.) Paper read before Staffordshire Iron & Steel Inst.

Strip Mills. Hot Strip Capacity Is Augmented. Iron Trade Rev., vol. 73, no. 24, Dec. 13, 1923, pp. 1609-1611, 4 figs. Pittsburgh district producer completes new unit at Leechburg, Pa. which will permit scheduling of wide sizes and light gages; mill arrangement affords rolling both ways of grain; details of installation. See also Iron Age, vol. 112, no. 24, Dec. 13, 1923, pp. 1581-1583, 5 figs.

ROOFS

Tower, Sheet Copper Covering. Covering Tower Roofs with Sheet Copper, Wm. Neubecker. Sheet Metal Worker, vol. 14, no. 23, Dec. 7, 1923, pp. 855-856, 7 figs. Constructive methods necessary when allowing for expansion and contraction of metal when temperature falls to 10 deg. below zero.

S

SAND, MOLDING

Silica Sand. Use of Silica Sand for Steel Foundry Purposes, L. Heber Cole Cement, Mill & Quarry, vol. 23, no. 9, Nov. 5, 1923, pp. 31-32. Its bonding power, permeability, and refractoriness; silica sand for furnace linings.

SAWS

Cold Circular. A Modern Cold Circular Saw of Maximum Output, R. Jungmann. Eng. Progress, vol. 3, no. 10, Oct. 1923, pp. 219-221, 6 figs. Machine bed-plate of circular saw; feed; setting device; chip protection.

SCREW THREADS

Milling. Producing Accurate Threads by Milling Process, H. P. Arnson. Can. Machy., vol. 30, nos. 19, 20 and 21, Nov. 8, 15 and 22, 1923, pp. 18-21, 22 and 33, and 13-17, 8 figs. General description of principles, methods and advantages of thread milling, with data on cutter design, and recommended speeds and feeds for cutting various materials.

SEWERS

Concrete. Muddy Run Trunk Sewer, Niagara Falls, Ont., E. M. Proctor. Can. Engr., vol. 45, no. 24, Dec. 11, 1923, pp. 561-565, 10 figs. Details of concrete sewer which carries sewage from four drainage areas to outfall on Niagara River; total length 9600 lin. ft.; construction methods; outfall shaft at river driven upwards through rock; cost details.

SEWAGE DISPOSAL

Activated Sludge. Six Months' Experimental Work with Activated Sludge at Hertford, C.E. Duckworth. Surveyor, vol. 64, no. 1660, Nov. 9, 1923, pp. 345-347. Experimental plant; particulars of operation of plant and results.

SHAFTS

Fits. Fits, H. P. Phillips. West. Machy, Wld., vol. 14, no. 11, Nov. 1923, pp. 357 and 362. Describes practice of Meese & Gottfried Co., San Francisco, Cal., who are called upon to bore for various classes of shaft fits from 6000 to 8000 iron castings used in transmission and conveying machinery.

SHAPERS

Automatic Bevel-Wheel. Automatic Bevel-Wheel Shaping Machines. Eng. Progress, vol. 4, no. 10, Oct. 1923, pp. 216-218, 4 figs. Describes shaping machine made by Zimmermann Works and points out advantages with regard to rapid and accurate production of bevel-wheel gearings, which are obtained by using described method of shaping profiles of teeth by means of templates.

Gear Box Inside Column. New Line of Shapers. Iron Age, vol. 112, no. 22, Nov. 29, 1923, pp. 1445-1446, 4 figs. New shapers known as Climax have gear box inside of column, automatic visible lubrication, and other improved features.

SHIPS

Growth of. The Probable Effect on Ports of the Future Growth of Ships, J. H. Walsh Soc. Nav. Architects & Mar. Engrs.—advance paper, no. 6, for meeting Nov. 7-8, 1923, 6 pp., 4 figs. on supp. plates. Discusses physical relations between ports and ships; sets forth growth that has occurred in different types of ships in more recent years and draws reasonable conclusions as to probable future growth of ships.

STANDARDIZATION

Variety vs. Extreme Variety Versus Standardization, L. A. Hawkins. Indus. Management (N. Y.), vol. 66, no. 6, Dec. 1923, pp. 327-334, 12 figs. Research at Gen. Elec. Co. and its effect on variety.

STEAM ENGINES

Corliss. Erecting a Corliss Engine, Guy Edwards, Southern Engr., vol. 40, no. 3, Nov. 1923, pp. 51-54, 18 figs. Handling flywheel, crank-shaft and engine bed from car foundation in plant; methods employed in handling stator of direct connected units.

Steam Consumption. Steam-Consumption and Performance Tests on Reciprocating Steam Engines and Steam Turbines in 1922 (Dampfverbrauches- und Leistungsversuche an Kolbendampfmaschinen und Dampfturbinen in Jahre 1922). Zeit. des Bayerischen Revisions-Verein, vol. 27, nos. 18 and 19, Sept. 30 and Oct. 15, 1923, pp. 137-142 and 150-151. Results of tests shown in tables.

The Steam Consumption of Sugar Factory Engines, P. H. Parr. Int. Sugar Jl., vol. 25, no. 299, Nov. 1923, pp. 578-583. Discusses the three most common steam pressures used in sugar factories, viz., boiler pressure, pressure at engine, and back pressure; mean effective pressure in lb. per sq. in., and steam consumption in lb. per b.hp., at a normal piston speed of 350-400 ft. per min.; other figures.

STEAM METERS

Throttling-Disk Transmission of Pressure from the Throttling Point in Steam Pipes to the Steam Meter (Uebertragung des Druckes von der Drosselstelle in Dampfrobrleitungen auf Dampfmesser), Hugo Ombeck. Wärme, vol. 46, no. 41, Oct. 12, 1923, pp. 449-450, 6 figs. Points out that in steam meters with throttling disk, proper transmission of pressure from throttling disk to measuring instrument is necessary for perfect results; shortcomings in present types of connecting links; recommends new solution through use of double container.

STEAM POWER PLANTS

Department-Store. Power Problems of Macy's Department Store. Power Plant Eng., vol. 27, no. 24, Dec. 15, 1923, pp. 1215-1220, 7 figs. Extensive change made in equipment to meet requirements of new addition; oil-burning and other improvements which will lead to large cut in operating expenses.

Wood-Waste-Fired. Generating 900-K.W. from Wood Waste, W. H. Rohr. Wood Worker, vol. 42, no. 8, Oct. 1923, pp. 38-40, 6 figs. Describes new power plant of Carr, Ryder & Adams Co., at Dubuque, Ia., which supplies steam heat, electric power, current, electric light current, compressed air and water for a mammoth sash, door and millwork factory.

STEAM TURBINES

Efficiency. Behavior of Turbines with Variable, Quantities of Steam with Throttle Control (Turbines förhållande vid variabel ängtillförsel, speciellt strypreglerade), Matts Bäckström. Teknisk Tidskrift (Mekanik) vol. 53, nos. 24 and 29, June 16 and July 21, 1923, pp. 61-65 and 73-76, 14 figs. Investigation of efficiency at different steam pressures; calculations, and diagrams of pressures; change of heat drop with steam pressure; etc.

Maximum Commercial Efficiency of Steam Turbines, Rob. Dowson. Beama, vol. 13, no. 68, Dec. 1923, pp. 359-365, 2 figs. Relation between thermodynamic efficiency and "Parsons coefficient."

High-Pressure. New Methods in the Construction of Steam Turbines (Neue Wage des Dampfturbinenbaues), W. G. Noack. Elektrischer Betrieb, vol 21, no. 19, Oct. 10, 1923, pp. 221-223, 5 figs. Describes design of BBC high-pressure turbine, constructed by Brown, Boveri & Cie., which operates with high-pressure and highly superheated steam up to 100 atmos. and 450 deg. cent. Abstracted from BBC-Mitteilungen, May 1923.

Repairing. Correcting Trouble in Small Steam Turbines, R. A. Cultra. Power Plant Eng., vol. 27, no. 24, Dec. 15, 1923, pp. 1221-1223, 6 figs. Deals with oil troubles; sprung shaft or rotor; repair work in plant.

Specifications. Turbine Specifications and Bid for Detroit Municipal. Power, vol. 58, no. 22, Nov. 27, 1923, pp. 844-845. Specifications intended to provide for all labor and materials necessary to furnish turbo-generator units specified.

Torsionmeters, Position of. The Accuracy of Torsionmeters. Mar. Engr. & Nav. Architect, vol. 46, no. 555, Dec. 1923, p. 449, 1 fig. Discussion as to best position for them alson line of shafting.

STEEL

Alloy. *See Alloy Steels.*

Classification and Selection. Classification and Selection of Steel, H. B. Knowlton. Forging-Stamping—Heat Treating, vol. 9, no. 11, Nov. 1923, pp. 467-471. Various grades of steel classed according to composition and method of manufacture together with complete review of their properties and applications.

STEEL

Magnetism of. Magnetism of Steels (Du magnetisme des aciers), H. Pecheux, Academie des Sciences—Comptes Rendus des Séances, vol. 176, no. 20, May 14, 1923 pp. 1387-1389. Results of tests on three carbon steels which contained small amounts of manganese, after annealing and after quenching; values for composition of the steels, Steinmetz constant and Brinell hardness members.

Decarburization. Observations on Decarburization, and Nitrogen and Silicon Absorption in the Annealing of Iron and Steel at 1100 to 1300 Deg. Cent. in Pure Nitrogen Stream (Beobachtungen über das Entkohlen, über Stickstoff- und Siliziumaufnahme beim Glühen von Eisen bei 1100 bis 1300° in reinen Stickstoffstrom), P. Oberhoffer and A. Heger. Stahl u. Eisen, vol. 43, no. 48, Nov. 29, 1923, pp. 1474-1476, 4 figs. Time-concentration curves; influence of nitrogen on decarburization and silicon absorption.

High-Speed. *See Steel, High-Speed.*

Manganese. *See Manganese Steel.*

Rail. A Comparison of the Deoxidation Effects of Titanium and Silicon on the Properties of Rail Steel, G. K. Burgess and G. W. Quick. U. S. Bur. Standards, Technologic Papers, no. 241, Oct. 1, 1923, pp. 581-635, 27 figs. Results of investigation on two series of heats of rail steel, one being finished with additions of ferro-silicon and ferro-manganese in ladle and other with ferro-manganese split between furnace and ladle with ferro-carbon-titanium added in ladle, planned on basis of a study of manufacture, tests of A rails, and service results of 1000 tons each of titanium-treated and silicon-treated steel.

Silicon, Effect of. The Effect of Silicon on the Thermal Critical Points of Steel, F. L. Meacham. Am. Soc. Steel Treating—Trans., vol. 6, no. 5, Nov. 1923, pp. 635-646, 13 figs. Investigation to ascertain position of points A1, A2, and A3 in iron-carbon-silicon steel and to compare position of these points with those of pure iron-carbon alloys.

Tellurium in. Properties of Steel Containing Tellurium, G. B. Waterhouse and I. N. Zavarine, Iron Age, vol. 112, no. 24, Dec. 13, 1923, pp. 1575-1576, 5 figs. Experimental heat of cast steel; forging qualities and structure; tellurium present as telluride.

Tool. *See Tool Steel.*

STEEL CASTINGS

Manganese. Specializes in Manganese Steel, H. E. Diller. Iron Trade Rev., vol. 73, no. 25, Dec. 20, 1923, pp. 1672-1677, 9 figs. Methods and equipment of foundry at High Bridge, N. J., which successfully turned from production of car wheels and axles ro manufacture of managane sesteel castings; ferro-manganese melted in cupola for converter steel; electric furnace also employed.

STEEL, HEAT TREATMENT OF

Annealing Sheet Metal. Annealing Sheet Metal for Stamping, F. G. White. Blast Furnace & Steel Pllant, vol. 11, no. 12, Dec. 1923, pp. 637-642, 11 figs. Chemical composition of sheets; laboratory study of annealing; mill study—cannon-ball type furnace; hand-fired vs. stoker-fired furnaces; blue annealing. Includes tables giving results of Erichsen's test.

Methods. Heat-Treatment of Steel with Special Reference to Production, J. W. Urquhart, Machy. (Lond.), vol. 23, no. 583, Nov. 29, 1923, pp. 268-271, 1 fig. Automobile and general springs; considers physical effects produced by varying both quenching temperature and drawing heats permissible.

Salt Baths. Value of Salt Baths for Heat Treating, C. B. Bellis. Forging—Stamping—Heat Treating, vol. 9, no. 11, Nov. 1923, pp. 480-481, 3 figs. Important characteristics of salt baths are melting point, heat conductivity, specific heat and viscosity; urges baths for treating high-speed steel.

STEEL, HIGH-SPEED

Tempering. The Tempering of High-Speed Steels and Their Electrical Resistivity (La trempe des aciers à outils à coupe rapide et leur résistivité), L. Guillet. Revue de Métallurgie, vol. 20, no. 10, Oct. 1923, pp. 656-664, 16 figs. Results of tests showing influence of tempering temperature and period of heating before tempering on resistibity and hardness.

STOKERS

Mechanical. A Corsthwaite Mechanical Stoker. Power Engr., vol. 18, no. 212, Nov. 1923, pp. 422-423, 1 fig. New improved type of stoker and self-cleaning furnace.

STORAGE BATTERIES

Weight Efficiency of. On the Weight Efficiency of the Secondary Battery, Sakae Makio. Denki Gakkwai Zasshi (Jl. Inst. Elec. Engrs. of Japan), nos. 422-423, Sept.-Oct. 1923, pp. 820-829, 12 figs. (In Japanese).

STRAIGHTENING MACHINES

Round Bars and Tubes. Continuous Straightening Machines for Round Bars and Seamless Tubes. Iron & Coal Trades Rev., vol. 108, no. 2908, Nov. 23, 1923, p. 771. 4 figs. Straightening machine for small sections; continuous straightening machines for heavy sections; straightening machines for seamless tubes.

STREET RAILWAYS

Cars, Emergency Braking on. Emergency Braking on Electric Cars, D. D. Ewing. Purdue Univ.—Bul., vol. 7, no. 7, July 1923, 162, pp., 89 figs. Report presented to Central Elec. Ry. Assn. of tests made on four electric cars; description of equipment tested, theoretical considerations, and discussion of tests results.

Cars, Light-Weight. Experience Shows Light Cars Increase Net of Interurban Lines, C. T. DeHorc. Elec. Ry. Jl., vol. 62, no. 22, Dec. 1, 1923, pp. 927-930, 3 figs. Analysis of operating results on several properties over period of six years showing material reduction in operating costs as compared with heavy cars; light cars take less power and can make schedules better; revenue increases have followed improvements in service made possible.

STRUCTURES

Marine. Deterioration of. The Deterioration of Structures in Sea-Water. Dept. Sci. & Indus. Research, Lond., Aug. 1923, 79 pp., 11 figs. on supp. plates, Third Interim Report of committee of Instn. Civil Engrs., on tests carried out on action of sea water on timber, metal and concrete structures.

SUPERHEATED STEAM

Superheating Principles. The Economy of Superheated Steam. Eng. & Boiler House Rev., vol. 37, no. 4, Oct.-Nov. 1923, pp. 100 and 103-104, 2 figs. Elementary facts concerning superheating.

SYMBOLS

Construction Engineering. Standard Terms and Symbols for Construction Engineering (Einheitliche Bezeichungen für die Entwürfe von Ingenieurbauwerken), H. Schaper. Bautechnik, vol. 1, no. 34, Aug. 10, 1923, pp. 332-333. Presents mathematical symbols, symbols for weight and measure units; terminology for expressions of mechanics and statics; and for dimensions, basic units and weights of steel superstructures; recommended for adoption by German authorities.

Heat and Steam. Report of Progress of Committee Number 20, on the Standardization of Technical Nomenclature. Eng. Education, vol. 14, no. 3, Nov. 1923, 135-141. List of symbols for heat and steam. List of symbols in mechanics and hydraulics adopted by Soc. for Promotion of Eng. Education on June 28, 1918.

T

TELEPHONY

Long-Distance. European Long-Distance Telephony (Comité Technique préliminaire pour la téléphonie à grande distance en Europe). Annales des Postes, Télégraphes et Téléphones, vol. 12, no. 9, Sept. 1923, pp. 1016-1061, 2 figs. Suggestions adopted by Preliminary Technical Committee and approved by administration of the six countries represented.

TEMPERATURE CONTROL

Automatic. An Automatic Temperature Control System. Power Engr., vol. 18, no. 213, Dec. 1923, pp. 454-456, 9 figs. Complete range of instruments and apparatus for automatic control of temperature in industrial processes developed by Cambridge & Paul Instrument Co.

TERMINALS, RAILWAY

Freight and Engine. Michigan Central Completes its Niles, Mich., Yard. Ry. Rev., vol. 73, no. 22, Dec. 1, 1923, pp. 791-794, 7 figs. Larger freight and engine terminal provides better operating conditions.

TESTING MACHINES

Temper Testing. The Pile Temper-Testing Machine, R. G. Johnston. Brass World, vol. 19, no. 11, Nov. 1923, pp. 353-355, 1 fig. Principle of design and method of operation of machine for testing or comparing temper of two pieces of thin non-ferrous strip or wire.

THERMOMETERS

Kata-thermometers. A New Recording Kata-Thermometer, E. H. J. Schuster. Jl. of Sci. Instruments, vol. 1, no. 1, Oct. 1923. p. 30. Notes on apparatus in which heating and cooling are carried out automatically and a tracing is made consisting of a horizontal line broken quarter of an hour to give a record of elapsed time, and above this a series of vertical ordinates, each representing by its length number of seconds which instrument took to cool at time of day shown in horizontal line.

TOOL STEEL

Tempering. The Tempering of Tool Steels, J. P. Gill and L. D. Bowman. Am. Soc. Steel Treating— Trans., vol. 4, no. 6, Dec. 1923, pp. 727-742 and (discussion) 742-747, 8 figs. Study of effect of time, temperature and mass on tempering of tool steels, including high-speed steels; it is shown that tempering colors can be produced on surface of piece of steel successively at low temperatures if held for sufficient length of time; molecular rearrangement takes place in hardened steels at atmospheric temperatures; discusses phenomenon of "temper brittleness" as it refers to steels.

TOOLS

Precision, Manufacture of. Manufacturing a Precision Tool, E. Sheldon. Am. Mach., vol. 59, no. 25, Dec. 20, 1923, pp. 903-907, 12 figs. Preparatory operations on frames; threading main and adjusting nuts by tapping; rigid inspection methods.

TRANSFORMERS

Rotary-Converter. Rotary Converter Transformers, G. Berg. Electrician, vol. 91, no. 2374, Nov. 16, 1923, pp. 538-541, 5 figs. Design influence by necessity of providing reactance. Describes method employed in studying leakage of sandwich type of winding in order to reduce a suitable formula for its reactance, and results obtained.

Loading on Heat Basis. Loading Transformers on Heat Basis, N. L. Dolph. Elec. World, vol. 82, no. 24, Dec. 15, 1923, pp. 1209-1212, 6 figs. Economic study of transformer operation shows possibility of great savings if lighting transformers are operated on temperature-rating basis; discusses other load limitations.

High-Voltage. Transformers for High-Voltage Systems, A. W. Copley. Am. Inst. Elec. Engrs.—Jl., vol. 42, no. 12, Dec. 1923, pp. 1259-1260. Solidly grounded neutral system is used and advantages is taken of this to use graded insulation and reduced voltage test; auto-transformers are used to connect between 220-kv. system and existing high voltages and are connected star-star with delta tertiary.

Distribution. Economies Possible in Discarding Distribution Transformers of High Core Loss, M. M. Koch. Nat. Elec. Light Assn.—Bul., vol. 10, no. 11, Nov. 1923, pp. 678-679. Notes on proper tests; fixed charges; saving in energy losses.

Overloads. Overloads and Short-Time Ratings, Reginald O. Kapp. Elec. Rev., vol. 93, no. 2397, Nov. 2, 1923, pp. 644-646, 3 figs. Graphical solution of problem for what period of time under given conditions electric plant will safely stand given overload; solution is applicable to transformers or cables.

TRANSPORTATION

Railway. Reports on Transportation to Chamber of Commerce of the United States. Ry. Rev., vol. 73, no. 22, Dec. 1, 1923, pp. 788-791. Committee reports on governmental relations to railway transportation, and on readjustment of relative freight-rate schedules.

TUBES

Pickling-Bosh Maintenance. The Electrolytic Maintenance of Tube Pickling Boshes. Metal Industry (Lond.), vol. 23, no. 21, Nov. 23, 1923, pp. 457-458. Economics of process; details of actual plant; operating considerations and results.

TUNNELING

Moffat Tunnel, Colo. Six-Mile Moffat Tunnel Through the Rocky Mountains. Eng. News-Rec., vol. 91, no. 24, Dec. 13, 1923, pp. 962-965, 4 figs. Novel plan to finance railway tunnel replacing open summit pass; small parallel pilot tunnel assists construction; excavation progress.

U

UNIVERSAL JOINTS

Dies for Boot. Dies for Producing a Universal Joint Boot. N. T. Thurston. Machy. (N. Y.), vol. 30, no. 4, Dec. 1923, pp. 253-256, 13 figs. Blanking, drawing, piercing, flanging, and wiring operations.

V

VACUUM TUBES

Thermionic Tubes. Thermionic Vacuum Tubes and Their Applications, Robert W. King. Bell System Technical Jl., vol. 2, no. 4, Oct. 1923, pp. 31-100, 79 figs. Discusses thermionic mission, thermionic properties of filaments, space current-voltage characteristic and temperature saturation and voltage saturation; two-electrode and three-electrode tubes; amplifier power supply; troubles in amplifier circuits; thermionic amplifiers, modulators, and detectors; vacuum tube oscillators; applications.

VIADUCTS

Calculation. Note on the Calculation of Viaducts (Note sur le calcul des viaducs), M. Grelot. Annales des Ponts et Chaussées, vol. 2, no. 4, July-Aug. 1923, pp. 92-111, 4 figs. Formulas for calculation and their numerical application to reinforced-concrete of a viaduct to be built at port of Marseilles.

VOCATIONAL TRAINING

Machinists and Draftsmen. Worth-while Vocational Training, George B. Frazee, Machy. (N. Y.), vol. 30, no. 4, Dec. 1923, pp. 289-293, 5 figs. Features of educational program of Grand Rapids vocational school for giving future machinists and draftsmen well-rounded knowledge of their trade.

VOLTAGE REGULATION

Synchronous Condenser for. Methods of Voltage Control of Long High-Voltage Lines by the Use of Synchronous Condenser, J. A. Koontz. Jr. Am. Inst. Elec. Engrs.—Jl., vol. 42, no. 12, Dec. 1923, pp. 1255-1256. Notes on inherent characteristics of high-voltage lines and transformers; effect of low power-factor load on high-voltage lines as to limiting capacity and uses of condenser for increasing line output and obtainiug voltage control; etc.

W

WAGES

Work on Dangerous Machines. Wage Systems for Work on Dangerous Machines and Their Influence on Accident Prevention (Lohnsysteme an gefährlichen Arbeitsmaschinen und ihr Einfluss auf die Unfallverhütung), H. Kleditz. Zeit. des Vereines deutscher Ingenieure, vol. 67, no. 44, Nov. 3, 1923, pp. 1024-1027. Report on experienees in varoius industrial district in Germany, from which it is shown that accidents are no more frequent with piece-rate than with hour rate system.

WASTE HEAT

Waste-Gas Utilization. Modern Waste-Gas Utilization Plants for the Production of Steam, Hot Water and Hot Air (Neure Abgasausnutzungsanlagen zur Gewinnung von Dampf. Warmwasser und Warmluft), O. Brandt. Wärme, vol. 46, no. 44, Nov. 2, 1923, pp. 379-482, 5 figs. Discusses importance and possibilities of waste-gas utilization in industrial furnaces of different temperature ranges; use of waste-heat boilers, waste-gas preheaters and waste-gas pocket air heaters in connection with induced-draft installations.

WATER METERS

Specifications. Report of the Joint Committee on Standard Specifications for Water Meters. Am. Water Works Assn.—Jl., vol. 10, no. 6, Nov. 1923, pp. 1093-1118. Discusses types of meters, maximum and minimum lengths of meters, recommended, equipment necessary to test meters for compliance with registration and capacity requirements as set forth in standard specifications, information to be furnished to manufacturers when requested to submit bids on meters, and care of meters. Standard specifications for cold water meters, adopted by Joint Committee of Am. Water Works Assn. and New England Water Works Assn., of current, compound, and fire-service types.

WATER PIPE

Reinforced-Concrete. Centrifugally-Cast Reinforced-Concrete Water Pipe, W. G. Chace. Can. Engr., vol. 45, no. 20, Nov. 13, 1923, 489-491, 6 figs. Description of outfits required for manufacture; construction of reinforcing cage, using steel wire and triangular mesh; for water pressures up to 100 lb. sq. in.; special flexible joint provided for contraction.

WATERPROOFING

Masonry Walls. Preservation of Masonary Walls by Waterproofing Processes. Stone, vol. 44, no. 10, Oct. 1923, pp. 569-570. Notes on method and compounds for waterproofing.

WATER SUPPLY

Surface, Canada. Surface Water Supply of Canada. Atlantic Drainage, South of St. Lawrence River—New Brunswick, Nova Scotia, Prince Edward Island, 1920-21 and 1921-22, K. H. Smith, Can. Dept. Inter., Dominion Water Power Branch, Water Resources Paper No. 37, 1923, 97 pp., 3 figs. on supp. plates. Hydrometric and Meteorological data.

Surface Water Supply of Canada. Pacific Drainage—British Columbia and Yukon Territory, 1921-22, R. G. Swan. Can. Dept. Inter., Dominion Water Power Branch, Water Resources Paper No. 39, 1923, 168 pp., 3 figs. on supp. plates. Hydrometric data obtained from regular gaging stations and miscellaneous measurements, and meteorological data.

WATER TANKS

Concrete Railway. Concrete Tanks for Railway Water Service, C. R. Knowles. Eng. & Contracting (Railways), vol. 60, no. 5, Nov. 21, 1923, pp. 1078-1081. General design features of tanks. and description of different types; permanent l ocation; cost.

WATER WORKS

Pumping Stations. The Selection of Pumping Equipment from the Standpoint of Station Economy, Frank A. Mazzur. New England Water Works Assn.—Jl., vol. 37, no. 3, Sept. 1923, 242-253 and (discussion) 253-260. Discusses turbine, electric, and oil-engine drive; comparison of operation costs of various types of pumping equipment.

WEIGHING MACHINES

Milligram Loans. Two Machines for Rapidly Weighing Loads of a Few Milligrammes. Jl. of Sci Instruments, Preliminary Number, May 1922, pp. 15-21, 14 figs. Describes the cantilever balance and the catenary balance, made for special purpose of sorting by weight small spiral filaments used in manufacture of gas-filled lamps.

WELDING

See Electric Welding; Electric Welding, Arc; Oxy-Acetylene Welding.

WIND POWER

Germany. Wind Power in Germany (Die Windkraft in Deutschland), Oscar Walter. Zeit. des Vereines deutscher Ingenieure, vol. 67, no. 45, Nov. 10, 1923, pp. 1037-1041, 9 figs. Note on wind intensity in Germany and detailed discussion of fluctuations in performance of wind-power plants; based on official data, gives annual wind-power output for several localities.

WOOD PRESERVATION

Treatment Processes. How Wood Is Treated. Wood Preserving News, vol. 1, no. 10, Nov. 1923, pp. 179-181, 3 figs. Describes standard processes.

Z

ZONING

Purposes and Limitations. Some Fundamental Purposes and Limitations in Zoning, Robert Whitten. Eng. & Contracting (Bldgs.), vol. 60, no. 3, Sept. 26, 1923, pp. 642-644. Decentralization by zoning; conservation of property values; fundamental limitations in zoning, (Abstract.) Report outlining tentative zoning plan.

ENGINEERING INDEX—Supplementary List

A

AMMONIA

Specific Heat. Specific Heat of Superheated Ammonia Vapor, N. S. Osborne, H. F. Stimson, T. S. Slight, Jr. and C. S. Cragoe. Refrig. Eng., vol. 10. no. 5, Nov. 1923, pp. 145-168, 18 figs. Series of measurements which is one of group of experimental investigations of thermodynamic behavior of superheated ammonia vapor; aim has been to obtain calorimetric data for superheated vapor comparable in accuracy with results of other experimental measurements of group, so that consistent tables might be formulated which would agree thoughout with experimental data.

APPRENTICES, TRAINING OF

Building Trades, Boston. Apprenticeship in the Building Trades of Boston, Wm. S. Parker, Geo. Thornton, Heywood S. French and Jas. M. Gauld. Boston Soc. Civ. Engrs.—Jl., nol. 10, no. 9, Nov. 1923, pp. 381-403 and (discussion) 403-410. Subject is discussed from viewpoint of architect, contractor and labor group.

AUTOMOBILE FUELS

Benzol. An Australian Motor Spirit. Indus. Australian & Min. Standard, vol. 70, no. 1821, Oct. 25, 1923, pp. 628-629, 3 figs. Fully-equipped plant for recovery of benzols has been installed at Newcastle works of Broken Hill Proprietary Co. as an adjunct to coke ovens plant and company is now in position to place on Australian market 1,250,000 gal. annually.

Benzol vs. Gasoline. Gasoline or Benzol (Benzin oder Benzol), H. Typke. Wirtschaftsmotor, vol. 5, no. 7, July, 25, 1923, pp. 12-13. Discusses standpoints for judgment of what may be termed high-grade fuel: volumetric unit; maximum output; efficiency, and price; judged by these factors, author concludes that superiority of benzol for German conditions is established.

Miles per Gallon, Increasing. What the Automotive and Oil Industries Can do for Each Other, H. L. Horning. Am. Petroleum Inst.—advance paper, for meeting Dec. 11-13, 1923, 14 pp. Points out that it is possible to double miles per gallon of gasoline and lubricating oil on cars, trucks, and in general, by small cost in design.

AUTOMOBILE MANUFACTURING PLANTS

American. What About Automobile Shops? A. L. DeLeeuw and K. H. Condit. Am. Mach. vol. 59, nos. 18, 19, 20 and 21, Nov. 1, 8, 15 and 22, 1923, pp. 643-645, 683-684, 723-724 and 753-754. Present conditions in American industry. Nov. 8: Drilling operations. Nov. 15: Lack of uniformity in shop practice. Nov. 22, Present and future development of new machines.

Machine Tools for. Equipping an Ideal Automobile Plant, A. L. DeLeeuw. Am. Mach., vol. 59, no. 23, Dec. 6, 1923. pp. 825-827. Author suggests types of machine tools new to automobile industry, such as magazine feeds, combination machines with rotating tables, non-adjustable standard-type machines and standard unit combinations.

AUTOMOBILES

American Improvements. American-Built Products Predominate at Automobile Salon. Automotive Industries, vol. 49, no. 20, Nov. 15, 1923, pp. 1004-1006, 6 figs. American exhibits at automobile salon in New York. Special bodies with dummy radiator shown on Franklin chassis; Minerva adds front-wheel brakes.

Bodies. Coachwork at the Show. Autocar, vol. 51, no. 1464, Nov. 9, 1923, pp. 963-973, 43, figs. Brief descriptions of bodies of exhibits at Olympia (Lond.) annual automobile exhibition, Nov. 2-10, 1923, arranged in alphabetical order. See also Auto-Motor Jl., vol. 28, no. 45, Nov. 8, 1923, pp. 990-991, 5 figs.

B

BLAST-FURNACE GAS

Purification by Electric Filter. The Electric Filter Experimental Station for the Purification of Blast-Furnace Gas at the Rhenish Steel Works in Duisburg-Meiderich (Dei Elektrofilter-Versuchsanlage zur Reinigung von Hochofengas auf den Rheinischen Stahlwerken in Duisburg-Meiderich), H. Lent. Stahl u. Eisen, vol. 43, no. 48, Nov. 29, 1223, pp. 1467-1471 and (discussion) 1471-1474, 4 figs. Fundamentals of electric gas purification; review of literature; tests of Siemens-Schuckert Works; difficulties with hot gas; results of tests at experimental stations of Rhenish Steel Works; conclusions.

BOILER ROOMS

Losses in, Pervention of. The Prevention of Boiler Room Losses, Jas. T. Beard, 2nd. Indus. Management, (N.Y.), vol. 66, no. 6, Dec. 1923, pp. 355-356, 5 figs. Discusses causes of losses and methods of prevention.

BRIDGES, CONCRETE

Strength of. Reinforced Concrete Overbridge at Wembley Hill Station. Engineering, vol. 116, no. 3019, Nov. 9, 1923, p. 602, 8 figs. partly on p. 603. Results of accidental test showed strength of bridge.

C

CALORIMETERS

Pressure and Tempreature Corrector. A New Automatic Pressure and Temperature Corrector for Gas Volumes, C. H. Beasley. Chem. & Industry, vol. 42, no. 48, nov. 30. 1923, pp. 457T-459T, 3 figs. Describes improvements made in Beasley recording net value calorimeter and how they were arrived at.

CASTING

Centrifugal. Casting Iron Centrifugally, J. A. Rathbone. Foundry, vol. 51, no. 24, Dec. 15, 1923, pp. 988-990, 2 figs. Piston-ring castings made centrifugally chilled when cast against metal molds and different types of cores were utilized to prevent this action; annealing, experiments. Paper presented at Am. Foundrymen's Assn.

COAL MINES

Fans. The Power Requirements of Mine Fans, Earl B. Stavely. Coal Industry, vol. 6, no. 11, Nov. 1923, pp. 459-462. Factors which effect power requirements; effect of possible changes in ventilating conditions on loading of driving the motor; cost of electrical energy.

CONDUITS

Pressure. Pressures in Pressure-Conduit Linings. (Ueber die Inanspruchnahme von Druckstollen-Ausleidungen), Ludwig Mühlhofer. Bauingenieur, vol. 4, no. 18, Sept. 30, 1923, pp. 309-516, 1 fig. Equations are set up for stresses occurring in lining of conduits due to working pressure.

CONNECTING RODS

Production Methods. Connecting Rod Production Accelerated by Gang System and Good Jigs, W. L. Carver. Automotive Industries, vol. 49, no. 23, Dec. 6, 1923, pp. 1155-1161, 13 figs. Methods in forge and machine shops in production of Jewett connecting rod.

D

DREDGES

Gravel. The Libertyville Dredge. Rock Products, vol. 26, no. 23, Nov. 17, 1923, pp. 27-29, 6 figs. Describes dredge of Interstate Sand & Gravel Co., designed for working in a heavy deposit with special arrangements for attacking ground and keeping our large stones.

E

ELECTRIC MOTORS, A. C.

Repulsion. Repulsion Motors Extensively Used in Saxony. Elec. World, vol. 82, no. 21, Nov. 24, 1923, p. 1061. Describes use of special electric (repulsion or 3-phase commutator) motors on spinning machines, for connection to 3-phase power lines.

ELECTRIC WELDING, ARC

Ships. Applications of Arc Welding to Ship Construction, E. H. Ewertz. Mar. Eng. & Shipg. Age, vol. 28, nos. 7, 8, 9, 10 and 12, July, Aug., Sept., Oct. and Dec. 1923, pp. 420-424 and 440, 480-491, 549-556, 625-630 and 774-778, 83 figs., 23 tables. Report prepared by author in co-öperation with Elec. Arc Weld. Comm. of Am. Bur. Weld. Includes summary of present applications of welding as compared with riveting, description of arc-welded ships in existence and their performance, review of tests to demonstrate the adequacy of welding in ship construction, etc. (To be continued)

H

HEATING

Factories. Heating of Factories (Chauffage d'ateliers), H. Jenny. Bul. Technique de la Suisse Romande, vol. 49, nos. 17 and 18, Aug. 18 and Sept. 1, 1923, pp. 197-200 and 216-218, 18 figs. partly on pp. 215-218 and 219. Connection between lighting, heating and ventilating; separate heating and ventilating and combined heating and ventilating; hot-water and hot-air heating; waste-steam utilization.

HIGHWAYS

American Development. The Development of an American Highway System, Austin F. Bement. Good Roads, vol. 65, no. 15, Nov. 7, 1923, pp. 151-156 and 158, 10 figs. Describes development of Lincoln Highway.

HYDROGEN

Manufacture. The Industrial Manufacture of Hydrogen (La fabrication industrielle de l'hydrogene), Max Verneuil. Genie Civil, vol. 83, no. 15, Oct. 13, 1923, pp. 340-346, 5 figs. Discusses water-gas catalysis process, and process of the Société l'Oxhydrique française which can be employed for production of small as well as large quantities.

I

ICE PLANTS

Oil-Engine-Driven. Oil-Engine Drive Promotes Ice-Plant Efficiency, Robert G. Skerrett. Compressed Air Mag., vol. 28, no. 11, Nov. 1923, pp. 693-697, 14 figs. Description of equipment of Central Ice & Cold Storage Coop., at Vineland, N. J.; electric current for illuminating, handling ice in tank room and on loading platform, driving brine agitators, operating centrifugal pumps, etc., generated by 65-kw. dynamo directly connected to a 100-hp. Ingersoll-Rand oil engine running at 257 r.p.m.

INTERNAL-COMBUSTION ENGINES

Shock Reduction. Shocks in Piston Engines (Einiges über die Stösse bei Kolbenmaschinen), Arthur Balogh. Wirtschaftsmotor, vol. 5, nos. 8-9, Sept. 25, 1923, pp. 12-13. In order to reduce shocks in piston engines during working period, a critical number of revolutions is determined based on condition that no change in direction of forces takes place.

IRON CASTING

Channel Beams. Making Iron Channel Frames' H. R. Simonds. Foundry, vol. 51, no. 23, Dec. 1, 1923, pp. 933-937, 9 figs. Describes practice at Saco-Lowell foundry in Lowell Mass., and successive steps in production of long channel beam castings for textile machinery.

L

LIGHTHOUSES

Improvements. The Latest Improvements in Lighthouse Equipment (Les derniers perfectionnements des phares et des projecteurs de lumiere intensive), E. Marcotte. Nature, no. 2588, Nov. 10, 1923, pp. 290-301, 20 figs. Describes improved lenses; gas, oil and electric lamps; and rotary apparatus.

M

MAPPING

Mine Workings, for. Anaconda Copper Mining Co.'s Mapping Practice, J. L. Hayes Eng. & Min. Jl-Press, vol. 116, no. 20, Nov. 17, 1923, pp. 841-843, 5 figs. How drawings coveringextensive mine workings are standardized; co-ordinate system used and method of indexing.

METALS

Deformation Due To Rolling. Material Displacement in Connection with Rolling (Ueber die Materialverschiebung beim Walzen), G. Gredt. Stahl u. Eisen, vol. 43, no. 47, Nov. 22, 1923, pp. 1443-1449, 6 figs. Observation of relative change of segregation; confirmation of Rummel theory that deformation is independent of plasticity.

N

NITROGEN

Fixation. Nitrates and Ammonia From Atmospheric Nitrogen, F. Kilburn Scott. Roy. Soc. Arts—Jl., vol. 71, nos. 3702, 3703 and 3704, Nov. 2, 9 and 16, 1923, pp. 859-876, 877-895 and 900-917, 24 figs. Nov. 2: World's production of fixed inorganic nitrogen; number of plants for fixing atmospheric nitrogen; nitrate supplies; arc furnaces; theoretical considerations; description of different plants. Nov. 9: Financial data; electric ppwer; cyanamid process; cyanide and nitride. Nov. 16: Synthesis of ammonia—German and American plants; Claude process; cost figures; research and development.

O

OIL ENGINES

Manufacture. Various Oil Engine Trials and Experiments, A. I. Nicholson. Motorship, vol. 8, no. 12, Dec. 1923, pp. 866-871, 10 figs. Résumé of trials carried out on Scott-Still combination oil and steam engine. (Abstract.) Paper read before Instn. Engrs. & Shipbldrs. in Scottland.

ORE DRESSING

Ball Milling. An Experimental Study of Ball-mill Grinding, Donald H. Fairchild. Eng. & Min. Jl.—Press, vol. 116, no. 4, Nov. 17, 1923, pp. 845-846, 2 figs. Large amount of inactive space in mills of ordinary type suggests variation from cylindrical form.

P

PILES

Foundations. Notes on Pile Foundations, Geo. A. McKay. Public Works of the Navy, U. S. Bur. Yards and Docks. Bul. No. 33, Oct. 1923, pp. 31-47. Some of the troubles and exceptional occurrences encountered by the bureau.

PUMPS

Priming, Interceptor for. The Seaborne "Intreceptor" for the Priming of Pumps, C. J. H. Penning. Int. Sugar Jl., vol. 25, no. 299, Nov. 1923, pp. 584-586, 5 figs. Particulars of Seaborne "interceptor," which provides means whereby a centrifugal or rotary pump is kept permanently primed, while there are no restricted passages in suction main, no fine adjustments, and no valves; is a receptable placed in suction pipe line just above pump housing.

R

RECLAMATION

Federal Land. Federal Land Reclamation: A National Problem. Eng. News-Rec., vol. 91, nos. 17, 18, 19, 20, 21, 22, 23, 24 and 25, Oct. 25, Nov. 1, 8, 15, 22, 29, Dec. 6, 13 and 20, 1923, pp. 666-673, 715-718, 756-761, 801-807, 838-841, 890-982, 924-925, 977-981 and 1019-1021, 9 figs. History and performance of great Government adventure in irrigation of arid lands of West. Oct. 25: Origin, problems and achievements. Nov. 1; Development of West under irrigation. Nov. 8; Agriculture on irrigated lands. Nov. 15: Twenty years of reclamation. Nov. 22: Organized land settlement. Nov. 29: Difficulties and complaints of farmer. Dec. 6: Financial troubles of reclamation farmer and how they may be re eved. Dec. 13: Faults of reclamation law and practice, and their remedies. Dec. 20: Future of federal reclamation.

REFRIGERATING PLANTS

Tests. Testing an Ammonia Refrigerating Plant, Chas. H. Herter. Power, vol. 58, no. 22, Nov. 27, 1923, pp. 846-849, 2 figs. Running of tests; evaporating system; condenser records; computed efficiencies; observations and deductions from tests made on 125-ton plant.

ROLLING MILLS

Rod Mill. New Rod Mill for Wire and Cable Plant. Iron Age, vol 112, no. 23, Dec. 6, 1923, pp. 1055-1507, 5 figs. Tonnage unit of combined continuous and looping type installed for rolling both steel and copper, at Kinkora plant, Roebling, N. J.

S

SEWAGE DISPOSAL

Plants. City Forces Build Sewage Treatment Works, Earl R. Perry. Eng. News-Rec., vol. 91, no. 21, Nov. 22, 1923, pp. 832-837, 10 figs. Construction plant installed by sewer department of Worcester, Mass., for force account; construction of Imhoff tanks and trickling filter.

The New Sewage Disposal Works of Lincoln, Neb. Eng. & Contracting (Water Works), vol. 60, no. 5, Nov. 14, 1923, pp. 1028-1031, 4 figs. Pumping station, sludge-separating and digesting tanks, dosing tanks, sprinkling filters and sludge beds.

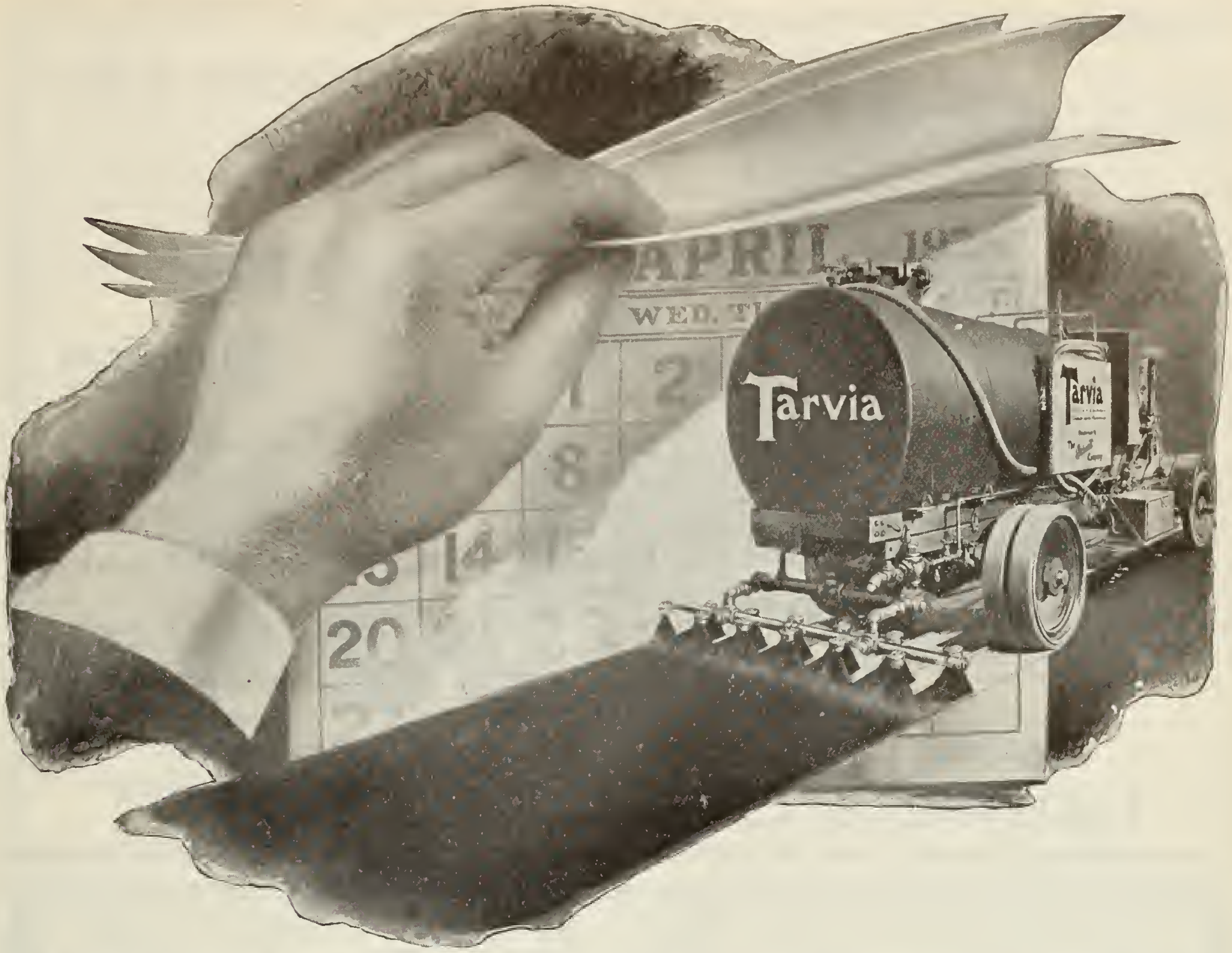
W

WATERWAYS

Power Production from. Utilization of Waterways for the Production of Power; Its Consequences and Applications, Wm. Kelly. World Ports, vol. 12, no. 1., Nov. 1923, pp. 21-24. Discusses development of Tennessee Mississippi, Ohio Columbia and St. Lawrence Rivers.

WATER WORKS

Coal Economy. The Water, Works Coal Pile, Donald H. Maxwell. Am. Water Works Assn.—Jl., vol. 10, no. 6, Nov. 1923, pp. 1072-1081, 3 figs. Coal savings possible; developments in steam plant economy; advantages of high pressure and superheat; limitations of water works plants; power plant and pump room operation.



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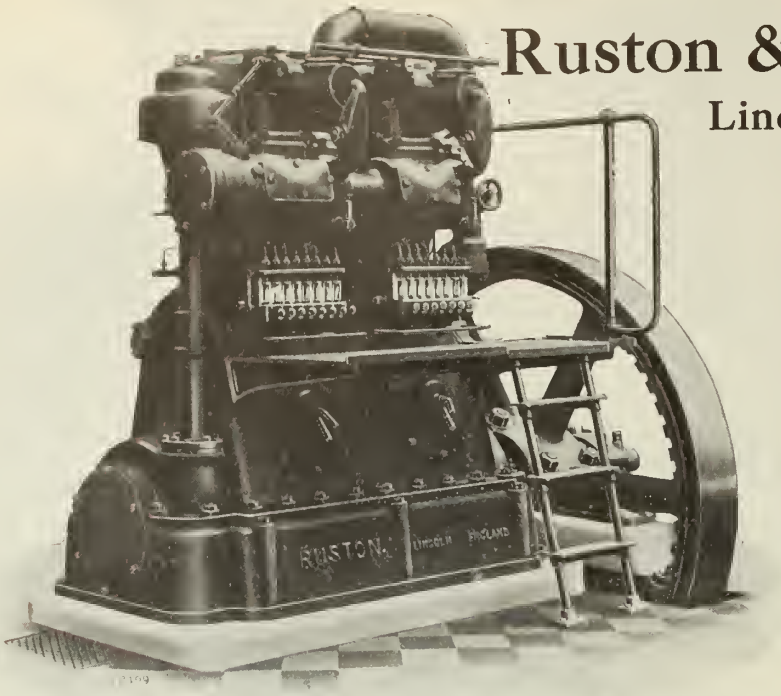

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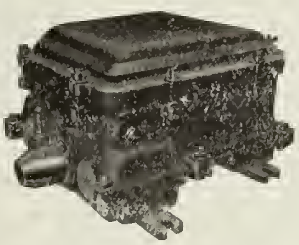

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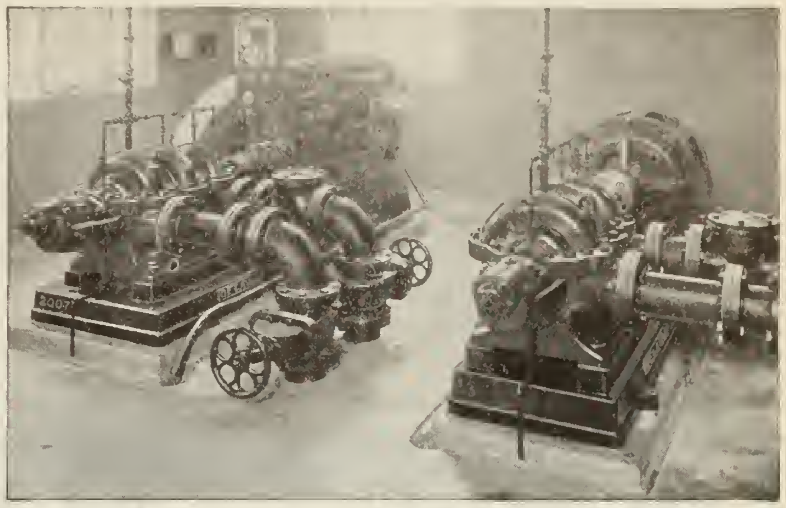

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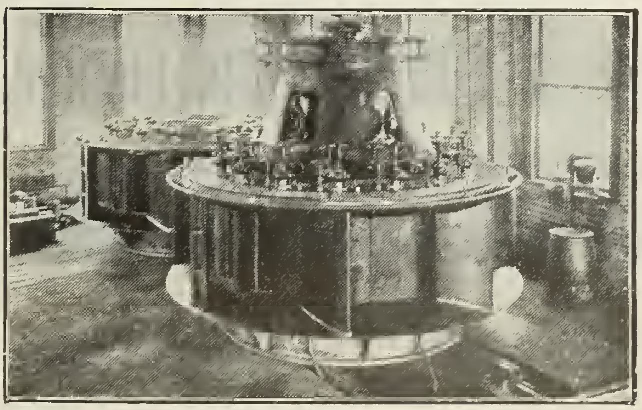

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—OF—

CANADIAN DESIGN AND MANUFACTURE
HIGHEST EFFICIENCY.
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OUR HYDRAULIC TURBINES ENSURE A SOUND INVESTMENT.

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Type B Midwest Air Filter for capacities of 465 cu. ft. per min. and over.

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Yet that is just what is being done when air compressors are fed clean oil and **dirty, dusty air!**

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Dept. F-16 will gladly send you a copy of our Filter Dust Book——

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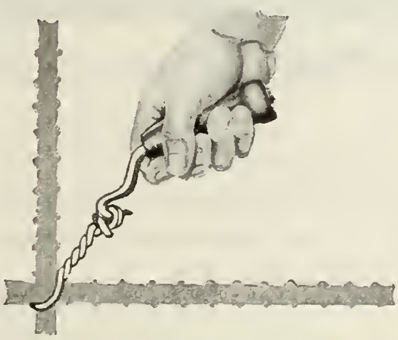
of Bar Tying for Reinforced Concrete Work

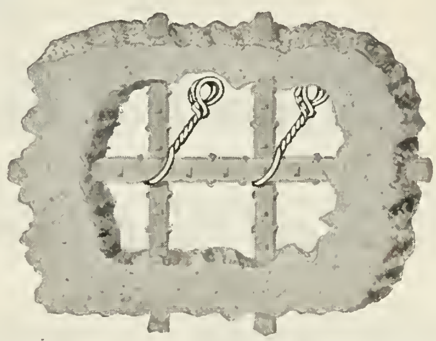


Illustrating ease with which Bates Bars Ties are applied

A saving of 2/3rds labor cost in laying reinforcing bars made possible by using Bates Wire Ties for Tying cross sections.

Two or three turns with the Bates Simplex Tying Tool and Bars are securely tied.

Prices and table showing tie required for various size bars on request.



Sectional View showing Reinforced Bars held in place by Bates Wire Ties.

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Why not install a Horton Elevated Steel Tank to avoid laying larger mains or buying more pumps? The tank is filled during the slack hours when demand is less than pump capacity and the water so stored is discharged into the mains during the peak load period when the pumps alone would be inadequate to supply the demand.

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245

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LIMITED

285 BEAVER HALL HILL, MONTREAL

Purchasers' Classified Directory

A Selected List of Equipment, Apparatus and Supplies

For Alphabetical List of Advertisers see page 52

A

Acids:
Nichols Chemical Co., Ltd.
Air Brakes:
Canadian General Electric Co., Ltd.
Air Coolers:
Laurie and Lamb.
Alumina Sulphate:
Nichols Chemical Co., Ltd.
Ammonia Controlled Water Regulators:
Under-Feed Stoker Co., of Canada, Ltd.
Ammonia Valves and Fittings:
Crane Ltd.
Anchorage Equipment:
Midwest Canada, Ltd.
Angles:
Dominion Bridge Co., Ltd.
Hamilton Bridge WorksCo.,Ltd
Arches, Flat:
Combustion Engineering Corp., Ltd.
Asphalt:
Imperial Oil Ltd.
Ash Handling Equipment:
Combustion Engineering Corp Ltd.
Automatic Air Valves:
Jenkins Bros., Ltd.
Automatic Underfeed Stokers:
Combustion Engineering Corp., Ltd.
Taylor Stoker Co., Ltd.

B

Balls, Chromang Grinding:
William Kennedy & Sons, Ltd.
Balls, Steel:
Canadian S.K.F. Co., Ltd.
Barge Cranes:
Industrial Works.
Bars, Reinforcing:
Algoma Steel Corp., Ltd.
British Empire Steel Corp., Ltd.
Burlington Steel Co., Ltd.
Bars, Steel & Iron:
Burlington Steel Co., Ltd.
Steel Co., of Canada Ltd.
Beams:
Dominion Bridge Co., Ltd.
Hamilton Bridge WorksCo., Ltd.
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Canadian S.K.F., Co., Ltd.
Openshaw & Bennett, Ltd.
Bearings, Fibre:
Diamond State Fibre Co., of Canada, Ltd.
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Canadian S.K.F. Co., Ltd.
Belting:
General Supply Co., of Canada, Ltd.
Jones and Glassco, Regd.
Bending Machines:
John Bertram & Sons Co., Ltd.,
Blowers, Centrifugal:
De Laval Steam Turbine Co.
Blue Print Machinery:
J. Frank Raw Co., Ltd.
Boilers:
E. Leonard & Sons, Ltd.
Mussens Limited
Boilers, Heating:
Combustion Engineering Corp., Ltd.
Engineering & Machine Works of Canada, Ltd.
E. Leonard & Sons, Ltd.
Taylor Stoker Co., Ltd.
Boilers, Marine:
Engineering & Machine Works of Canada, Ltd.
Boilers, Power:
Engineering & Machine Works of Canada, Ltd.
Boilers, Portable:
E. Leonard & Sons, Ltd.
Boilers, Return Tubular:
Babcock-Wilcox & Goldie-McCulloch Co., Ltd.
Bolts:
British Empire Steel Corp., Ltd.
Steel Co., of Canada, Ltd.
Books:
John Wiley & Sons, Inc.
Renouf Publishing Co.
Boring and Turning Mills:
John Bertram & Sons Co., Ltd.,
Boxes, Valve:
Jenkins Bros., Ltd.
Bridges, Highway:
Hamilton Bridge Works Co.,Ltd.
Bridges, Steel:
Canadian Bridge Co., Ltd.
Dominion Bridge Co., Ltd.
Hamilton Bridge Works Co.,Ltd.
Broadcasting Equipment:
Marconi Wireless Telegraph Co., of Canada, Ltd.
Northern Electric Co., Ltd.
Buckets, Clamshell, Grab:
Industrial Works.
Buckets, Clamshell, Orange-peel:
F. H. Hopkins & Co., Ltd.
Bucket Loaders:
Mussens Ltd.
Builders Supplies:
Jno. E. Russell Co., Ltd.
Building Papers:
Barrett Co., Ltd.
Buildings, Steel:
Canadian Bridge Co., Ltd.
Dominion Bridge Co., Ltd.
Hamilton Bridge Works Co.,Ltd.
MacKinnon Steel Co., Ltd.

C

Cars, Dump:
Hydro Salvage Syndicate.
Mussens Ltd.
Car Dumpers:
Canadian Mead-Morrison Co., Ltd.
Car Equipment Specialties:
Dominion Insulator & Mfg. Co Ltd.
Car Pullers:
Canadian Mead-Morrison Co., Ltd.
Car Steps, Safety:
Irving Iron Works Co.
Car Wheels, Chilled Iron.
Canada Iron Foundries, Ltd.
Cars - Dump:
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Cargo Cranes:
Industrial Works.
Casements, Steel:
Canadian Metal Window & Steel Products, Ltd.
Trussed Concrete Steel Co., of Canada, Ltd.
Castings:
Babcock-Wilcox & Goldie-McCulloch Co., Ltd.
William Kennedy & Sons, Ltd.
Castings, Brass:
Engineering & Machine Works of Canada, Ltd.
Superheater Co., Ltd.
Castings, Bronze:
Engineering & Machine Works of Canada, Ltd.
Castings, Car and Locomotive:
Canadian Steel Foundries, Ltd.
Castings; Ferro-Alloy.
Canadian Steel Foundries, Ltd.
Castings, Iron:
Canada Iron Foundries, Ltd.
Engineering & Machine Works of Canada, Ltd.
Gartshore-Thomson Pipe and Foundry Co., Ltd.
E. Leonard & Sons, Ltd.
Superheater Co., Ltd.
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Catenary Materials:
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Cement, Dealers:
Jno. E. Russell Co., Ltd.
Cement Gun:
General Supply Co., of Canada, Ltd.
Cement, Manufacturers:
Canada Cement Co., Ltd.
Cement, Waterproofing:
Dominion Tar & Chemical Co., Ltd.
Chain Grate Stokers:
Babcock-Wilcox & Goldie-McCulloch Co., Ltd.
Chains:
Link-Belt, Ltd.
Chains, Silent:
Jones and Glassco, Regd.
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Hamilton Bridge Works Co., Ltd.
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Milton Hersey Co., Ltd.
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Combustion Engineering Corp. Ltd.
Circuit Breakers:
Dominion Engineering Agency, Ltd.
Clamshell Buckets:
Industrial Works.
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Coal Handling Equipment:
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Dominion Bridge Co., Ltd.
Link-Belt, Ltd.
Mussens Limited
Coke:
British Empire Steel Corp., Ltd.
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Compressor Filters:
Midwest Canada, Ltd.
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Babcock-Wilcox & Goldie-McCulloch Co., Ltd.
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Hydro Salvage Syndicate.
Mussens Limited
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Taylor Stoker Co., Ltd.
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Concrete Mixers:
General Supply Co., of Canada, Ltd.
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Condensite Celoron Silent Gears.
Diamond State FibreCo., of Canada Ltd.
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Northern Electric Co., Ltd.
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E. O. Leahey & Co., Ltd.
Randolph MacDonald Co., Ltd.
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F. H. Hopkins & Co., Ltd.
Mussens Limited
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Cranes, Electric:
Industrial Works.
Cranes, Locomotive:
F. H. Hopkins & Co., Ltd.
Industrial Works.
Link-Belt, Ltd.
Mussens Ltd.
Cranes, Pillar:
Industrial Works.
Cranes, Transfer:
Industrial Works.
Cranes, Travelling:
Dominion Bridge Co., Ltd.
Cranes, Tunnel:
Industrial Works.
Cranes, Wrecking:
Industrial Works.
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Barrett Co., Ltd.
Dominion Tar & ChemicalCo., Ltd.
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Burlington Steel Co., Ltd.
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Gartshore-Thomson Pipe and Foundry Co., Ltd.
Jno. E. Russell Co., Ltd.
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Canada Lock Joint Pipe, Ltd.
Cutters, Milling:
Pratt & Whitney Company of Canada, Ltd.
Cutting off Machines:
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D

Damper Regulation:
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Mussens Ltd.
Die Screw Plates:
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Dumb Waiters, Electric:
Turnbull Elevator Co., Ltd.

E

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Combustion Engineering Corp., Ltd.
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E. Leonard & Sons. Ltd.
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Engineering & Machine Works of Canada, Ltd.
Mussens Limited
Exhaust Steam Injectors, Locomotive:
Superheater Co., Ltd.

Consult the advertiser, his information is valuable.

Purchaser's Classified Directory

F

Fan Engine Regulators:
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Feed-Water Heaters, Locomotive:
Superheater Co., Ltd.
Fence Posts, Steel:
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Fibre, Hard Vulcanized:
Diamond State Fibre Co., of Canada, Ltd.
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Midwest Canada, Ltd.
Fire Alarm Apparatus:
Northern Electric Co., Ltd.
Fish Paper:
Diamond State Fibre Co., of Canada, Ltd.
Floor Stands:
Jenkins Bros., Ltd.
Flanges, Companion:
Jenkins Bros., Ltd.
Files, Valve:
Jenkins Bros., Ltd.
Flooring, Fireproof:
Irving Iron Works Co.
Flooring, Open Steel:
Irving Iron Works Co.
Flooring, Steel:
Irving Iron Works Co.
Flooring, Non-Slipping:
Irving Iron Works Co.
Flooring, Ventilating:
Irving Iron Works Co.
Forgings:
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Dominion Bridge Co., Ltd.
Friction Clutches:
Dodge Manufacturing Co., Ltd.
Fuel, Oil:
Imperial Oil, Ltd.
Furnaces, Automatic:
Under-Feed Stoker Co., of Canada, Ltd.

G

Gantry Cranes:
Industrial Works.
Gasoline:
Imperial Oil, Ltd.
Gauges:
Pratt & Whitney Co., of Canada, Ltd.
Gear Reductions:
Hamilton Gear & Machine Co
Gears:
Dominion Engineering Works Ltd.
Hamilton Gear & Machine Co
Link-Belt, Ltd.
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Jones and Glassco, Regd
Gears, Silent, Waterproof:
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H

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I

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J

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K

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L

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Canadian Westinghouse Co. Ltd.
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N

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O

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P

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Dominion Paint Works, Ltd.
Paints, Concrete:
Dominion Paint Works, Ltd.
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Pinions:
Hamilton Gear & Machine Co.
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Dart Union Co., Ltd
Pipe Fittings:
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Pipe, Lock Joint:
Canada Lock Joint Pipe, Ltd
Pipes, Cast Iron:
Canada Iron Foundries, Ltd.
Gartshore-Thomson Pipe and Foundry Co., Ltd.
General Supply Co., of Canada Ltd.
National Iron Corp., Ltd.
Pipe Lock Bar:
General Supply Co., of Canada, Ltd.
Pipes, Reinforced Concrete:
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Pumps:
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Pumps, Hydraulic:
Taylor Stoker Co., Ltd.
Pumps Oil,
Taylor Stoker Co., Ltd
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Pratt & Whitney Company of Canada, Ltd.
Punches and Shears:
John Bertram & Sons Co., Ltd.,

R

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Jenkins Bros., Ltd.
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Marconi Wireless Telegraph Co. of Canada, Ltd.
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Rawhide Pinions:
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Rawlplugs:
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Reamers:
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Receptacles, Fibre:
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Refrigerating Machinery:
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Burlington Steel Co., Ltd.
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Consult the advertiser, his information is valuable.

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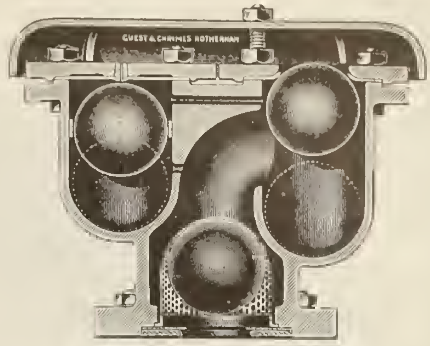

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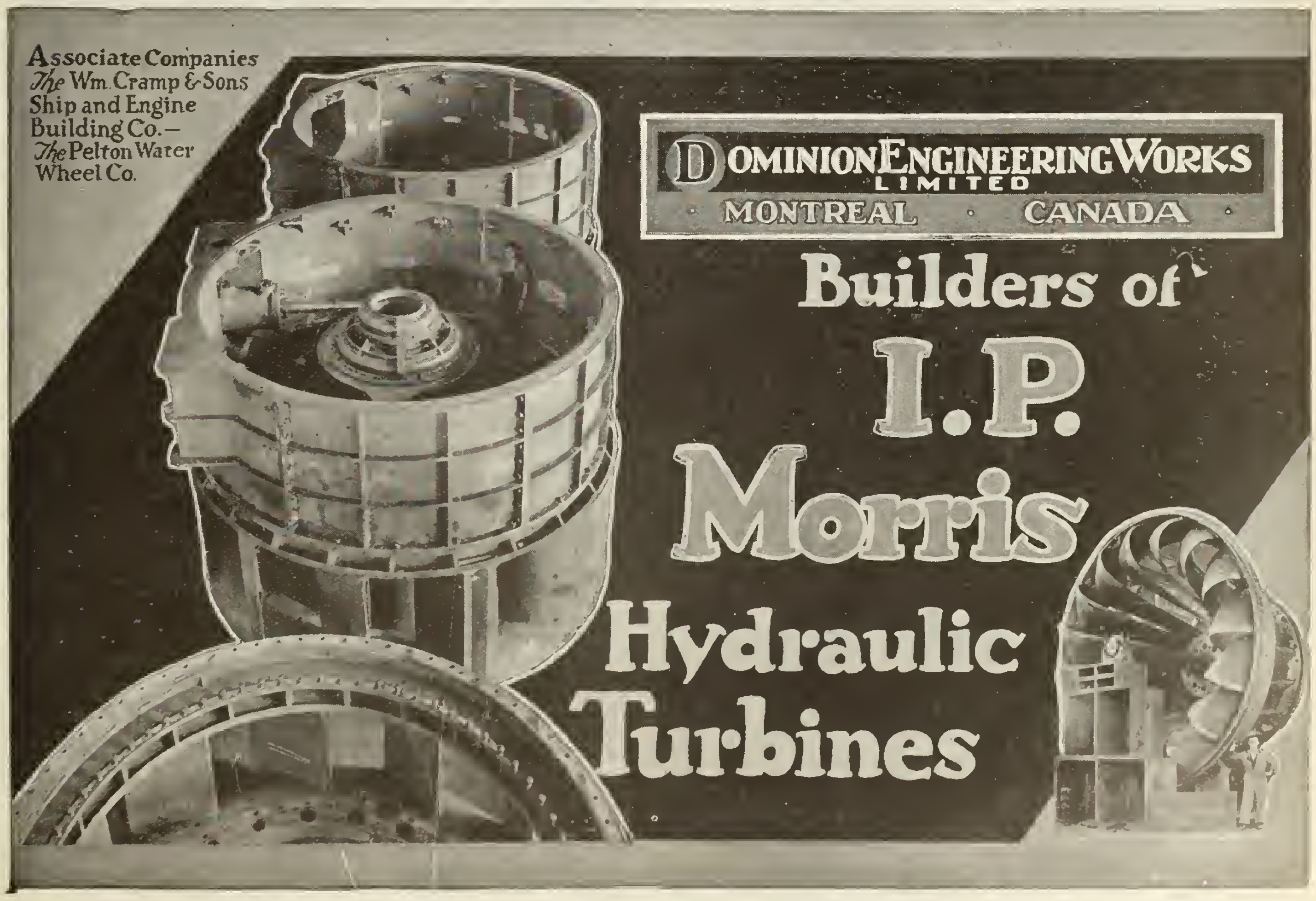

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Department of Public Works & Labour.
Province of Quebec

Tenders For The Ste. Anne-Isle Perrot Bridge

Notice is hereby given that sealed tenders endorsed with the words: "Tender for Ste. Anne Bridge" and addressed to the Honorable Antonin Galipeault, Minister of Public Works and Labour, will be received at his office, Parliament Buildings, Quebec, from now till Monday, March 10th, 1924, at noon, for the construction of a steel deck plate girder and through truss bridge with approaches at each end, etc., across the Ottawa River between Ste. Anne de Bellevue, Jacques Cartier County and Ste. Jeanne de l'Ile Perrot, Vaudreuil County.

The works shall be carried out according to plans and specifications deposited in the office of Mr. Ivan E. Vallee, Chief Engineer of the Department of Public Works and Labour, Parliament Buildings, Quebec, also in the office of the Engineer of the Isle Perrot Bridges Commission, Mr. V. Denis, Room 505, Shaughnessy Building, 137 McGill St., Montreal. Copies of these plans and specifications can also be obtained from the undersigned on depositing $100.00; this deposit will be refunded on return of the plans and specifications.

Tenders must be made on the printed forms furnished by the undersigned. Each bidder must attach to his tender an accepted cheque made to the order of the Honorable Minister of Public Works and Labour for 10% of the amount of his tender. This cheque will be returned to each one of the unsuccessful bidders, but held up until the final acceptance of the works in the case of the successful tenderer and shall be forfeited if he should refuse to sign the contract after being required to do so.

The contractor will be paid in accordance with article 187 of the general specifications of the Department of Public Works and Labour, with the exception that the total amount held back will be paid to the contractor only three months after the final acceptance of all works of the bridge and approaches.

Work must be started within fifteen days after the acceptance of the tender, and the bridge, including the approaches, etc., shall be finished in every detail 18 months after the date of the acceptance of the tender.

The Department of Public Works and Labour does not bind itself to accept the lowest nor any tender.

The contractor will pay to the notary the cost of drafting the contract and will furnish a certified copy of same to the Department.

The Department of Public Works and Labour reserves the right to divide the contract; the contractor should therefore give separate prices for each of the following items both for the original and for the alternative projects.

1. Substructure complete including approaches, both culverts, demolition of buildings, etc., but not including the re-inforced concrete floor slab on the steel spans.

2. Steel superstructure including guard-rails, lamp posts, brackets, expansion joints, but without including concrete slab of the roadway and sidewalk nor the installation of the wires, etc., necessary for the lighting of the bridge.

3. Re-inforced concrete slab for the roadway and sidewalk on the steel spans, including the installation of the wires necessary for the lighting of the bridge.

4. A lump sum price for the whole work, that is to say for each project complete.

Newspapers publishing this notice without authorization will not be paid.

IVAN E. VALLEE,
Chief Engineer,

Department of Public Works
and Labour,
Quebec, January 21st, 1924.

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MARCH 1924

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AT 176 MANSFIELD STREET, MONTREAL

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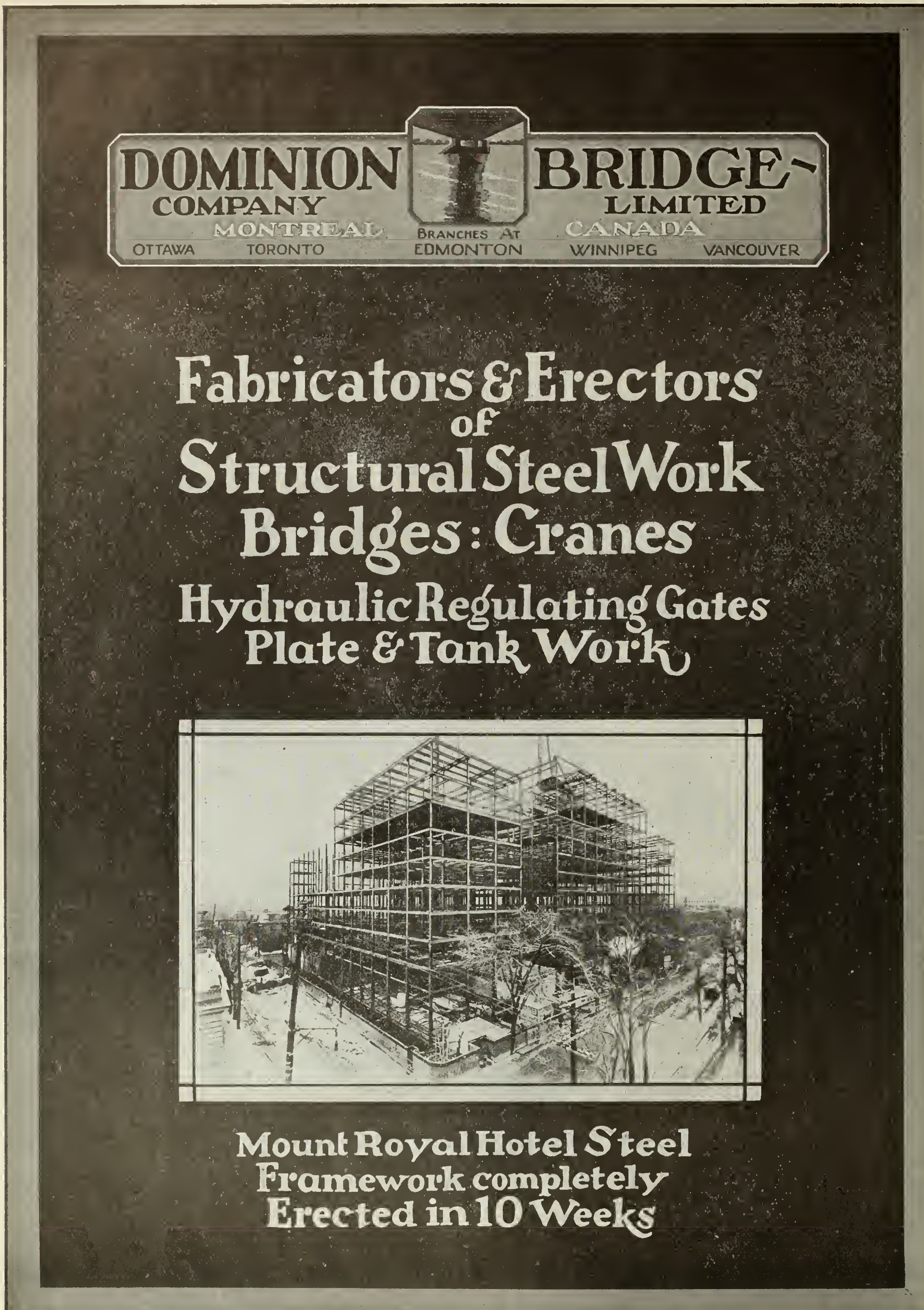
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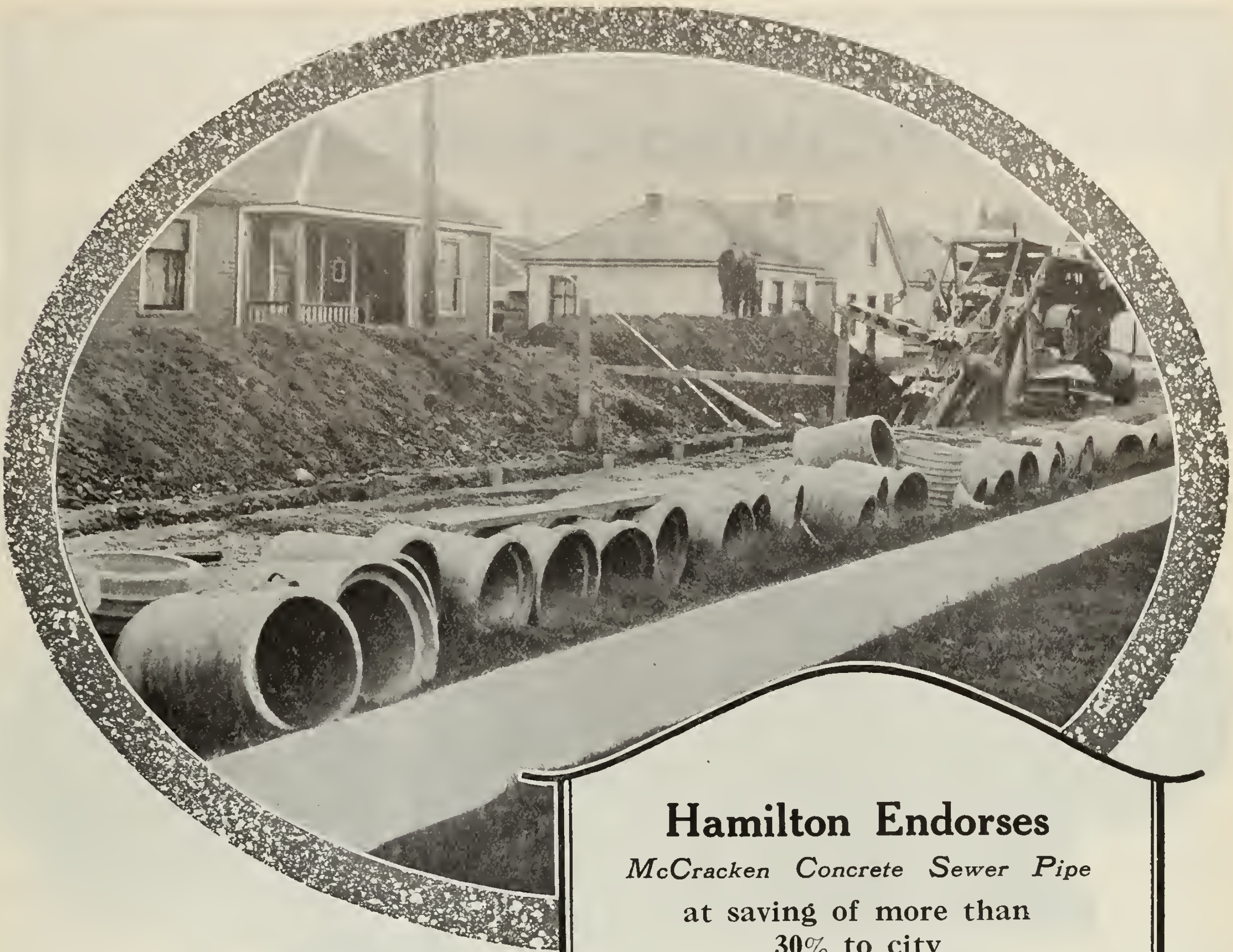

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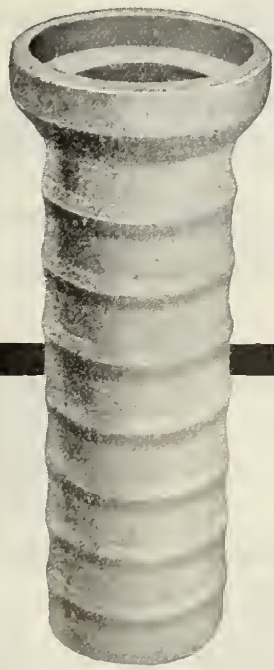

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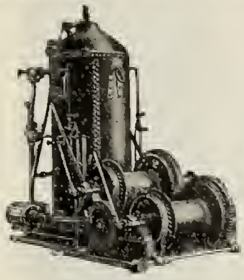
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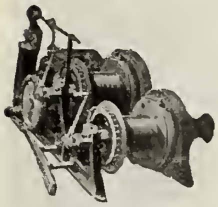
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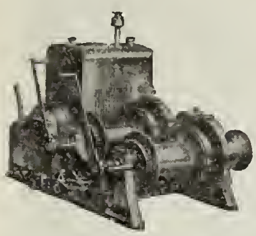
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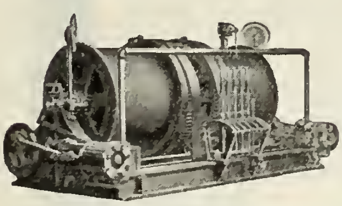
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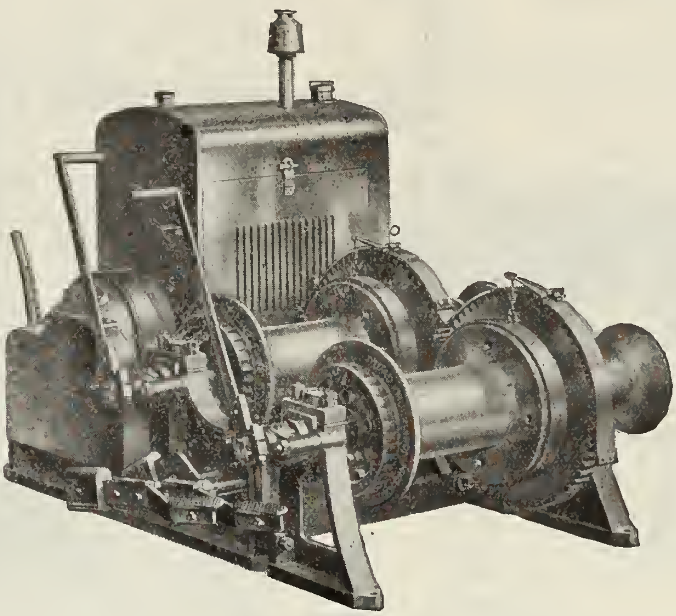

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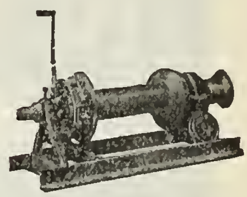
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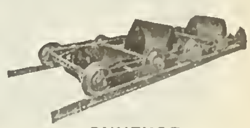
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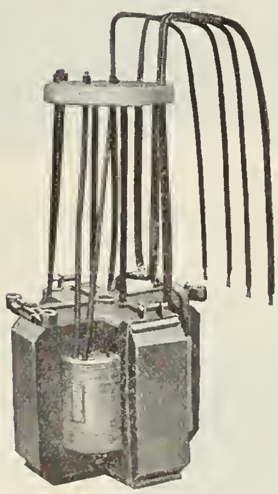

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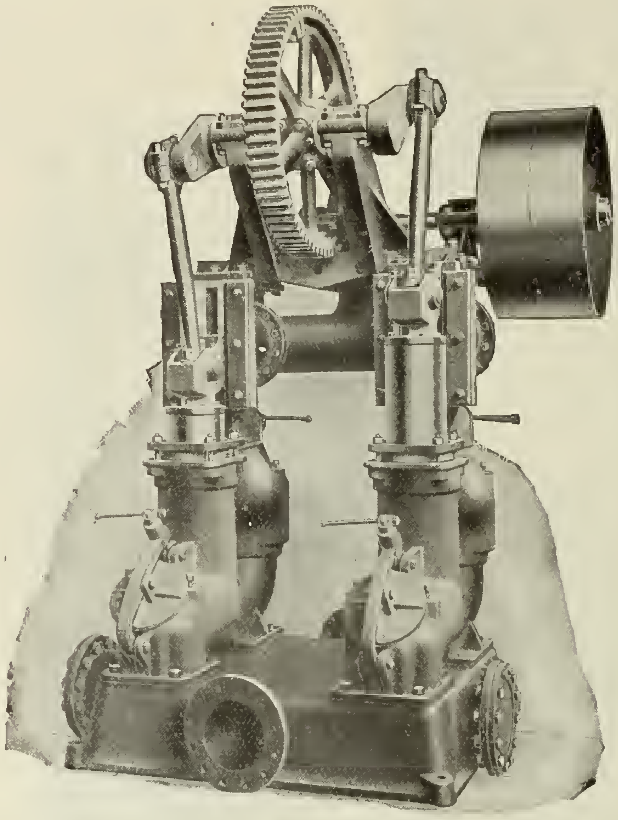

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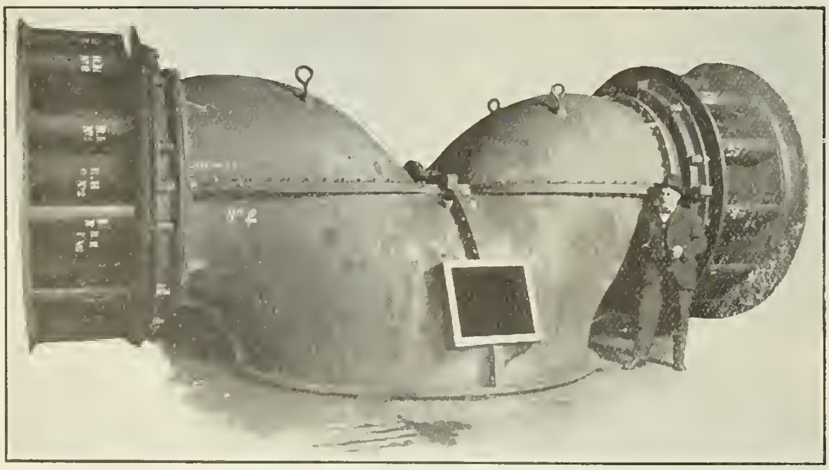

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The St. Lawrence River Problem

Important features of various projects for the improvement of the St. Lawrence River for power and navigation.

D. W. McLachlan, M.E.I.C.,
Engineer in charge, St. Lawrence Ship Canal, Department of Railways and Canals.

Paper read before the Annual General and General Professional Meeting, The Engineering Institute of Canada, Ottawa, January 24th, 1924.

International Status

The proposal to improve the St. Lawrence river for power and navigation, which is now attracting attention, is one that originated in the United States Congress when a resolution expressing a desire to refer the matter to the International Joint Commission was approved on March 2nd, 1919. After exchange of views on the matter, the governments of the United States and Canada referred the proposal for investigation and report to the above commission. Attached to the reference there was a request for answers to certain specific questions. The reference also contained a notification that an engineer was to be appointed by each government for the purpose of preparing plans and estimates of four specified methods of improvement. The United States government appointed Colonel W. P. Wooten as their engineering representative on January 30th, 1920, and the Canadian government appointed W. A. Bowden, M.E.I.C., as its engineering representative on April 14th, 1920.

After a little over a year of study and conferences, Messrs Wooten and Bowden submitted a report to the International Joint Commission which indicated that they had agreed upon all matters connected with the design and location of the works but had not agreed upon matters, connected with the regulation of the flow out of lake Ontario and the general effect of ice conditions.

After receiving the report of the internationally appointed board of engineers, the Joint Commission exposed the plans for public criticism and a number of alternative proposals were received from public officials and interested corporations. After perusal of these and some months of conference and further study, the commission in substance made the following recommendations:—

1. That a treaty be entered into for the improvement of the river from lake Ontario to Montreal with the Welland ship canal incorporated as a part of the project.
2. That the works solely required for power be built and paid for by the country in which they are located.
3. That the cost of the works for the combined use of power and navigation be divided equally between the two countries.
4. That the cost of the works solely for navigation be divided between the two countries on the basis of the freight tonnage actually using the waterway after its completion.
5. That further study be given to the design of the works proposed with special attention to the question of lands to be flooded.

Since the report summarized was filed it has been widely discussed in both countries, but such discussions have not gone far towards explaining the proposal to the citizens of either country. In some sections of Canada the proposal has been endorsed in its entirety. In other sections a fear is expressed that international rights would be sacrificed if United States money were accepted for works solely in Canada, while in others the reliability of the engineer's estimates is questioned.

Although the engineering press has given some publicity to the official report of the government engineers, and the alternate schemes proposed by others, it is felt that the general body of Canadian engineers has not had the necessary data placed before them so that the character of the problem, and the efficiency of proposed solutions can be fully appreciated by them. Some data will also be presented having a bearing upon objections to the general scheme from non-engineering critics.

It will be assumed that everybody present knows the general features of the St. Lawrence and Great Lakes system, and time will not be spent describing them. The St. Lawrence below Montreal has been improved by the people of Canada to a depth of 28 feet at low water, and no further work is required to make it fit in with a deep waterway project from lake Superior to the sea.

At the American Sault two new locks hold a similar relation to the deep waterways project. They are deep enough to pass a boat drawing 25 feet of water over eighty per cent of the time, and no further work is required to make them fit in with the deep waterways project. The problem of a deep waterway may be taken to begin at Montreal and end at the foot of the American Sault locks.

In describing the proposed work on the St. Lawrence it is convenient to refer to the all Canadian part of the river as the Quebec section, and to the part from St. Regis to lake Ontario as the international section.

The Quebec section is 67 miles long and is subdivided into:

Division No. 1 extending from Montreal harbour to deep water in lake St. Louis.

Division No. 2 extending from deep water in lake St. Louis to the foot of lake St. Francis, mile 41.

Division No. 3, extending from the foot of lake St. Francis to St. Regis, mile 67.

Division No. 1, from Montreal Harbour to deep water in Lake St. Louis

The drop of the water level of the river in division No. 1 is 46 feet in summer and about 30 feet in winter. The Lachine rapids account for most of the fall in this division. They are located about 7 miles above Montreal harbour. In this division specially built passenger boats use the open rapids on the downward journey, but these have to use the Lachine canal in the upward journey, and freight boats have to use the canal on both the up and down journey.

For carrying the deep waterways project through division No. 1 the board of engineers recommended a side canal with locks which for

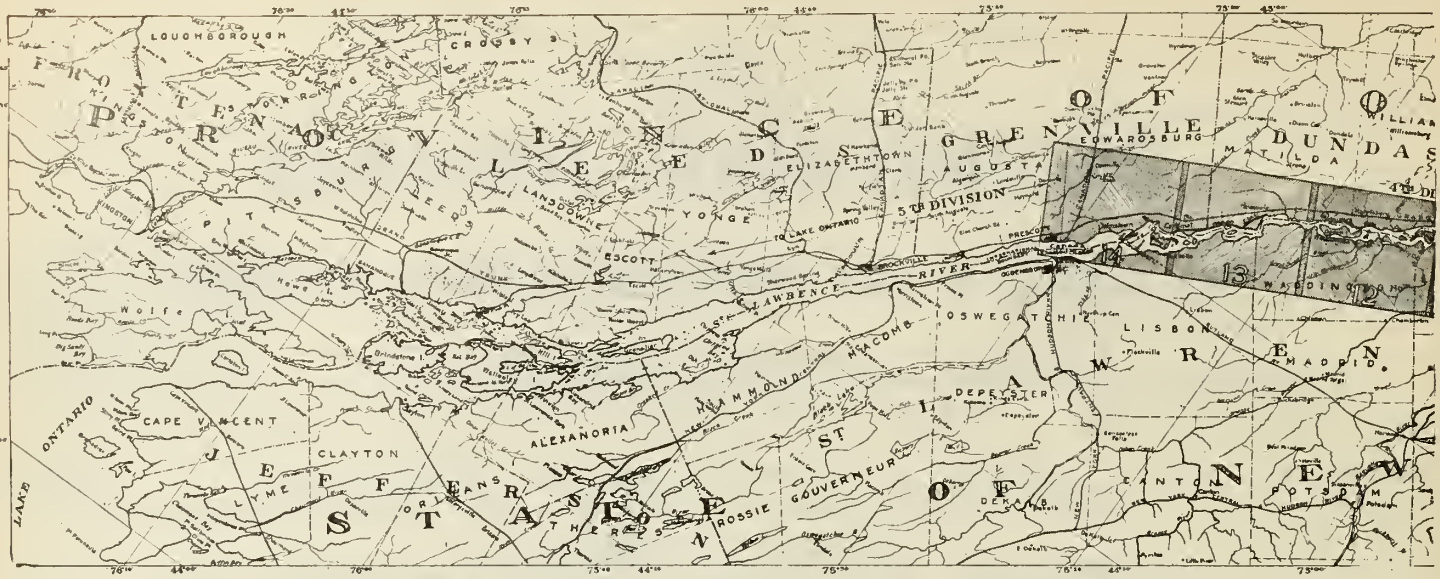


Figure No. 1.—Map of St. Lawrence

six miles of its length followed an inland route along the southwesterly outskirts of Verdun, Ville Emard and Lachine. The main features of this project are as follows:—

1. A lock a short distance east of Victoria bridge, the lift of which will vary from 22 to 32 feet depending on the stage of the river.

2. A high level artificial basin between Victoria bridge and the city of Verdun. This basin to be retained in part between the present Point St. Charles levee and a concrete retaining wall out in the river, and in part by two retaining walls parallel with one another, and three hundred feet apart.

3. A second lock in the westerly outskirts of the city of Verdun. The lift of this lock to be 16 feet. It is drawn to elevate ships from elevation 50 to almost the level of low water in lake St. Louis.

4. An earth and rock cut two miles long extending from lock No. 2 to a junction with the hollow which lies along the Lachine canal.

5. A shallow earth and rock cut 1½ miles long, lying just south of and parrallel with the Lachine canal.

6. A third lock at Lachine, the lift of which will vary from one to seven feet depending on the stage of the river.

7. A submarine earth and rock cut from Lachine to deep water in lake St. Louis.

8. Large syphon culverts under the canal opposite the city of Verdun for the purpose of getting rid of the sewerage and drainage water of Verdun and the valley of the St. Pierre river.

9. Syphon culverts under the canal at the point where the waterway crosses the Montreal city supply, along with similar culverts and pipe connections under the canal for the intakes of the city of Verdun, and that of the Montreal Water and Power Company which supplies a number of districts in and around Montreal.

The plan above described was drawn with the idea of carrying the waterway from Montreal harbour to lake St. Louis with the least damage possible to the city of Montreal and its suburbs. The possibilities offering for the development of terminal and dock facilities in Montreal were not brought out or shown. It would now appear that a plan showing what can be done in this way is desirable and a study of this kind has been prepared. Its feasibility depends upon the municipalities of Montreal and Verdun, and the Montreal Water and Power Company getting together and drawing all their raw water supplies from the Montreal aqueduct. A short history of what has occurred regarding this water supply situation will be given.

Many years ago the city of Montreal built an aqueduct extending from above the Lachine rapids to Atwater avenue where a pumping station was built. At a later date when the suburban cities of Westmount and Verdun came into being they established their own water supply systems. which drew their raw supply from the shallow river between Nuns island and the Verdun shore. Subsequent to this the city of Montreal decided to enlarge its aqueduct and use it for power as well as a pure water supply. As a preliminary to this a concrete pipe in the bank of the aqueduct was necessary and the enlargement of the westerly part of it to a width of 160 feet was completed when mis-

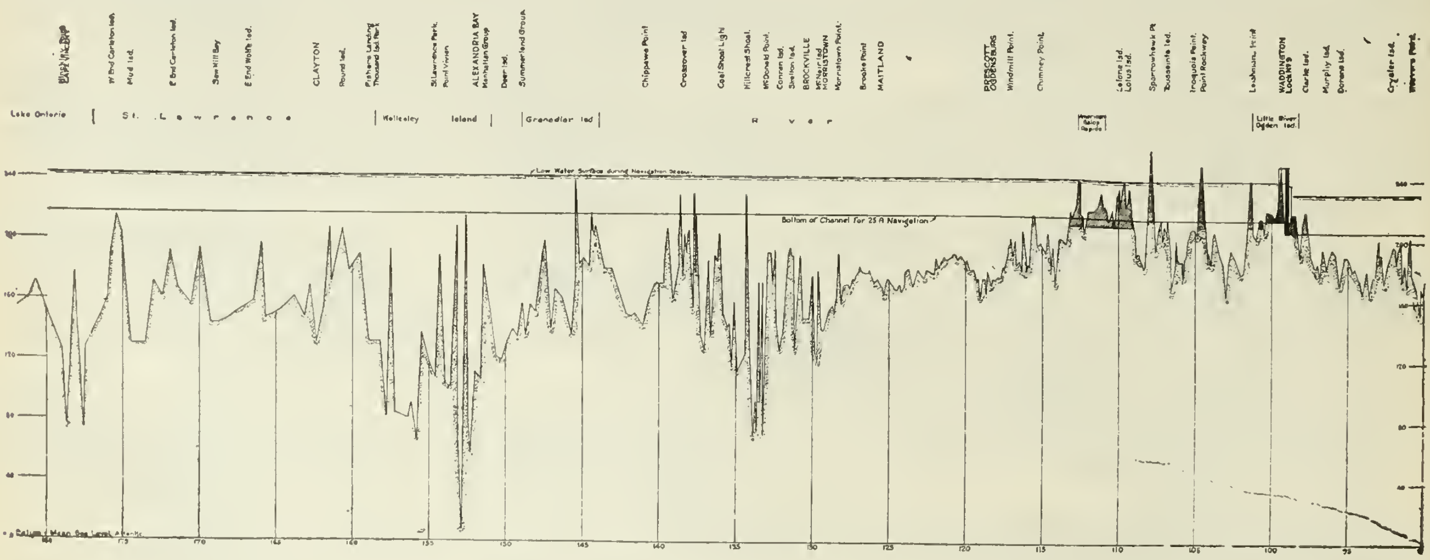
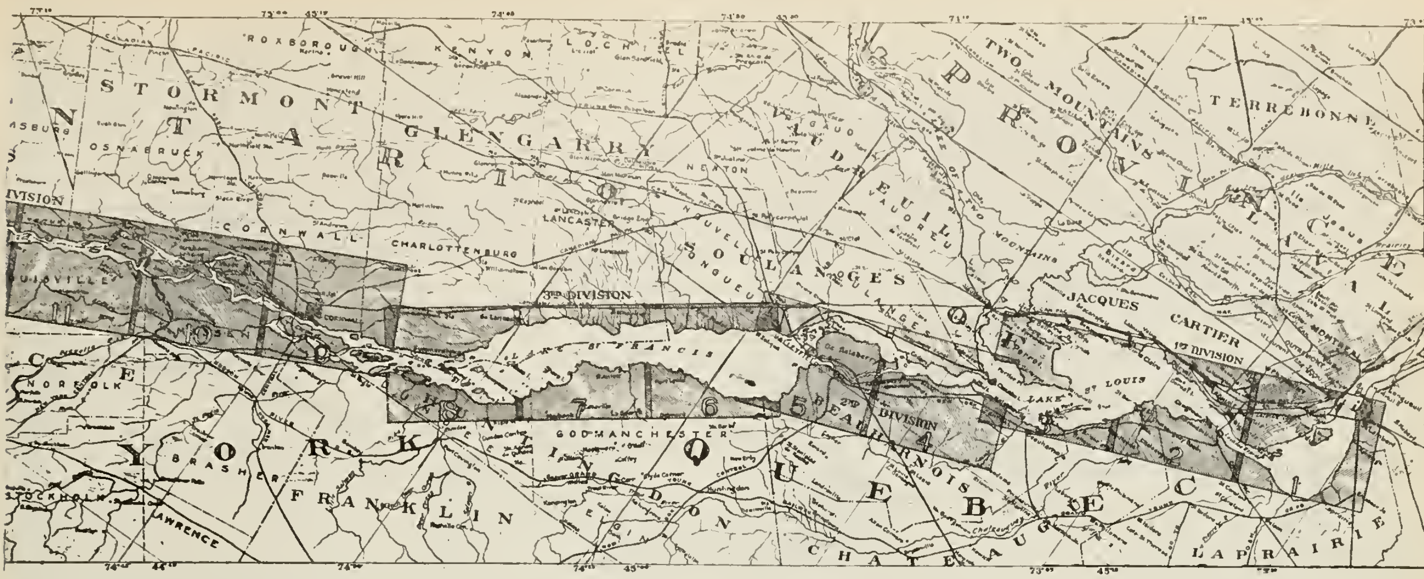


Figure No. 2.—Profile of



River, Montreal to Lake Ontario.

givings arose as to its utility as a power project, and the enlargement of the easterly end of it was never completed. As it stands to-day it can supply much more clear water than Montreal and all its suburbs will ever require.

The city of Verdun and the Montreal Water and Power Company could quite easily draw their water from the Montreal city aqueduct without endangering it in any way, and a supply drawn from this source would be a much purer one than those they have now.

If these communities and the city of Montreal would co-operate with the federal government in bringing this pooling of interest about, then a great industrial area could be reclaimed from the St. Lawrence river by utilization of the excavation from the deep canal cutting west and south of Verdun and Ville Emard. In front of this reclaimed area a great high level controlled basin could be made by simply moving the retaining works of the plan as recommended about 1,100 feet south of where they are shown in the Wooten-Bowden report. This basin would be 470 acres in area, and in it the present dockage facilities of Montreal harbour could be duplicated for half what they would cost in the lower river. This is on account of the fact that the water level would be controlled and held at a constant level and on account of the fact that solid rock would always be found at an ideal elevation for dock and other terminal works.

In order to provide for a future enlargement of the canal to a depth of 30 feet by this scheme, a slight variation is made from the Wooten-Bowden project and instead of the walls being designed for a future raise in water level the lock floor is lowered and the rock in front of the walls is channelled for a depth of 4 feet, so that the grade of the canal can be lowered in future without disturbing these works. Its estimated cost on the basis of unit prices recently bid for Welland canal contracts is $48,190,000.

The plan also shows a jetty in lake St. Louis and indicates the points where excavated material should be deposited in order to eliminate cross currents in the submarine rock channel at the foot of that lake.

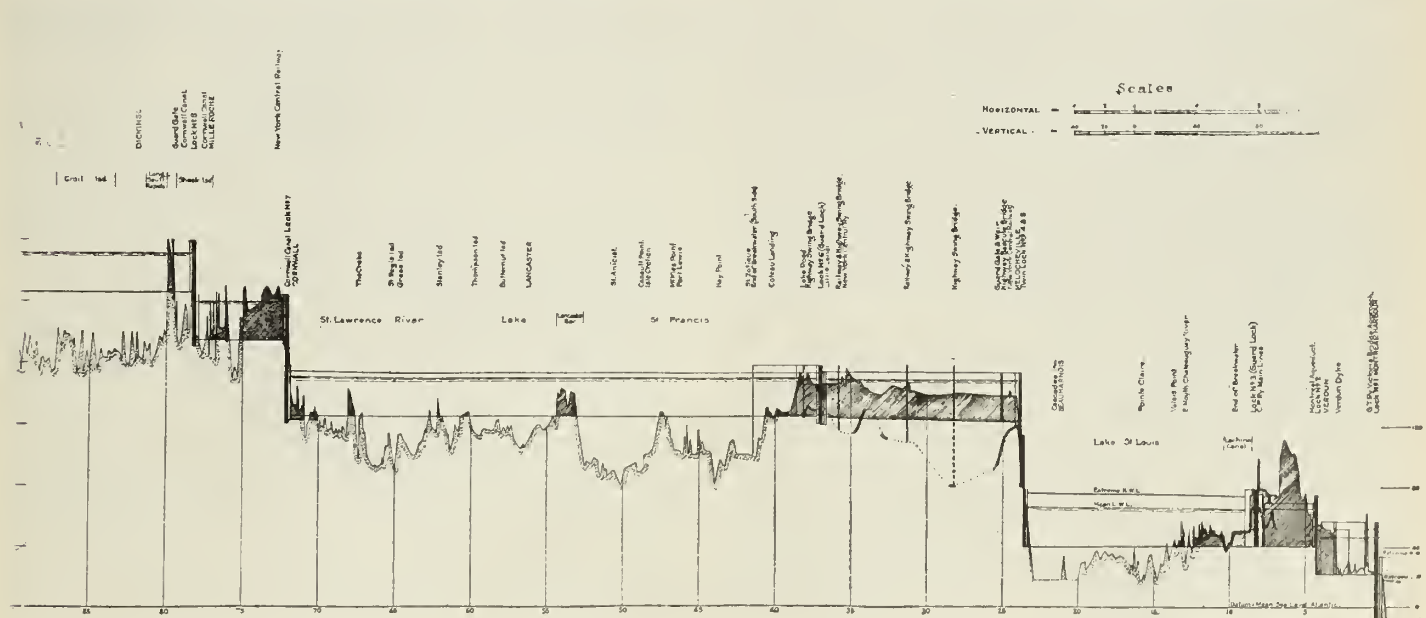
Between the upper end of the artificial channel of division No. 1, mile 14, and the lower end of construction works in division No. 2, mile 23, a deep straight stretch of lake St. Louis intervenes. It is nine miles long and is chiefly remarkable in that a drop of water surface of only a few inches in summer becomes a drop of 15 feet or more in severe winters.

Division No. 2, Deep Water in Lake St. Louis to foot of Lake St. Francis

For the deep waterway in this division the board of engineers recommends a canal on the south side of the river which follows an inland route from Melocheville at the head of lake St. Louis to Hungry bay at the foot of lake St. Francis.

The main features of this project are as follows:—

1. Two pairs of locks in flight in the village of Melocheville. The combined lift of which amounts to about 82 feet at low water.



Proposed Navigation Channel.

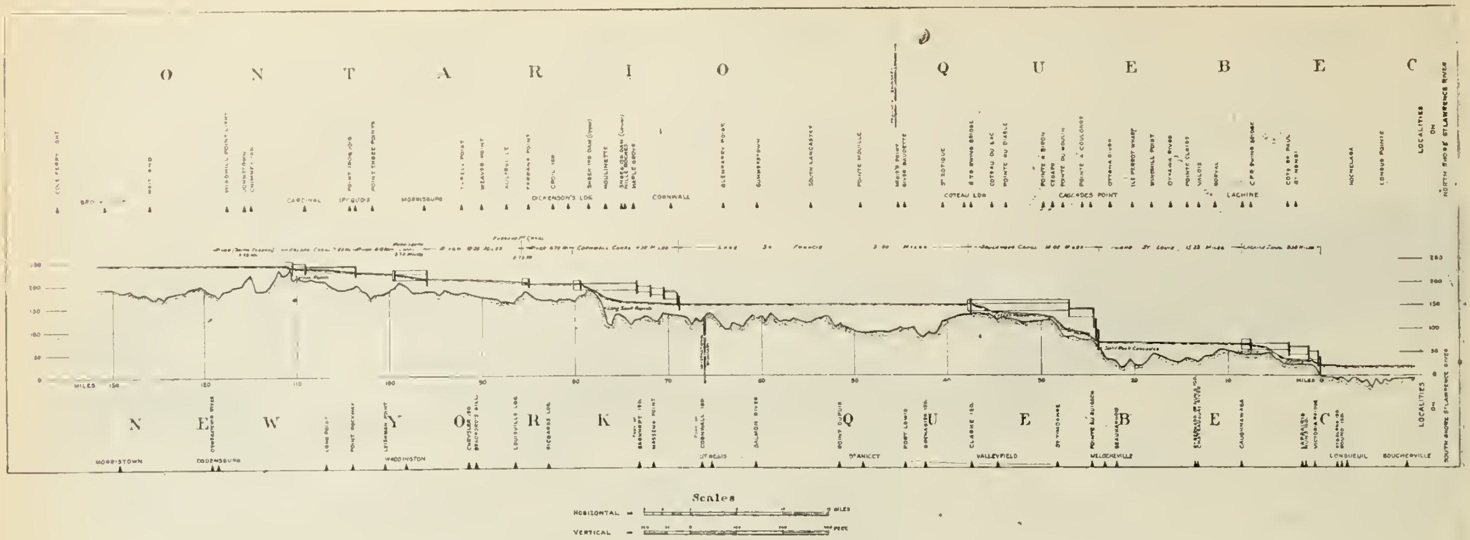


Figure No. 3.—Profile of Existing St. Lawrence Canals

2. An inland reach of canal contained between low embankments 500 feet apart and traversing the flat in a great southern sweep from Melocheville to Hungry bay.

3. A guard lock at the point where the inland canal enters lake St. Francis about 2¼ miles south of the city of Valleyfield.

4. A breakwater or jetty running out into St. Francis to prevent cross currents in the entry channel.

5. Three combined railway and highway swing bridges and three swing bridges for highway traffic alone.

6. Certain road diversions, supply weirs and other structures.

As shown in the above report the side canal, via Melocheville and Hungry bay to deep water in lake St. Francis, is much less expensive to build than any river route available between these points. At prices now current the estimated cost of the waterway via the Melocheville route is $32,784,000. At unit prices used in the Board of Engineers' report, the estimated cost is $36,590,000. By comparative estimates it can be shown that even though the cost of building a dam across the St. Lawrence near the head of the Cedars rapids, and all the cost of enlarging the river section at Coteau rapids, so as to bring down the level of lake St. Francis to this dam had not to be met, it would still be more costly to construct the purely navigation works via the river route than via the Melocheville side canal route as recommended. Thus the construction of the waterway cannot help the development of power by following a river route in division No. 2.

On the other hand, the adoption of the Melocheville-Hungry bay route for future navigation will benefit power development between lake St. Francis and lake St. Louis, in the following ways:—

1. The abandonment of the lower end of the Soulanges canal will enable a power house developing the full head of 78 feet to be located at Cascades Point at some future time.

2. The abandonment of the Soulanges canal will make it available as a drainage ditch for about two-thirds of its length. It can be used to intercept the flow of the Delisle, Rouge and La Graisse rivers, and the cost of the works connected with the creation of a high level pool above Cedars, which some day must come, will be greatly reduced from what it would be if the Soulanges canal were not available for drainage purposes.

3. The side canal proposed offers opportunities for easy enlargement and use for power to a limited extent. Such use would not be an injury to a river development but would be a benefit to it as a diversion down the navigation canal would reduce the amount of frazil formed in Coteau rapids and would make it easier for the natural agencies to store the frazil carried into the pool above Cedars, than if the full flow of the river were left to go over Coteau rapids as at present.

In order to protect navigation from all contingencies that might arise in this diversion, the banks of the canal are placed 400 feet apart, and clear openings of 170 feet on either side of swing bridges are shown, so if a small velocity is set up in the canal it will not injure navigation.

It is possible to carry an overland canal from the foot of lake St. Francis via the lake of Two Mountains and river de Prairie to the foot of Montreal island. It is also possible to carry an overland canal from the foot of lake St. Francis to Longueuil or via Chambly Basin and the Richelieu river to a junction with the St. Lawrence at Sorel. Careful estimates, however, show that the cost of the waterway by any of the above routes would be about $5,000,000. more than via the route recommended, and as all of these projects place Montreal on a spur of the waterway instead of on its main line, and as they show no economy they need not be further discussed.

Division No. 3, Lake St. Francis to foot of Cornwall Island

Lake St. Francis is the name given to the expansion of the St. Lawrence river which extends from the Coteau Landing to the foot of Cornwall island a distance of 28 miles. At the easterly end the transformation from lake to river is abrupt, but at the westerly end, the transformation is very gradual, and it is difficult to say where lake ends and river begins. The land on both shores of the lake from Coteau Landing to St. Regis opposite the foot of Cornwall island is in Canadian territory, but west of St. Regis, the south shore becomes United States territory, and from that point west, the international boundary follows the bed of the St. Lawrence river.

The works connected with the waterway, which are proposed in the Board of Engineers' report, in lake St. Francis are entirely in Canadian territory, and consists of dredging at a few points to a width of 450 feet and a depth of 26 feet. At the prices now current for such work the cost of this dredging would be $1,505,000. Lake St. Francis is of interest chiefly on account of the ice phenomena exhibited there, and although this does not affect the works in the lake itself, it greatly affects the works in division No. 4.

The international section extends from St. Regis, mile 67, to lake Ontario opposite Kingston, mile 180. It is subdivided into division No. 4, which extends from St. Regis to Prescott, and into division No. 5, which extends from Prescott to lake Ontario.

Division No. 4, St. Regis to Prescott

Division No. 4 is international as the boundary between Canada and the United States follows the river throughout its length. It is 48 miles long and all the rapids that can be improved for power in the international part of the river occur in this division.

For carrying the deep waterway through this division the Board of Engineers in the official plan recommended a river improvement which requires two dams and two short side canals with power development at the lower dam. The main features of this project are as follows:—

1. A series of dams across the various channels of the river at the Long Sault rapids, 34 miles east of the natural crest now controlling the level of lake Ontario. The water elevation to be held above this dam to be about 231 feet above the sea, or 74 feet above the present low water level at the foot of Barnhart island.

2. A second series of dams at Ogden island, 24 miles below the head of Gallops rapids; this series of dams to control lake Ontario and to hold a head of about seven feet in the summer season. The water level below this dam to be about elevation 234, and above it about elevation 241, under conditions of mean discharge. This latter elevation to be about 5½ feet below the level of lake Ontario.

3. A side canal on the Canadian side of the river which leaves the river at Cornwall and returns to it again at the head of Sheeks island above the Long Sault dam, this side canal to be 8 miles in length and to have two lift locks, one of 47 feet lift at Cornwall, and one of 32 feet lift on the north side of Sheeks island near Moulinette.

4. A side canal on the American side of the river near Waddington. This canal to utilize the bed of the Little river south of Ogden island, and to have one lock with a lift of about seven feet.

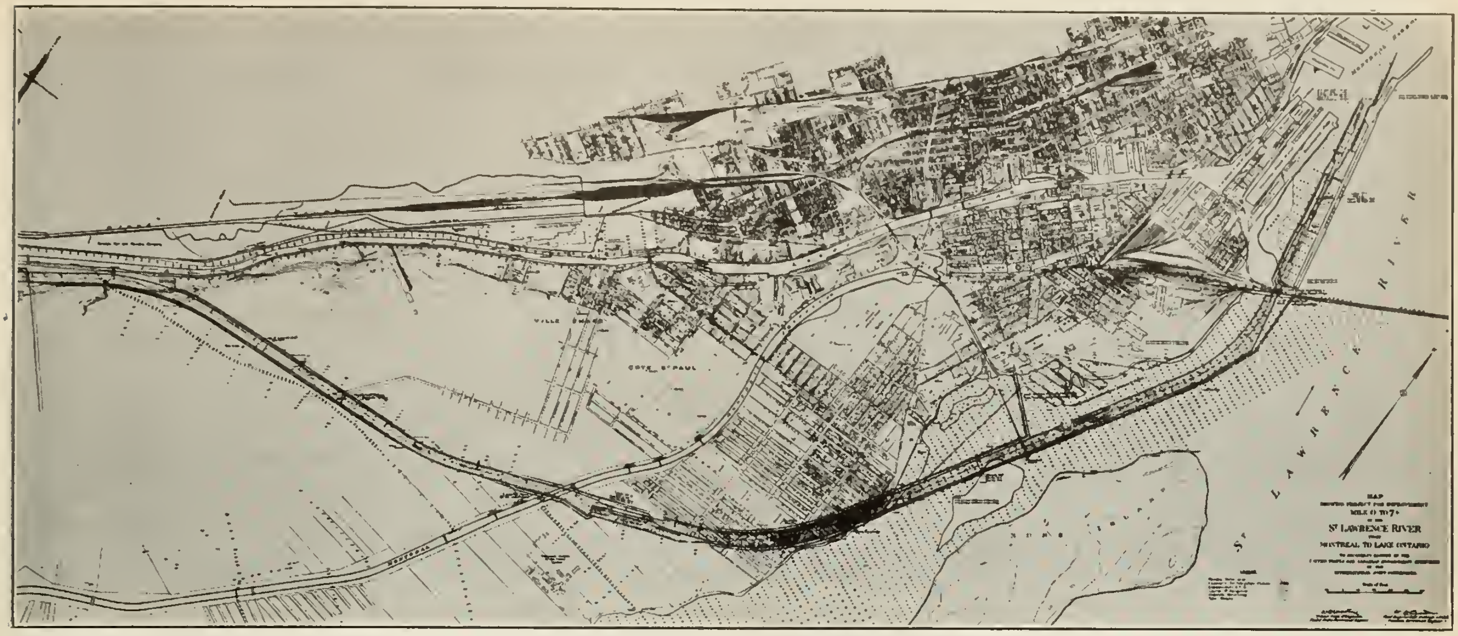


Figure No. 4.—Official Plan St. Lawrence River Improvement Project, Mile 0 to 7.

5. Such channel enlargements north of Cornwall island and in the river above Ogden island as will ensure a velocity of not more than 4½ feet per second in the navigation parts of the river during flood discharges.

6. An American and a Canadian power house at the foot of Barnhart island which will utilize a head of 75 feet under ordinary conditions with such channel improvements above and below them as will give a water section of 45,000 square feet. These plants to have a machine installation capable of using 220,000 c.f.s., with two units lying idle in each plant.

7. An American power plant at the head of the Massena canal which is designed to utilize 20,000 c.f.s., at a head of 28 feet, with one unit standing as a spare.

8. Certain road diversions and bridges to replace similar facilities to be destroyed by the raised water level of the Long Sault and Ogden Island reaches.

9. A massive earth dam across the valley of Hoople's creek and a diversion channel to lead the discharge of this stream to Bergen lake below lock No. 8.

10. A diversion cut and dam at a narrow point in Long island for facilitating the unwatering of the Long Sault Rapids dam site.

11. An earth dyke around a small part of the town of Morrisburg with a pumping station to care for the sewage and surface drainage of the area interferred with.

12. A core wall embankment to rock around the village of Iroquois, along with a pumping station to care for the surface drainage and sewage in that village.

13. A raised grade for the Grand Trunk Railway for a length of one mile east of Morrisburg and one mile east of Iroquois.

14. Expropriation of 10,860 acres of land in the Long Sault reach, 3,320 acres of which are on the Canadian mainland, and also 2,960 acres of land above the Ogden Island dam, 1,219 acres of which are on the Canadian mainland.

15. Provision in base width of the power-house and concrete structures in the Long Sault reach for a future possible raising of the operating level to be about elevation 238.

16. Such provision of sluice gates area in the Ogden Island dam as will enable 200,000 cubic feet per second to be passed through it with a loss of head of not more than one foot.

The estimated cost of the project is given in the above report as $159,097,200.

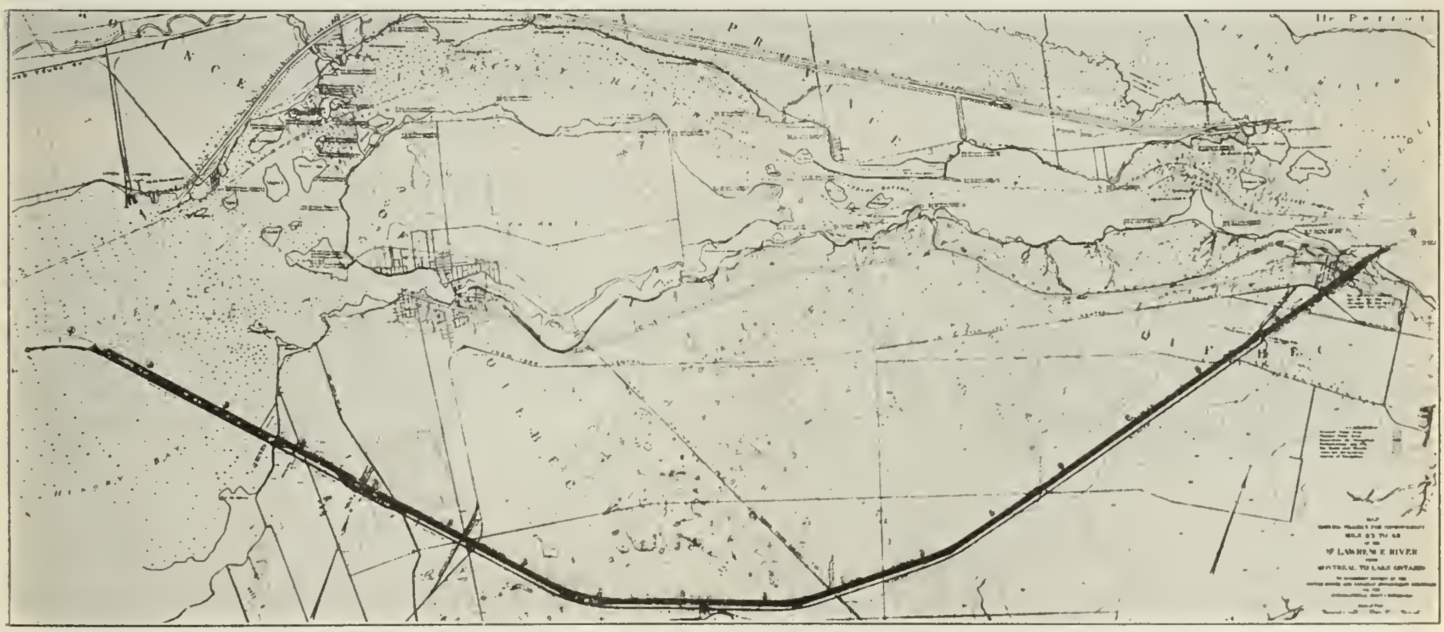


Figure No. 5.—Official Plan St. Lawrence River Improvement Project, Mile 23 to 42.

Figure No. 6.—Official Plan St. Lawrence River Improvement Project, Mile 40 to 57.

Figure No. 7.—Official Plan St. Lawrence River Improvement Project, Mile 65 to 84.

Figure No. 8.—Official Plan St. Lawrence River Improvement Project, Mile 84 to 102.

The bulk of the navigation works in this division are on the Canadian side and it is thus apparent that the project recommended is favourable to Canada if coupled up with the partnership system of dividing the cost, but if coupled up with a geographical system of dividing the cost it would not be favourable, and something might be done to improve Canada's position in such a contingency should it be considered.

The feature of the official plan which is most troublesome has to do with lack of finality in the elevation set for the Long Sault reach. There are a number of reasons why a Canadian engineer should not approve of a crest level for the Long Sault dam higher than proposed, viz, 231. The most important are as follows:—

1. It would make a spillway useless for the discharge of ice sheets in winter.
2. It would place on Canada an immediate additional financial burden from which she would not receive any adequate return, as the extra power secured could not be delivered in winter.
3. It would flood too much land.
4. A crest level higher than 231 would make its safety too dependent on long earth banks for a structure of such importance.

On the other hand the prospective value of hydro-electric power within a reasonable transmission distance of New York and Boston is so great that it need not be expected that any American engineer will readily approve any project which does not ultimately secure all the power available in this division of the river.

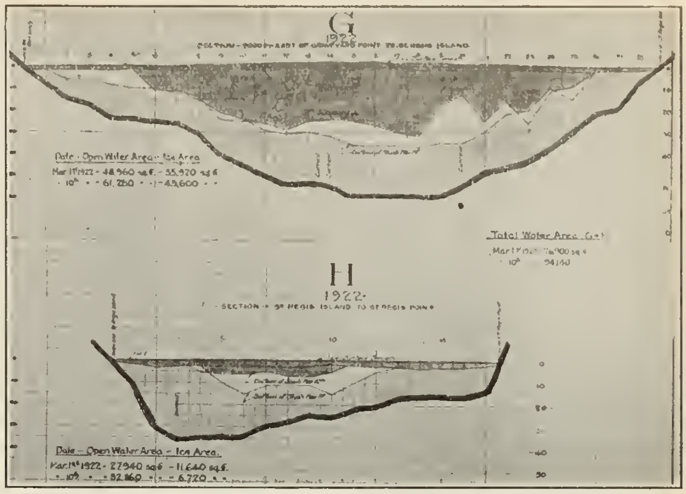


Figure No. 10.—Sections showing Ice Cover and Open Water between Graveyard Point and St. Regis Point.

Ice Conditions

Before modification of the official plan can be discussed some data on the special ice conditions of the St. Lawrence must be given. The large flow of the river, the coldness of the climate, and the fact that reaches of ice-covered water alternate with long stretches of rapids, combine to produce unusual winter phenomena.

The river is usually open, even in the coldest winters, from the head of the Galops rapids above Cardinal to the site of the proposed power house at the foot of Barnhart island, a distance of about 38 miles. Above this for a distance of about 60 miles to the outlet of lake Ontario there is a more or less continuous ice sheet in winter. Below the site of the proposed power house and through lake St. Francis there is a stretch of 36 miles, 23 miles of which freezes over early in the winter, and 13 miles covers gradually as ice is brought down from above.

From the foot of lake St. Francis to the head of lake St. Louis, there is a distance of 16 miles which has always remained open in the coldest winters. The drop in this section is 82 feet. The upper end of lake St. Louis for a length of 10 miles, between Melocheville and the mouth of the Chateauguay river, freezes over early every winter and this surface gradually tilts as the winter progresses and ice is carried into the section and stored underneath the surface cover. From the mouth of the Chateauguay to the head of La Prairie basin, there is an 8 mile stretch of river which always remains open.

Between the head of LaPrairie basin and the upper end of lake St. Peter there is a section 52 miles long over which the ice packs during the first week of zero weather, which occurs about the first of January each year. With the formation of this ice cover is associated a rise of about four feet at Sorel, 16 feet in Montreal harbour and 10 feet in LaPrairie basin. The winter condition in this stretch of the river was carefully investigated and reported upon by the Montreal Flood Commission in 1886-1887 and 1888, and the data found need not be shown again. However, it should be pointed out that the amount of frazil and slush carried under the surface cover in this stretch is very variable and depends on the rapidity and severity with which the winter begins. As a consequence of this no information of great value can be secured in this stretch of the river excepting at very great expense, and no attempt has been made to measure the frazil carried into it since 1887. The greatest drop in water level in winter between St. Helen's island and Sorel has been about 7/10 foot per mile. This is much less than would occur if deposits of ice were not stopped by the ice cover extending up to LaPrairie basin at an early period in the winter. The volume of ice found below Lachine rapids in 1887 was 6,800,000,000 cubic feet.

A tabular statement showing the effect of ice deposits on the surface slope of lake St. Louis is appended. An inspection of this table shows that the drop through this lake exceeded 1.3 foot per mile on eight occasions of which we have record. Above Coteau rapids the expanse of lake St. Francis freezes over about the third week of December as far up as Summerstown. From this point the bridge quickly extends upstream to the middle of Cornwall island where it becomes arrested by the swift water above, which flows faster than 3½ feet per second.

For a time the floating frazil and board ice, instead of being held at the head of the ice bridge, is carried beneath it and is deposited further downstream in the form of a great hanging mass of slush under the surface ice cover. As time passes and more and more frazil and chunks of board ice are disposed of in this manner, the depth of the flowing belt of water becomes more and more reduced and the resistance to flow becomes greater and greater. The difference in the level of the water between lock No. 15 at Cornwall and Summerstown is sometimes found to be 1.2 or 1.3 foot per mile for two months at a time. The

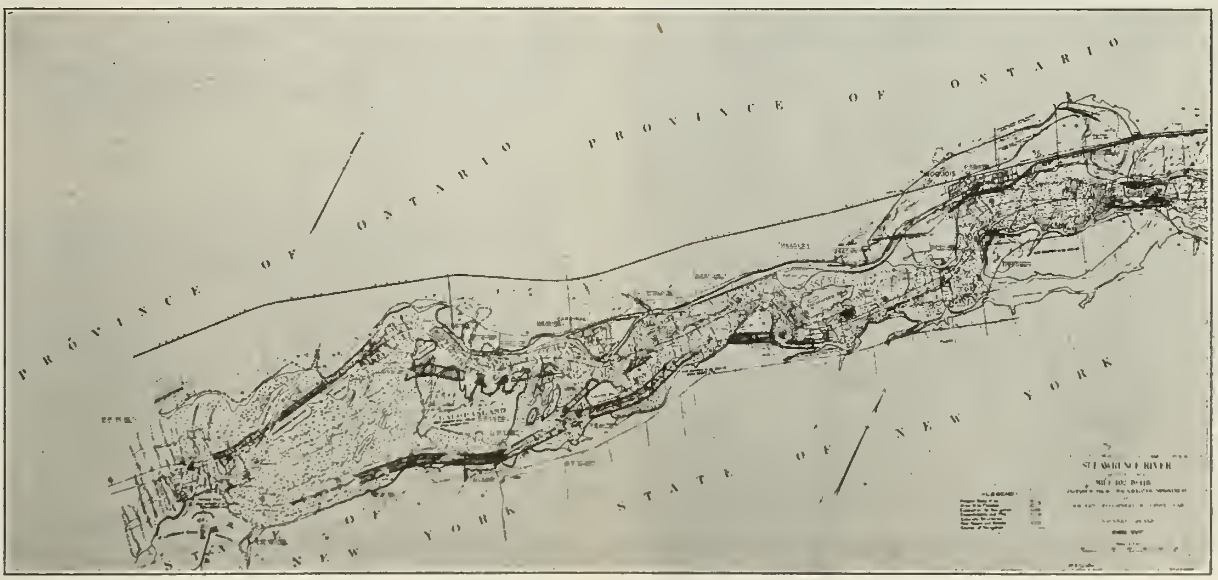


Figure No. 9.—Official Plan St. Lawrence River Improvement Project, Mile 102 to 116.

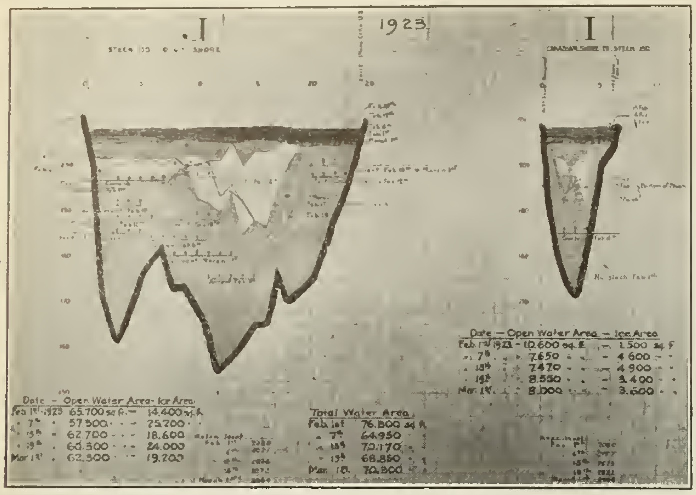


Figure No. 11.—Sections showing Ice Cover and Open Water at Steen Island.

slope is not always uniform and if for any reason a large percentage of the ice carried into the section is board ice, the slope may be as much as 2.0 feet per mile for a few miles at its upper end.

East of Summerstown no deposits of frazil have been found by our survey parties, nor has any great change been found in the slope in winter as compared with summer. When the accumulation of ice in the section below Cornwall raises the water level above elevation 162, the head of the ice pack moves upstream because the reduced velocity can no longer submerge and carry the frazil and board ice under the ice cover as it did when the velocity was under 3½ feet per second.

In long severe winters the head of the ice pack forms up to the foot of the Long Sault rapids and this pack often raises the water level to a height of 18 feet above summer level at the foot of Barnhart island. The surface slope under such conditions is generally 2.0 feet per mile at the upper end and about 1.3 foot per mile at the lower end of the section, where the bulk of the frazil is stowed. During the winters of 1921 and 1922 many cross-sections were made of the ice pack between Summerstown and the foot of the Long Sault rapids. From this information an approximate estimate of the quantity of frazil carried in that reach during those winters has been made. In the winter of 1922 about 4,000,000,000 cubic feet were deposited in this reach.

The formation of the ice bridge at Croil island on Januray 21st, 1923, prevented the usual quantity of ice being carried into lake St. Francis, and it also reduced the length of open water between Prescott and Cornwall from 38 to 26 miles. The volume of frazil found by

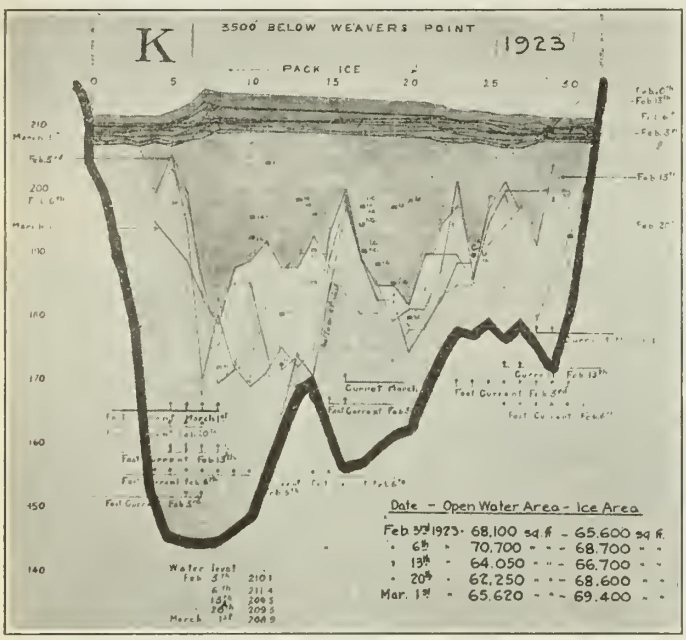


Figure No. 12.—Sections showing Ice Cover and Open Water below Weavers Point.

measurement between Croil island and Morrisburgh was 1,400,000,000 cubic feet. The open water above this Croil island jam varied from 16 to 18 miles in length. No frazil was carried through the Croil island jam after it had formed except what was blasted away, and the water level at the foot of Barnhart island fell to within a few feet of summer level.

The slope between Weaver's Point and the head of Croil island, where the bulk of the frazil was deposited, was found to be about 1.5 foot per mile in February and 1.3 foot in March. The average velocity of the water flowing under the deposits of frazil was found to be about 3.2 feet per second, and the sectional area about 65,000 square feet.

Although it is quite evident from the tables exhibited that winter slopes of 2.0 feet per mile are found in the upstream third of ice packs, yet in the lower two-thirds where the bulk of the frazil is stowed the slope is about 1.3 foot per mile and this slope has been adopted for the determination of heads obtainable in winter by various schemes.

Direct observations below the first rapids on the St. Lawrence show that in zero weather the surface will freeze over as a lake freezes if the surface velocity is less than 2.0 feet per second, and that ice will pack upstream in zero weather against an average velocity of 3.5 feet per second.

In support of all the foregoing deductions the accompanying tables and diagrams are exhibited:—

Table No. 1,—Statement showing net heads obtainable in winter by various schemes considered.

Single stage power scheme; Control dam at Ogden island; Power house at Barnhart island; With ice cover.

Average water level above Ogden island dam..................		240.0 feet	
Average water level below dam, Ogden island................		239.0 feet	
Fall in ice pack, Ogden island, to Doran island 2.5 miles @ 2.0.	5.0 feet		
Fall in ice pack Doran island, to Weaver's Pt. 5.0 miles @ 1.3.	6.5 feet		
Fall in unobstructed channel Weaver's Pt. to Barnhart island, 15.5 miles............	1.5 feet		
	13.0 feet	13.0 feet	
			226.0 feet
Water level Graveyard Pt.......		152.9 feet	
Rise in ice pack, — Graveyard Pt. to Cornwall 1.3 miles @ 2.0	2.6 feet		
Rise in ice pack, — Graveyard Pt. 2.7 miles @ 1.3..........	3.5 feet		
Rise in open water Cornwall to Barnhart island.............	1.5 feet		
	7.6 feet	7.6 feet	
			160.5 feet
Head available for power			65.5 feet

Double stage power scheme; Power houses at Ogden island and Barnhart island; With ice cover between.

Average water level below Barnhart island power house......		160.5 feet	
Average water level above Barnhart island power house......		210.0 feet	
Head available........			49.5 feet
Rise in unobstructed channel Barnhart island Power house to head of Croil island.......	3.3 feet		
Rise in ice pack head Croil island to Willard creek 7.3 miles @ 1.3.......................	3.5 feet		
Rise in ice pack head Willard creek to Ogden island 3.7 miles @ 2.0....................	7.4 feet		
		20.2 feet	
Winter water level below Ogden island power house..........		230.2 feet	
Average water level above Ogden island dam.................	240.0 feet		
Drop in head race to Ogden island power house...........	0.8 feet		
Water level above Ogden island power house................		239.2 feet	
Head available Ogden island power house			9.0 feet
Total...........................			58.5 feet

Table No. 2,—Showing drop in water level in feet per mile and ice packed cover Morrisburg to Willard Creek.

1923			Lock 23	Willard Creek	Distance	Drop	Drop in Feet per Mile
Feb.	16th	Only 90 per cent ice covered..............	221.2	216.9	12,000 feet	4.3	1.89
"	17th	Least section from chart 57,000 sq. ft......	221.5	216.85		4.65	2.04
"	18th	Head jam at lock 23.....................	221.5	217.0		4.5	1.98
"	20th	Head jam at lock 23.....................	220.9	217.4		3.5	1.54
"	21st	Water section 62,800 square feet..........	220.9	217.8		3.1	1.36
"	22nd	Head jam above lock 23..................	220.65	217.7		2.95	1.30
"	23rd	....	220.3	217.4		2.9	1.28
"	24th	....	220.2	217.1		3.1	1.36
"	25th	Ice shoved from above into section........	221.1	217.4		3.7	1.62
"	27th	....	221.2	217.4		3.8	1.67
"	28th	More slush south of Goose Neck island than on February 21st....................	220.8	217.3		3.5	1.54
Mar.	7th	Section newly filled with chunk ice........	220.4	215.4		5.0	2.20
"	8th	....	220.6	215.4		5.2	2.28
"	13th	Head jam changing.......................	222.4	216.3		6.1	2.68
"	14th	....	222.4	216.3		6.1	2.68
"	15th	....	221.0	215.9		5.1	2.24
"	17th	....	220.9	215.6		5.3	2.33
Apr.	11th	Section clear of ice......................	216.4	215.0		1.4	.61
"	12th	....	214.3	212.7		1.6	.70
May	4th	....	.....	210.2		...	...

Willard creek is at head Goose Neck island.

Table No. 3,—Showing falls in water level in feet per mile in St. Lawrence when ice pack completely covers water and frazil is carried into stream.

1923				Weaver's Point	Head Farran's Pt. Canal 187.01	Drop Weavers Pt. to Farran's Pt.		Fall per Mile
Jan.	31st	Noon,	Head bridge just below W.P.......	211.9	207.71	2.2	20.000	.58
Feb.	2nd	"	Head jam down stream 4,000 feet.	211.6	208.01	3.6		.95
"	5th	"	Head jam west Weaver's Pt.......	214.0	206.61	7.4		1.95
"	6th	"	Head jam west Weaver's Pt.......	214.5	207.11	7.4		1.95
"	7th	"	Head jam west Weaver's Pt.......	214.3	206.71	7.6		2.00
"	8th	"	Head jam west Weaver's Pt.......	215.4	207.5	7.9		2.08
"	9th	"	Jammed at Strawberry island.....	215.5	207.4	8.1		2.14
"	10th	"	Head jam at Church.............	214.1	207.3	6.8		1.80
"	12th	"	Head jam at Church.............	213.0	206.9	6.1		1.61
"	15th	"	Head jam at lock 23.............	211.7	206.0	5.7		1.51
"	16th	"	....	211.5	205.7	5.8		1.53
"	17th	"	....	212.0	206.4	5.6		1.48
"	19th	"	Greatest slush at this date........	212.2	206.4	5.8		1.58
"	23rd	"	....	211.8	205.9	5.9		1.56
"	28th	"	....	211.7	205.9	5.8		1.53
Mar.	3rd	"	....	211.4	205.8	5.6		1.48
"	6th	"	Opened South Goose Neck........	210.9	205.8	5.1		1.35
"	9th	"	....	211.2	206.1	5 1		1.35
"	13th	"	Opened to Murphy's island.......	211.1	206.1	5.0		1.32
"	19th	"	....	210.4	205.9	4.5		1.19
"	22nd	"	....	210.7	206.2	4.5		1.19
"	24th	"	....	210.8	206.4	4.4		1.16
"	26th	"	....	209.7	205.3	4.4		1.16
"	31st	"	....	210.2	206.0	4.2		1.11
Apr.	8th	"	Opened at head Section...........	211.2	207.2	4.0		1.05
"	11th	"	....	211.6	206.5	5.1		1.35
May	4th	"	Open Water......................	205.8	204.8	1.0		.26

Bridge formed at Croil island on January 19th, 1923.
Bridge formed at Strawberry island on February 9th, 1923.

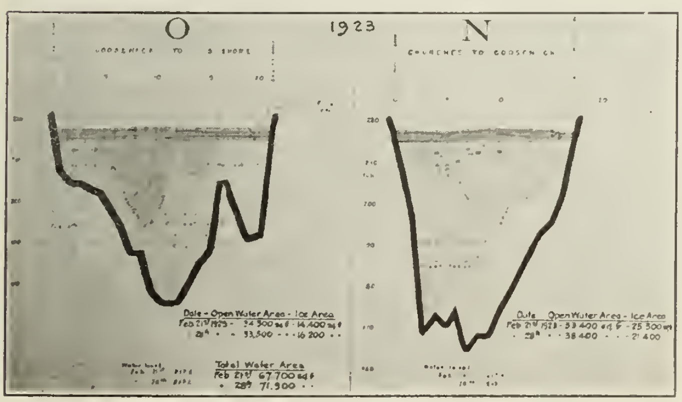


Figure No. 13.—Sections showing Ice Cover and Open Water at Gooseneck Island.

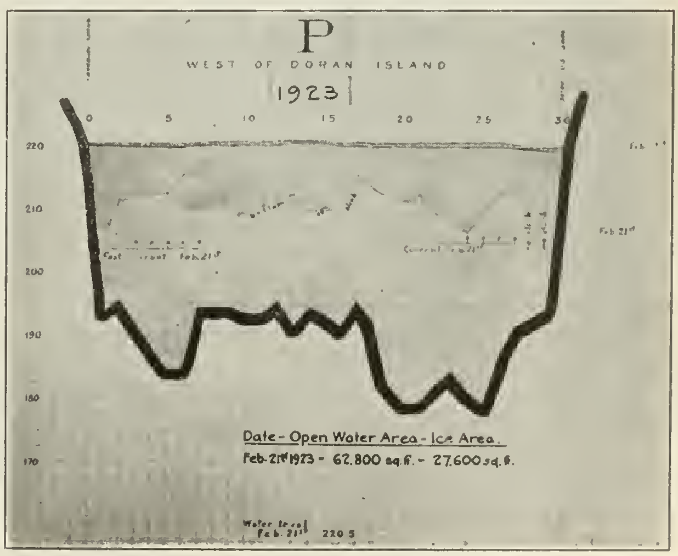


Figure No. 14.—Sections showing Ice Cover and Open Water at West of Doran Island.

Table No. 4,—Showing falls in water level in feet per mile in St. Lawrence when ice pack completely covers water and frazil is carried into stream.

1923		Willard Creek	Strawberry Island	Distance	Drop	Fall Feet per Mile
Feb. 9th	Partly open	218.9	217.4	10.000	1.5	.79
" 13th	Complete ice cover	218.1	214.7*	"	3.4	1.79
" 15th	Head jam Hoosic creek	218.0	214.0*	"	4.0	2.11
" 16th	Head jam Murphy's island	216.9	213.9	"	3.0	1.58
" 17th	Open water South Goose Neck island	216.8	214.3	"	2.5	1.32
" 22nd	Head jam lock 23	217.7	214.7	"	3.0	1.58
" 26th	Head jam lock 23	217.4	214.4	"	3.0	1.58
Mar. 15th	Open South Goose Neck	216.25	213.9	"	2.35	1.24
" 31st	Open South Goose Neck	215.6	213.2	"	2.4	1.27
Apr. 9th	Prescott ice refills section	218.5	212.4	"	6.1	3.20
May 4th	Summet condition	210.2	208.3	"	1.9	1.00

*Apparently section 68,000 square feet.
Willard creek is at head Goose Neck island.

Table No. 5,—Showing drop in water level in feet per mile with ice packed cover.

					Distance	Drop	Fall Feet Per Mile
	Foot Barnhart island		167.2				
Winter	Lock 15			158.4	22,500	8.8	2.06
1923 Jan. 17th	Foot Barnhart island		175.6				
" 17th	Lock 15			167.4	22,500	8.2	1.92
1922 Feb. 2nd	Polly Gut	167.43	167.73				
" 14th	Monument 3			157.48	23,500	10.3	2.32
" 18th	Massena point			162.36	15,000	6.1	2.14
" 18th	Lock 15		168.51				
Mar. 2nd	Massena point			161.36		6.3	2.22
" 2nd	Lock 15		167.7				
Feb. 2nd	2,000 ft. West O.N.Y. Ry. bridge		167.2	161.56	13,000	5.6	2.28
1921 Feb. 18th	Lock 15		158.06				
" 25th	Hog island			154.11	12,000	3.95	1.74
1921 Feb. 21st	Lock 15		157.96				
	Glengarry point			152.00	27,600	5.86	1.12
1887	Foot Long Sault island		199.0				
	Lock 15			181.8	45,000	17.2	2.00

Table No. 6,—Showing drop in feet per mile Cornwall to Summerstown.

	Lock Reading	Lock 15 Cornwall Elev.	Summer-stown	Drop in W.L.	Distance in Miles	Fall in Feet Per Mile
Low water of summer		152.0	151.1	0.9	9.3	0.10
High water of summer		154.3	153.1	1.2	9.3	0.13
Dec. 25th, 1921 (winter)	14.7	152.6	151.7	0.9		0.10
Jan. 1st, 1922	17.4	155.3	152.3	3.0		0.32
" 5th, 1922	20.5	158.4	152.6	5.8		0.62
" 9th, 1922	23.3	161.2	152.6	8.6		0.92
" 20th, 1922	21.8	159.7	152.1	7.6		0.82
Feb. 1st, 1922	23.2	161.1	151.7	9.4		1.01
" 10th, 1922	22.4	160.3	152.2	8.1		0.87
" 20th, 1922	24.5	162.4	152.0	10.4		1.12
Mar. 1st, 1922	23.2	161.1	151.6	9.5		1.02
" 5th, 1922	23.0	160.9	151.5	9.4		1.01
" 15th, 1922	20.5	158.4	152.7	5.7		0.61
" 25th, 1922	16.4	154.3	152.3	2.0		0.21
Dec. 25th, 1922	14.5	152.4	151.2	1.2		0.13
Jan. 1st, 1923		156.0	152.0	4.0		0.43
" 4th, 1923		161.2	151.7	9.5		1.02
" 9th, 1923	20.3	158.3	151.3	7.0		0.77
" 11th, 1923	29.9	166.6	151.4	15.2		1.64
" 15th, 1923	24.3	162.2	152.1	10.1		1.09
" 17th, 1923	29.5	167.1	152.1	15.0		1.61
" 21st, 1923	26.1	164.1	152.1	12.0		1.29
Feb. 1st, 1923	23.3	161.4	152.3	9.1		0.98
" 15th, 1923	21.0	159.4	151.4	8.0		0.86
" 28th, 1923	20.8	158.8	151.1	7.7		0.83
Mar. 10th, 1923	20.4	158.3	151.4	6.9		0.74
Apr. 20th, 1923	20.0	157.7	151.6	6.1		0.66
" 1st, 1923	19.2	157.2	151.8	5.4		0.58

Table No. 8,—Showing distances head of ice pack travels upstream over night on St. Lawrence river during cold weather.

Night 1923	Morning			
Jan. 24th to	Jan. 25th.	lock 22 to Steen island	9,500 feet	4°F.
Jan. 25th "	Jan. 26th,	Steen island to Pillary bay	10,000 feet	0°F.
Feb. 12th "	Feb. 13th,	Churches to Doran island	7,000 feet	5°F.
1922				
Feb. 23rd to	Feb. 24th,	lock 19 to Robinson bay	12,000 feet	4°F.
Jan. 11th "	Jan. 12th,	opp. cotton mills to lock 19	13,000 feet	3°F.
Jan. 24th "	Jan. 25th,	foot Barnhart island to Robinson bay	8,000 feet	18°F.
Dec. 28th "	Dec. 29th,	below lock 15 to lock 15	6,500 feet	1°F.
1923				
Jan. 3rd "	Jan. 4th,	waste weir to lock 18	6,500 feet +	9°F.

Table No. 7,—Showing extreme slopes in Lake St. Louis.

	W.L. Meloche-ville	W.L. Lock 5 Lachine	Drop in W.L.	Drop corrected to opposite mouth of Chateau-guay River	Drop in Feet per Mile
Mar. 3rd-17th, 1868	78.5	65.7	12.8	11.6	1.16
Mar. 1st-20th, 1872	76.7	65.3	11.4	10.2	1.02
Mar. 5th, 6th and 7th, 1868	79.6	65.1	14.5	13.3	1.33
Feb. 5th-10th, 1871	81.6	66.5	15.1	13.9	1.39
Feb. 25th, 1874	78.6	65.5	13.1	11.9	1.19
Feb. 14th-28th, 1875	82.4	65.0	17.4	16.2	1.62
Mar. 23rd, 1876	80.1	67.1	13.0	11.8	1.18
Mar. 24th, 1885	81.3	65.6	15.7	14.5	1.45
Mar. 2nd, 1886	80.6	67.9	12.7	11.5	1.15
Mar. 6th, 1887	81.3	68.3	13.0	11.8	1.18
Mar. 6th, 1888	81.7	66.6	15.1	13.9	1.39
Feb. 21st, 1900	77.3	65.4	11.9	10.7	1.07
Feb. 18th, 1904	83.2	65.0	18.2	17.0	1.7
Feb. 19th, 1905	83.4	66.3	17.1	15.9	1.59
Feb. 26th, 1907	80.6	67.3	13.3	12.1	1.21
Mar. 6th, 1887	81.3	68.3	13.0	11.8	1.48*

*End of frazil determined by measurement of Flood Commission. Distance Melocheville to mouth of Chateauguay 10 miles.

An analysis of the river as transformed by the official plan shows that the pool between Croil island and Weaver's point would freeze over at a very early date in the winter and that an ice pack would quickly extend from Weaver's Point to the foot of Ogden island. Thereafter throughout the winter the ice cover in this section would gradually tilt as the under surface filled with the frazil and ice deposits brought to it from the open water between the head of Gallops island and the dam at Ogden island. Towards the end of the winter it would be expected that the 15 miles of water would form about 2,000,000,000 cubic feet of frazil, when in 1923 an average exposure of 30 miles formed 4,000,000,000 cubic feet, or 26 miles of exposure in two months formed 1,400,000,000 cubic feet.

Calculations show that 2,000,000,000 cubic feet of frazil can be stowed between the foot of Ogden island and Weaver's Point with a water surface elevation of 239 at Ogden's island and 227.5 at Weaver's Point. A water level of 227.5 at Weaver's Point means a water level of 226 at the Barnhart Island plants, and a 65 foot head available for power at that point.

Provision for additional safety is secured in the official plan in two ways. There is a large space between Weaver's Point and Aultsville where an additional 2,000,000,000 cubic feet of frazil could be stowed with only a slight lowering of the water level at the Barnhart Island plant, and in addition an ice cover can be formed above Ogden island by manipulation of the openings in the Ogden Island dam during extremely cold weather.

Double Development Projects

Before discussing modification of the official plan which recent ice data indicate can be made, double development power schemes will be dealt with. All estimates prepared with the best data available show that all double development power schemes cost 40 per cent more than single stage schemes and none of those which have been suggested will work in winter with the exception of the Crysler Island and the Cat Island schemes.

The latter is impracticable on account of foundation conditions and need not be discussed. At Crysler island there is a reasonable rock foundation for power houses and dams and a scheme with a dam located there shares with the official plan the advantage of being able to stow 2,000,000,000 cubic feet in the short distance of six miles between that point and Ogden island, and the loss in head through the winter slopes above would not reduce that available at the plant below what is considered a practical operating head. The objections to this scheme are its huge cost, viz, $230,038,000. and the fact that it would bring down lake Ontario level to Morrisburgh and inundate a large area of land below that town. It would give a head of 15 feet at Crysler island and 49 feet at Barnhart island, or a total of 64 feet in winter, which is just one foot less than obtained by the official plan under similar conditions.

A double development project having a power house at Ogden island coupled with a power house at Barnhart island would give an arrangement which would work in summer, but in winter it would not work as with a 30 per cent reduction in velocity above Croil island that section will easily freeze over in winter, and one of two contingencies will occur, either the great volumes of frazil and slush ice which cannot be prevented from forming between Ogden island and the head of Gallops rapids will be stowed in the reach below Ogden island and a slope of from 2.0 to 1.3 foot per mile will be set up for a length of 13 miles, or ice breakers which have been suggested as a means of meeting this condition would, if they functioned at all, in the release of the great areas of ice-pack formed overnight, send down such volumes of slush that the plants at Barnhart island would be put out of commission.

In the former contingency the plant at Ogden island would have its head reduced to 9 feet which would be useless, and in the latter case, besides suffering a tremenduous rise in the tail water level due to the storage of huge quantities of frazil at the head of lake St. Francis, the power house at Barnhart island would be subject to frequent and disastrous interruptions to operation.

Further estimates show that the cost of improving the Long Sault reach for navigation alone would be increased by $20,000,000. if a crest level of 210 was adopted instead of one about 17 feet higher.

The best data available shows that such a project, even if it were workable, would overrun the cost of a single stage scheme developing the full winter head, to the extent of about $62,000,000. This does not take into account the cost of operating ice breakers or other devices which might be employed in futile effort to combat the forces of nature.

Recently the idea of building a power house and lock at Ogden island as a first move in the development of the St. Lawrence has been advocated. This proposal has no merit for the following reasons:—

1. The citizens of the United States who have a market waiting for all their share of the power available will not be satisfied with a 26-foot power development yielding 300,000 h.p., when a 71-foot power development yielding 722,000 h.p., can be secured for an increase of only 51 per cent in expenditure over that required for a 26-foot development.
2. Canada should not be satisfied to terminate lake navigation at Ogden island when it can be extended to below the Long Sault dam, neither should she be satisfied with a plant at Ogden island with an ultimate capacity of 300,000 h.p., when a plant at Barnhart island with an ultimate capacity of 816,000 h.p., can be secured for almost the same initial expenditure. Canada's part of the former proposition, viz, 300,000 h.p., and navigation to Ogden island would be $44,500,000., while Canada's part of the latter, viz, 300,000 h.p., installed, room for 816,000 h.p., and lake navigation past the Long Sault dam will be $51,700,000. To subsequently extend deep navigation to lake St. Francis in the former case would require an additional expenditure of $82,049,000. In the latter case it would only require an expenditure of $17,390,000.
3. Estimates show that even if a power plant developing a 26-foot head were in existence at Ogden island it would still cost $10,000,000. less to develop a 71-foot head at Barnhart island than to develop a 54-foot head and provide for deep water navigation. This is due to the large amount of dredging required at elevation 210 to make the Long Sault reach navigable for deep draft ships, and to the indications what any power house built at Ogden island will be ultimately closed in winter.

Possible Modification of Official Plan

The estimates of cost of single and double stage schemes clearly show that progress in the evolution of the ideal plan for the development of the international section lies in the direction of improvement to the Wooten-Bowden project. The ice data secured during the winter of 1923 clearly establish the fact that the winter level above a future Long Sault dam must stand at about elevation 227 above the sea.

The necessity for discharging the ice sheets over a spillway at the Long Sault dam combined with the small value attached to secondary power in eastern Canada make it Canada's interest to keep the Long Sault crest down to the water level that can be held in winter, and United States interests will no doubt agree to this modification of the official plan when the data requiring it is properly presented to them.

The slight lowering of the Long Sault crest mentioned above will increase the head on the control dam at Ogden island, and it will make it more expensive to introduce provisions for the ultimate recovery of all the potential summer power available. However, another way of meeting the view of the United States interests is available as it will cost but little to place the floor of the lock at Ogden island ten

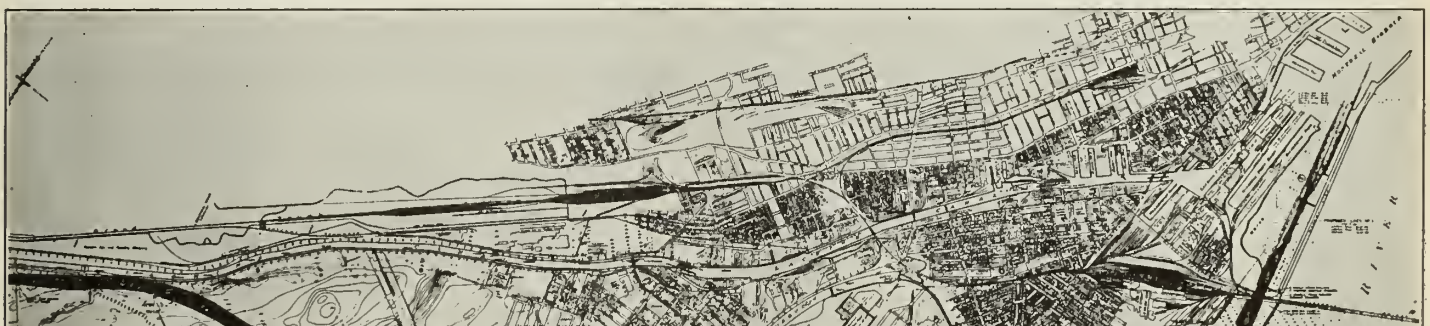


Figure No. 15.—Proposed Modification, St. Lawrence River Improvement Project, Mile 0 to 7.

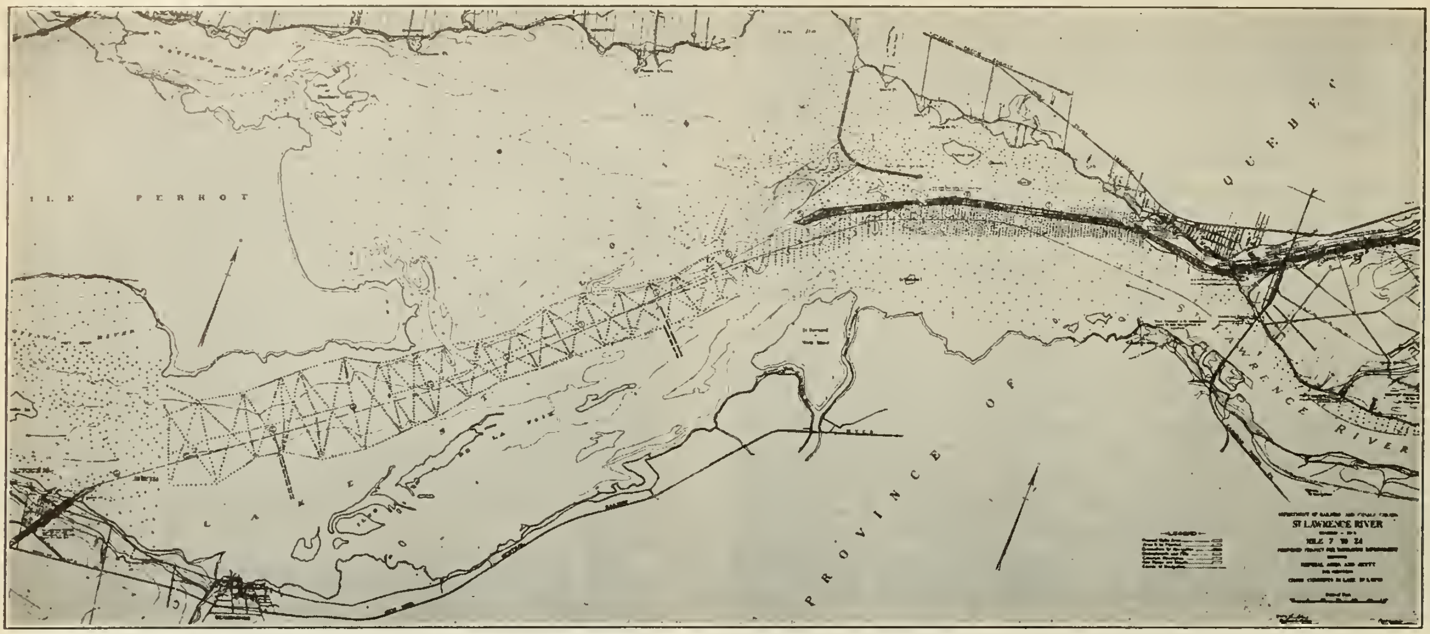


Figure No. 16.—Proposed Modification, St. Lawrence River Improvement Project, Mile 7 to 24.

feet lower than is required at the outset, and in the distant future the Long Sault reach can be lowered, when there is no ice running, to elevation 217., and a power house can be built at Ogden island that will recover all the summer power in the river. The introduction of this provision at the Ogden Island lock changes the location of the works at that point to some extent, but does not add nearly as much to the cost of the works, as a whole, as providing for a future possible raise of the Long Sault and Barnhart island works.

A crest level of 227 for the Long Sault dam will mean that Farren's Point and Aultsville escape unhurt and the only thing necessary to protect Morrisburgh is some filling of low ground and a pumping station for handling sewage such as many communities along the St. Lawrence now have, all of which is only estimated to cost $400,000. This project is estimated to cost $152,926,000. The installed capacity in the power plants at Barnhart island and at the head of the Massena canal is 1,763,200 h.p. It is shown on the plan labelled scheme F.

Modification of Plans for Geographical System of Dividing Costs

The location of the side canal and locks from the head of lake St. Francis to above the Long Sault dam as shown in the official plan is the cheapest and best that has been found for such a waterway, provided its cost and operating efficiency are the only things to be considered, and provided the deep waterways project is to be financed on a partnership system of dividing total cost between this country and the United States. If, however, a geographical system of dividing the cost were to be considered some changes might be made to improve Canada's position and lighten her contribution to the project.

At a sacrifice in economy of about $3,277,000. the side canal required at the Long Sault could be located on American territory instead of on Canadian territory, thereby transferring work estimated to cost about $22,000,000. from one country to the other. This transfer if made would place all the works solely required for navigation in division No. 4, entirely in United States territory, where they could be built as purely national works, but complimentary to similar works built by Canada between lake St. Francis and the ship channel at Montreal.

This modification of the official plan, which is called scheme "N", is not of great interest from an engineering point of view, but it does give a project the economics of which can be freely discussed in our own country. In this project all the works which are solely required for navigation and which are estimated to cost $30,387,000. are in the United States territory. The works required for both power and navigation are partly in the United States and partly in Canada. The estimated cost of those in Canada is $12,054,000. and the estimated cost of those in the United States is $35,382,000. The estimated cost of the works required for power alone is $72,691,000. of which $41,089,000. is for power equipment and machinery.

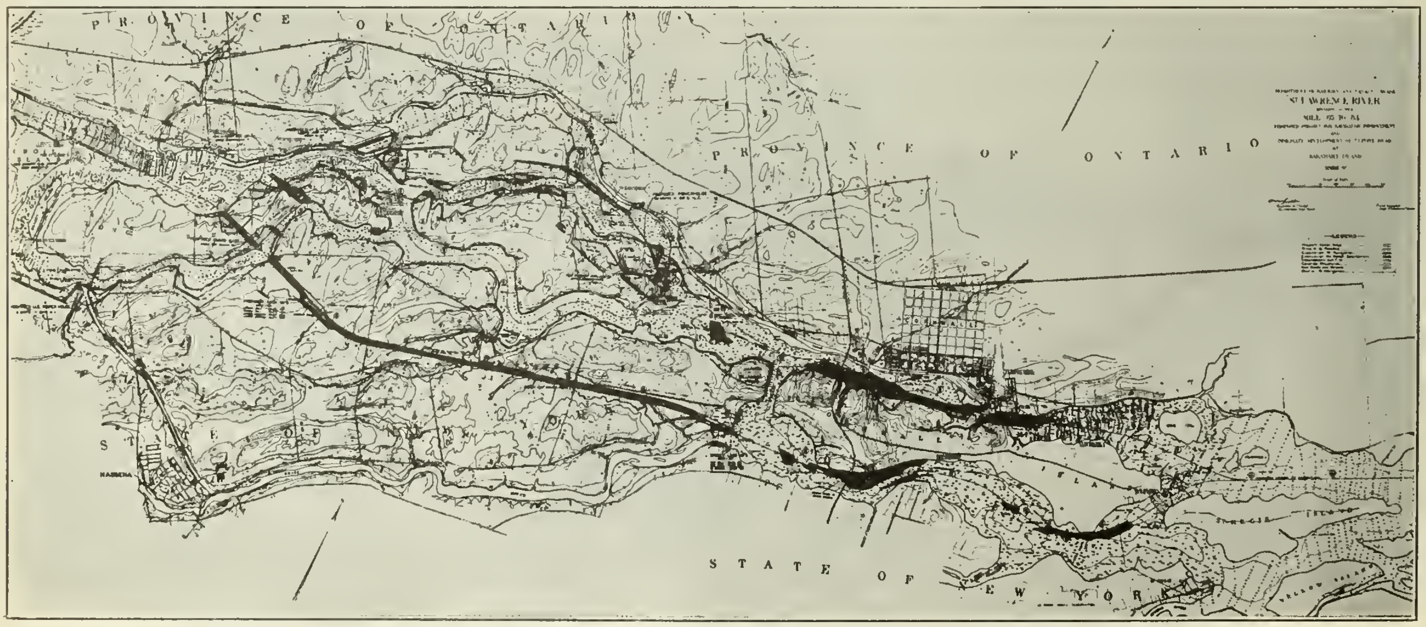


Figure No. 17.—Proposed Modification, St. Lawrence River Improvement Project, Mile 65 to 84.

Division No. 5.—Prescott to Lake Ontario.

This division, like No. 4, is international and the boundary between Canada and the United States follows the river throughout its length. It is 65 miles long and requires some river imporvements at intervals between Brockville and lake Ontario. The improvements required are partly in Canada and partly in the United States. The cost of the work which would have to be done in Canada is about $700,000. and the cost of what is required in United States territory is about $1,600,000.

Table No. 9,—Cost of St. Lawrence Project to United States and Canada if Geographical System of Division used.

	Navigation	
	Canada	United States
Navigation works — division No. 1....	$ 48,190,000	
" " division No. 2....	32,784,000	
" " division No. 3....	1,505,000	
" " division No. 4....		$30,387,000
" " division No. 5....	700,000	2,300,000
Channels lake Erie to lake Superior.....		45,000,000
	$83,179,000	$77,687,000

	Power	
	Canada	United States
Division No. 4 — Common works $41,595,000		
Divided equally.....	$20,797,000	$20,798,000
Joint power works $12,451,000	7,951,000	4,500,000
Canadian power plant	32,535,000	
U.S. plant at Barnhart island head of Massena canal....		33,394.000
	$61,283,000	$58,692,000

Table No. 10,—Dimensions of Structures.

1. Locks — Usuable length 820 feet, width 80 feet, depth 30 feet, at low water.
2. Canal prism — 220 feet wide in land reaches, 450 feet in submerged channels, 300 feet wide where one side submerged.
3. Curves — One mile radius.
4. Dams of concrete to have base width 85 per cent of water height. Aprons to be 30 to 60 feet long, 5 feet thick, reinforced.
5. Lock walls — To have bases 65 per cent of their height.
6. Retaining concrete face walls to have bases 55 per cent of their height.
7. Entrance piers of cribwork to have bases same widths as height.
8. Power house to have base upstream from draft tube 85 per cent of maximum emergency head retained above floor of draft tube.
9. Piers of dams to be so designed for an ice thrust of 50,000 lbs. per linear foot at regulated low water level or maximum static head with 100 per cent uplift at upstream face tapering off to downstream toe.
10. Dams of earth where holding more than 11 feet of water at regulated low water level to have core walls to rock.
11. Dams of earth where holding up to 11 feet of water at regulated low water to have core walls of concrete trenched into ground a distance equal to the head retained at that stage.
12. Embankments of protecting dykes founded on ground above regulated low water level to be built without cores.
13. All earth dams and dykes to be 80 feet wide on top, 135 feet wide on the water line and to stand 11 feet above regulated low water level in the Long Sault reach and 15 feet above it in the Ogden Island reach.

Table No. 11,—Acreage of lands flooded from lake St. Francis to Galops Rapids for various regulated water levels at the Long Sault dam.

	Canadian Side	American Side	Islands	Total
1 — Long Sault crest 210 (Ogden Island scheme)............ Flooding to 217.	978	2,718	2,488	6,184
2 — " " crest 227, single stage scheme "F" (Canadian side)................ Flooding to 233.	2,448	2,559	4,392	9,399
3 — " " crest 227 single stage scheme "N" (U.S. side) Flooding to 233.	1,861	4,362	4,392	10,615
4 — " " crest 231 official plan..... Flooding to 238.	4,859	3,705	7,244	15,808
5 — " " crest 238 Gen. Beach's suggestion......... Flooding to 248.	10,703	6,158	7,244	24,105

Table No. 12,—Comparative statement showing the length of embankments without corewall to rock subjected to different heads for various regulated water levels at Long Sault dam.

	Length of Embankments	
Regulated Water Level	7 ft. head or more	2 ft. head or more
238	1.41 mile	2.56 miles
231	0.48 "	1.16 mile
227	0.17 "	0.33 "
210	0.13 "	0.29 "

Figure No. 18.—Proposed Modification, St. Lawrence River Improvement Project, Mile 84 to 102.

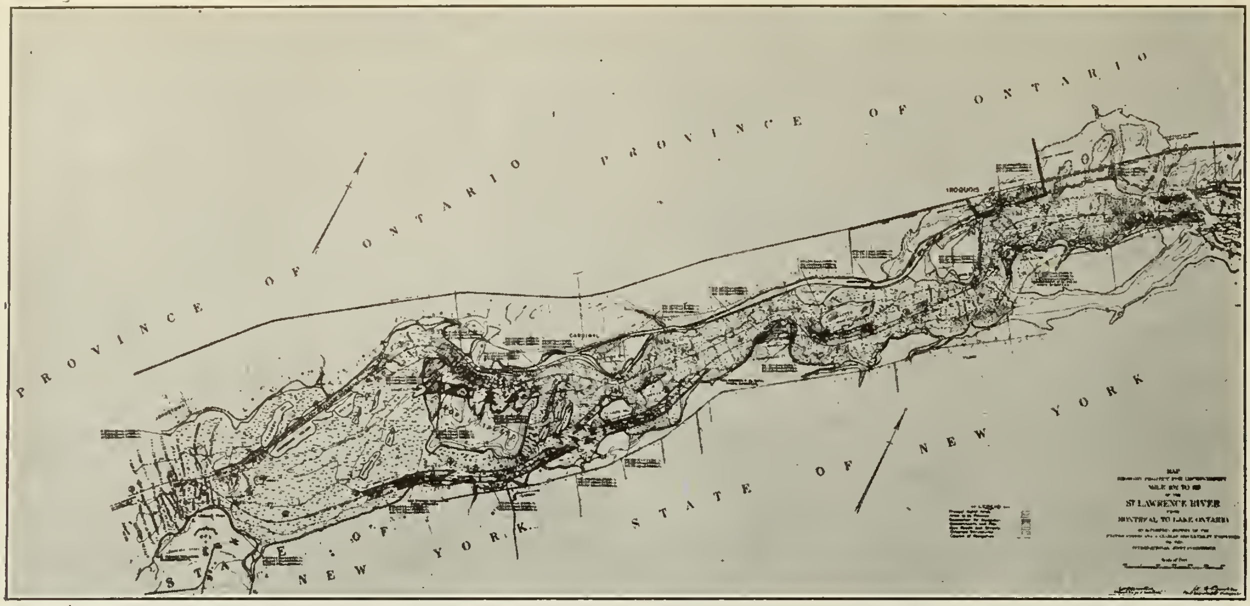


Figure No. 19.—Proposed Modification, St. Lawrence River Improvement Project, Mile 102 to 116.

Table No. 13,—Unit Prices

Concrete in dams, locks, retaining and core walls, Quebec section	$8.00	per cu yd.
Concrete in dams, locks, power houses, retaining and core walls, International section	9.00	" "
Concrete in protection lining of prisms, embankments etc.	10.75	" "
Concrete in intercepting sewers and aqueducts	15.00	" "
Wet rock excavation in limestone and dolomite	4.25	" "
Dry rock " " " " "	1.60	" "
Dry rock " " shale	1.20	" "
Earth excavation including disposal to spoil	0.65	" "
Extra for rehandling earth into water-tight embankments, Quebec section	0.45	" "
Extra for rehandling earth into earth dams with cores to rock, Quebec section	0.10	" "
Extra for rehandling earth into water-tight embankments, International section	0.80	" "
Extra for rehandling earth into earth dams with cores to rock, International section	0.25	" "
Water-tight dykes and earth embankments from borrow, International section	1.10	" "
Earth dams with cores to rock from borrow, International section	0.75	" "
Stone protection lining including placing	2.00	" "
Stone dressing in rear of walls 6 inches deep	1.61	" "
Sodding	0.43	" "
Trimming embankments, etc	0.24	" "
Structural steel in bridges and lock gates	0.07	" lb.
" " " sluice gates, bridges of dams	0.08	" "
" " " cranes, etc	0.20	" "
Machinery and castings in swing bridges and lock gates	0.25	" "
" " " " cranes and winches	0.25	" "
Metal in water wheels and hydraulic machinery	0.30	" "
Steel sheet piling, including delivery and drawing	0.05	" "
Sheeting and bracing, trenches	84.00	m.ft.b.m.
Macadam, surfacing	1.35	per sq.yd.
Roads, provincial and state	8.00	" lin.ft.
Roads, municipal, earth and gravel	2.00	" "
Lands to be acquired, division No. 2	100.00	" acre
Lands to be acquired, International section	200.00	" acre

Economy of Waterway Project

The Welland ship canal is on the way towards completion and lake navigation is sure to be extended to Kingston or Prescott at an early date.

The St. Lawrence canals from Prescott to Dickinson's Landing do not afford 24-hour navigation in their present condition, and if the traffic should be doubled their capacity would be reached. Terminal works at Prescott will cost a considerable sum, and extension of terminal works in the open river below Montreal will also be costly.

If the deep waterway was put through at once no terminal works would be required at Prescott, and any that would be built at Montreal could be placed in the controlled basin where their cost would be moderate. It is therefore evident that the value of the St. Lawrence project depends upon a comparison of two methods of transportation, neither of which are in actual operation at the present time.

If the Welland ship canal was completed and terminal works were built at Prescott, the 2,400-ton canal steamship would continue to use the present canal. The transfer points being Prescott and Montreal instead of Port Colborne and Montreal, as at present, the lake type of ship would haul from Fort William to Prescott and the ocean tramp or freighter would haul the grain from Montreal to Liverpool as at present. In order to assemble data of an unimpeachable character to see what saving would be realized by direct shipments from Fort William to Liverpool, as well as by reducing the number of transfers, a great many ship builders and operators, in 1922, were asked for specific information as to the contract prices and actual performance of certain ships built by them. The replies received were carefully compared with one another so that a reliable figure for everything pertaining to the operation of each type of ship would be secured. The data evolved in this way is attached to this paper. Tables showing insurance rates, sailing distances and times of travel between ports is given for each type of ship, and each route that can be compared with the future deep waterway. The follwing table shows the results derived from the use of the above described data,—

Table No. 14,—Cost of Transporting Grain by Various Routes at Different Seasons of the Year.

	Cost of Transportation Per Ton. May 1st. to Aug. 31st	Oct 1st. to Oct. 30th	Nov. 1st. to Nov. 25th
Fort William to Liverpool			
1. *Under present conditions.*			
Via present system of canals	$6.25	$6.38	$6.63
Via Port McNichol and Montreal	6.61	6.74	7.00
Via Buffalo and New York	6.30	6.38	6.45
2. *New Welland ship canal but without enlargement of St. Lawrence canals*	6.00	6.10	6.32
3. *New Welland ship canal and St. Lawrence canals improved for 25 feet.*			
(a) Tramp steamer — Fort William to Liverpool	4.24	4.37	4.47
(b) Transferring from lake freighter to ocean tramp at Montreal	5.04	5.14	5.37
(c) Transferring from lake freighter to ocean tramp at Quebec	5.01	5.08	5.29
(d) Transferring from lake freighter to ocean tramp at Sydney	5.00	5.12	5.23

An inspection of this table shows that if through shipments were possible from Fort William to Liverpool a saving of $1.76 per ton would be realized over the cost of a transfer at Prescott and canal boat to Montreal. If for marketing reasons a transfer from bulk freighter to tramp ship is made at Montreal, the saving would only be 0.96 cents per ton

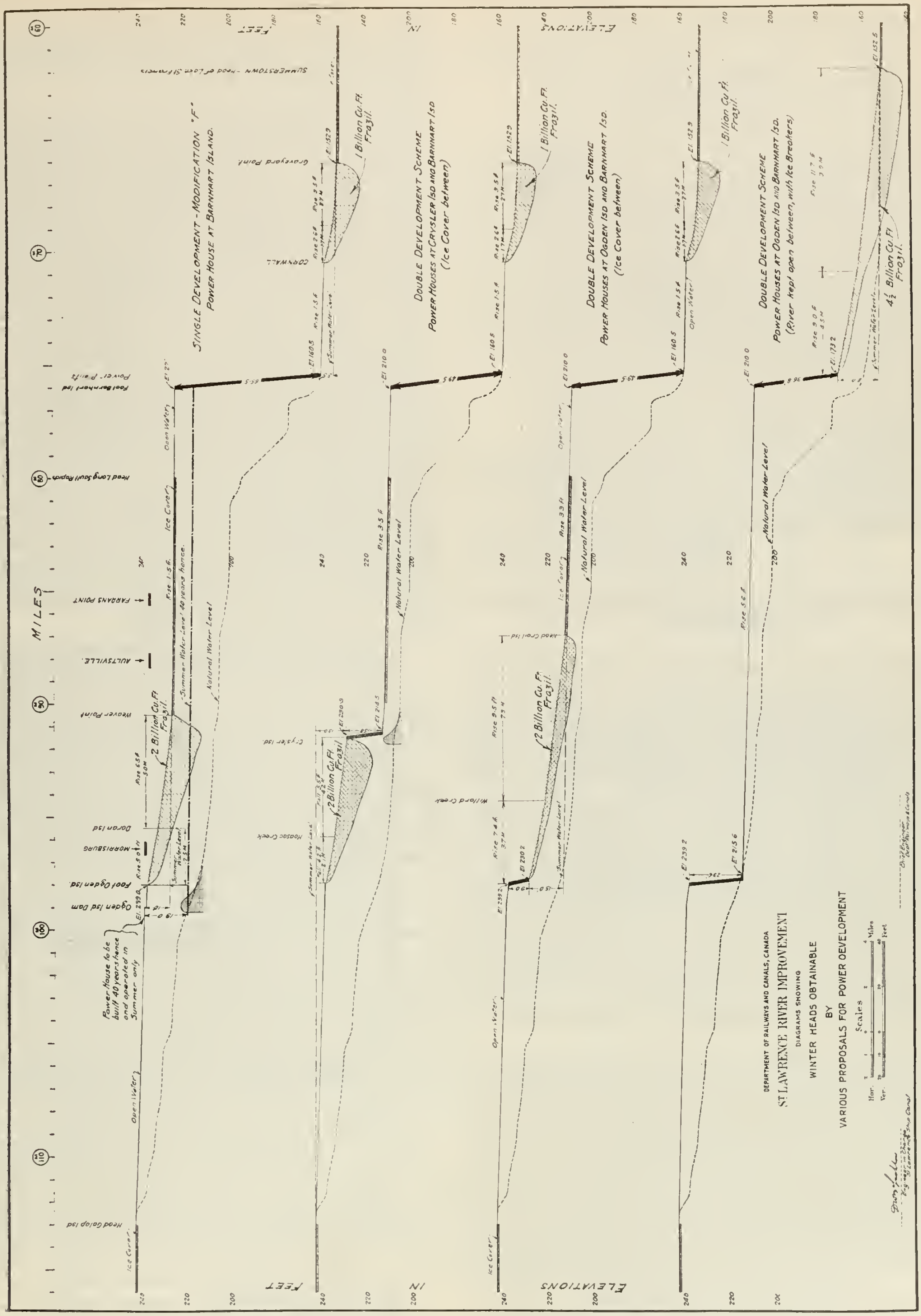


Figure No. 20.—Diagram of Winter Heads Obtainable by various Proposals for Power Development, St. Lawrence River Improvement Project.

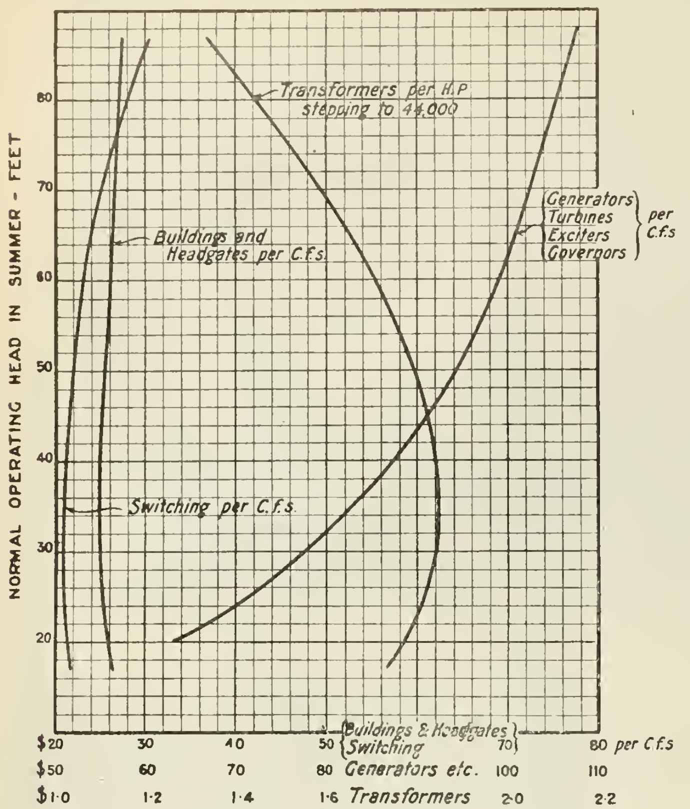


Figure No. 21.—Assembled Costs of Superstructure and Equipment of Proposed Power Plants, St. Lawrence River Improvement.

over the Prescott route with canal boat to Montreal and tramp ship to Liverpool.

The volume of Canadian traffic offering for transportation by a deep waterway from the Great Lakes to the sea cannot be estimated closely. A survey of water borne movements in the world generally shows that a special distribution of ore deposits, coal deposits, and oil fields, does sometimes account for a huge interchange between the manufacturing and mining districts, and strangely enough such traffic often develops where least expected.

The eastward movement of Canadian grain especially when en route to Europe is now very large and it is increasing rapidly. Will it continue to increase? That is the question. There is no sign, as yet, of Canadian wheat being required in the United States in other than small quantities, and consequently the destination of wheat exported must continue to be the United Kingdom and the continent of Europe. If the statistics of the past are a guide to the future, the wheat exports of Canada to countries other than the United States may be taken at 5,600,000 tons seven years hence. The exports of other grains may be taken at 700,000 tons. Of this amount a small part must be conceded to the Vancouver and Buffalo routes. Possibly 5,000,000 tons of Canadian grain and grain products is all that would move by the waterway if completed seven years hence. On this tonnage the St. Lawrence project, exclusive of the Welland ship canal, would be credited with an average saving of $1.36 per ton, or a total of $6,800,000. per year.

The effect of the deepening of the St. Lawrence on the cost of transporting hard coal and soft coal from lake Ontario and lake Erie ports to Montreal will not be large, and its effect on the cost of transporting pulp wood from the lower St. Lawrence, to the mills in Ontario and New York state will also be small. But the effect of the through deep waterway on the movement of material from the maritime provinces, the Atlantic seaboard, the continent of Europe, and other distant countries, to western Canada will be very great, and its effect on the cost of transporting lumber from British Columbia to western Ontario will be important. By assuming that the population in western Ontario and the prairie provinces will be 5,000,000 in ten years, it is not difficult to identify a westward movement of 1,000,000 tons on which $2.50 per ton would be saved, and an equal volume of east and west movement on which about 50 cents per ton would be saved. The total of all these savings in transportation appears to amount to about $10,300,000. per year.

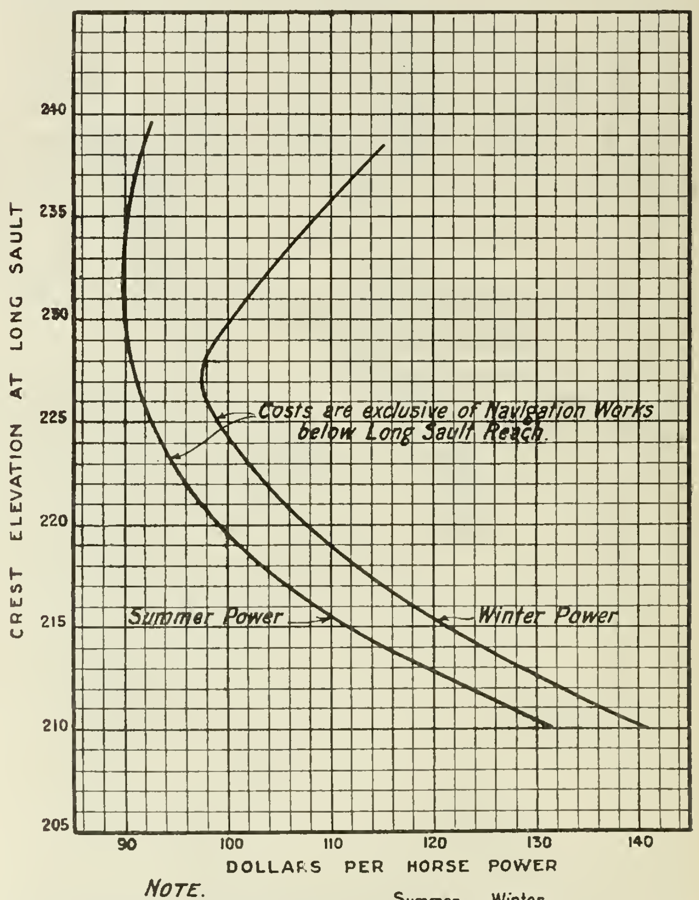
Practicability of Waterway

If the official plan is carried out, the through deep waterway between Fort William and Montreal will consist of 16 lift-locks, 2 guard gates, 56 miles of canal 200 to 220 feet wide on the bottom, 6 miles 300 feet wide, 58 miles 450 to 600 feet wide, 229 miles of deep wide river, and 868 miles of lake. A ship of 25 feet draft will be able to navigate this waterway 80 per cent of the time, and one of 24½ feet draft 95 per cent of the time. This waterway will accommodate 71 per cent of the ships now afloat and fifty per cent of the carrying capacity of cargo ships on the ocean. It will also accommodate fifty-five per cent of the ships launched in recent years.

Critics of this waterway argue that ocean carriers will not enter the proposed St. Lawrence waterway on account of the alleged restrictions of the waterway and the dangers of passing through its 18 lift-locks. No waterway exists that can be compared with the proposed St. Lawrence in all respects. The only extensively used waterways which have a comparable number of locks are our present St. Lawrence and Welland canals, the Manchester canal, the Amsterdam canal and the Panama canal. As regards the narrowness of the channel, it may be pointed out that shipping has extensively used the Suez canal, which is 50 feet narrower for a length of 53 miles than any part of the proposed waterway, that ships have extensively used the Manchester canal, which for a length of 35 miles, is only slightly more than half as wide as the narrowest stretch of the proposed St. Lawrence canal project. The radius of curvature on the proposed St. Lawrence waterway is about double that of the channel leading to the important port of Antwerp. The radius of curvature proposed on the St. Lawrence waterway is about 50 per cent greater than that in use on the Manchester canal.

A ship now plying between Hamburgh and any Chinese or Asiatic port passes through as great a length of artificial channel as there will be between Liverpool and Fort William on the proposed route. A ship on the Hamburgh-Asiatic route would pass through channels that are only two feet deeper than the depth that will be available in the new St. Lawrence route, if built for an initial depth of 26 feet. It will only be about three feet shallower than the St. Lawrence ship channel now is below Montreal at low water.

The effect of introducing 18 lift-locks on a waterway route 4,537 miles long, cannot be serious when it is apparent that boats now travelling from Fort William to Montreal, a distance of 1,217 miles, pass through 46 locks which have no surplus length over that of the ships using these locks. Neither can such locks be a serious obstacle when it is apparent that ships readily go through 5 locks to Manchester, to save a rail haul of only 35 miles, or when it is apparent that ships go through the Amsterdam entry lock and 17½ miles of restricted canal to save a few miles of rail haul to Rotterdam.



NOTE.

	Summer	Winter
Cost of Power at Ogden Island with Elev. 210 at Long Sault	$146·00	$156·00
When Ice Breakers required	160·00	170·00

Figure No. 22.—Relation between Crest Level at the Long Sault and cost of Development per horse power in the Long Sault Beach, St. Lawrence River Improvement Project.

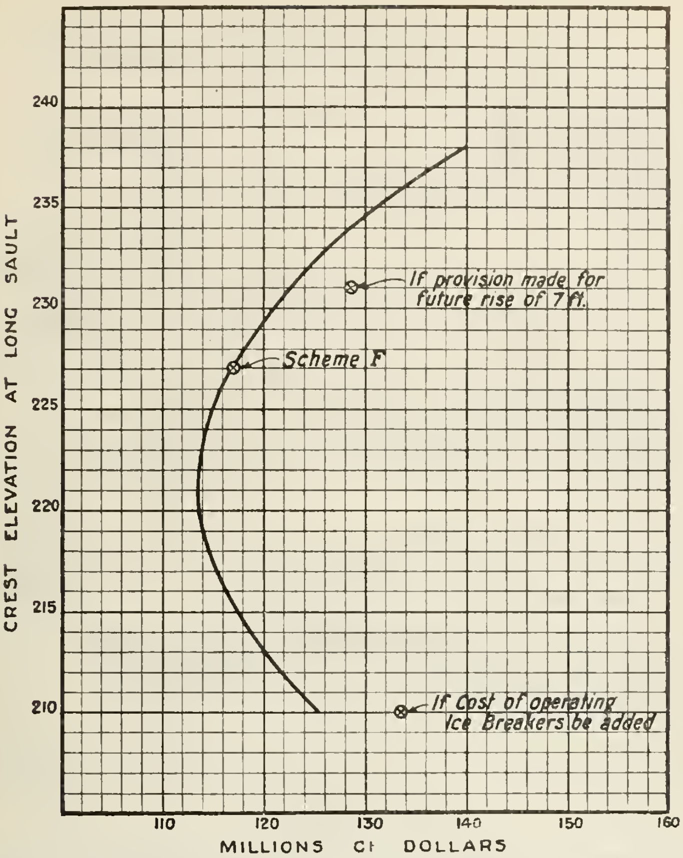


Figure No. 23.—Relation between Crest Level at the Long Sault and estimated cost of all works East of Ogden Island. Division No. 4, St. Lawrence River Improvement.

There is usually a slightly higher rate of insurance on goods shipped from Montreal to Manchester than to Liverpool, but when the cargo is grain, or other commodity which has only a value of about $50.00 per ton, the extra rate of insurance only brings about an increase of four cents per ton in the cost of transportation. This is almost negligible and only amounts to about one cent per lock in the canal. Every ship must pass through locks to reach the loading wharves of London, Liverpool, Manchester, Avonmouth, Cardiff, Swansea, and Amsterdam, while locks must be used to reach important sections of many other large ports of the world, such as New Orleans, Seattle, Quebec, Havre, Dunkirk Calcutta, Bombay, Singapore, Melbourne, and Buenos Aires. The fact that 90,000,000 tons of freight is carried through the locks at Sault Ste. Marie each year is proof that a few locks of themselves are not a barrier to the growth of a large traffic on a waterway.

In the locks of the present Welland and St. Lawrence canals, there is no surplus length over that of the ships using these canals, and in entering such locks, ships must be kept in motion until they almost collide with the gates. Nearly all the accidents on these canals are due to this feature, and it is responsible for the extra insurance rate of 1 per cent to 2 per cent which is now charged on ships that enter these canals. In the proposed waterway the lock length of 800 feet above fender chain will give a large surplus in length over that of the ships that will probably be in use on the Great Lakes and even on the ocean, except for passenger business. In the proposed waterway a great improvement over present conditions in the river stretches is made by raised water levels and dredging so that the navigation of the waterway from Port Colborne to Montreal by the largest boats should command a lower rate of insurance than is now being charged canal boats plying between Montreal and Sydney. In fact a mean rate between the canal rate and the Fort William-lake Erie rate should be expected.

The great volume of grain shipped from the ports of Rossario and San Lorenzo on the upper river Parana is most conclusive proof of the fact that a draft limitation of 24½ feet does not prevent ocean ships using such routes. The grain exports of the above ports in 1920 amounted to 3,500,000 tons and their cereal exports generally about 55 per cent of those of the Argentine Republic. Rossario is 226 miles by water above Buenos Aires, and only 186 miles from it by rail. The depth in the river averages from 21 to 24 feet dependant upon the season of the year.

Calculations of Future Channel Slopes in Open Season

Up to this time no mentions have been made of the future hydraulic gradient of the improved river. Needless to say it is important and some information as to how it has been calculated should be given.

Hydraulic gradients of flowing streams has heretofore been largely determined by engineers through the use of the complicated Kutter formulae which is as follows,—

$$V = \frac{41.6 + \frac{1.811}{n} + \frac{0.00281}{s}}{1 + \frac{n}{\sqrt{r}}\left(41.6 + \frac{0.00281}{s}\right)} \sqrt{rs}$$

Its functioning depends upon the use of coefficients which are derived on the spot from nature, or from experience with similar situations. The terms and constants in the formulae are supposed to make the coefficients applicable to all variations of slope and velocity that may occur in such sections of the river.

For many years the writer, like many other hydraulic engineers, has been dissatisfied with Kutter's furmulae and a few years ago concluded an investigation on the Trent which showed that velocity in channels varries with slope to the power 0.54 to 0.55 when the depth is kept constant. This deduction was corroborated by reference to the elaborate investigation on the flow of liquids in pipes conducted by the Boston Institute of Technology who give a formulae of the form

$$V = C \left(\frac{r^{.67} \quad S^{.554}}{(SP)^{.445} \times Z^{.111}} \right)$$

It was also found that an engineer by the name of Williams had proposed the formulae $V = CR^{.67}S^{.54}$ some years ago and that the coefficients of this formulae are being given equal prominence with those of Kutter's by many American hydraulic engineers

Last winter when an ice jam occurred at an appropriate place on the St. Lawrence a check of Williams' formulae was secured which shows it to be as accurate as can be desired. The following table shows the data in part upon which this statement is made:—

Table No. 15,—Results of check of Williams' formulae secured on St. Lawrence River.

Date	Sta. to Sta.	Area	Hydraulic R.	Velocity	Discharge	Distance	Drop in W.L.	C.	Measured Drop in Water Level.
Means	C to A.	26,300	23.9	8.83	232,000	9,000	4.69	62.5	
Apr. 4	C to A.	24,800	22.54	8.37	207,500	9,000	4.58	62.4	
	C to A.	29,200	26.54	6.77	197,500	9,000	2.50	62.4	2.50
Feb. 18	C to A.	33,420	34.4	5.54	190,400	9,000	1.36	62.4	1.30
Mar. 14	C to A.	33,050	30.05	5.54	183,000	9,000	1.46	62.4	1.50
Mar. 31	C to A.	30,146	27.40	6.43	194,400	9,000	2.23	62.4	2.30
	L24 to C.	24,730	18.7	8.78	217,000	6,800	4.9	62.4	
H.W.	L24 to C.	25,786	19.5	9.0	232,000	6,800	5.0	60.4	
L.W.	L24 to C.	22,750	17.22	8.40	190,600	6,800	4.45	62.7	
Mar. 14	L24 to C.	29,900	22.65	6.10	182,500	6,800	1.95	(61.8)	1.95
Mar. 8	L24 to C.	29,150	22.05	6.12	178,200	6,800	2.05	(61.8)	2.00

The following table shows the relation between "C" in Kutter's and Williams' formulae for the value n 0.035 in the former.

Table No. 16,—Relation between "C" in Kutter's and Williams' formulae for values of n 0.035 in the former.

Hydraulic Radius in feet.	Slope K	In 1000. W	Slope K	In 5000. W	Slope K	In 20,000 W
10	65	57.0	67	63.4	101	72.5
20	72	57.2	76	63.5	85	75.6
50	79	53.6	85	61.5	101	75.8

In all the hydraulic data given in this paper Williams' formulae is used.

The values of C used in determining slope from the head of Galop island to Ogden island, and from Ogden island to Barnhart island are largely derived from natural conditions in the section considered. These vary from 51 to 71 in the unimproved parts. A value of 62.0 has been taken in the parts where improvements are shown.

A future diversion of 5,000 c.f.s., has been assumed at Chicago and history is supposed to repeat itself as regards precipitation and runoff. Under these assumptions the water levels and heads lost at Ogden island at various times work out as follows, assuming the crest of the Long Sault dam established at elevation 227.

Table No. 17,—Scheme "N".—Summary of results obtained from regulation of lake Ontario and Williams formulae
$V = CR^{.67}S^{.54}$

5,000 c.f.s. diversion at Chicago assumed.

Per Cent at Time	Regulated Discharge		Elev. of Lake Ont. under regulation		Elev. at head of Galops under regulation		Elev. above Ogden Isl. Dam		Head at Ogden Isl.Dam
	Summer	Winter	Summer	Winter	Summer	Winter	Summer	Winter	Summer
Min.	200	193	244.04	244.43	242.5	241.8	238.1	237.5	4.8
100	200	193	44.04	44.43	42.5	41.8	38.1	37.5	4.8
90	212	208	46.10	45.50	44.6	43.1	40.1	39.2	6.8
80	223	211	46.40	45.80	44.9	43.4	40.5	39.5	7.6
70	230	213	46.60	46.10	45.0	43.6	40.9	39.7	8.6
60	237	214	46.70	46.40	45.2	43.8	41.1	39.8	9.3
50	244	215	46.90	46.60	45.3	44.0	41.3	40.0	10.0
40	253	218	47.00	46.90	45.4	44.2	41.4	40.1	10.5
30	267	231	47.20	47.10	45.5	44.3	41.6	40.2	11.0
20	287	245	47.30	47.40	45.6	44.6	41.8	40.5	11.6
10	304	254	47.70	47.80	45.8	44.9	42.0	40.9	12.0
1	325	267	48.50	48.29	46.3	45.3	42.6	41.7	12.9
Max.	328	268	48.72	48.29	46.4	45.3	43.0	41.7	13.2

The affect of change in viscosity in the flow of water in a river has not yet been determined. Laboratory experiment indicates that a variation of six per cent would be found with a change of temperature of 40 degrees fahrenheit.

Table No. 18,—Statement Showing Characteristics and Performance of Ships

	Canal Size Ship	Lake Freighter	Ocean Tramp 8,500 tons	Ocean Tramp 13,100 tons
Deadweight carrying capacity	2,400 tons	12,000 tons	8,500 tons	13,100 tons
Length	253 feet	600 feet	430 feet	490 feet
Beam	43.0 feet	58.0 feet	54.0 feet	61.0 feet
Depth			28.4 feet	36.3 feet
Draft	14.2 feet	21.0 feet	24.0 feet	28.0 feet
Gross tonnage		8,750 tons	5,752 tons	
Weight of ship			3,610 tons	5,234 tons
Crew	20	30 (on lake)	40	50
I. H. P.			2,515 h. p.	3,230 h. p.
Speed—Knots per hour:				
Calm weather	10.0	10.0	10.0	10.0
Average	9.7	9.7	9.7	9.7
Coal consumed per day:				
On voyage	16 tons	42 tons	35 tons	46 tons
In port	2.5 tons	6 tons	5.5 tons	5 tons
Stores per day:				
At sea	8 tons	14 tons	16 tons	20 tons
In fresh water	2 tons	5 tons	5 tons	
Cost per ship	$190,000	$750,000	$480,000	$733,000
Operating season	230 days	230 days	330 days	330 days
Expenses per day				
Fixed charges:				
Interest	6%			
Depreciation	4%			
Maintenance and repairs	3%			
	13%			
13 per cent for fixed charges	$107.	$424.	$189.	$289.
Crew and sustenance	70.	105.	132.	161.
Coal — On voyage	80.	210.	175.	230.
" In port	13.	30.	27.	30.
Engine and deck stores	15.	36.	33.	50.
Management	5.	16.	14.	14.
Total expenses per day:				
On voyage	$277.	$791.	$543.	$744.
In port	210.	611.	395.	544.

If voyage between Montreal and Prescott, add 72 cents per ton for coal.
Total expenses per day
On voyage $289
In port 212

If voyage between Fort William and Georgian Bay ports, add 72 cents per ton for coal.
Total expenses per day
On voyage $821
In port 616

Table No. 19,—Statement Showing Time of Navigation of Waterways.

Ships loaded with bulk freight on eastbound journey only.

Fort William to Port Colborne and return —
Standard ship — 600′ x 58′ x 21′ draft

2 lockages @ 0.8 hrs	1.60 hrs.	
2 miles canal — 200′ wide @ 5 m. p. h.	0.40 "	
104 miles restricted and shoal water @ 9 m. p.h.	11.55 "	
201 miles river @ 10 m. p. h.	20.10 "	
1,390 miles lake @ 11 m. p. h.	126.27 "	
	159.92 "	6.6 days
1¾ days in each terminal and ½ day coaling		4.0 "
Total time		10.6 days

Port Colborne to Montreal and return via present canal system —
Present canal sized boats — 253′ x 43′ x 14′ draft.

90 lockages @ 0.6 hrs	54.00 hrs.	
135 miles of canal 100′ wide @ 4 m.p.h.	33.70 "	
247 miles of river @ 10 m.p.h.	24.70 "	
346 miles of lake @ 11 m.p.h.	31.50 "	
	143.90 "	6.0 days
Time in terminals and coaling		3.0 "
Total time		9.0 days
Total with delay Gallop to Dickinson's Landing		9.25 "

Prescott to Montreal and return via present canal system —
Present canal sized boat — 253′ x 43′ x 14′ draft.

21 + 17 lockages @ 0.6 hrs	22.8 hrs.	
81 miles canal @ 4 m.p.h.	20.2 "	
159 miles river @ 10 m.p.h.	15.9 "	
	58.9 "	2.5 days
Time in terminals and coaling		3.0 "
Total time		5.5 "
Total with delay — Prescott to lock 21		5.75 days

Fort William to Prescott and return via enlarged Welland ship canal. —
Standard ship — 600′ x 58′ x 21′ draft.

18 lockages @ 0.8 hrs	14.40 hrs.	
54 miles canal — 200′ wide @ 5 m.p.h.	10.80 "	
107 miles restricted and shoal water @ 9 m.p.h.	11.90 "	
297 miles open river @ m.p.h.	29.70 "	
1,736 miles lake @ 11 m.p.h.	157.80 "	
	224.60 "	9.4 days
1¾ days in each terminal and ½ day coaling		4.0 "
Total time		13.4 days

Fort William to Montreal and return via improved St. Lawrence and Welland ship canal. — Standard ship — 430′ x 54′ x 24′ draft.

36 lockages @ 0.8 hrs	28.80 hrs.	
111 miles of canal 200′ — 220′ wide @ 5 m.p.h.	22.20 "	
130 miles of restricted and shoal water @ 9 m.p.h.	14.40 "	
457 miles of open river @ 10 m.p.h.	45.70 "	
1,736 miles of open lake @ 11 m.p.h.	157.80 "	
	268.90 "	11.2 days
1¾ days in each terminal and ½ day coaling		4.0 "
		15.2 days

Fort William to Port McNichol and return (lake freighter).

2 lockages @ 0.8 hr	1.60 hrs.	
2 miles canal @ 5 m.p.h.	0.40 "	
39 miles restricted channel @ 9 m.p.h.	4.33 "	
111 miles river @ 10 m.p.h.	11.10 "	
930 miles lake @ 11 m.p.h.	64.55 "	
	101.90 "	4.24 days
1¾ days in each terminal and ½ day coaling		4.00 "
Total time		8.24 days

Montreal to Liverpool and return (ocean tramp) —
Route — out via Sydney — in via Belle Isle.
Via Sydney — Montreal to Quebec:—

64 miles restricted and shoal water @ 9 m.p.h.	7.1 hrs.	
97 miles open river @ 10 m.p.h.	9.7 "	
	16.8 "	0.70 days

Quebec to Sydney:—
23 miles restricted and shoal water @ 9 m.p.h. 2.6 hrs.
630 miles open river and gulf @ 10 m.p.h.... 65.0 "

67.6 " 2.80 days

Sydney to Liverpool:—
2,624 miles @ 11 m.p.h.................. 238.5 hrs. 9.95 "

Total time — Montreal to Liverpool via Sydney 13.45 days

Via Belle Isle:—
Montreal to Quebec (as above)............. 0.70 days
Quebec to Liverpool via Belle Isle 23 miles restricted and shoal water @ 9 m.p.h...... 2.6 hrs.
847 miles open river and gulf @ 10 m.p.h.... 84.7 "
2,158 miles @ 11 m.p.h.................. 196.2 "

283.5 hrs. 11.80 days

Total time — Liverpool to Montreal via Belle Isle.................................. 12.50 "
Time on voyage — Montreal to Liverpool and return, 13.45 + 12.50..................... 25.95 "

Time in port — 1¾ days in each terminal and ½ days coaling.......................... 4.00 days

Total time — return trip.................... 29.95 days

Vancouver to Liverpool and return — ocean tramp route — via Panama canal:—

Vancouver to Panama and return:—
9,320 miles @ 11 m.p.h...................... 847.3 hrs. 35.30 days

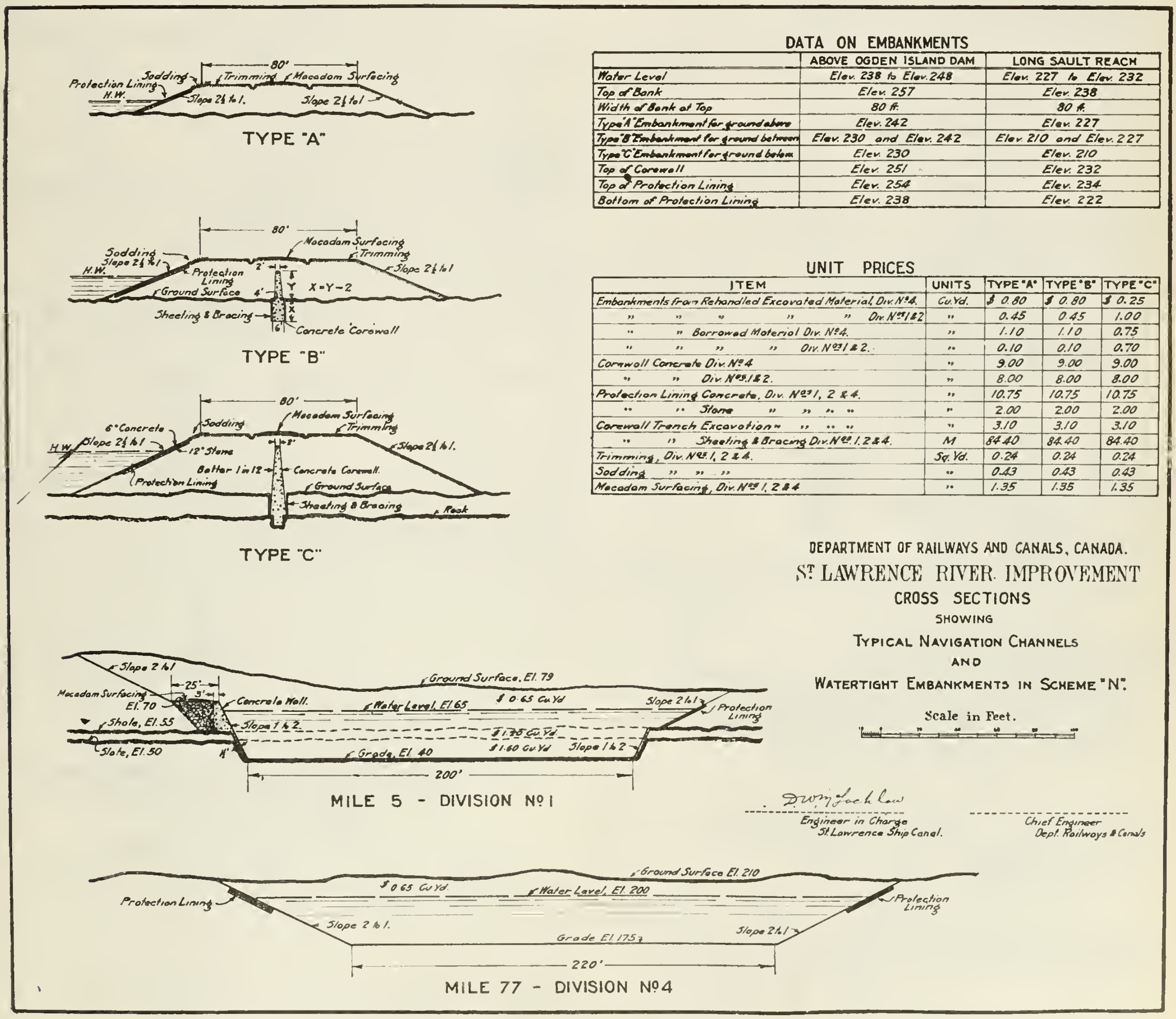
Panama canal east and west:—
96 miles of restricted and shoal water @ 8 m.p.h. 12 hrs.
10 locks @ 0.8 hrs.......................... 8 "

20 hrs. .83 "

Colon to Liverpool and return:—
10,420 miles @ 11 m.p.h..................... 947.3 hrs. 39.45 "

Total time on voyage........................ 75.58 days
Add 1¾ days in each terminal and ½ day coaling 4.00 "

Total time....... 79.58 days



DATA ON EMBANKMENTS

	ABOVE OGDEN ISLAND DAM	LONG SAULT REACH
Water Level	Elev. 238 to Elev. 248	Elev. 227 to Elev. 232
Top of Bank	Elev. 257	Elev. 238
Width of Bank at Top	80 ft.	80 ft.
Type "A" Embankment for ground above	Elev. 242	Elev. 227
Type "B" Embankment for ground between	Elev. 230 and Elev. 242	Elev. 210 and Elev. 227
Type "C" Embankment for ground below	Elev. 230	Elev. 210
Top of Corewall	Elev. 251	Elev. 232
Top of Protection Lining	Elev. 254	Elev. 234
Bottom of Protection Lining	Elev. 238	Elev. 222

UNIT PRICES

ITEM	UNITS	TYPE "A"	TYPE "B"	TYPE "C"
Embankments from Rehandled Excavated Material, Div. No. 4.	Cu. Yd.	$ 0.80	$ 0.80	$ 0.25
" " " " " Div. Nos. 1 & 2	"	0.45	0.45	1.00
" " Borrowed Material Div. No. 4.	"	1.10	1.10	0.75
" " " " Div. Nos. 1 & 2.	"	0.10	0.10	0.70
Corewall Concrete Div. No. 4	"	9.00	9.00	9.00
" " Div. Nos. 1 & 2.	"	8.00	8.00	8.00
Protection Lining Concrete, Div. Nos. 1, 2 & 4.	"	10.75	10.75	10.75
" " Stone " " " "	"	2.00	2.00	2.00
Corewall Trench Excavation " " " "	"	3.10	3.10	3.10
" " Sheeting & Bracing Div. Nos. 1, 2 & 4.	M	84.40	84.40	84.40
Trimming, Div. Nos. 1, 2 & 4.	Sq. Yd.	0.24	0.24	0.24
Sodding " " "	"	0.43	0.43	0.43
Macadam Surfacing, Div. Nos. 1, 2 & 4	"	1.35	1.35	1.35

Figure No. 24.—Typical Navigation Channels and Watertight Embankments, St. Lawrence River Improvement Project.

Table No. 20, — Statement showing cost of operation of elevators transferring 33,000,000 bushels per year from one ship to another.

Port Colborne handling 33,000,000 bushels per year.

Staff	$36,000.	Shortage and shrinkage	$ 18,000.
Repairs	30,000.	Interest $2,400,000 @ 6%	144,000.
Shovelling	42,000.	Depreciation	49,000.
Power	14,000.	Insurance (on building)	4,200.
Insurance (on grain)	4,000.		
		Total	$341,200.
Add management and overhead 10%			34,100.
Total			$375,300.
			=1.14c per bushel.

Table No. 21.—Statement showing cost of transporting grain via present system of canals—Fort William to Liverpool.

Assuming no return cargoes

Fort William to Port Colborne — 12,000 ton ship.

Coal consumed 6.6 days @ 42 = 277 tons.
4.0 " " 6 = 24 "
10.6 " " 5 = 53 "

Net cargo, 12,000 tons — 354 tons = 11,646 tons.
6.6 days on voyage @ $791 = $5,220.
4.0 days in port @ $611 = 2,444.
Insurance — hull 10.6 days @ $163. = 1,728.
cargo 11,646 tons @ $0.15 = 1,748.
Total $11,140 ÷ 11,646 = $0.96 per ton.
Tranfer at Port Colborne @ 1.25 cents per bushel = 0.42 per ton.

Port Colborne to Montreal 2,400 ton ship.

Coal consumed, (coaling at Charlotte).
6.0 days @ 16 = 96 tons
3.25 " @ 2.5 = 8 "
Stores 9.25 " @ 2.0 = 19 "

Net cargo 2,400 tons — 123 tons = 2,277 tons.
6 days on voyage @ $277 $1,662.
3.25 days in port @ $210 682.
Insurance, — hull 9¼ days @ $58. 536.
cargo 2,277 tons @ $0.15 342.
Total $3,222. ÷ 2,277 = $1.42 per ton.
Transfer at Montreal @ 1.25 cents per bushel = 0.42 " "

Montreal to Liverpool — 8,500 ton ship.

Out via Sydney — in via Belle Isle.
Coal consumed, (coaling near Liverpool and Sydney).
10 days @ 35 = 350 tons.
2 " @ 5.5 = 11 "
Stores 15 " @ 16 = 240 "

Net cargo 8,500 tons — 601 tons = 7,899 tons.
25.95 days on voyage at $543 = $14,091.
4.00 days in port at $395 1,580.
Insurance — hull 29.95 days @ $102 = 3,055.
cargo 7,899 tons @ $0.28 = 2,210.
Pilotage to Montreal 331.
Pilotage to Sydney for coal 75.
Total $21,342 ÷ 7,899 = $2.70 per ton.
Transfer into warehouse at Liverpool @ 1 cent per bushel. 0.33 " "

Total — May 1st to August 31st $6.25 " "
If Oct. 1st to Oct. 30th, then total 6.39 " "
If Nov. 1st to Nov. 25th, then total 6.64 " "

Table No. 22,—Statement showing cost of transporting grain Fort William to Liverpool—via Port McNichol and Montreal.

Assuming no return cargoes

Fort William to Port McNichol — 12,000 ton ship.

Coal consumed 4.24 days @ 42 = 178 tons
4.00 " @ 6 = 24 "
8.24 " @ 5 = 41 "

Net cargo 12,000 tons — 243 tons = 11,757 tons
4.24 days on voyage @ $821 = $3,481.
4.00 days in port @ $616 2,464.
Insurance — hull 8.24 days @ $163 @ 1,343.
cargo 11,757 tons @ $0.15 = 1,764.
Total $9,052 ÷ 11,757 = $0.77 per ton.
Transfer at Port McNichol @ 1.14 cents per bushel 0.42 " "
Rail to Montreal, 365 miles @ 0.54 cents per long ton mile. 1.97 " "
Transfer at Montreal @ 1.14 cents per bushel 0.42 " "
Montreal to Liverpool, as shown in table No. 21 2.70 " "

Total May 1st to August 31st $6.61 " "

If Oct. 1st to Oct. 30th, then total $6.74 per ton.
If Nov. 1st to Nov. 25th, then total $7.00 " "

Table No. 23, — Statement showing cost of transporting grain Fort William to Liverpool via improved Welland Ship Canal but without enlargement of St Lawrence canals.

Assuming no return cargoes

Fort William to Prescott — 12,000 ton ship.

Coal consumed (coaling at Cleveland).
9.4 days @ 42 = 395 tons.
4.0 " @ 6 = 24 "
Stores 13.4 " @ 5 = 67 "

Net cargo, 12,000 tons — 486 " = 11,514 tons.
9.4 days on voyage @ $791 = $7,435.
4.0 days in port @ $611 = 2,444.
Insurance — hull 13.4 days @ $196. = 2,626.
cargo 11,514' @ $0.22 = 2,535.
Total $15,040 ÷ 11,514 = $1.30 per ton.
Transfer at Prescott @ 1.25 cents per bushel 0.42 " "

Prescott to Montreal — 2,400 ton ship.

Coal consumed 2.5 days @ 16 = 40 tons.
3.25 " @ 2.5 = 8 "
Stores 5.75 " @ 2. = 12 "

Net cargo 2,400 tons — 60 " = 2,340 tons.
2.5 days on voyage @ $289 = $723.
3.25 days in port @ $212 = 690.
Insurance — hull 5.75 days @ $58 = 334.
cargo 2,340 @ 0.08 cents = 187.
Total $1,934 ÷ 2,340 = $0.83 per ton
Transfer at Montreal @ $1.25 per bushel $0.42 " "
Montreal to Liverpool as shown on table No. 21 2.70 " "
Transfer into warehouse at Liverpool @ 1 cent per bushel 0.33 " "

Total — May 1st to August 31st $6.00 " "
If October 1st to October 30th, then total 6.10 " "
If November 1st to November 25th, then total 6.32 " "

Table No. 24, — Statement showing cost of transporting grain Fort William to Liverpool via new Welland Ship Canal and St. Lawrence canals improved for a depth of 25 feet.

Assuming no return cargoes

Fort William to Liverpool — 8,500 ton ship.

Route — via Belle Isle:
Time — In fresh water — Fort William to Montreal and return 11.2 days
At sea — Montreal to Liverpool and return via Belle Isle 25.0 "
In port — 1¾ days at each terminal and ½ day coaling 4.0 "

Total time 40.2 days
Coal consumed (coaling at Liverpool and Cleveland):
18.5 days on voyage @ 35 tons = 648 tons
2 days in port @ 5.5 " = 11 "
Stores 12.5 days @ 16 " = 200 "
7.5 days @ 5 " = 37 "

Net cargo, 8,500 tons — 896 = 7,604 tons
36.2 days on voyage @ $543 = $19,656.
4.0 days in port @ $395 = 1,580.
Insurance—hull Fort William —Sydney and return, 18.2 days @ $102 = 1,856.
Sydney — Liverpool and return, 22.0 days @ $73 = 1,606.
cargo 7,604 @ $0.58 4,410.
Pilotage 660.

Total $29,768 ÷ 7,604 = $3.91 per ton
Transfer into warehouse at Liverpool @ 9/10 cents bushel 0.33 " "

Total May 1st to August 31st, 4.24 " "
If Oct. 1st to Oct. 30th, then total 4.37 " "
If Nov. 1st to Nov. 25th, then total, 4.47 " "

Table No. 25,—Statement showing cost of transporting grain Fort William to Liverpool via New Welland Ship Canal and St. Lawrence Canals Improved for a Depth of 25 Feet.

Assuming transfer at Montreal and assuming no return cargoes.

Fort William to Montreal — 12,000 ton ship.

Coal consumed (coaling at Cleveland):
11.2 days on voyage @ 42 tons = 471 tons.
4.0 " in port @ 6 " = 24 "
Stores 15.2 days @ 5 " = 76 "

Net cargo, 12,000 tons — 571 Tons = 11,429 tons.
11.2 days on voyage @ $791 = $8,859.
4.0 days in port @ $611 = 2,444.
Insurance — hull 15.2 days @ $228 = 3,465.
cargo 11,429 @ $0.30 = 3,432.
Total $18,200 ÷ 11,429 = $1.59 per ton.

Transfer at Montreal @ 1.14 cent per bushel.......... = 0.42 per ton
Montreal to Liverpool as shown on table No. 21,..... = 2.70 " "
Transfer into warehouse at Liverpool @ 9/10 cent per bushel = 0.33 " "
Total May 1st to August 31st.................... $5.04 " "
If Oct. 1st to Oct. 30th, then total.................... $5.14 " "
If Nov. 1st to Nov. 25th, then total.................. $5.37 " "

Table No. 26,— Statement showing cost of transporting grain Fort William to Liverpool via New Welland Ship Canal and St. Lawrence Canals Improved for a Depth of 25 Feet.

Assuming transfer at Sydney and assuming no return cargoes.

Fort William to Sydney — 12,000 ton ship.

Time on voyage.
Fort William to Montreal.................... 11.20 days.
Montreal to Sydney.......................... 7.00 "
1¾ days in each terminal and ½ day coaling.. 4.00 "

Total time............................ 22.20 days.

Coal consumed (coaling at Sydney and Cleveland):
9.1 days @ 42 tons........................ 382 tons
2 days @ 6 tons........................... 12 "
Stores 11.90 days @ 5 tons.................... 69 "

Net cargo .... 12,000 tons—454 tons = 11,546 tons
18.20 days on voyage @ $791......... = $14,396.
4.00 days in port @ $611.............. = 2,444.
Insurance — hull 22.2 days @ $228.. = 5,062.
cargo 11,546 @ $0.35........ = 4,040.
Pilotage Montreal-Sydney............ = 331.
At Sydney.................. = 75.
Total $26,348 ÷ 11,546 = $2.28 per ton
Transfer at Sydney at 1.14 cent per bushel.............. $0.42 " "

Sydney to Liverpool — 8,500 ton ship.

Time on voyage.............................. 19.90 days.
1¾ days in each terminal and ½ day coaling.. 4.00 "

Total time............................ 23.90 "

Coal consumed (coaling near Liverpool and Sydney):
9.95 days @ 35 tons........ 340 tons
2. days @ 5.5 " .... 11 "
Stores, 11.95 days @ 16 tons........ 191 "

Net cargo .... 8,500 tons—550 tons = 7,950 tons.
19.90 days on voyage @ $543............ = $10,806.
4.00 days in port @ $395.................. = 1,580.
Insurance — hull 23.90 @ $73........... = 1,745.
cargo 7,950 @ 0.18 cent......... = 1,430.
Pilotage.............................. = 75.
Total $15,636 ÷ 7,950 = $1.97 per ton
Transfer into warehouse at Liverpool @ 9/10 cents per bushel.. 0.33 " "

Total — May 1st, to August 31st,................ $5.00 " "
If Oct. 1st to Oct. 30th, then total..................... 5.12 " "
If Nov. 1st to Nov. 25th, then total.................. 5.23 " "

Table No. 28,—Statement showing insurance and pilotage rates — Various routes.

Ship	Canal Size Ship			Ocean Tramp			Lake Freighter		
Carrying capacity	2,400 tons			8,500 tons			12,000 tons		
Cost	$190,000.			$480,000.			$750,000.		
Operating season	230 days.			330 days.			230 days.		
	May 1 to Aug. 31	Oct. 1 to Oct. 30	Nov. 1 to Nov. 25	May 1 to Aug. 31	Oct. 1 to Oct. 30	Nov. 1 to Nov. 25	May 1 to Aug. 31	Oct. 1 to Oct. 30	Nov. 1 to Nov. 25
Fort William to Georgian Bay or Buffalo									
Hull insurance per year	5%	5%	5%				5%	5%	5%
Equivalent per day	$42.	$42.	$42.				$163.	$163.	$163.
Cargo insurance	0.30%	0.40%	0.50%				0.30%	0.40%	0.50%
Equivalent per ton at $50. per ton	$0.15	$0.20	$0.25				$0.15	$0.20	$0.25
Fort William to Prescott									
Hull insurance per year	6%	6%	6%				6%	6%	6%
Equivalent per day	$50.	$50.	$50.				$196.	$196.	$196.
Cargo insurance	0.44%	0.44%	0.52%				0.44%	0.44%	0.52%
Equivalent per ton at $50. per ton	$0.22	$0.22	$0.26				$0.22	$0.22	$0.26
Fort William to Montreal									
Hull insurance per year	7%	7%	7%				7%	7%	7%
Equivalent per day	$58.	$58.	$58.				$228.	$228.	$228.
Cargo insurance	0.60%	0.60%	0.70%				0.60%	0.60%	0.70%
Equivalent per ton at $50. per ton	$0.30	$0.30	$0.35				$0.30	$0.30	$0.35
Fort William to Quebec — Insurance on cargo = $0.10 per ton greater than to Montreal.									
Fort William to Sydney									
Hull insurance per year				7%	8%	8.5%	7%	7.5%	8%
Equivalent per day				$102.	$116.	$124.	$228.	$245.	$260.
Cargo insurance				0.80%	0.90%	1.00%	0.70%	0.80%	0.90%
Equivalent per ton at $50. per ton				$0.40	$0.45	$0.50	$0.35	$0.40	$0.45
Pilotage per return trip above gulf				$660.	$660.	$720.	$331.	$331.	$360.
Pilotage at Sydney				$75.	$75.	$75.	$75.	$75.	$75.
Montreal to Liverpool									
Hull insurance per year				7%	7.5%	8%			
Equivalent per day				$102.	$109.	$116.			
Cargo insurance				0.56%	0.70%	1.00%			
Equivalent per ton at $50. per ton				$0.28	$0.35	$0.50			
Pilotage per trip — Canadian end				$331.	$331.	$360.			
Sydney to Liverpool and *New York to Liverpool*									
Hull insurance per year				5%	5%	5%			
Equivalent per day				$73.	$73.	$73.			
Cargo insurance				0.36%	0.44%	0.50%			
Equivalent per ton at $50. per ton				$0.18	$0.22	$0.25			
Pilotage — New York				$200.	$200.	$200.			
Sydney				$75.	$75.	$75.			

Table No. 27,—Table showing cost of transporting grain Fort William to Liverpool via Buffalo and New York.

Assuming no return cargoes

Time:—

Fort William to Buffalo and return

2 lockages @ 0.8 hrs.................... = 1.60 hrs.
2 miles canal 200 ft. wide @ 5 m.p.h....... = 0.40 "
104 miles restricted and shoal water @ 9 m.p.h.......................... = 11.55 "
201 miles river @ 10 m.p.h............... = 20.10 "
1,419 miles lake @ 11 m.p.h.............. = 129.00 "

162.65 hrs. = 6.8 days
1¾ days in each terminal and ½ day coaling........... = 4.0 "

Total time.................................. 10.8 days

New York to Liverpool and return

7,142 miles @ 11 m.p.h.................. = 643.3 hrs. = 27.1 days
1¾ days in each terminal and ½ day coaling........... = 4.0 "

Total time.................................. 31.1 days

Cost:—

Fort William to Buffalo — 12,000 ton ship

Coal consumed...... 6.8 days @ 42 tons = 286 tons
4.0 " @ 6 " = 24 "
Stores.............10.8 " @ 5 " = 54 "

Net cargo...................12,000 tons — 364 tons = 11,636 tons.
6.8 days on voyage @ $791............ = $5,378.
4.0 days in port @ $611............ = 2,444.
Insurance — hull 10.8 days @ $163..... @ 1,760.
Insurance—cargo 11,636 tons @ $0.15.... = 1,747.

Total.......$11,329 ÷ 11,636............. = $0.97 per ton
Transfer at Buffalo @ 1.14 cents per bushel..........= 0.42 " "
Rail to New York 440 miles @ 0.54 cents per long mile= 2.37 " "
Transfer at New York @ $1.06 per bushel...........= 0.39 " "

New York to Liverpool 8,500 ton ship

Coal consumed......13.55 days @ 35 tons = 474 tons
2.0 " @ 5.5 " = 11 "
Stores.............18.55 " @ 16. " = 249 "

Net cargo...................8,500 tons — 734 tons = 7,766 tons.
27.1 days on voyage @ $543............ = $14,715.
4.0 days in port @ $395............ = 1,580.
Insurance — hull, 31.1 days @ $73....... = 2,270.
Insurance — cargo, 7,766 tons @ $0.18..... = 1,396.
Pilotage........... = 200.

Total...........$20,161 ÷ 7,766........ = $2.60 per ton
Liner rate = 70 per cent of $2.60.................. = 1.82 " "
Transfer into warehouse at Liverpool @ 9/10 cents per bushel................................ = 0.33 " "

Total May 1st to August 31st.....................$6.30 per ton
If Oct. 1st to Oct. 30th, then total.....................$6.38 " "
If Nov. 1st to Nov. 25th, then total.................... 6.45 " "

Table No. 29,—Table showing average production of wheat per capita in the United States for the ten year periods from 1870 to date.

Year	Population	Production Bushels	Production Per Capita Bushels
1870 (Av. 1862-72)	38,558,000	247,000,000	6.4
1880 (Av. 1876-84)	50,156,000	419,940,000	8.37
1890 (Av. 1886-96)	62,948,000	466,900,000	7.43
1900 (Av. 1896-1904)	75,994,000	591,000,000	7.78
1910 (Av. 1907-14)	91,972,000	702,500,000	7.65
1920 (Av. 1920-22)	105,710,000	836,674,000	7.82
1923		781,737,000	

Table No. 30,—Table showing average exports of wheat per capita of the United States for ten year periods from 1870 to date.

Year	Population	Exports Bushels	Exports Per Capita Bushels
1870 (Av. 1868-72)	38,558,000	44,073,000	1.14
1880 (Av. 1876-84)	50,156,000	124,600,000	2.48
1890 (Av. 1886-94)	62,948,000	139,400,000	2.22
1900 (Av. 1896-1904)	75,994,000	171,000,000	2.25
1910 (Av. 1907-14)	91,972,000	124,704,000	1.47
1920 (Av. 1920-22)	105,710,000	265,606,000	2.51

Table No. 31,—Table showing average production of wheat per capita in Canada for ten year periods from 1871 to date.

Year	Population	Production Bushels	Production Per Capita Bushels	
1871	3,689,000	16,724,000	4.54	
1881	4,324,810	32,350,000	7.48	
1891	4,833,239	42,223,000	8.75	
1901 (Av. 1900-01-02)	5,371,315	75,500,000	14.05	
1911 (Av. 1908-14)	7,206,640	181,770,000	25.00	
1921 (Av. 1920-21)	8,788,000	282,024,000	32.10	
1922	8,788,000	399,786,400	45.40	43.70
1923	8,788,000	470,328,000	53.60	

Table No. 32,—Table showing average net exports of wheat per capita of Canada for ten year periods from 1891 to date.

Year	Population	Exports Bushels	Exports Per Capita Bushels
1881 (Av. 1876-1885)	4,324,810	3,247,000	0.75
1891 (Av. 1886-1895)	4,833,239	5,637,000	1.17
1901 (Av. 1896-1905)	5,371,315	17,842,000	3.31
1911 (Av. 1906-1915)	7,206,640	73,858,000	10.30
1921 (Av. 1920-1921)	8,788,000	136,800,000	15.55
1922	8,900,000	Est. 251,020,486	28.22
1923 (11 months)	8,900,000	229,574,973	

Table No. 33,—Table showing average production of grain other than wheat per capita in Canada for ten year periods from 1871 to date.

Year	Population	Production Bushels	Production Per Capita Bushels
1871	3,689,000	72,705,000	19.67
1881	4,324,810	117,111,000	27.08
1891	4,833,239	133,323,000	27.55
1901 (1900-01-02)	5,371,315	172,226,000	32.06
1911 (1908-09-10-11-12-13-14)	7,206,640	417,825,000	58.10
1921 (1920 and 1921)	8,788,000	617,321,000	70.20
1922	8,900,000	656,425,000	73.80

Table No. 34,—Table showing average net exports of grain other than wheat and wheat flour per capita of Canada for ten year periods from 1881 to date.

Year	Population	Exports Bushels	Exports Per Capita Bushels
1881 (1876-1885)	4,324,810	10,757,000	2.48
1891 (1886-1895)	4,833,239	6,318,000	1.31
1901 (1896-1905)	5,371,315	7,757,000	1.41
1911 (1906-1914)	7,206,640	15,297,000	2.11
1921 (1920 and 1921)	8,788,000	28,659,000	3.26
1922	8,900,000	43,853,000	4.94

Table No. 35,—Table showing the average net exports from United States and Canada to other countries of corn, oats and other grain except wheat, and of flour and grain at various periods from 1876 to date.

Period	Average Net Total Corn, Oats and Other Grain Except Wheat	Average Net Total Grain and Flour
Average 1876 to 1885	74,207,000	202,110,000
" 1886 " 1895	63,502,000	208,535,000
" 1896 " 1900	235,364,000	428,353,000
" 1901 " 1905	110,560,000	295,481,000
" 1906 " 1910	88,710,000	258,951,000
" 1911 " 1915	102,329,000	349,212,000
" 1920 " 1921	142,172,000	544,782,000

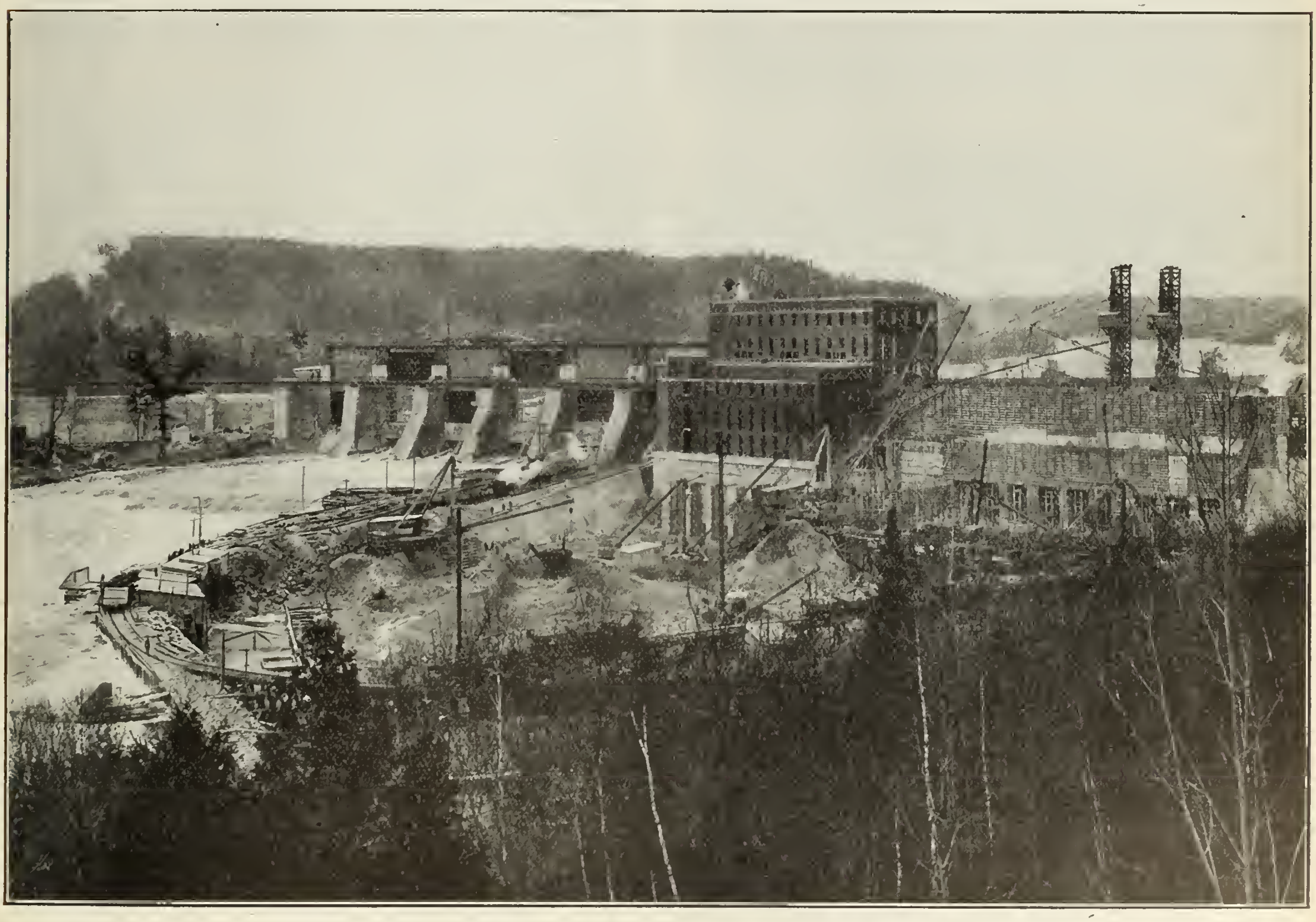
TABLE SHOWING RATES ON GRAIN PER 100 TON MILES BETWEEN VARIOUS PORTS
—— LONG TONS —— STATUTE MILES —— AMERICAN FUNDS ——

* Published by the International Institute of Agriculture.

Year	Month	Discount-Can. Funds	Montreal to Liverpool. (3189 Miles) *Shillings/ton.	*Cents/100 ton Miles.	New York to Liverpool. (3660 Miles) *Shillings/ton.	*Cents/100 ton Miles.	Northern Range to Liverpool (3907 Miles) *Shillings/ton.	*Cents/100 ton Miles.	Northern Range to Genoa (5001 Miles) *Shillings/ton.	*Cents/100 ton Miles.	Northern Range to Antwerp. (4250 Miles) *Shillings/ton.	*Cents/100 ton Miles.	New Orleans to Liverpool. (5396 Miles) *Shillings/ton.	*Cents/100 ton Miles.	Northern Pacific (Including Panama Canal Tolls about 0.75 cts per 100 ton miles) to United Kingdom. (9930 Miles) *Shillings/ton.	*Cents/100 ton Miles.
1922	Jan.	6%			16/8	9.5	19/	10.3	22/4	9.4	17/7	8.6	21/8	8.5	35/	7.4
	Feb.	4%			16/8	9.9	21/1	11.9	21/8	9.4	17/7	9.4	21/6	8.7	35/	7.7
	Mar.	3%			16/4	9.8	20/1	11.1	21/7	9.4	16/9	8.4	21/6	8.5	44/8	9.9
	Apr.	3%			8/5	5.1	17/10	9.9	18/10	8.3	14/11	7.4	18/3	7.4	45/	9.9
	May	1%	15/11	11.3	9/4	5.5	16/4	9.2	20/4	9.0	14/1	7.4	19/1	7.8	37/6	8.3
	June	1%	15/	10.6	9/1	5.3	13/1	7.4	19/5	8.7	14/1	7.4	18/7	7.5	37/	8.4
	July	1%	14/1	9.9	9/11	6.0	13/4	7.6	16/11	7.5	12/10	6.7	15/9	6.5	36/3	8.1
	Aug.	0	12/7	8.8	9/7	5.6	12/11	6.7	17/6	7.9	12/5	6.2	15/3	6.3	35/11	8.0
	Sept.	0	12/10	9.0	7/3	4.4	11/6	6.6	16/7	7.3	10/9	5.6	15/	6.2	33/3	7.5
	Oct.	0	14/4	10.0	8/2	4.9	13/4	7.5	16/3	7.2	13/7	7.1	14/	5.7	35/10	8.0
	Nov.	0	17/11	12.5	14/	8.6	13/4	7.6	18/3	8.2	13/11	7.3	18/3	7.6	37/6	8.4
	Dec.				15/6	9.6	16/4	9.4	21/	9.6					37/3	8.5
Average.			14/8	10.3	11/9	7.0	15/8	8.8	19/3	8.5	14/5	7.4	18/1	7.3	37/6	8.3
Absorbed Transfer Charges				.9		.8		.8		.6		7		.6		.3
				9.4		6.2		8.0		7.9		6.7		6.7		8.0

Year	Month	La Plata (down river) to United Kingdom. (6635 Miles) *Shillings/ton.	*Cents/100 ton Miles	La Plata (up river) to United Kingdom. (6877 Miles) *Shillings/ton.	*Cents/100 ton Miles	Karachi to United Kingdom. (7011 Miles) *Shillings/ton.	*Cents/100 ton Miles	Melbourne to Liverpool. (12764 Miles) *Shillings/ton.	*Cents/100 ton Miles.	Danube to Liverpool. (3990 Miles) *Shillings/ton.	*Cents/100 ton Miles.	Fort William to Buffalo. (863 Miles) Cents/bus.	Cents/100 ton Miles	Fort William to Port Colborne. (849 Miles) Cents/bus.	Cents/100 ton Miles.	Fort William to Georgian Bay. (541 Miles) Cents/bus.	Cents/100 ton Miles.
1922	Jan.	33/9	10.7	36/3	11.1	22/7	7.0	49/	8.1								
	Feb.	30/4	10.0	32/6	10.3	21/10	6.8	50/7	8.6								
	Mar.	25/7	8.5	28/1	9.0	24/1	7.5	50/4	8.7	21/6	11.8						
	Apr.	25/11	8.1	28/1	8.5	20/6	6.4	49/1	8.0	18/3	10.1	2.3	10.0	3.44	15.2	2.99	20.6
	May	26/10	9.1	29/8	9.7	18/4	5.8	44/7	7.9	16/6	9.2	2.2	9.4	3.02	13.3	2.43	16.9
	June	23/9	8.0	24/7	8.0	17/5	5.5	41/10	7.3	17/10	10.0	2.0	8.7	2.96	13.1	2.46	17.2
	July	20/3	6.8	22/	7.1	17/6	5.4	37/10	6.6	18/4	10.2	2.3	9.9	3.01	13.2	2.54	17.6
	Aug.	21/	7.1	22/4	7.2	19/	6.1	35/	6.1	17/6	9.9	2.7	11.9	3.33	14.7	2.85	19.8
	Sept.	19/6	6.5	20/7	6.6	19/6	6.2	35/	6.1	18/2	10.0	2.8	12.3	3.72	16.4	3.00	20.8
	Oct.	23/7	7.9	25/7	8.3	23/2	7.4	42/10	7.6	22/	12.2	4.5	19.3	4.29	18.9	3.88	26.8
	Nov.	25/3	8.5	27/7	9.0	27/3	8.7	46/7	8.2	21/5	12.0	4.9	20.9	4.71	20.7	5.65	39.2
	Dec.	26/1	8.9	28/	9.2	27/1	8.8	45/	8.0	21/	12.4	5.9	25.4	5.74	25.2	6.25	43.4
Average.		25/2	8.3	27/1	8.6	21/6	6.8	44/	7.6	19/3	10.8	4.19	14.2	3.81	16.7	4.13	24.7
Absorbed Transfer Charges			.5		.4	Average-Apr. to Sept.	.4		.2		.8	2.4	10.4	3.25	14.3	2.71	18.8
			7.8		8.2		6.4		7.4		10.0		1.9		1.9		3.0
													8.5		12.4		15.8

Table No. 36,—Table showing Rates on Grain per 100 Ton Miles between various Ports.



General View La Gabelle Development, December 1923.

Discussion on the St. Lawrence River Problem

Discussion by Professor Howard T. Barnes, D.Sc., F.R.S.

Mr. President and Members of *The Engineering Institute*, — It is an exceedingly great pleasure to be here to-day and to have listened to Mr. McLachlan's paper. I shall be as brief as possible, but I wish to mention just a few points that have occurred to me in this connection.

First I want to congratulate my old student, Mr. McLachlan, on the exceedingly able investigation that he has carried out and the pains he has taken in his method of presentation. The clearness with which the subject was presented has been quite a revelation to me, although I would have anticipated it. I have always followed Mr. McLachlan's career with a great deal of pleasure, and have also been very much interested in his taking up the study of ice, which to me is the most absorbing subject that one could study.

Greater use of Remedical Measures of Ice Prevention

There are just three or four points that I would like to touch upon in connection with this presentation. In the first place, I am not at all deeply impressed by pictures of ice packs and measurements of the depths of frazil under the surface ice; they do not convey very much to me except as an example of how an unbalanced force of nature gets away with us if we let it go. Now, an example of that is a smoker in the woods who throws away his match without first breaking off the end to make sure that it is not glowing, starts a conflagration and burns up many square miles of valuable forest. When we realize that very minute changes of temperature in the water are responsible for the first production of those minute crystals that ultimately form big dams and in some cases produce tremendously devastating effects,— rivers have been known to be turned entirely out of their courses by these ice dams and ice jams, — when we realize that intelligence and education and remedial measures in the matter of ice prevention can be utilized to a much greater extent than many people can fully appreciate, why, then we will see that such things ought not to be allowed. It is a fact that ice breakers are doing splendid work down in the lower reaches of the river in preventing spring floods which have the effect of devastating farms and farm property; there is no doubt that measures of that kind are exceedingly important and exceedingly effective.

Ice Dams under Surface Ice

I want to say just a word about the pictures Mr. McLachlan showed of the ice dams under the surface ice, indicating that there is a certain relation between that under surface and the bed of the river. I have studied this phase of the subject quite a little, chiefly through diagrams and charts which I received through the courtesy of an engineer on the Neva, near Petrograd, where a great many of these diagrams have been obtained. It has been shown there that the under surface of the frazil dams more or less conform to the bed of the river. That is to say, they are apt to take up a position which is sometimes a reflection, sometimes otherwise, of the contour of the bed of the river; and that it is not due to internal heat, as Mr. McLachlan suggests, but mostly to temperature effects in the water occasioned by springs or tributaries, and by the contour of the river bed. I am sorry I did not know that Mr. McLachlan was making these observations, because I would like to have put a sensitive thermometer down there and actually observed the temperatures through the holes which were made for the purposes of the measurements. It would have been easy to get accurate measurements of those temperatures, and you would undoubtedly have found that minute changes of temperature in the water would bear a very direct relationship to the contour of the under surfaces of those dams, even a variation of one five-hundredth of a degree above the freezing point producing an effect in connection with the formation of air holes. Where you have that temperature your water would never freeze; and I have a great deal of information, which I cannot go into here, in relation to the temperature of the water and the thickness of the ice masses.

All Interests must be Considered

Now, there is a trinity of interests in the St. Lawrence which is very important and which should be seen to at once. First of all is the safeguarding of navigation to Montreal. The levels of the river are lower than they have been for fifty years. No doubt many causes are contributing to that; some of them can be controlled, others cannot. That is very important. Coupled with that is the problem of extending the period of navigation into the winter months. That is a thing I am much interested in, and it will prove to be a problem capable of muchmore ready solution than we imagine· The second interest is the problem of the deep waterways to the Great Lakes, and the next is the development of power on the St. Lawrence. All these will have to be considered together; in my opinion you cannot consider one without considering the others. We must study the whole St. Lawrence river, which is the most wonderful river in the world and our greatest heritage. When that is done all these problems will be found much more capable of solution than we imagine.

That is about all I feel I have time to mention. I should like to give the reasons why I hold these opinions about the river, but I must reserve that for another occasion.

Discussion by H. G. Acres, M.E.I.C.

Mr. President and Gentlemen, — I think it is not necessary for me to implement the remarks that have been made by the previous speakers in regard to the impressiveness and scope of Mr. McLachlan's presentation of his subject. Mr. McLachlan and I are old friends, and no lengthy expression of appreciation is called for on my part. I only regret that he did not have a proper opportunity this morning to enlarge upon it as he probably would wish to have done; and I am sure that all the rest of us would have been glad had he been able to do so. Furthermore, I do not think that in the short interval between now and the time when nature's demands must be met we shall have an opportunity of discussing the subject as fully as its importance demands, or as the manner of its presentation would merit.

Ice Trouble is Related to Power Development

The point upon which Mr. McLachlan laid the most emphasis, I think, was the question of ice trouble, and inasmuch as ice trouble is essentially a factor related to power development and not to navigation, his presentation of the subject under that head must of course be looked upon as a discussion of one particular phase of the problem which, in the final analysis, is of primary concern only to the combined interests, on both sides of the boundary, which must assume the responsibility and risks of power development, rather than to the purely governmental interests which will be responsible for the provision and maintenance of navigation facilities.

Taking up what I can remember, offhand, of what Mr. McLachlan mentioned, and what he showed us, possibly the most interesting part of his discussion was that in connection with his diagrams of frazil formation. I think possibly there is one factor bearing upon the formation of the ribbons of clear water under the hanging dam that he has not taken into consideration, and that is that beyond the purely fortuitous factors of velocity and transportivity in various portions of the river section, and the disturbance of current filaments due to changes in direction of flow, both vertical and horizontal, there is another factor that influences the formation and limitation of these hanging dams, particularly with regard to that peculiar manifestation he mentioned of the hanging dams dropping down suddenly in points throughout the bed of the stream, and then suddenly receding. Apart from the uncertain distribution of current filaments I think that the reason for these sudden excrescences, and their disappearance, is largely due to the fact that they project into the lower strata where water of maximum density tends to lodge, and which therefore naturally has a temperature above freezing point. The water at the bed of the stream has a temperature of about seven degrees above freezing point, and that variation between freezing point and naturally controlled water temperature decreases as the various strata of water superimposed on each other come up toward the surface. So I think that the variation in the contours of these hanging dams is due to the fact that they cannot exist below a certain critical depth, because the water at and below that depth must always be above freezing point, and the loosely composed particles of frazil and anchor ice, when they project into this zone, disappear simply through the agency of melting and erosion.

Ice Problems of St. Lawrence and Niagara Compared

It might be interesting to compare in a general way the ice problem on the St. Lawrence with that on the Niagara river. We have had to-day and yesterday probably the worst ice conditions which have existed on the Niagara river since April, 1909. The river yesterday was full practically from Fort Erie to Niagara-on-the-Lake, and below the falls was heaving up in mounds as high as fifteen feet above the natural water level. This condition is more intense and more fraught with danger than any condition that can possibly occur on the St. Lawrence, either under natural conditions, or under any which may arise from the improvement of the river by virtue of any scheme now proposed. The reason for this abnormal condition is found in the fact that the open water of lake Erie extends absolutely unbroken to the point where the plane of lake Erie intersects the plane of the Niagara river, so that following a period of cold, freezing weather, the strong winds on lake Erie break up the ice, which flows unobstructed into the funnel mouth at Fort Erie, and the Niagara river must thereafter take everything that lake Erie drives out in the way of ice. The Niagara river is simply the small end of a funnel through which the broken ice from lake Erie passes as best it can, and under conditions which are largely beyond human control.

The relationship along similar lines which exists between lake Ontario and the St. Lawrence river is very radically different. We have at the head of the St. Lawrence river a great area of land-locked, sinuous channels extending from Wolfe island nearly down to Prescott. In that area, where the climate has more of the characteristics of a northern winter, as compared with the more or less temperate climatic conditions in the region of lake Erie, the ice takes in the early part of the winter and usually holds and thickens until the spring breakup. Any ice formed in the open reaches of lake Ontario which may be subsequently broken up by wind simply, you might say, leans up against this solid ice barrier, and the effective discharge section at the entrance of this ice barrier is so enormous, and the velocity therefore so inappreciable, that the suction impulse of velocity cannot overcome the floating impulse of the loose slush and ice, and that it simply bobs up and down in open water, and none of it passes under the ice sheet or into the St. Lawrence river. The result is that during the spring breakup this loosely composed material disappears first, and as the heavy ice sheet locked between the shores of the Thousand Islands also rots in place, neither of these conditions is a factor of the ice problem in the river below Prescott.

We have therefore one condition which is a governing and vital condition at Niagara, but which is comparatively an unimportant factor as applied to the ice problem in the St. Lawrence river. That problem, as Mr. McLachlan has now discussed it, exists in the reach of the river from Prescott to lake St. Francis, as far as concerns the interests of the province of Ontario. We have in that stretch of river certain phenomena which occur every winter in accordance with certain immutable laws of nature. The problems that nature has to handle in that reach of the river are as follows, — of course, I am referring to the winter season. First, there is the formation of a generally stationary ice sheet over such portions of the river as fortuitous combinations of velocity, temperature and wind will permit, and, next to that, the formation and the disposal of frazil which forms, to a preponderating extent at least, in the more turbulent sections of the river at the Galops, Rapide du Plat, and the Long Sault. Then, after that, there is the formation and disposal of anchor ice which forms in the shallow sections of these same three turbulent portions of the river. In disposing of this material, nature's remedy is simply to vary the gradient so as to build up a velocity head sufficient to transport it, and the problem which confronts the engineer who has to consider the question of utilizing the river for power purposes, under winter conditions, is to devise such means as will conform to the natural laws of ice formation and disposal, while at the same time varying and adjusting the natural gradients in such a way as to efficiently reclaim the potential energy of the river. If the structures necessary to produce this potential energy are such as to unduly conflict with the natural process which nature will insist upon, in controlling the regimen of the river in the winter season, any plant for power development will be a failure. If the expedients adopted to develop power are so proportioned and so designed as to assist in the natural process of controlling the winter regimen, the objective of utilizing the potential power of the river will be attained. In other words, the measure of success will be the extent to which human expedients harmonize with natural requirements. I do not think anyone would be so reckless or so presumptuous as to say that human expedient can wholly, at certain times, compensate for or offset the natural process which controls the St. Lawrence river in its natural state. In other words, there must be some compromise between nature and human ingenuity, and the point at issue is simply this: which of the various schemes proposed for the development of power in the St. Lawrence river is most efficient from the standpoint of the attainment of a maximum degree of harmony in this respect.

Some of Mr. McLachlan's slides, as I remember, showed actually measured winter gradients of the river, which he rightly claimed to have considerable value. Without going into a discussion of just what those records mean and how they may be interpreted, I might say that they are undoubtedly interesting as records, but as a basis of deduction as to what might happen or what might be expected, under the ultimate improved condition of the St. Lawrence river, they are more or less open to question, due to the fact that the river gradients are going to be locally changed through artificial agencies.

Single and Double Stage Developments Compared

Mr. McLachlan showed a very interesting diagram purporting to be a comparison between the single stage and the two stage developments from the standpoint of the handling of frazil, in which he endeavoured to prove that the double stage development would require such an extensive sub-sheet ice volume, for the storage of floating ice from the upper river, that a very material loss in head would result at Morrisburg on account of the back water. Mr. McLachlan's argument on this point appeared to me to be premised on the assumption that the formation of frazil in the river above the regulating dam at Ogden island was a function of the length of open channel only. My own view is that the formation of the frazil in that section of the river is almost entirely a function of area, and consequently of velocity, and therefore of turbulence.

This brings us to the point of considering what are the expedients by which nature obviates trouble arising from the various forms of ice which are created in the winter season on a river like the St. Lawrence. We get the sheet ice, and we get frazil, the formation of which is a function of temperature or weather, and a certain condition of water surface. We have anchor ice, which is a function alone of temperature and depth of channel. Nature's means of handling this problem are two, and two only: first, to prevent altogether the formation of two of those classes of ice by a more universal formation of the other class, which simply means that if you have an almost entirely quiescent pool for the formation of a permanent ice cover, you practically obviate altogether the formation of the other two classes of ice. Failing the consummation of this expedient, the other natural remedy is simply to keep the ice which does form in motion, in an open channel. To my mind this means, as regards the various proposed methods of developing power on the St. Lawrence river, that you must do one of two things. Either you must go to the Long Sault and build a dam of sufficient dimensions and height to ensure the formation of a practically quiescent pool from the Long Sault to lake Ontario; or, failing the application of this primary remedy, from considerations of physical feasibility, or expediency, or whatever reasons may have weight in the consideration of the problem, we are forced to the other alternative of keeping the ice which forms moving in an open channel. That brings us to a consideration of the double stage scheme.

In this scheme we have at Morrisburg a structure which is designed to regulate the levels of lake Ontario, and under all ordinary conditions to maintain moving water in an open channel from the point at which the open water usually begins in the St. Lawrence river under natural conditions; that is, the assumption of a solid ice sheet from the lake Ontario entrance to somewhere in the neighbourhood of Prescott, and from there on a channel of which the medial thread will at all times be open water. One of the incidental factors promoting this condition is the fact of the necessary improvement of the channel at the Galops by the excavation of a 600-foot ship channel, which will greatly improve the velocity contours at that point, and create mid-section velocities sufficiently high to maintain open water under severe winter conditions.

Briefly the effect of the improvement of the river as far as Prescott will be this: You will remove altogether the anchor ice hazard which now exists by reason of the shallow turbulent channels in the Galops and the Rapide du Plat. You will eliminate, to a very great extent at least, the formation of frazil by reason of the removal of turbulence in these two sections of the river, reducing that hazard practically to conditions which will arise at critical temperatures through the disturbance of an otherwise smooth water surface by wind, which is an almost negligible factor at the present time, as compared with the frazil forming capacity of the turbulent water of the Rapide du Plat and the Galops.

We now come down to the regulating works for the power construction itself at Morrisburg. In the sluices at this point we have unavoidable sources of turbulence which may at times lead to the formation of frazil at critical temperatures. In the case of a purely regulating dam at Ogdensburg the frazil forming agency of the turbulence of sluice discharge cannot be prevented by any reasonable or cheap means. With a power house located at Ogden island, in connection with the regulating sluices, this factor in the situation can however be very largely eliminated simply by the fact that under the majority of conditions we shall have sufficient turbine gate-opening capacity in the power house to pass the bulk of the winter flow of the St. Lawrence river, which simply means we will get a temperature change in the passing of the water through the power house such that by the time it reaches the tailrace its critical temperature will have disappeared and the tailrace turbulence will not be an agency for the forming of frazil. This will be the case within a very short time after power would be developed at Morrisburg. I say this because I know it to be a fact that the full capacity at Morrisburg will be developed within a very short time after the plant is put in operation. Such being the case, we will have largely eliminated all the factors which to-day make the ice conditions, between Prescott and Morrisburg, a subject of so much controversy.

Now, with regard to that portion of the waterway between Morrisburg and the Long Sault: I think it will be admitted that the factor which has in the past been mainly responsible for the jams building up stream from Croil island is the large quantity of frazil and anchor ice which is carried down from the present points of generation at the Rapide du Plat and the Galops. With these points of generation blotted out, the main cause of the jams above Croil island will be largely eliminated. These jams have occurred about five times, I think, in the last fifty years; it is reasonably certain that the periodicity of their occurrence would be so extended by the improvement of the river as to reduce these jams to the class of a very ordinary hydraulic hazard, and one which is immeasurably less severe than the existing conditions at Niagara, which can never be obviated to any very appreciable extent.

In discussing his alternative proposition for the recovery of the lost winter head, for seasonal use, Mr. McLachlan made a rather slighting reference to the value of secondary power. I shall not enlarge on that myself, because Mr. Gaby is far more competent than I am to give this meeting some idea of what secondary power is worth to-day, and to do so, furthermore, without the necessity of basing conclusions upon any conjectural value it may have forty years hence. All I may say is that the older standards of water power appraisal are a thing of the past in Ontario, and that so far as the St. Lawrence is concerned its value to Ontario and its value to the United States must be reckoned on one basis and one basis only, and that is kilowatt hours per annum.

Cost of making Seasonal Power available

Mr. McLachlan also mentioned that it would cost $600. per horse power to make that seasonal power available. I think our estimates show that under a national scheme of development at Morrisburg it would cost about $130. or something less. Of course I am not in a position to discuss the unit prices which Mr. McLachlan showed us, because they were not on the screen long enough for anybody to comprehend them. But if they are appreciably lower than the Wooten-Bowden estimates, or the figures on which the Wooten-Bowden estimates were originally based, I think that probably the other alternative schemes will benefit to just as great a degree as the estimates in the Wooten-Bowden report. I do not think I can profitably enlarge on this phase of the situation. As I have said I could only skim the surface of this subject with the preparation I had.

I may add, that from a purely hydraulic standpoint it is undoubtedly true that what you might call the *full* single stage development, not the seventy-foot head proposition, but the development of full physically possible head at the Long Sault, is the ideal hydraulic solution. It would, however, require a volume of elaboration to prove the point that I am simply going to mention: that, while the comprehensive single stage scheme may be the ideal hydraulic solution, it is not feasible from the more pressing viewpoint of economy and expediency, and also from the viewpoint of certain circumstances and conditions of long standing which exist on the north shore of the St. Lawrence river in connection with land damages.

Land Damages

In passing, I may say I cannot quite understand Mr. McLachlan's illusion to the fact that the estimate of 29,000 acres of damage for the *full* single stage development was false; I do not know whether that was the exact way he put it, but that was his inference; when a few minutes after saying that he threw on the screen General Beach's estimates of that same scheme showing a land damage amounting to nearly 25,000 acres. The small discrepancy between the two estimates is possibly due to the fact that General Beach's estimate was a measurement taken within the net flooded contours. In figuring land damages we always make it a rule to figure a margin of at least three feet above the net flooded contour to allow for severence and seepage. I think possibly this might account for the discrepancy of 5,000 acres between General Beach's estimate and the estimate we made for the damages under the full single stage scheme.

Under Mr. McLachlan's amended proposition for a possible future development for seasonal power at Morrisburg, it is of course evident that he proposes to saddle his scheme with three separate and distinct power developments, with all the operating and other hazards which a multiplicity of developments involve. On the other hand, the originally proposed double stage scheme involves only the operation of two plants of substantially similar characteristics.

The only other matter I might mention is Mr. McLachlan's rather amusing reference to the Taylor inverted turbine. I may say that at Queenston the ordinary type of reaction turbines are so designed and installed that they can amble along quite comfortably under a possible 60-foot rise in tailwater, or a water level six feet above the main power house floor. Yesterday we were making preparations for just such a contingency, and they may be operating with the water up to the window sills of the power-house at this minute, because if there was a change of wind yesterday to an easterly direction up lake Ontario, there might by this time be fifty feet of ice building up from the mouth of the river. If by any chance such a thing has happened I am quite sure that they are still getting power in Toronto, in spite of the fact that they have not got Taylor inverted turbines in operation at Queenston.

Mr. McLachlan: Mr. Acres holds that the formation of frazil is dependent upon area and turbulence. I am not sure what "area" means. Does he mean cross-sectional area, vertical area or exposed area?

Mr. Acres: Cross-section, as related to velocity and turbulence.

Mr. McLachlan: Mr. Acres argues that the formation of frazil on the St. Lawrence is dependent upon the rapids. He means that the rapids form frazil in that river, that is, that the roughness of the surface, intermixing with the air, I suppose, cools the water off. That would be splendid if proof was not at hand that that is not the case. If you went down the St. Lawrence two weeks ago and measured the temperature of the water at Ogdensburg and at the Galops rapids and determined the drop in temperature between the head of the Galops rapids and say the foot of the rapids opposite Cornwall, you would find a drop of one and a quarter degrees.

Mr. Murphy: From what figure?

Mr. McLachlan: As winter gets on the temperature of the water, of course, is continually dropping. The water in that distance dropped that number of degrees, whereas crossing lake St. Francis it dropped six degrees. Now, if you take the superficial area of the two expanses you find that the drop is almost proportionate to the superficial area; that apparently the rapids have nothing to do with it. And so far as I can see, that is the case. Why should the rapids have anything to do with it? There are only two places on the St. Lawrence between the Galops rapids and lake St. Francis where the water breaks. It breaks to a slight extent in Galops rapids, but those rapids are fourteen feet deep and the breaks are mostly standing waves, quite unlike the wave you get with a wind on a lake; the air and the spray do not mix in the same way. At Long Sault there is practically no break; it is pretty rough all right, but the water does not break and fly into the air to any considerable extent. From the best information we can gather, based on temperatures taken at different times and on other investigations, the formation of frazil depends entirely on the extent of superficial area exposed to the air. Of course I will not say that to a certainty because I do not know the entire workings of the Almighty, but so far as anybody can assemble data and information it depends on superficial area and that almost directly.

With regard to the 29,000 acres of land flooded, the statement has been made over and over again that the Wooten-Bowden project flooded 29,000 acres. It has been made in the engineering papers; representatives of municipalities have come here and made the statement in Ottawa; it has been made hundreds of times. I think I can prove that without any difficulty. I am sure that is the meaning of the statement that has been made; perhaps it has not been made by Mr. Acres in so many words, but that is what the engineers throughout the country generally would be led to believe by the things they read.

With regard to that $600., which I say they will have to spend for secondary power when they develop it forty years from now, $7. forty years from now is only worth one dollar now; divide $600 by seven and you get $90., and that gives the present value of the expenditure you have to make forty years hence. Candidly I think it is a very fortunate thing that we can unload on posterity this expenditure of 60 or 65 million dollars for future development at Morrisburg, and it is very fortunate that we can leave it off for forty years. It is a wonderful thing that we can develop 71 feet at Long Sault at such a low rate, $60,000,000 for 800,000 horse power of twenty-four hour power, — that is what it is, approximately. I cannot speak within very close limits, but that is about what it is. Even if posterity does have to spend $600. per horse power, what a fortunate thing it is that we can get outs at the present time for something like, — is it $75. per horse power? The advantage can readily be seen.

Discussion by Frederick A. Gaby, M.E.I.C.

Mr. Acres has dealt with the ice conditions on the international section of the St. Lawrence river, and referred to the investigations of the Hydro-Electric Power Commission on the proposed development for power purposes of this section, and has also referred to the two stage development which is recommended by the commission. He pointed out that from our information and our study of that river, we expected by the maintaining of an open channel on these developments to overcome the ice difficulties, and by the improvement of the river sections, with its resultant lower velocities and straightening out of the channels, to eliminate to a greater extent than at present the generation of frazil. Mr. McLachlan's interesting discussion on ice formation has been based upon the conditions at present existing in the river, but improvements of the channel and reduction of velocities will result in different conditions from those obtaining to-day and it is expected that the results anticipated will not occur.

I quite agree with Mr. McLachlan on the basis of the information available, that superficial area and the agitation of the surface of the water has a great deal to do with the generation of frazil under certain conditions of temperature. We have an illustration of that pretty nearly every year at the Decew Falls plant of the Dominion Power and Transmission Company, where frazil has developed by agitation under certain weather and temperature conditions, resulting in serious interference with the operations of the plant. From our investigations we believe that a narrow channel can be maintained which will enable us to expose as far as surface agitation is concerned, a small area for the development of frazil, and the velocity having been reduced and sectional agitation to a large extent reduced the generation of frazil will be to a large extent eliminated. I was very much interested in the remarks of Dr. Barnes, who has made a very thorough investigation of the ice conditions on the St. Lawrence, when he stated that no matter what might be determined upon as the most economical development for power purposes in this river, he was confident that a solution could be found for the ice difficulties. That is the view of the engineers of the Commission after a most thorough study of the subject extending over at least ten years, and with information for a great many years before that time.

The economics of the problem is one in which the engineering profession is very much interested so far as the development of the St. Lawrence for power purposes is concerned. As engineers of the Hydro-Electric Power Commission, which serves some 380 municipalities, and is delivering at the present time upwards of 720,000 horse power in Ontario, we are very much interested in the economics of the problem as to power development, not disregarding the importance of navigation, and the necessity of adequately providing for same, and we believe the maximum development possible should be obtained in the interests of the public.

Three Schemes of Development

The commission has submitted report to the International Joint Commission on three schemes of development in the international section of the St. Lawrence river.

(1) A single stage development providing for development at the Long Sault at the maximum possible head, which will give an increased quantity of power over that proposed by Mr. McLachlan.

(2) A two stage development at Chrysler's Island and Barnhart Island.

(3) A two stage development located at Morrisburg and Barnhart Island.

The present impending shortage of power and the public interest would require us to consider a two stage development which gives a maximum output and the least damage to other interests.

It will be agreed as far as summer conditions are concerned that the most economical development of water powers in the international section of the St. Lawrence river can be obtained through the medium of a two stage development, which will give at least 100,000 horse power more than the proposed single stage development, due to the more efficient utilization of the head that is available on the international section of the river.

It has also been estimated that with the two stage development power can be made available three years earlier than with a single stage development. This is of vast importance at the present moment, in view of the impending shortage of power within the next three years.

Any difficulties encountered in the maintaining of these maximum heads for power purposes in winter as well as in summer will be more or less of a minor character, and by proper methods same can be overcome.

Mention has been made of the formation of an ice dam on Croil island by accumulation of frazil and anchor ice. My information is that this serious flooding and back water condition has only obtained in this section five times in fifty years; therefore, in the interests of the public with such a remote possibility of continued shortage, the maximum development should be undertaken from the economic point of view.

Market for Power

There is a market at the present time in Ontario for 720,000 horse power. In 1926 there will be a market for 1,150,000 horse power, and with all the hydro-electric developments operated to full capacity there will be available to meet this market from 900,000 to 1,000,000 horse power, with a resultant shortage of hydro-electric horse power to the extent of 150,000.

The commission's loads at the present time increase at the rate of from 90,000 to 100,000 horse power per annum, and it is estimated that the market with normal expansion will be by 1934, in the neighbourhood of 2,650,000 horse power. Even if authority were given at once it would not be possible or safe to estimate on the completion of the Morrisburg development before the fall of 1926. In order to provide the 150,000 horse power necessary to meet the demands, it will be necessary to look for some other form of energy such as steam, or other motive power, fuels, oil, etc.

Each succeeding year an additional 100,000 horse power will be required to meet the ever increasing demands of the market. It has been estimated that it will take from four to five years from the commencement of operations to complete the development at Morrisburg, which means that an additional source of power of approximately 300,000 to 350,000 horse power will be required to supply the market before this development will be ready for operation.

Canada's share of the Morrisburg development will be in the neighbourhood of 300,000 horse power which will be barely sufficient to meet the increased market demands during the period of its construction. In the meantime it will be necessary to provide this 300,000 horse power by means of steam plants, which will require a capital expenditure of approximately $30,000,000., and in each succeeding year, until the hydro-electrical developments are made available, an additional $10,000,000., or $12,000,000., of capital expenditures on steam plants will be necessary in order to augment the available power supply, until the St. Lawrence development is made available, which as far as Ontario is concerned, is the most economical hydro-electrical development.

The greater part of the above mentioned power is required in the western parts of the province and by the development of the St. Lawrence it will be possible to meet this demand by the building of transmission lines through the intervening territories, thus these intervening sections of Ontario in the vicinity of Morrisburg in the Central Ontario System district, on account of the construction of this trunk line can obtain power at a cost which will enable them to supply their customers without any material increase in rates. Any other solution of the problem of generating power to meet the demands in this district means a very great increase in rates and is not economically feasible.

By 1928 I have stated that a capital expenditure of $30,000,000. will be invested in steam plants, but a more serious aspect of the situation is that the development of power by steam at the load factors obtaining in Ontario will cost from $12,000,000. to $15,000,000., per annum more than the cost of power generated at the hydro-electric development on the St. Lawrence, so by 1930 the extra cost of supplying 300,000 horse power by steam over the cost of developing hydro-electrically generated power at Morrisburg or the Long Sault, will have reached the enormous sum of from $36,000,000., to $45,000,000., or sufficient money to have completed the development at Morrisburg, in addition to which we have a capital expenditure of $30,000,000., in each succeeding year for the development of 300,000 horse power by steam; the increased cost to the community will therefore be from $12,000,000., to $15,000,000., per annum until the hydro-electric developments are made available, and capital expenditures will likewise increase from $10,000,000., to $15,000,000., per annum.

Cost of Developing Seasonal Power

Mr. McLachlan has stated that forty years from now the investment of an additional $3,000,000., would make it possible to get seasonal power as far as Morrisburg is concerned. The conditions at the present time are such as would now warrant the expenditure of this money, and from what I have already said it shows the enormous advantage to Ontario even to obtain seasonal power as every unit of energy that can be generated hydro-electrically will mean a saving. Even in an unfavourable year, if the output of this plant is reduced to 75 per cent of capacity, it will mean from $12,000,000., to $17,000,000., saving per annum on our operating costs. We can, however, even at least do as our European friends are doing, maintain a channel in the St. Lawrence between Morrisburg and Barnhart island, which will eliminate the formation of the ice bridge, which is the cause of the extreme backwater that has been mentioned by Mr. McLachlan. Therefore, with the very small investment that Mr. McLachlan refers to, and if we only get 75 per cent of the capacity, there would be a saving of over $7,000,000., per annum over the cost of generation of steam, which would be more than twice the additional cost of developing at Morrisburg in the first year of operation.

Auxiliary plants being available can readily take care of the shortage periods during which there may be a diminution in the supply from the Morrisburg development. In other words, gentlemen, hydro-electric plants will be used as basic plants operating at as nearly 100 per cent load factor as possible, the fluctuations being taken by steam plants.

From the present progress of the demand for power it is estimated that by 1930 the whole amount of power available to the province of Ontario from the St. Lawrence development both at Barnhart island and the Long Sault development would be entirely utilized by the market, so that Mr. McLachlan need have no fear as to the marketing of this power in Ontario.

In my opinion the proper plan of development and the best one from the economic point of view is to develop the water powers in the St. Lawrence river to the maximum possible available heads, as suggested in the latter remarks of Mr. McLachlan.

As Mr. Acres pointed out the 20,000 acres that was referred to was an estimate of the damaged land including those areas, which in all probability will be flooded and soured by the seepage or by the water within three feet of the surface. In estimating the damaged lands we have taken into consideration this soured condition of farm lands, because land which has water three feet from the surface is not a very good farming proposition and is very difficult of drainage.

Mr. McLachlan's presentation of this subject has been very voluminous; a very great amount of information has been presented in a very short space of time, and I would like to have an opportunity of going into the details of his report, and of presenting a written answer or a written discussion of it. We feel confident that the generation of frazil will be, with the improved conditions of the river, only a fraction of the amount estimated by the elimination of the turbulence of the areas of the stream at the Galops and at the Rapide du Plat. We have arrived at this conclusion of being able to maintain an open channel and thus eliminate the extreme backwater conditions anticipated by Mr. McLachlan, by a thorough investigation of ice conditions, which investigations have been carried on by the commission during the last ten years.

Mr. McLachlan: There is only one point that Mr. Gaby has made to which I desire to refer, that is, he thinks that by improving the river so as to bring the level of the lake down to the level of his power station at Morrisburg, he will have a narrower open channel in the river exposed to air in the future. Well, the reverse is the case. The widening of these points, the smoothing out of the velocity and the making of it more uniform will mean a much wider belt of open water existing in the future than in the past and consequently a greater amount of frazil. His whole hypothesis is based on an incorrect deduction in the first instance.

Mr. Gaby: I believe that in your remarks on the section above Morrisburg you stated that it would be quite possible under certain conditions to obtain an ice cover there. Now, if you can obtain an ice cover on this section it would be quite easy to maintain a small channel in the ice cover, and we could probably get in the proposition we have submitted an ice cover as easily as you could in the one you suggest.

Mr. McLachlan: Quite right. You can get an ice cover, but you will have to cut down your discharge out of lake Ontario. I do not think you could discharge more than 170,000 feet a second under an ice cover. You could produce an ice cover there but you would reduce your quantity of water available for power; you would cause lake Ontario to raise and perhaps get into difficulties in the spring. I think it is better to leave open water above the Ogden Island dam on account of the interests involved around lake Ontario and those below Montreal, in lake St. Francis and at other points. The idea of allowing your ice cover to form and then cutting a channel by means of saws, or something like that, so as to make it narrow, is, I suppose, physically conceivable, but I would think it is practically absurd.

Mr. Gaby: I quite appreciate that, but I was simply taking your own argument in connection with it.

Mr. Acres: There seems to be some misapprehension as to what I said about frazil. I think in the course of my rambling remarks I said something about wind being an agency for forming frazil, and when I said that, of course I meant that a certain amount of open water area was involved. What I did say was, I thought that the main agency for forming frazil in that particular river was the rapids, and I still think so. Of course while there is open water there and while there is wind there is certainly going to be a certain amount of frazil formed, but I really think that is not going to be a preponderating issue as it is at the present time, due to constant and uninterrupted formation of anchor ice and frazil in the rapids as against the intermittent formation of frazil alone in wind-ruffled stretches of water.

So far as the 29,000 acres is concerned, that simply arose from the fact that I thought the Wooten-Bowden report mentioned that the substructure of the works at Barnhart island was designed to accommodate, I think it was, an ultimate ten feet rise in head, and our report on the single stage development plainly says that that 29,000 acres of estimated land damages applied to the projected rise of the initial head at Barnhart island. What the newspapers said about it or what anybody else said about it, of course, cannot be helped. The true statement is a matter of record in the two reports I have mentioned.

Mr. Forward: I was struck with the remarks Mr. McLachlan made just a moment ago in regard to a wider channel being created when you slow up the current.

Mr. McLachlan: When you cut off the points.

Mr. Forward: If we are going to slow the current we are going to reduce the speed of the water very greatly; should we not get an ice cover with less trouble then? And in that case if there was a difficulty in getting an ice cover it occurs to me it might be obtained by pushing out bays at various points.

Mr. McLachlan: We have kept every winter for about a dozen winters a plan showing the areas of ice cover, how far out the bays extended, roughly, the width of the belt of flowing water; and you will find it is very narrow, especially in severe winters. These bays usually run from point to point and the water beyond them is flowing fast. If you cut off the points and widen the river at the narrow places you reduce the area covered by bays; the boundary line, where the ice cover forms now and where open water ends and ice cover begins, will be pushed shoreward on both sides and you will have a greater surface area of exposure than you have now. I do not say it will hurt you; certainly it will not hurt the official plan, we have carefully provided for it. Mr. Gaby has said, that on account of narrowing the open belt of flowing water he is going to get less frazil. But the reverse is the case, and I think anybody who investigates the matter will come to this conclusion. Of course you may say, "Oh, we won't widen the river anywhere; we will deepen it". All right; perhaps you can do that — but that is not what your plans have shown; that is not what everybody has accepted. What everybody has accepted is this: We will get a channel thirty feet deep and cut off any points necessary to get us the area required, and that is what we have done. If you accept the official plan with regard to the improvements to be carried out between the Galops Rapids and Morrisburg you will find that in the future you will have a somewhat greater surface of water exposed than you have had in the past. I do not think it will be a material disadvantage. It will be a very small disadvantage, but I think it will not do to let Mr. Gaby establish a lengthy argument on false suppositions.

Mr. Gaby: I did not say the channel would be narrower; I said it would be narrow.

Mr. McLachlan: Oh, I beg your pardon; I thought you said narrower.

Mr. Gaby: No, I said "narrow". What I had in mind was that the bays would be filled in with ice during the greater part of the season and, as I have stated, it was part of our scheme to maintain this open water from lake Ontario to Barnhart island.

Mr. Forward: I agree with Mr. McLachlan when he says that in the open river the bays form from point to point, and there would be some counterbalancing of that in the slowing up of the stream on account of the changed levels.

(*Discussion to be continued.*)

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THE

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The Canadian Institute of Mining and Metallurgy Invite Institute Members to Annual Meeting

The Canadian Institute of Mining and Metallurgy have again extended to all officers and members of *The Engineering Institute of Canada* an invitation to attend their Annual Meeting in Toronto. The following letter conveying this information was received from Geo. C. Mackenzie, M.E.I.C., Secretary-Treasurer of the Mining Institute.

Montreal, February 11th, 1924.

Dear Mr. Keith:—

The Council of the Canadian Institute of Mining and Metallurgy extend a cordial invitation to all officers and members of *The Engineering Institute of Canada* to attend our forthcoming Annual Meeting in Toronto, March 5th-8th, inclusive, and to take part in all technical sessions and social functions.

Yours faithfully,

(Signed) GEO. C. MACKENZIE,
Secretary-Treasurer.

Permanent Honour Roll

An opportunity will be given every member of *The Institute* to contribute to the fund for a war memorial to be erected in memory of those members of *The Institute* who were killed in action during the Great War, and a bronze record containing the names of all who served overseas.

It is anticipated that the proposal made by the Honour Roll and War Trophies Committee, and endorsed by the annual meeting, that these memorials should be designed by members of *The Institute,* for which a prize of one hundred and fifty dollars for the war memorial and one hundred dollars for the bronze record is offered, will meet with general approval.

It is further planned that framed photographs of these be sent to each branch for permanent record.

The war memorial will contain approximately one hundred names and the bronze record approximately one thousand names. It is proposed to set aside the same amount for each one, consequently an opportunity will be afforded of greater scope for artistic treatment in the war memorial. The latter, in addition to containing the names of those who fell, will embody the name of *The Institute,* the crest of *The Institute,* and an inscription, "To the memory of the members of *The Engineering Institute of Canada* who gave their lives in the Great War 1914-1918". On the bronze record it is intended to include the crest, the words "*The Engineering Institute of Canada*", and the inscription "Those who served across the seas 1914-1918".

The competition mentioned above is open to any Member, Associate Member, Junior, Student or Affiliate of *The Institute.* Further particulars will be supplied any members deciding to compete, giving size of wall space and approximate proportions. It is intended that the competition should close July first, nineteen twenty-four.

Classification and Remuneration

There is apparently some misunderstanding as to the status of the reports of the Committee on "Classification and Remuneration" concerning which a brief discussion took place at the annual meeting, held in Ottawa in January. At the annual meeting in Montreal, January, nineteen twenty-three, the report on "Classification and Remuneration of Engineers" which had previously been published in *The Journal,* was presented, adopted and referred to Council for action. This report related to the annual remuneration of engineers and to the classification of those not in consulting practice.

During the past year the committee presented a further report on the tariff of fees. This report was considered by the Council, the decision being that it should also be adopted as a guide, for the benefit of members of the profession. Both of these reports were published in *The Journal* of October last. At the annual meeting this year the status of the two reports was somewhat different. The former report had already been adopted at an annual meeting, and the latter report had been approved by Council and presented to the annual meeting this year for the first time. The report was received but not adopted. The discuss on dealt with the classification and remuneration of engineers on salary. Since the annual meeting the Council further approved of the latter report.

It should be definitely understood by the members that while these reports are in the nature of official guides, they are open for discussion at any annual meeting, and may be amended as improvements suggest themselves from time to time. Any member of *The Institute* has the privilege of expressing his ideas regarding these reports, either in the form of a discussion in the pages of *The Journal,* or as an official recommendation for action by Council. The committee which prepared the reports are cognizant of the fact that improvements will doubtless be made so that ultimately they will approach the ideal and be of the greatest possible benefit. In the meantime, every member should make himself familiar with the various classifications of salaried engineers with the suggested salaries attached thereto, as it is only by a thorough knowledge of what they contain that the profession itself will be in a position to use these reports as a means of educating those not in the profession as to the engineers' value.

The constructive suggestions made at the annual meeting, proposing amendments in the schedule, will be considered by Council, together with any others that members of *The Institute* may forward to headquarters.

Canadian Engineering Standards

The splendid work being done by the Canadian Engineering Standards Association merits recognition. Since its inception by members of *The Institute,* this organization has been in the closest touch with its activities, the progress being made having been reported from time to time. In view of the fact that the work being done is largely that of members of *The Institute,* under the guidance of the secretary of the Association, Captain R. J. Durley, M.E.I.C., *The Institute* as a whole has more than a passing interest in the Association's success.

In the report submitted to the annual meeting by the vice-president of the Association, Major-General Sir Alex Bertram, M.E.I.C., he called upon all members of *The Institute,* who are associated with the manufacturing industries in Canada, to use their influence to see that additional support be given the Association to meet its requirements. The Council of *The Institute* at a meeting held recently expressed the belief that members of *The Institute* should co-operate to the closest extent in furthering the work of the Engineering Standards Association.

It is hoped therefore that all members of *The Institute* occupying positions of influence in the industrial world, will lend their efforts in the organizations with which they are associated, in order that even greater support may be rendered to the Standards Association by the industries of Canada than has been given in the past.

American Society of Mechanical Engineers presents Artistically Illuminated Resolution to the Institute

February 21st, 1924.

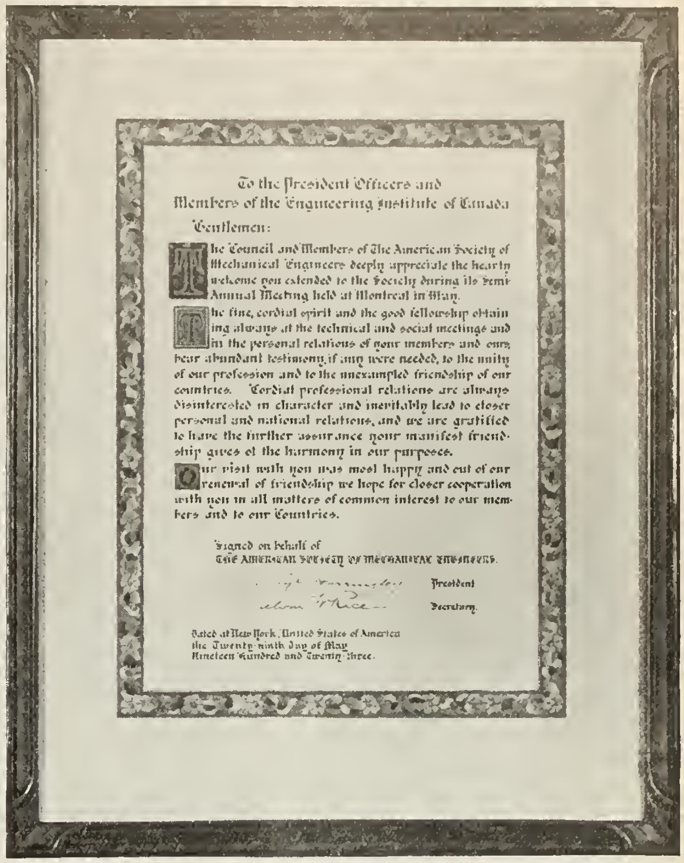
The Council and Members of

The American Society of Mechanical Engineers.

Gentlemen:—

The beautifully framed and artistically illuminated resolution kindly prepared by the Council and members of the American Society of Mechanical Engineers was presented to the Council of *The Engineering Institute of Canada* at a meeting held on February nineteenth, nineteen twenty-four, on which occasion your thoughtful action received manifest appreciation.

It was unanimously resolved that the sincere and hearty thanks of the Council of *The Engineering Institute of Canada* be expressed to the Council and members of the American Society of Mechanical Engineers for their kindness in presenting such an acceptable souvenir of the meeting of the American Society of Mechanical Engineers held in Montreal, May, nineteen hundred and twenty-three.



To the President Officers and Members of the Engineering Institute of Canada

Gentlemen:

The Council and Members of The American Society of Mechanical Engineers deeply appreciate the hearty welcome you extended to the Society during its Semi-Annual Meeting held at Montreal in May.

The fine, cordial spirit and the good fellowship obtaining always at the technical and social meetings and in the personal relations of your members and ours bear abundant testimony, if any were needed, to the unity of our profession and to the unexampled friendship of our countries. Cordial professional relations are always disinterested in character and inevitably lead to closer personal and national relations, and we are gratified to have the further assurance your manifest friendship gives of the harmony in our purposes.

Our visit with you was most happy and out of our renewal of friendship we hope for closer cooperation with you in all matters of common interest to our members and to our Countries.

Signed on behalf of
The American Society of Mechanical Engineers.

President

Secretary.

Dated at New York, United States of America
the Twenty-ninth day of May
Nineteen Hundred and Twenty-three.

It was further resolved to request the Library and House Committee to hang the framed resolution in an appropriate place in the headquarters building.

Yours faithfully,

FRASER S. KEITH,
Secretary.

Calvin W. Rice, Esq., Secretary,
The American Society of Mechanical Engineers,
Twenty-nine West Thirty-ninth Street,
New York, N.Y.

Research Narratives

In January 1921, Engineering Foundation, of New York, began printing twice a month little leaflets entitled Research Narratives. Each contained a five-minute story of research, invention or discovery. The stories, or the materials for them, were contributed by scientists and engineers of international reputation.

The purposes were to broaden general intelligence about research in science and engineering and to increase interest. Means at disposal of the Foundation permitted mailing the Narratives only to a limited list. The editions were soon exhausted; numerous requests for back numbers could not be satisfied. Suggestions came to the Foundation that the Narratives should be collected into a book and reissued.

Believing that these Narratives would be interesting and useful to thousands of persons who have not known about them, Engineering Foundation is having the first fifty made into a small well bound book and offering it at fifty cents a copy.

The Narratives cover a wide range of subjects. A few titles will be suggestive: The Story of Mendelism; Electric Welding; Nitrogen, Its Capture and Utilization; Whittling Iron; A Serbian Herdsman's Contribution to Telephony; The Birth of Bakelite; The Upper Critical Score. Most of the Narratives are readable by students in the last years of good secondary schools as well as by their elder in business, industry, engineering, teaching and other vocations.

ALFRED D. FLINN.

Address by President Francis

Delivered at the Annual Banquet of The Institute, Thirty-Eighth Annual Meeting at Ottawa, Wednesday, January twenty-third, nineteen twenty-four.

Mr. Chairman and Gentlemen, — I thank you most heartily for the manner in which you have received the toast. I think you will agree with me that the thirty-eighth annual meeting of *The Institute* has so far been a wonderful success. Nevertheless, I think I appreciate the fact that if I were to make a proposal to you now that we adjourn for the purpose of proceeding across the River, you would adopt it with greater alacrity than was manifested even in connection with the various motions that were dealt with in the course of our meetings to-day. I am free to confess to you that I was over at the Honourable Dr. King's banquet last night; I was glad when I got back into Quebec. And I shall be glad when to-morrow comes, for I understand that we are going back into Quebec to-morrow afternoon. Meanwhile you must be good, law-abiding citizens; of course, over there you do not have to break the law. (Laughter.)

During the whole life of *The Institute*, covering a period of thirty-odd years, there has never been an occasion when the members did not listen to a presidential address at the annual meeting. This time you are going to be spared the agony — agony on my part, and on the part of at least one of my illustrious predecessors, for I asked him what I should say, if I had to say anything, and he replied, "It is a ghastly proceeding; do not attempt it". Regretfully we think of the departure of that eminent French-Canadian engineer who was my predecessor. Arthur St. Laurent was a gentleman, cultured, modest, a Canadian engineer, a man we all respected. We cherish his memory. Happily, this organization has never before been called upon to mourn the loss of a president in office, and we rejoice that so many of his illustrious predecessors are still with us, participating in the activities of *The Institute.* Under the circumstances, I have decided not to inflict an address upon you, and if you will bear with me, I shall try to say something which is in accord with the keynote of this long-to-be-remembered gathering.

An Engineer — One who Devises or Creates

We are here, gentlemen, as representing the engineers and the engineering profession in this broad Dominion of ours. We have been wont to joke about the word "engineer" and what "engineering" means. Not long ago I happened to be going down a street in Montreal, I will not tell you what time of the morning it was. On one side of me was an eminent professor of one of the universities in Ontario, and on the other side a dean of a great university in the state of Illinois. Well, at that particular hour in the morning when one is feeling happy he is apt to speak the truth. We had just come from a banquet where some reference had been made to engineers and to members of other professions, and the dean said to me, "Say, Francis, just what is an engineer?" Now, that was a fair and truthful indication of what the public thinks about us. Who and what are we? Sometimes I question whether we ourselves know what we are. The other day, just in a fit of despondency, I tried to classify engineers, and when I got down to one hundred and eighteen different varieties; somewhat in excess, I believe, of the number of varieties claimed by Mr. Heinz the pickle man; I figured I had reached a factor of safety of something over two, and I stopped dead. I was reminded of the last reference I had seen to specializing in engineering; it was at Atlantic City, where a fellow had a sign out, "Hot Dog Engineer". After all, gentlemen, seriously, is it any wonder that we do not understand ourselves and that the public do not understand us? We use this word "engineer" in the most flippant manner; there is no question about it. If we go on applying it to every man who runs a contrivance I cannot help wondering what in thunder we will have to call the fellow who runs a wheelbarrow; it will be up to you to coin a word to cover the case. Shall an operator usurp a title which belongs alone to the person who devises and creates?

In any event, gentlemen, I do take that word very seriously. If you may not regard it as sacrilegious, I would refer to the commonly used expression, "The Great Architect of the Universe", and suggest that if I had my way that expression would be, "The Great Engineer of the Universe". We deal with the great sources of power in Nature in motion. All here agree that engineers are head and shoulders over the architects, the efforts of whom are directed towards things quiescent and artistic. Sometimes I think engineers went one better than Nature inasmuch as the engineer is responsible for an element that does not occur in nature, that is, the wheel; and of course our friends of the mechanical persuasion will feel gratified that a "mud" engineer can make such an acknowledgment as that.

But, to come back to the consideration of this word "engineer". I choose to think of him as a creator, a man who does things, a producer par excellence. Professions are well represented all over the world by various organizations, but none of them, I believe, stand for their professions as *The Engineering Institute of Canada* stands for engineering in this country. I do not make any reflection at all on any of the sister bodies; far from it. But I do believe that we have reached an enviable position in that we stand for the engineering profession in this broad Dominion of ours.

The Phenomenal Growth of The Institute

Our growth has been phenomenal. If I make a presidential address next year, I may inflict upon you a little study of the progress of *The Institute*, because that progress has been very remarkable indeed. Just at this moment, however, I wish to show you on the screen a curve which will indicate the various stages in the growth of *The Institute.* (*A slide of figure No. 1 was shown.*)

This uppermost curve, gentlemen, the curve of total membership, shows the growth of our organization from its inception in 1887 as the Canadian Society of Civil Engineers right up to the time of its being designated *The Engineering Institute of Canada* and on to the present day.

The lowest curve of the three represents the non-corporate membership. You will see that it is a fairly constant upward curve from 1887 up to about 1903. It rises a little more rapidly until 1907. In 1908 it takes quite a jump, and that upward tendency continues until 1912, when there is a rapid decline. Then the growth of the non-corporate membership becomes more uniform until 1919 is reached, and later on its rises.

The second curve is perhaps not so good an indication of the growth of *The Institute* as the other two. It is the curve of corporate membership, namely, Associate Members and Members. You can see that there is a fairly uniform growth from the time the old society was established in 1887 until about 1903. The rise of the line is fairly uniform between those years. Then, from 1903 until 1910, we get a different rate of progress, a rate which is more rapid and which undoubtedly corresponds with the development of the Dominion and the general growth during those days. The rise becomes still more rapid from 1910 to 1918. The latter was a notable year on account of the change in the policy of the organization, and the increase in corporate membership became even more rapid thereafter.

The top curve is the sum total of the other two, indicating, as it does, the development of the total membership. It shows the progress from 1887, when we had less than 500 members, until the present time when our total membership is 5,432. (Applause.)

But the significant thing about this curve, gentlemen, is this: There was a steady, uniform and healthy growth from the inception of the body up to the year 1903; then with the development of the country the growth became more rapid, and in 1910, when Canada was more prosperous, perhaps, than in any other single year, the acceleration became more marked; the membership figures ran right up. In 1917-18 we put into effect the report of the Committee on Society Affairs, which meant the engagement of a full-time secretary, the publication of a monthly journal, and so on. I shall not deal further with that curve at the moment, but I should like to give you a few figures that are even more significant as indicating our growth.

In 1917 we had but nine branches; now, at the end of 1923, we have 24 branches, and there are others in prospect; before long we shall have three or four new ones. In 1908 the rebates to branches were $544; at the end of 1923 we were rebating $7,500 a year to the branches. Receipts in 1917, when the report of the Committee on Society Affairs came into effect, were $26,000; in 1923 they were $75,000, three times the amount. The membership in 1917 was 3,100; of whom, I desire to mention in passing, 1,000 were serving at the Front; in 1923 the total membership amounted to the figure I have already given you, 5,432. In 1918 the circulation of *The Journal* was 1,800 copies; to-day it is 5,600 copies and more are constantly being needed. The expenditure in 1917 was $25,000; the expenditure in 1923 was $70,000. Now, gentlemen, I give you these figures as significant of the advantage that accrued to us from the adoption of the report of the Committee on Society Affairs.

Our branches are all flourishing. It is my good fortune to have some personal acquaintanceship with branches from one end of the country to the other, and I sincerely trust that the coming year will enable me to visit every branch in the whole *Institute.* The fellows in Sydney, Cape Breton, are just as enthusiastic as the men in Edmonton, Calgary or Vancouver. I recently returned from attending the annual meeting of the Toronto, of the Peterborough, of the Hamilton and of the London Branch, and I can assure you that the utmost enthusiasm abounds. Their enthusiasm equals that of the Ottawa Branch, sir, and while many of their members are here many more would have been at this annual meeting had it been possible.

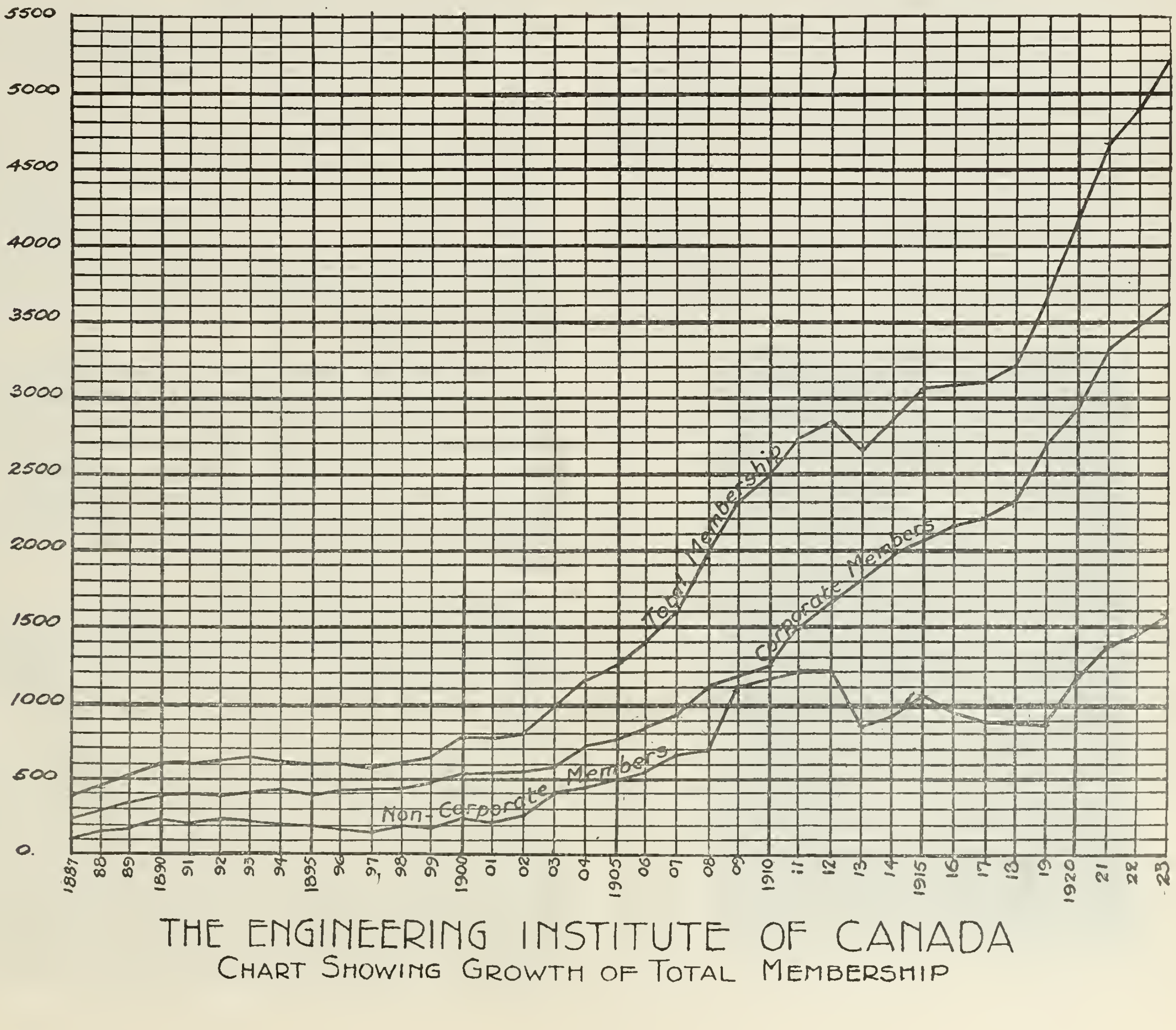
The formation of the Saguenay Branch in August last was a very interesting function. You may be surprised when I tell you something about that branch. Perhaps you do not know where the Saguenay Branch is. It may be that your geography was just as rusty as mine when I did not know where lake St. John is, although I did have a hazy recollection of a little blue spot about as big as a pea on the map, away down near Labrador. But when we went to Chicoutimi to form that branch we found one hundred enthusiastic engineers ready to receive us, and we listened there to an address from Sir William Price which was a masterpiece and which needed no amplification whatever on our part. The Saguenay Branch is thriving to-day; among the reports of the branches that you passed was included that of the Saguenay Branch. If time would permit I would like to say some other things about the branches, because they are intensely interesting; things you do not get in the printed page, things to which the secretaries and chairmen are too modest to make reference in their reports. But I want to assure you that so far as my personal knowledge goes our branches are organizations of which every member may be justly proud. (Applause.)

A Tribute

Gentlemen, so much for the development of *The Institute.* I have given you a few pointed figures which indicate in a very graphic way how we have gone on from the time to which Past-President Mountain referred at noon, when he said that here in the city of Ottawa in 1886 the meeting was held that led up to the formation of the Canadian Society of Civil Engineers. It was a wonderful organization in those days. I pay the greatest tribute to the men who carried on in those earlier stages, and when I say that the credit for the present satisfactory condition of *The Institute* is due in no small measure to the tireless energy and unbounded enthusiasm of Mr. Keith, our general secretary, I say what is true. (Applause.) I take off my hat to the late Professor McLeod, to Dean Bovey, and to the others who persevered in the days when everything was not all beer and skittles and when we were not able to pay in dollars for the services we received. Hats off to the men who carried *The Institute* in the old days, some of whom are present here to-night, but most of whom have passed on. Hats off to old McGill, for without McGill there would never have been *The Institute* there is to-day. (Applause.) I say that in all sincerity, gentlemen, although I am a Toronto man. Hats off to old McGill for what she has done and what she is doing for *The Institute*, although she might be doing more to-day.

The Eight Objects of The Institute

The developments in *The Institute* itself are only parallel to the developments in the engineering profession. When one looks back a few years he realizes that the necessities of to-day were the luxuries of yesterday, even if they had been heard of at all. You could not get along to-day without the telephone and other similar modern inventions; and I understand from the chairman that we shall not be able to get along without the radio much longer to-night. In any event there has been a marvellous development. But to me the most important development of all is the fact that the members of our body have realized their responsibilities as citizens of this great Dominion. I want to point out to you that when the Canadian Society of Civil Engineers started it was a technical society pure and simple, a body organized for the writing and presentation of papers. To-day what is it? It is a body that recognizes many things. I just want to remind you at this time of the objects of our organization. I am sure you all know them, but at the same time you will forgive me if I just recount them to you. There are eight of them, I shall not say eight commandments, but eight precepts; we call them "objects" in the constitution. They are: To maintain and uphold high standards in the engineering profession; to facilitate the acquirement and the interchange of professional knowledge among its members; to advance the professional, the social and the economic welfare of its members; to enhance the usefulness of the profession to the public; to collaborate with universities and other educational institutions in the advancement



THE ENGINEERING INSTITUTE OF CANADA
CHART SHOWING GROWTH OF TOTAL MEMBERSHIP

of engineering education; to promote intercourse between engineers and members of allied professions; to co-operate with other technical societies for the advancement of mutual interests; to encourage original research, and the study, development and conservation of the resources of the Dominion. I say to you, gentlemen, that it would be pretty hard to conceive of broader objects than these. In this list of objects is set forth our service and our duty to the profession at large, in the first; and of the members themselves to one another, in the second and third. Then there is our duty to the public in enhancing the usefulness of our profession; our duty in the matter of education through helping the universities; our duty to our sister professions; our duty to our sister societies; and, perhaps the greatest of all, our duty in the way of original research and the study, development and conservation of our country's resources. I believe, gentlemen, that that constitutes the greatest advance that has been made by *The Institute* during the years that have been shown to you on the diagram. I would far rather take the stand that the members had realized their responsibilities, as the individuals in the branches throughout the country are doing, than merely look with pride upon our growth in numbers, because numbers do not count for much unless those concerned are actuated by the right spirit.

Now, as my time is pretty nearly up, I am going to refer to only one other point; a little preachment that I should like to give you. One of the great privileges of this organization, and it was very manifest in the meetings to which I referred a few moments ago, very manifest at the professional meeting in St. John late in September, is the development of friendship and the mutual confidence which it inspires. He who would have friends must show himself friendly, and every one of us should bear his full share of responsibilities for the development of those closer personal relationships which will enable us all to derive and impart a maximum of assistance and inspiration from the activities of *The Institute*. (Applause.) It is most delightful to know how these friendships are being cultivated. Out of them a mutual confidence must grow. When this body of five thousand men throughout our broad Dominion have faith in themselves and faith in each other, then Canada will be a better place than it is to-day, and that will be going some. (Applause.)

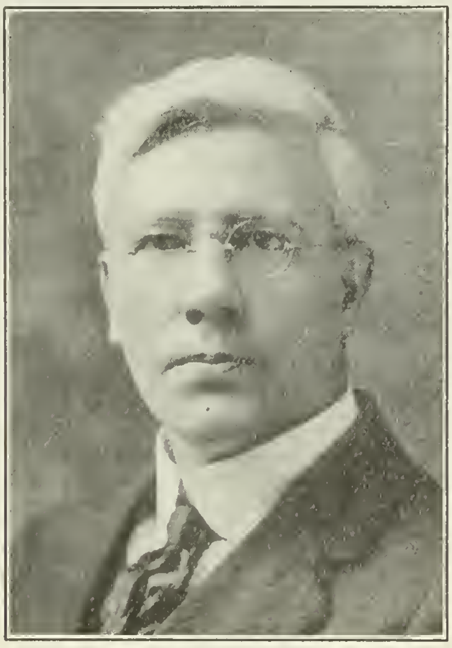
I wish to congratulate the Ottawa Branch on the success of their meeting. (Applause.) I am reminded of a little story I heard just the other day, because it does not apply to the friendships which have sprung up here at this gathering. One man was being introduced to another, and he said, "Haven't I met you before? Didn't I meet you in Mexico?" "No," said the other, "I have never been in Mexico". "Well," said the first, "Neither have I; it must have been two other fellows". I thank you. (Applause.)

OBITUARIES

William A. Bowden, M.E.I.C.

William A. Bowden, M.E.I.C., chief engineer of the department of rai ways and canals, died suddenly at his home, 305 Waverley street, Ottawa, at an early hour Sunday morning, February 3rd, 1924. He was unable to be at his office on Saturday but received calls at his home, where he had remained throughout the day.

The late Mr. Bowden had been the Canadian engineering representative on the international board in the St. Lawrence power project which at present occupies a foremost place in international affairs between Canada and the United States. He was appointed to this board by the Dominion government in April, 1920, and took an active part in its deliberations.



WILLIAM A. BOWDEN, M.E.I.C.

For fourteen years the late Mr. Bowden had been chief engineer of the Department of Railways and Canals, and during that time had directed the execution and operation of many of the great public works of Canada, besides being responsible for the character and the construction of thousands of miles of railway which were built under subsidy and other forms of agreement. Among the great works which he designed and superintended may be placed the Hudson Bay Railway, the Trent river improvements, the Prince Edward Island car ferry terminals, the Moncton shops, the Port Colborne elevator and the Welland ship canal. The operation of the canal system of Canada was directly under his charge up to the time of his death.

The late Mr. Bowden was born at Melbourne, Que., July 18th, 1872. His father died when he was but a child of five years and his early boyhood was largely spent on his grandfather's farm near Richmond, Que. He attended St. Francis College, from which he matriculated at an early age. At the age of sixteen years he became a rodman on the Drummond county railroad, and in 1889 entered McGill University. From that institution he was graduated in civil engineering in 1893.

After graduation the late Mr. Bowden was engaged in land survey work in northern Quebec for about two years, after which he entered the employ of the Department of Railways and Canals, and was engaged on the construction of the Trent and Grenville canals for about a year.

In 1896 he left the government service and entered the employ of E. Vanier, A.M.E.I.C., of Montreal, and while in his employ superintended the construction of many sewer systems and buildings in and around the city of Montreal. After a few years' experience in general construction work Mr. Bowden decided to specialize in structural steel work, and entered the designing office of the Riter Connolly Company, of Pittsburgh. After being employed in various designing offices in the United States for some years he returned to Canada to accept the position of checker and chief draftsman with the Locomotive and Machine Works in Montreal. It was in April, 1906, that he re-entered the employ of the Dominion government in the Department of Railways and Canals as designing engineer, and four years later he was promoted to the position of chief engineer of the department. Mr. Bowden was elected an Associate Member of *The Institute* January 5th, 1899, and was transferred to Member on April 9th, 1910.

He was married in March, 1905, to Marie Moure, daughter of the late J. B. Moure, of the Spanish diplomatic service. Besides his widow, he leaves his mother, Mrs. G. M. Bowden; two daughters, the Misses Doris and Enid Bowden, and a sister, Mrs. Fred Pereira, all of Ottawa.

"There are many engineers but few Bowdens," said Hon. George P. Graham, minister of railways and canals, commenting upon the death of Mr. Bowden. Mr. Graham appointed Mr. Bowden to the post of chief engineer of the railway department in April, 1910, so that his sudden death came to the minister with additional schock.

"His death to me is deeply affect ng," said Mr. Graham, "as I had the honour over twelve years ago of naming Mr. Bowden to his present position. He was a quiet retiring man but at the same time was decided in his views on matters related to his work. He was an exceptionally able engineer and absolutely upright. No man could persuade him to do something of which he did not approve. Mr. Bowden believed that he was serving the people of Canada and not any particular party or government. He regarded his duties in a broad manner, commanding the respect and affection of the entire staff of the railway department."

William Cecil Way, M.E.I.C.

William Cecil Way, M.E.I.C., a well known and respected Civil Servant, and a member of the Ottawa Branch, passed away at Lindsay, Ontario, on January 16th, after a long illness.

The late Mr. Way was born at Belleville, Ont., on October 10th, 1881. From his early days he excelled in scientific studies, and at high school was awarded a scholarship in science. He then proceeded to Queen's University, where he had a very successful career, graduating in mechanical and electrical engineering in 1905. After graduation Mr. Way became a demonstrator, and conducted a research on the application of the electric furnace to the reduction of zinc ores. As a result of this work he was awarded the degree of M.Sc., in 1906.

In 1907, Mr. Way entered the drafting and testing department of the Canadian Allis Chalmers Company, Montreal, and in the following year became engineer to the sales department of the Canadian Ingersoll-Rand Company at Montreal. Returning to his university in 1909, he was appointed lecturer in descriptive geometry and in mechanical drawing and design, which position he relinquished in 1911 to join the Topographical Survey Branch, Department of the Interior.

At Ottawa, Mr. Way had charge of the surveys laboratory which is devoted to the testing and standardization of measures of length and of a wide range of scientific instruments. He was responsible for many developments at the laboratory and also conducted a number of researches, the best known of which were concerned with the visual definition of small telescopes and the performance of the aneroid barometer. He had a strong belief that the latter instrument could be adapted to give much more accurate results than was generally realized, and he succeeded in introducing improvements of great value in the application of the aneroid to topographical surveying. His last important work, in progress at the time he was forced to give up active duties, was the design and construction of a special comparator for studying yard and metre rules, and with which he intended to investigate the relation between the present Canadian standard yard and the international metre.

Never of robust health, he was yet well blessed with mental energy, and his death is a distinct loss to the technical side of the Civil Service.

Mr. Way was elected an Associate Member of *The Institute* on April 27th, 1920, and a Member on February 16th, 1923. He was also a member of the American Society of Mechanical Engineers.

George Gray Anderson, M.E.I.C.

After an illness of nearly nine months, George Gray Anderson, M.E.I.C., died at Los Angeles, California, on Sunday, December twenty-third, nineteen twenty-three. Although in very poor health, as a result of an attack of influenza in March nineteen twenty-three, the late Mr. Anderson continued his consulting work for Colorado Springs until July of that year. From that time he was confined to his home but, in spite of the serious condition of his health, he insisted on making the trip to Richmond, Virginia, in October to attend the fall meeting of The American Society of Civil Engineers.

The late Mr. Anderson was born at Aberdeen, Scotland, April 20th, 1858, and received his education at Robert Gordon's Hospital, (College) of which he was a medallist and at the University of Aberdeen from 1872 to 1874, attaining honours in all subjects.

From 1874-79, he was apprentice with Messrs. James F. Beattie and Son, subsequently Walker and Beattie, surveyors and engineers, Aberdeen, and remained with that firm, after completing his apprenticeship, until August 1879 when he entered the service of the engineering department of the London and Northwestern Railway Company at London, England, as ass stant engineer on maintenance on the London-Rugby division.

In April, 1880, he was appointed assistant engineer on the construction of the Northern Colorado Irrigation Company's project near Denver, Colorado. Three years later he was engaged on the construction of the Platte Valley Irrigation canal for the same company, and for the next seven years he was general superintendent of these two canal systems in addition to the Larimer and Weld canal and the Loveland and Greeley canal.

In June 1890 Mr. Anderson entered private practice as consulting engineer in the firm of Campbell, Greene and Anderson which subsequently, in 1891, became Campbell and Anderson. During the following six years his work included many irrigation projects in Colorado, New Mexico, Oregon, Idaho, Arizona, and Washington. In 1896, the Denver Union Water Company appointed him as expert in connection with their litigation with the city of Denver. The following year he was engaged in various irrigation works in Arkansas valley, Colorado, in connection with what is now the Fort Lyon canal.

In 1898, Mr. Anderson was appointed consulting engineer for the Alberta Railway and Irrigation Company, Alberta, and continued in this capac ty until 1905. During that period he made a number of investigations of other irrigation projects. His subsequent work involved many appointments for the investigation of irrigation and water supply projects, and on numerous occasions he was retained by various corporations to give expert evidence in cases of litigation relating to irrigation works.

He visited Canada several times investigating and reporting on irrigation schemes in Alberta, the last of which was in 1921 when he reported on various projected irrigation districts in Alberta for the Canadian government.

The late Mr. Anderson was the author of numerous papers on the subject of irrigation, among which are the following: — "Irrigation in Colorado", Transactions of American Society Civil Engineers, volume 62; "The Effect of Alkali on Concrete," Transactions of the American Society of Civil Engineers, volume 67; "Some Aspects of Irrigation Development in Colorado," Colorado Scientific Society, volume 4; "Irrigation in Colorado," 16th National Irrigation Congress, 1908; "The Combination of Water Resources for Irrigation and Hydro-Electric Purposes," Second Pan-American Scientific Congress.

Mr. Anderson was elected a Member of *The Engineering Institute of Canada* on October 8th, 1903. He was also a member of the following technical societies: — Institute of Civil Engineers, England; American Society of Civil Engineers; Colorado Association of Members of American Society of Civil Engineers; Los Angeles Section of American Society of Civil Engineers; Colorado Scientific Society; Seismological Society of America, Honorary Member, Tau Beta Pi; In addition to these, he was a member of the Denver Club, Denver, Colorado; Mile High Club, Denver, Colorado; University Club of Los Angeles, California; Celtic Club of Los Angeles, California.

Mr. Anderson leaves a wife, two daughters and a son, Robert Anderson, who is in the Flight Research Department, McCook Field, Dayton, Ohio.

William Alexander Davidson, M.E.I.C.

Sincere regret is expressed at the untimely death of William Alexander Davidson, M.E.I.C., manager of the Rosedale Coal Company, Rosedale, Alberta, on February 13th, 1924, who sustained fatal injuries in an accident at the mine.

The late Mr. Davidson was born at Peterborough on June 8th, 1877, and received his primary education at the public schools and Collegiate institute of that city. In 1899 he graduated from McGill University with his degree of B.Sc., in mechanical engineering and in 1914 received his degree of M.Sc., from the same university. He also held mine manager's certificates for British Columbia, Alberta and Saskatchewan.

His early work was on the Trent Valley canal at Peterborough in 1896, followed by five years of railway work, first with the Grand Trunk Railway and later with the Algoma Central Railway. In 1901 and for the next five years Mr. Davidson was with the Dominion Coal Company at Glace Bay. He was then appointed chief engineer of the West Canadian Collieries, Limited, Blairmore, Alta., and after two years accepted the position of chief engineer of the International Coal Company, Limited, at Coleman, Alta. He was later appointed mine superintendent and chief engineer of the company, which position he occupied for seven years. In 1916 he took over the position of supervisor of instruction in mining, in the Provincial Institute of Technology and Arts, Calgary.

It was not until 1920 that he was appointed superintendent of the Rosedale Coal Company, Rosedale, Alta., and was still occupying this position at the time of his death.

The late Mr. Davidson was admitted to *The Institute* as Student on March 16th, 1899, was transferred to Associate Member on October 9th, 1909, and to Member on October 17th, 1916.

PERSONALS

Francis R. Sherlock, Jr.E.I.C., formerly resident engineer, Department of the Interior at Banff, Alberta, is now living in Venice, California.

E. R. Millidge, M.E.I.C., roadmaster for the Canadian National Railways at Blue River, B.C., has been transferred to the same position at Edson, Alta.

R. D. Keenleyside, S.E.I.C., of London, Ontario, has accepted a position with the Ingersoll-Rand Company of Phillipsburg, N.J.

J. E. St. Laurent, M.E.I.C., district engineer for the Department of Public Works at Winnipeg, Manitoba, has been transferred to the Ottawa district, in the same capacity.

A. F. Macallum, M.E.I.C., commissioner of works for the city of Ottawa, has been granted two months leave of absence to visit Europe to study the latest methods of water filtration.

A. E. Woollam, A.M.E.I.C., until recently with the Eddy Paper Corporation of Three Rivers, Quebec, has been appointed maintenance engineer with the Standard Paper Company of Kalamazoo, Michigan.

F. W. Elliott, B.A.Sc., S.E.I.C., graduate of the University of Toronto with the class 2T3 has been elected the first president of the Canadian Westinghouse Apprentice Club. Mr. Elliott was elected a Student of *The Institute* on January 25th, 1921.

Lieut.-Col. A. E. Dubuc, M.E.I.C., superintending engineer of canals, province of Quebec, has received the appointment of acting chief engineer of the Department of Railways and canals, Ottawa, temporarily filling the vacancy caused by the death of W. A. Bowden, M.E.I.C.

C. H. Jackson, Jr.E.I.C., has been appointed to the engineering department of the Canadian Explosives Limited of Montreal, Que. Mr. Jackson is a graduate of McGill University of the class of 1921, in electrical engineering.

H. Chandler, S.E.I.C., has accepted a position in the fuel and ore testing laboratories, Mines Branch, Ottawa, Ontario. Mr. Chandler was recently with the Malt Products Company of Canada Limited, of Guelph, Ontario. He is a graduate of the University of Toronto with the class of 1922.

A. G. Barrett, S.E.I.C., who graduated from Queen's University with the class of '21, and who was for a time with the department of public highways of Ontario as instrumentman at Kingston, Ontario, has accepted a position on the engineering staff of the Quebec Development Company, Limited, at St. Joseph D'Alma.

J. O'Neill, A.M.E.I.C., is at present engaged as engineer on the construction of a twelve storey apartment building in New York City for Thompson-Starrett Company. Mr. O'Neill was transferred by the company from New Haven, Conn., where he was located for the past few months.

V. M. Meek, A.M.E.I.C., has been transferred from Calgary, where he was connected with the Irrigation Branch, Department of the Interior, to Ottawa where he is assistant to the director of water powers and reclamation. Mr. Meek has been chairman of the Calgary Branch for the past year.

R. B. Young, M.E.I.C., recently presented a paper on Controlling Qualities of Concrete in Theory and Practice before the forty-fifth annual convention of the Michigan Engineering Society, which was held at Port Huron, Michigan. Mr. Young is assistant laboratory engineer, in charge of the engineering materials laboratories for the Hydro-Electric Power Commission of Ontario.

J. S. Tempest, M.E.I.C., is now acting commissioner in the Water Power and Reclamation Branch of the Department of the Interior at Calgary, having assumed this position on the transfer of V. Meek A.M.E.I.C. to Ottawa. It was not long ago that Mr. Tempest was a resident of Calgary, and he has been employed by the Dominion Government for many years past in various capacities in the east and in the west.

J. Warren Smith, M.E.I.C., has been appointed to the position of manager of the London Bridge Works, Limited, London, Ontario. Since resigning from the position of chief engineer of the Toronto plant of the Dominion Bridge Company, Limited, Mr. Smith has been designing engineer for the Toronto Transportation Commission handling principally the design of their new Senecal repair shop, new car houses, etc.

D. M. Mawhinney, A.M.E.I.C., has severed his connection with the State Road Commission of West Virginia and has become junior partner in the firm of the Dayton Construction Company, Incorporated of Elkins, West Virginia. Mr. Mawhinney was formerly located at Stonewall, Manitoba, where he was municipal engineer for Rockwood municipality. He will be superintendent and engineer of the firm of which he is now a partner.

Alex. Ferguson, M.E.I.C., honored by friends at Ottawa.

Alex. Ferguson, M.E.I.C., of the Department of Railways and Canals, was entertained at luncheon by a few of his friends of the Ottawa Branch of *The Engineering Institute of Canada* and of the Professional Institute of the Civil Service, at the Chateau Laurier on February 15th, prior to his departure for Port Colborne, where he will be stationed in future.

J. L. Rannie, M.E.I.C., chairman of the Ottawa Branch, presided, and brief addresses were made by G. A. Mountain, M.E.I.C., D. W. McLachlan, M.E.I.C., John Murphy, M.E.I.C., and K. M. Cameron, M.E.I.C. Mr. Rannie on behalf of the gathering presented Mr. Ferguson with a silver cigarette case, bearing the crest of *The Engineering Institute.* Mr. Ferguson made a suitable reply, expressing his regret at leaving Ottawa and his many friends here. Both in *The Engineering Institute* and the Professional Institute Mr. Ferguson has been very active, and is held in high esteem by the many members of both organizations.

H. B. Muckleston, M.E.I.C., enters Private Practice

H. B. Muckleston, M.E.I.C., has announced that he has opened an office at 901 Rogers Building, Vancouver, B.C., for consulting practice in structural engineering, foundations, irrigation, drainage, power, water supply and purification, sewerage and sewage disposal, reports, estimates, valuations, and appraisals.

Mr. Muckleston was in the employ of the Canadian Pacific Railway for seventeen years on design and construction of their large irrigation systems in Alberta, and for the last four years has been chief engineer of the Lethbridge Northern Irrigation District at Lethbridge, Alberta, which project serves an area of 105,000 acres and involved an expenditure of $5,400,000. It was completed on time and within the estimated cost.

Capt. Melville Promoted

Captain J. L. Melville, A.M.E.I.C., whose promotion to major and appointment to the command of the Third Field Company, Canadian Engineers, was recently announced in the Canada Gazette, went overseas with a draft of Canadian Engineers, and took part in all the operations of his company for nearly two years. In March, 1918, he joined the Canadian Corps Engineers, which was responsible for a great deal of bridging work during the latter part of the war. They spanned the canal du Nord at Marquion with an Ingles steel bridge, the total span of 108 feet being completed in eight hours, a record of time. Another bridge, slightly smaller, was built at Valenciennes. Major Melville received the Military Cross for his services with the 10th Field Company and a bar to the cross for the canal du Nord action and returned to Canada as a captain. Upon the reorganization of the 3rd Field Company, Major (then Capt.) Melville became captain of the company and has continued in that capacity until the present time. He is in charge of Vetcraft work for the Department of Soldier Civil Re-Establishment.

Councillor for St. John Branch

Frank P. Vaughan, Hon.M.Sc., M.E.I.C., past-chairman of the St. John Branch and recently elected representative on Council, was born at Liverpool, England in 1874 and educated in primary schools and Regent College, England. Mr. Vaughan has been a pioneer in experimental investigation in wireless telegraphy and telephony and high potential high frequency currents He was granted the first license issued from Ottawa for experimental wireless telegraphy in 1904, and in 1908 talked a distance of three miles by wireless telephone. Mr. Vaughan is an authority on the latest radio developments, has read a number of papers before *The Institute* and other scientific societies and is a contributor to magazines. As manager of The Vaughan Electric Company Limited of St. John, Mr. Vaughan was consulting electrical engineer during construction of the St. John drydock. He is a member of American Institute of Electrical Engineers, American Association for the Advancement of Science, American Electro-Chemical Society, Association Professional Engin-

FRANK P. VAUGHAN, M.E.I.C.

eers of N.B. (member of Council 1921-23), Canadian Building and Construction Industries, and an Associate member The Institute of Radio Engineers.

Degree of Doctor of Science awarded to H. B. Dwight, A.M.E.I.C.

At a meeting of the Corporation of McGill University held in Montreal Wednesday, February 13th, the Faculty of Graduate Studies and Research recommended that the degree of Doctor of Science be awarded to H. B. Dwight, B.Sc., A.M.E.I.C.; and the Corporation accordingly ordered that the degree be granted at the next Convocation, which will be toward the end of May.

This degree is open only to graduates of the University, and is one of the highest honours which McGill can confer. A candidate for the degree must be a graduate of not less than seven years' standing, must have published original scientific papers showing a very high standard of scholarship, and which contribute materially to man's knowledge of science, and he must also have attained a pre-eminent position in his profession. The requirements for the degree are so high that very few men have been successful in winning it.

Mr. Dwight graduated from McGill in 1909 with the degree of B.Sc., in electrical engineering. He had previously taken two years of the arts' course at the University of Toronto. Shortly after his graduation he commenced publishing articles, and about 1913, he published his first book on transmission line calculations, which is still one of the recognized text books on the subject. Since then Mr. Dwight has published several articles on transmission line operation, skin effect and proximity effect, special capacity calculations in cables, and other allied subjects. He is counted among the authorities on calculation of transmission lines and on skin effect.

Mr. Dwight is not only a man well versed in theory, but he is also a very successful practical engineer. Since his graduation he has been identified with the Canadian Westinghouse Company, and is now designing engineer in charge of all direct current and synchronous alternating current machinery.

H. B. DWIGHT, A.M.E.I.C.

ELECTIONS AND TRANSFERS

At the meeting of Council held on February 19th, 1924, the following students were admitted:—

ABERNETHY, Gordon McKellar, 2500 First Avenue West, Vancouver, B.C.
BARBOUR, Ronald Granville, 895 Charlotte Street, Fredericton, N.B.
BARNSLEY, Frank Richard, 2820 Spruce Street, Vancouver, B.C.
BURPEE, Laurence H., Ottawa, Ont.
CANE, William Kenneth, 161 Oxford Street, Halifax, N.S.
FEAR, James, Nova Scotia Technical College, Halifax, N.S.
FOLMSBEE, Frank, Jr., 396 Victoria Avenue, Niagara Falls, Ont.
FORDE, George Burnet, 2160 Windsor Road, Victorio, B.C.
GRIERSON, Cyrus Arthur William, 161 Oxford Street, Halifax, N.S.
HOLMAN, John Longmaid, 262 St. James Street, St. John, N.B.
HOPKINS, Arthur Douglas, 276 Johnson Street, Kingston, Ont.
JOHANSON, Joseph Andreas, 18 Seymour Street, Halifax, N.S.
LOCKWOOD, Geoffrey Parker, Central Y.M.C.A., Montreal, Que.
MacINTOSH, Charles Alexander Daniel, 18 Carleton Street, Halifax, N.S.
MORAN, William Gregor, P.O. Box 71, Truro, N.S.
PRINGLE, George Hugh, Pine Hill Residence, Dalhousie Univ., Halifax, N.S.
RATZ, Herbert G., 264 Kennedy Avenue, Toronto, Ont.
ROGERS, John Albert, Nova Scotia Technical College, Halifax, N.S.
SECORD, Ralph Edmund, Fredericton, N.B.
STEVENSON, Cecil Douglas, 3751 Granville Street, Vancouver, B.C.
WALSH, Harold Edgar, 4554 Sixth Avenue West, Vancouver, B.C.
WARDLEWORTH, Theophilus Hatton, 168 Cote St. Antoine Road, Westmount, Que.

Books added to the Library

Transactions, Proceedings, etc.

Presented by the Societies.
- Calendar of The National University of Ireland, for 1923.
- Proceedings and Transactions of The Royal Society of Canada, third series, volume XVII, meeting of May, 1923.
- Association of Professional Engineers of the Province of Ontario, Act of Incorporation, By-Laws, Code of Ethics, List of Members, 1923.
- Minutes of Proceedings of The Institution of Civil Engineers, Volume CCXVI, 1922-23, Part 2.

Reports.

Presented by The University of Minnesota.
- Transmission of Heat Through Building Materials, by Frank B. Rowley, volume XXVI, No. 41, bulletin No. 3.

Presented by Department of Interior, Canada.
- Mining Development in the MacKenzie District, 1922.

Presented by Department of Commerce, Bureau of Standards, Washington, D.C.
- Elimination of Waste, Woven-Wire Fencing and Asphalt.
- Recommended specification for quicklime and hydrated lime for use in the manufacture of sand-lime brick, Circular No. 150.
- Recommended specification for quicklime and hydrated lime for the manufacture of silica brick, Circular No. 153.
- A measure of the color characteristics of white papers, by R. E. Lofton, Technologic paper No. 244.
- Embrittlement of Malleable Cast Iron resulting from heat treatment, by Leslie H. Marshall. Technologic paper No. 245.
- Spectroradiometric Analysis of Radio Signals, by Chester Snow. Scientific Paper No. 477.
- Stresses in a few welded and riveted tanks tested under hydrostatic pressure, by A. H. Stang and T. W. Greene. Technologic paper No. 243.
- Dynamometer tests of automobile tires, by W. L. Holt and P. L. Wormeley. Technologic paper No. 240.
- A comparison of the Deoxidation effects of titanium and silicon on the properties of rail steel, by George K. Burgess and G. Willard Quick. Technologic paper No. 241.
- Standards for electric service, 2nd. edition. Circular No. 56.

See also page 170.

EMPLOYMENT BUREAU AND MEMBERS' EXCHANGE

Situations Wanted

Civil Engineer

Wanted by a civil engineer of eighteen years general railway experience partnership in well established active engineering firm in British Columbia. Would consider taking an interest in an engineering agency or manufacturing business with good prospects for expansion. Apply box No. 115-W.

Civil Engineer

Recent graduate, 27 years old, desires position with a firm of contractors or general consulting engineers. Experience includes, surveying, two summers railroad work and two summers highway work. At present employed on non-technical work and desires a change. Apply box No. 137-W.

Construction Engineer

Construction engineer or superintendent, civil engineer, B.Sc., A.M.E.I.C., Ontario professional engineer, age 30, desires position with contractors or engineering firm as engineer or superintendent. Ten years railroad construction and municipal engineering and construction. Position must offer opportunity for advancement. Employed as engineer and superintendent at present. Will go anywhere. Apply box No. 138-W.

Metallurgical Engineer

Graduate McGill University 1923, in metallurgical engineering, with B.A. from Laval University, desires position where there is a good possibility of advancement. Experienced as draughtsman, chainman, chemist, inspector, and electrician. Married. Speaks French and English. Apply box No. 139-W.

Situations Vacant

Electrical Engineer

Electrical engineer, graduate with experience in power house layout and switchboard work. Salary in accordance with qualifications. Apply box No. 60-V.

Combustion Engineer

A pulp and paper company in Quebec have an opening for an engineering graduate who has had experience in combustion engineering, to be in their boiler house control. Salary $175. Apply box No. 70-V.

Assistant Manager

Capable business man with executive and selling ability, capable of superintending the installation of large equipment. Electric experience. Of advantage to be able to speak French. Apply box No. 91-V.

Mechanical or Electrical Engineer

Mechanical or electrical engineer with three or four years experience in power plant engineering. Apply box No. 94-V.

Structural Draughtsmen

Experienced structural draughtsmen wanted. Apply to chief draughtsman, Dominion Bridge Company, Limited, Dominion Ave., Lachine, Que.

Power Equipment Sales

Engineer, recent graduate preferred, required as power equipment salesman of small units for electrical company. Apply box No. 95-V.

Inspection of Coking Plant in Hamilton

On February 4th, a party of representatives of the Dominion government visited and inspected the plant of the Hamilton Coke and By-Products Company, at Hamilton, and watched the Nova Scotia coal under test ejected out of the giant coke ovens into the special car waiting for it, throwing out sparks and blazing in the wind, saw the car run down to the apparatus where the coke was drenched with water, and watched the dense clouds of smoke that concealed car and everything in the vicinity from view, during the course of inspection of the plant whose success means so much to every householder, for as the Hon. Charles Stewart stated, supplies of anthracite to Canada in the near future will be cut off; and the coking process will be a great step in the solution of the fuel problem of Ontario and Quebec.

The party visited the boiler house where the Cox stoker utilizing the coke breeze which cannot be used in the process, heated the steam which goes into the making of the blue gas; climbed the ladders to the top of the various plants, climbed down into smokey and black rooms, beneath the boiler room, and watched the operations whereby the by-products of tar and ammonium sulphate are obtained, and observed the tests of the four car loads of Nova Scotia and New Brunswick coal, in which the Minister of the Interior and Mines, and the Dominion Fuel Board is intensely interested, for it points the way to Ontario and Quebec homes being heated by Canadian fuel.

The party consisted of Hon. Charles Stewart, minister of Interior and Mines; Dr. Charles Camsell, M.E.I.C., chairman of the Dominion Fuel Board and deputy minister of mines; John McLeish, M.E.I.C., director of the Mines Branch of the board; R. E. Gilmore, superintendent of the Dominion Fuel Board's testing laboratories; B. F. Haanel, M.E.I.C., fuel board laboratories; C. P. Hotchkiss, A.M.E.I.C., secretary of the Dominion Fuel Board; J. H. Landt, expert on coke plant construction; J. Wallin of the British Empire Steel Corporation; R. King, Toronto, manager of the Dominion Glass Company, and Wm. Ainslie chairman of the Hamilton Harbour Board.

The plant is directed by the Somet Solvay Company, Syracuse, New York, and is one of the largest coke oven plants in the world. It is considered the last word in coke-oven plants, and is superior to anything which has been erected so far on the continent.

R. A. Foley is superintendent for the construction of the Somet Solvay Company, and P. V. Byrnes, president of the Hamilton Coke and By-Products Company has been the moving spirit in promoting the enterprise, and a great deal of the credit for its construction here belongs to him. Mr. Byrnes has visited most of the coke oven plants on the continent before he decided to adopt the principles used in the Hamilton plant now in operation.

The chief feature of the plant is its flexibility of operation. On a few hours' notice the quantity of gas produced can be increased very materially, as the following figures will show. At ordinary speed the plant will coke 325 tons of coal a day, and from this quantity of coal 230 tons of coke is produced. About two million cubic feet of gas is produced at the same time, and at a few hours' notice with the same consumption of coal the plant can be made to produce three and a half million cubic feet of gas.

At maximum speed of operation it is capable of carbonizing 550 tons of coal a day, producing therefrom a gas output between five and a half to six million cubic feet. This flexibility is of very great advantage where the summer demand for coke falls off.

The plant saves the tar and ammonium sulphate that is produced. The tar is used for road building material, fuel, analine dyes and roofing materials, while the ammonium sulphate is used for fertilizer.

It produces 125,000 gallons of tar, and 400,000 thousand pounds of sulphate of ammonia per month. For million pounds of structural steel was used in its construction and two and a half million brick, over half of the latter being purchased in Hamilton. All the material in its construction wherever possible, was purchased in Canada. There is over one mile of standard railway track at the plant.

The plant has been running in first-class shape, which is proved by the fact that the coke it has turned out so far has run only five per cent of ash. The anthracite coal now in use usually runs about twenty to twenty-five per cent ash.

New plant of the Hamilton By-Products Coke Ovens, Limited, Hamilton, Ont.

About eighty-five men will be employed on the plant, which will operate in three eight-hour shifts. It represents an investment of four million dollars. Through the United Gas and Fuel Company it will supply the city of Hamilton with gas, and it is intended eventually to scrap most of the old plant. The product will sell at $14.00 per ton, delivered.

It is claimed that the by-products coke, which is superior to ordinary gas house coke, has equivalent or even greater heating value than anthracite. It gives a quick, hot fire, and with little attention, it can be made to last over night. The fuel is clean, with no dust, soot or gas, and is suitable for furnaces, grates, stoves and ranges.

At the conclusion of the inspection, C. P. Hotchkiss stated that the government experts would remain in Hamilton for about a week, and would continue their experiments with Nova Scotia coal and also the New Brunswick coal. The latter has never yet been put to a thorough government test, and the experts will experiment with various mixtures of the Canadian coals. Mr. Hotchkiss expressed himself as being keenly interested in the results obtained with the New Brunswick coal. A lot of samples will be taken by the experts to Ottawa when analyses will be made and the results co-ordinated.

Asked how the success of these experiments would affect the use of Canadian coal, Dr. Charles Camsell said that it was a question of transport. With opening of the St. Lawrence waterway and the Lachine canal, he said, it would be quite within the bounds of possibility that coal from the maritime provinces would be used in Hamilton.

Handling Coal with Gondola Car Dumper

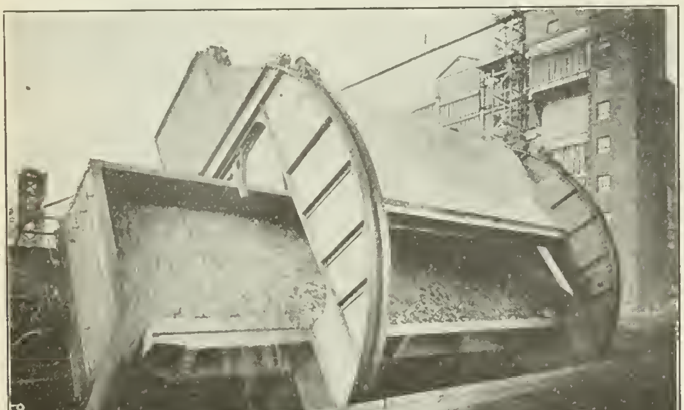
Dumping a fifty-ton car of coal in one minute ten seconds, with only one, unskilled man and a 35 h.p. motor, is the feat being performed daily by the gondola car dumper recently installed at the new Cahokia plant of the Union Electric Light and Power Company, St. Louis, Missouri, according to the statement of the manufacturers of this equipment.

The operator of the car dumper has but one controller handle to operate, which is of the drum type, and while it provides speed control its primary function is the starting of the rotating motor. All other operations are cared for automatically by limit switches.

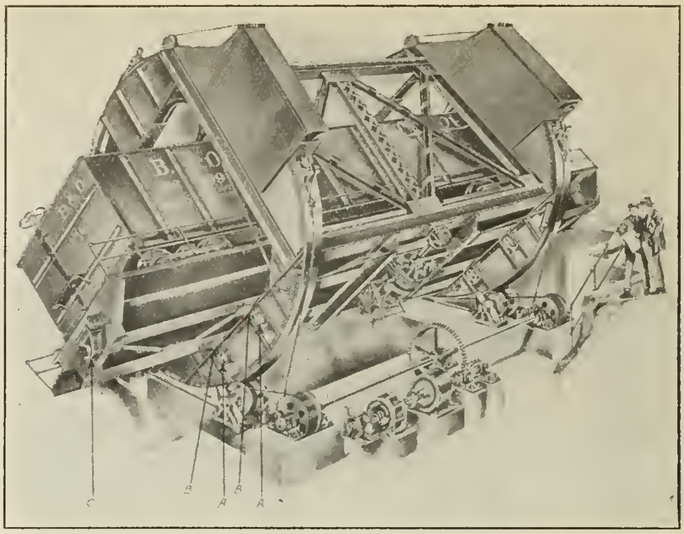
The gondola car dumper is made up of two distinctly separate structures; the two roller rings, twenty-four feet in diameter, and the transfer table of platen upon which the car stands. The transfer table is carried on four rollers, two in the plane of each roller ring. The track for the rollers consists of four wedge shaped or beveled castings, attached to the under side of the transfer table. The rollers (A) and the bevel castings (B) are to be seen in the accompanying wash drawing.

The bevel of these castings is such that the transfer table, with the car, would move over to the side support if it were not restrained. It is held in place, however, by the hook shaped casting (C) fastened to the ends of the transfer table. Each of these castings engages a roller which is an integral part of the foundation.

As the dumper starts to rotate these hook shaped castings remain in contact with the rollers, serving as a retarding device for the transfer table. That is, there is a relative movement between the transfer table and the rest of the dumper, until the car has reached its side support. The angle of the beveled plates, which causes the platen to move towards the dumping side simultaneously with the rotating movement, is approximately six degrees and the distance of car travel from six to twelve inches, depending upon the width of car.



Gondola Car Dumper in operation



Gondola Car Dumper

With the return movement the reverse of these operations takes place. The car remains supported by the side structure until the hook shaped castings engage the rollers. After engagement, the continued rotation of the dumper causes a force or pressure to be exerted between the rollers and hook castings which is sufficient to push the transfer table up the slight incline made by the slope of the beveled supports and to perfectly align the rails.

Extreme care was used in determining the amount and correct location for the counterweights used and the result has been the minimizing of the power requirements, the rotating motor being 35 h.p.

The gondola car dumper was designed, manufactured and erected by the Link-Belt Company of Chicago.

Elements of Engineering Thermodynamics

By J.A. Moyer, J.P. Calderwood, and A.A. Potter

Reviewed by Arthur R. Roberts, M.Sc., A.M.E.I.C.,
Associate Professor, Department of Mechanical Engineering,
McGill University, Montreal, Que.

This book is designed for use as a text by students in a junior year and is intended to bring out the fundamental principles of thermodynamics which underlie the action of heat-power apparatus.

Of the ten chapters, three are devoted to the properties of gases and a study of gas cycles, three to vapors and vapor cycles, one to entropy and entropy diagrams, one to the flow of gases and vapors and one to the applications of thermodynamics to compressed air and refrigerating machinery.

Diagrams and examples worked out in the text are freely used for illustrative purposes and a large number of problems are included as exercises.

The book is published by John Wiley and Sons.

A Diesel-Driven Motor Car Ferry For Victoria

The great increase of motor traffic to and from Vancouver Island was the cause of the building of a special motor car ferry which has capacity for 45 motor cars and their passengers. In several ways the design of this unique vessel is exceptional. Cars are carried on both lower and upper decks, and to make the former accessible a ramp was installed admidships which will enable cars to climb to it under their own power.

This ferry has a length of 170 feet, a breadth of 42 feet, and draws 11 feet of water. The hull is of wood.

The propelling machinery consists of two sets of six-cylinder four stroke-cycle 600-brake-horsepower marine Diesel engines, which on trial tests gave the ferry a speed of 14½ knots per hour.

In addition to the accommodation for 45 cars, there is a comfortable dining saloon with a maple floor so that the passengers can plan their itinerary with a view to dining and dancing while crossing to the Island. The ferry is provided with electric lighting, hot and cold water, and heating devices. In general appearance she resembles an ordinary steamer more than a ferry. In spite of the necessity of designing her for a maximum deckload capacity.

BRANCH NEWS

St. John Branch

W. J. Johnston, A.M.E.I.C., Secretary-Treasurer.

The annual meeting of the Association of Professional Engineers of the Province of New Brunswick was held in St. John on January 30th. The result of the election of officers for 1924 is given elsewhere in this issue of *The Journal.*

B. M. Hill, M.E.I.C., president for 1923, presided at the meeting. In his retiring address President Hill spoke of the present standing of engineers in the community having been raised as a result of the formation of the association. He stressed the prospects for a greater need for the services of all branches of engineering work in the future with the possible exception of railway construction, with a consequent greater employment of engineers in Canada.

The registration of attendance was thirty-eight. After discussion of routine business of the association the chair was taken by F. O. Condon, M.E.I.C., newly-elected vice-president in the absence of G. G. Murdoch, M.E.I.C.

St. John Branch Dinner

In the evening the St. John Branch of *The Engineering Institute* held a dinner which was attended by several members attending the annual meeting of the association. The place of the gathering was the Union Club, with H. F. Bennett, A.M.E.I.C., acting as toast master. The menu card contained a number of appropriate quotations from Burns, as the date nearly coincided with the anniversary of Bobbie Burns' birthday.

The toast to the King was observed with musical honours. In proposing the toast to the Association of Professional Engineers of the Province of New Brunswick, C. C. Kirby, M.E.I.C., traced the growth of the association from its formation four years ago and compared its progress with that of similar bodies in the other provinces. In replying B. M. Hill, M.E.I.C., the retiring president, spoke in particular of the work of the association during his year in office. Engineers had at last, he said, as a result of the associations of professional engineers in the several provinces, assumed the status of professional men in the eyes of the public; this had long been due the engineer.

R. H. Cushing, M.E.I.C., proposed the toast to *The Engineering Institute of Canada.* Mr. Cushing spoke of his association with the Canadian Society of Civil Engineers almost since its formation and dealt briefly with early events down to the absorbing of the Society in *The Institute.* Alex. Gray, M.E.I.C., replied to the toast. As a visitor at the annual meeting in Ottawa the speaker related the several events he attended and gave his impressions of the meeting in such a way that the members who had not attended realized they must have missed something worth while. Particular mention was made of the growth of *The Institute* during the past ten years from a struggling society with a scattered membership throughout Canada having little cohesion among its members or headquarters in Montreal to a present membership of over 5,300, in twenty-four branches at centres of population in Canada. As a native Scot, the speaker related at his own expense how the author of "The Deserted Village" on a visit to Scotland received the inspiration for his poem by happening to visit the city of Aberdeen on a tag day.

G. C. Torrens, A.M.E.I.C., replied briefly for the Moncton Branch, and Professor Stephens of Fredericton also spoke. Singing, college yells, and Scottish songs by J. Simpson, in Highland costume, added to the evening's enjoyment.

Ice Formation and Prevention

On the evening of February 12th, the St. John Branch had the privilege of hearing Dr. Howard T. Barnes, D.Sc., F.R.S., of McGill University, deliver his illustrated lecture "Ice Formation and Prevention".

Winter floods recurring annually due to ice backing up water on St. Lawrence river did enormous damage to waterfront property of towns along the St. Lawrence and made imperative an intelligent study of ice to make possible its control. The lecture is a condensed study of experiments made with ice conditions largely on the St. Lawrence practically since 1895, and in particular during 1905-07 when the lecturer made investigations at request of Montreal Harbour Commission.

Early experiments were carried on to learn the conditions governing ice formation. From a hut built on the ice a study was made with an electric-resistance thermometer of the temperature of the water at different depths. This led to a study of the different kinds of ice found at surface and under water. Comparisons of temperature of air and water at surface disclosed conditions when ice formed at surface and the important fact that slight changes of water temperature amounting to hundredths of a degree around freezing point either made for or prevented ice forming.

Surface ice was shown to be formed by temperature of water falling below freezing point, that it was formed by conduction, its thickness depended on temperature, it formed very slowly, and it was very sterile and free from salts. The freezing of water was claimed to eliminate bacteria equal to a sand filtration process of water purification. The crushing strength of ice was claimed to be about 400 pounds per square inch at either right angles or parallel to ice crystals (grain). The cracks in ice were V-shaped and changed with temperature variation; by minute instruments the width of crack could be measured at different temperatures and a graph plotted over different ranges of temperature.

Anchor ice forms on the bottom of a river or stream and usually around the weeds or plant life. It frequently breaks away from the bottom and rises to the surface in large cakes so as to be a menace to navigation.

Frazil ice was shown to be formed of ice needles held in suspension in the water, and to be caused largely by rapids in a river where the spray freezes. The frazil ice forms ice dams as much as 60 feet deep and may also stand from 10 to 15 feet out of water. The frazil ice by retarding the normal flow of water interferes with power development and in earlier years plugged many a turbine, frazil being very sticky and adheres to anything it touches. At present turbines are built large so they will pass large blocks of ice.

The variation between summer and winter discharge of a stream is a limiting factor in water power development and is largely due to ice. Many devices have been tried to overcome ice conditions at the power house, — some canals leading to power house are not allowed to freeze over; at others the design of the intake limits velocity of water entering turbine to one mile per hour so ice is not sucked down from the surface.

The closed season of navigation on the St. Lawrence is shortened by steamers known as ice-breakers; in late years the "Montcalm", "Lady Grey," and the more powerful "Mikula" (formerly "J. D. Hazen") have been so engaged. These ice-breakers cut open-water lanes through the ice sheets and by breaking up jams hasten the departure of the ice from the river. It is an advantage to have ice-breakers work in pairs when a wider lane may be cut and one helps to free the other when it becomes stuck in the ice.

The iceberg broken off from a fiord in Greenland drifts southerly with the Arctic current at a rate of from 10 to 30 miles per day and may take two years to reach opposite Newfoundland. Here the path followed by the iceberg gradually widens fan-shaped to its lower limit in the Atlantic some distance beyond Newfoundland. In northern waters the iceberg is large and easily seen, but as it moves southerly it desintegrates into several smaller ones which are largely below the surface and become scattered over a wider area. The speaker claimed the northern lane of navigation through the path followed by icebergs in the Atlantic was narrower and consequently safer than the southern lanes from American ports to Europe where the danger zone was much wider, and the insurance rates in favour of the southern Atlantic route are an unfair discrimination against Canadian ports.

The lecture was not confined to ice conditions on the St. Lawrence. A number of slides gave an idea of ice conditions on the river Neva in Russia. The effect of ice conditions on the Rock river in Illinois was noted, and where a crop of ice 18 inches thick two miles downstream had been harvested before the establishment of a cement works, after the warm discharge from works entered the river a crop of ice could not be obtained at site where formerly ice was obtained.

On February 13th, Dr. Barnes spoke at noon luncheon to Rotary Club in Fredericton on the diversion of Great Lakes water into Chicago drainage canal with its adverse effect on power and navigation interests on the St. Lawrence. In the afternoon he repeated the lecture "Ice Formation and Prevention" before the Engineering Society at the University of New Brunswick.

Victoria Branch

E. P. Girwood, M.E.I.C., Secretary-Treasurer.

A very successful luncheon attended by practically every engineer in Victoria was held in Spencer's dining-room on January 19th. The luncheon was in honour of F. M. Preston, A.M.E.I.C., city engineer, in order to congratulate him on the successful completion of the Johnson Street bridge.

The chair was occupied by F. C. Green, M.E.I.C., chairman of the branch. Addresses, expressing appreciation of Mr. Preston's work, were given by P. Philip, M.E.I.C., chief engineer, Public Works Department, by his worship Mayor Hayward and by G. B. Mitchell, M.E.I.C., western manager for the contractors on the construction on the Esquimalt drydock.

Mr. Preston responded, and gave credit for the success and perfect working of the bridge to the loyal co-operation of his assistants Mr. Icke, Mr. Allwood, and others.

E. P. GIRWOOD, M.E.I.C.,
Secretary-Treasurer, Victoria Branch.

The gathering was also addressed by W. W. Fraser, president of The Professional Engineers' Club of Vancouver, and by F. H. Allwood and H. A. Icke, A.M.E.I.C., J. R. Reid, A.M.E.I.C., and R. J. Leckie, visiting engineers from Saskatchewan.

Address by P. Philip, M.E.I.C.

Gentlemen:—

I am glad and proud to be present at this luncheon in honour of our brother engineer, Mr. Preston. It is indeed a healthy sign to be gathered together as we now are. It shows that we are emerging from that attitude of quiet reserve so common in engineers in general, and that we are, by our meeting here to-day, breaking down that reserve. R. L. Stevenson aptly described engineers when he said: "Engineers are practically the only ones who have anything to worth saying and don't know how to say it". I often reflect and wonder why engineers are so reserved, and I thought possibly one of the reasons is, that engineers in their daily practice, are concerned mainly with the forces of Nature, and in the contemplation of Nature, whether in the harnessing of water, or combatting the actions of the wind and tides, we silently and with reserve reflect on the words of the Psalmist, "How wonderful are Thy works, Oh Lord!"

I have always been intensely interested in bridges, particularly the substructure. At the opening ceremony I wondered how many of the great mass of people driving over the bridge thought of the substructure. There is nothing spectacular, no ringing of bells, connected with the work being done by the mass of concrete carrying the huge spans. The great majority naturally, are only concerned with the finely balanced bascule. How many care to take the trouble to examine the handiwork of the men who toiled in the cofferdams, work that demands skill in design, for the relentless tide will not tolerate any slipshod short cut methods.

Mr. Preston is to be congratulated, and on behalf of the Victoria Branch of *The Engineering Institute of Canada*, I am proud to offer sincere congratulations for his having completed the work so successfully, I would go further and congratulate the civic administration on having as the engineer a man of Mr. Preston's outstanding ability. This fair city, with its maximum hours of sunshine, with its miles of well-paved streets and beautiful boulevards, is in capable hands. The city has many problems ahead, and in these Mr. Preston may rest assured that he has the sympathy, and will receive the support at all times of the engineering fraternity.

As Lord Rosebery said, "We grope blindly along the catacombs of the world; we climb the dark ladder of life; we feel our way to futurity". But in doing so it is a comfort to us that our fellow men are interested in our progress.

Should Engineers enter Parliament ?

Apparently not, as they are unable or unwilling to rise to the occasion and make political capital out of statements giving excuse for misconstruction.

Suppose the following words had been used on the floor of any House (it was really on the occasion of a complimentary luncheon to a fellow engineer upon completion of a bridge across the harbour).

Chairman: It is my intention to call upon the member from Vancouver to address you. An order for some old "Port" was sent there recently, but being without the necessary mature article, they replied to that effect with the qualification that if desired, they would manufacture it specially. As showing the progressive spirit of that place he knew any remarks the member made would be of great interest.

Member for Vancouver: It being my privilege to address the members at this gathering, I must first disclaim any interest in the "Port" of Vancouver.

An engineer aspiring to political honours should have made capital out of such an obvious remark in favour of Victoria, at the expense of Vancouver, in some such manner as this:—

Member for Victoria: "Mr. Chairman, Gentlemen, I am unable to refrain from expressing my surprise that the member for Vancouver should make the statement which you heard him make a few minutes ago. We are discussing a matter of vital interest to the welfare of our harbour, and one that has claimed our attention for many years before it has been possible to bring it to fruition. What opinion will the electors in the members' constituency have when his statement is brought to their attention? I will recall his words to you: he said, "I have no interest in the "Port" of Vancouver". Those were his words, sir. Could any other words incite us more than those to redouble our efforts on our own behalf. But let me inform the honourable member that that is not the way we look upon our own "Port", we do honour, as this gathering will testify to all, those who have the courage to plan and execute works of monumental utility for the benefit of the "Port" of Victoria."

Needless to say, no one took advantage of the situation to make fame for himself at the expense of a fellow engineer.

Destructive Marine Organisms

A diligent reader of the engineering press will probably have noticed a curious and interesting item of information in connection with the activities of marine organisms at San Francisco. The harbour authorities of that famous city, in conjunction with the National Research Council, have recently reported the increased activities of these organisms in their attacks on marine structures in the harbour. They state that since a destructive attack on the dykes of Holland in the fifteenth century, the activities of marine organisms have attained a maximum at intervals of about fifty years, and at the present time one of these maxima is being experienced.

Previous observations of their destructive effect have been generally limited to timber structures, but in the present instance they are reported to have successfully attacked concrete. It has been found in San Francisco that timber piles, which had been fitted with concrete jackets for their protection against certain organisms, have had these jackets bored through by other organisms leaving the interior piles exposed.

Some of these concrete sheathings have been found to be infested with a borer which is stated to bear the name of pholadidea penita. The authorities mentioned above point out that they had spent a great amount of time and money in arriving at the mixture of concrete best suited to resist the action of sea water, but they did not anticipate provision would also have to be made against the attack of marine organisms as now is shown necessary.

Some eighteen months ago a report on a similar matter was received from New York, but in this earlier report the organism concerned was the teredo navalis or common ship-worm, whose methods and activities were better known and are restricted to timber structures. The New York authorities reported it had been found that this organism had entered the harbour, had multiplied with extraordinary rapidity, and it was recommended that for protection against their desperations, all wooden structures liable from their position to attack should either be creosoted or treated with corrosive sublimate. The two reports indicate the increased activity of these destructive organisms.

Hamilton Branch

W. F. McLaren, M.E.I.C., Secretary-Treasurer.

The Hamilton members journeyed to Brantford on Friday, January 18th, 1924, as guests of the members in Brantford, Galt, Kitchener and Simcoe. Capt. F. P. Adams, A.M.E.I.C., met the party and conducted them to the Y.W.C.A. hall, where he extended a hearty welcome to all present and turned the meeting over to J. W. Tyrrell, M.E.I.C., branch chairman.

Engineering Achievements in Canada

After songs from Mr. Walker, Prof. Peter Gillespie, M.E.I.C., was called upon for his address, "Engineering Achievements in Canada in the Last Half Century". What has been accomplished is truly marvelous and is due to the virility of her people and her wonderful natural resources.

We owe a great deal to Portland cement first discovered in England about 100 years ago. Steel is another of our most valuable materials, entering into all modern structures. Power is essential for industrial supremacy and Canada is well supplied with hydro electric energy. We realize that thoughtful men are studying the question of sources of power when so eminent an engineer as Sir Charles Parsons suggests tapping the center of the earth to extract its heat.

Starting at Halifax, we see the wisdom of Joseph Howe in laying the foundations for a port there. Today we see his dreams being realized. The Champlain drydock in the St. Lawrence at Quebec and the great Ballantyne Pier at Vancouver indicate what is being done for shipping elsewhere. Last year 20 million bushels of grain were shipped to Liverpool from Vancouver via the Panama. Other achievements along this line are the Welland canal, the Canadian lock at the Sault and the Peterboro hydraulic lift lock.

In 1871, British Columbia entered confederation on condition that she was connected by rail with the east, which resulted in the building of the C. P. R. Sir Sanford Fleming's original survey was laid out through the Yellow Head pass, but Sir William Van Horn preferred the more southerly route through the Kicking Horse pass.

The Canadian Northern Railway afterwards followed the Fleming route. Then the Grand Trunk Pacific was built, so that now railway building has been overdone to the extent of about 22,000 miles, with 5,000 miles of duplicate lines.

At the Kicking Horse pass, snow sheds had to be built to protect the line. These have now been replaced by the Connaught tunnel, 5 miles long and under nearly a mile of rock.

Between Hector and Field two spiral tunnels have been driven and though the length of haul has been doubled, the grade is nearly cut in half, from 4.5 per cent to 2.2 per cent which is the ruling grade of the C. P. R. The C. N. R., has the remarkably low grade of 0.7 per cent.

It is noteworthy that of some fifty engineers on Fleming's staff during the building of the Intercolonial, five are still living. They are Henry J. Cambie, M.E.I.C., at Vancouver, Hiram Donkin, M.E.I.C., at Halifax, General Ruttan at Winnipeg, Mr. McGee at Ottawa and James B. Hegan, M.E.I.C., at Charlottetown, P. E. I.

The Victoria tubular bridge was built in 1860 across the St. Lawrence above Montreal by Robert Stephenson. The new truss bridge replacing this is built upon the same piers made wider. The C. P. R., bridge across the St. Lawrence above Lachine, was built in 1887. This was afterwards replaced by the present bridge. The suspension bridge at Niagara Falls was built by Roebling and replaced by the present single arch bridge in 1897. Other large bridges are the Michigan Central's cantilever bridge at Niagara Falls, the Lethbridge viaduct, 300 feet above the valley, the Toronto Bloor Street viaduct, and the Otonabe River bridge at Peterboro.

A remarkable dam, known as the St. Andrews dam, has been built below Winnipeg to improve the navigation. By lowering steel frames and wooden curtains in the summer the water level is raised 6 feet at Winnipeg and 20 feet at the dam. The C. P. R., has laid out large irrigation schemes, notably the Bassano dam at lake Newell, and the Brooks viaduct, which carries a steel trough 20 feet wide and 9 feet deep, delivering 900 cubic feet, per second, at Okonagon, near Penticton, B. C. This trough is of such a shape as would be taken by canvas filled with water.

Hydro-electric power on a large scale is developed at Shawinigan Falls and Grand Mere, totalling 250,000 h. p. At Three Rivers the transmission line crosses the St. Lawrence suspended between steel towers 300 feet high, so as to clear navigation, and having a span of between 5,000 and 6,000 feet. The Chippawa development of the Hydro-Electric Power Commission carries water from Chippawa creek above Niagara to Queenston, where a head of over 300 feet is obtained and 500,000 h. p., may be developed. At Point du Bois, Winnipeg has built a municipal plant of 90,000 h. p., and sells power at 3 cents per k. w. hr., where the price used to be 20 cents. The B. C. Electric Railway Company, developed a head of 400 feet, by tunnelling from lake Coquitlam. The Jordan River plant on Vancouver Island has a head of 1,150 feet. Winnipeg was troubled with the hardness of its water supply and spent 13 to 15 million dollars in getting water from Shoal lake which is soft. The saving to the householder more than compensates for the expense.

A highway is being built from Banff to Windermere through the most beautiful Rocky mountain scenery. When it is realized that from 300 to 400 million dollars a year is said to be spent in Canada by tourists, we can see the justification for such highways.

It may be said that from the time a man rises in the morning and takes his bath, until he retires at night and turns off his electric light, he is in constant touch with the work of the engineer.

The lecture was illustrated with an excellent set of slides, which told more than can be put in words.

At the close of the lecture a telegram from London was received announcing that the Grand What'l y'er would arrive at 10 p. m. to perform an initiation. Great excitement prevailed and the intervening time was filled in with solos by Mr. Walker and short remarks from others. At 10 p. m. the initiation was pulled off much to the amusement of those present, and after light refreshments and a vote of thanks moved by Charlie Marrs, M.E.I.C., and seconded by E. H. Darling M.E.I.C., the meeting closed.

The attendance was about seventy. The next meeting of the branch will be February 14th, when Germain P. Graham of the Asphalt Association of New York will speak on "Asphalt Paving".

At the meeting in the auditorium of the Technical School, on January 14th, 1924, an excellent address was given by Germain P. Graham, on asphalt paving.

Asphalt Paving

Mr. Graham said that asphalt was the oldest known waterproofing material. It had been used by the early Romans and on the streets of Babylon. Asphalt occurs naturally in petroleum or is obtained by distillation. When it occurs at or near the surface of the earth it is called native asphalt, and when distilled, petroleum asphalt, which is nearly pure bitumen. It can be dissolved in carbon bi-sulphide. The production was fairly constant until 1913, when heavy Mexican petroleum was placed on the market and now over 1,000,000 tons is produced annually.

Road oil with suitable solvent can now be supplied to suit any kind of pavement. It is now supplied with a high melting point so as not to be affected by summer heat. Only about 1.75 gallons per square yard of pavement is necessary.

Pictures were also shown illustrating different types of road construction, including the new highway between Hamilton and Toronto, which is a very fine type of engineering.

Moving pictures were shown of the latest plant construction for melting, mixing and applying the materials while hot, as well as best methods of rolling, both lengthwise and crosswise where possible.

Mr. Graham urged that the engineer should be allowed to decide the type and design of road to be used in any given case and not over-ruled by laymen. Canada has millions of tons of asphaltic sands, mis-named tar sands, which has been successfully used in Edmonton but were not economical to transport owing to the sand content.

Asked regarding comparative costs of asphalt and concrete, the speaker said that they had a case in Michigan where the asphalt was $6,000. per mile cheaper than concrete, with a five year guarantee for the asphalt against no guarantee for concrete. In another case asphalt cost $35,000. per mile against $60,000. per mile for concrete.

He strongly condemned placing pavements over new trenches and said they were endeavouring to have double lines of sewer and water mains placed at the sides of streets.

Mayor Jutten and members of the works department of the city were present and took part in the discussion.

During the evening, the students' prize awarded to J. R. Dunbar, Jr.E.I.C., for paper on "Local Transportation by Rail" was presented by J. W. Tyrrell, M.E.I.C., chairman of the branch.

The following Nominating Committee was chosen: F. H. Hubbard, A.M.E.I.C., (chairman), A. H. Munson, A.M.E.I.C., H. S. Philips, M.E.I.C., J. G. Campbell, A.M.E.I.C., A. R. Hannaford, A.M.E.I.C., H. B. Dwight, A.M.E.I.C., and the Secretary.

Kingston Branch

A. Jackson, A.M.E.I.C., Secretary-Treasurer.

Water Supply

On January 28th, the Kingston Branch held a joint meeting with the Queen's branch of the Canadian Institute of Chemistry, with Professor W. P. Mason of the Renssalaer Polytechnic Institute, Troy, N.Y., as speaker. Professor Mason spoke on water supply and showed in a number of cases how an epidemic of disease in a community has been traced to impure water; why the supply had become contaminated and the measures taken to improve it.

Spot maps, that is a plan of the city or town with the location of the cases of disease marked, give an indication as to what the epidemic may be traced. If the spots are in a tenement area and the time is summer, it may be the cause is flies, or if the spots follow along certain streets only, it may be due to milk supply, which can be checked up by noting the milkman doing business in the area, and obtaining their lists of customers. If the disease is spread over the whole city, the water supply in all probability is at fault. The city of Erie had typhoid cases spread in this manner and the cause was traced to an old intake, which had not been completely closed up. The intake in use close by had about a thousand gallons per day leakage from the old one added to it, with the resulting typhoid. In the opinion of the speaker, old intaked should be closed up in such fashion as to make it impossible to use them again, even at an increased fire risk.

The city of Albany installed a filter at the cost of three quarter of a million dollars, which cut down cases of typhoid 95 per cent, but they had an epidemic due to the surface of the ground becoming covered with a glaze of ice, followed by cold rains, which washed refuse into the river, impairing the efficiency of the filter.

Maidstone, Kent, England, draws its water supply from soil pipes sunk about six feet in the ground, but the deep cracks in the dry earth in the summer almost expose the pipes. Farm labour was brought in from London one summer and they lived in the open. The refuse from these people got in the water supply, which resulted in an appalling typhoid epidemic.

Water is often contaminated with plankton under favourable conditions, and although it is harmless, the odor and taste resulting are not pleasant. This form of life may be destroyed by rowing a boat through the reservoir, trailing a bag of copper sulphate. The amount of copper sulphate left in the water is harmless to those drinking it.

Professor Mason pointed out that an epidemic of typhoid in the fall need not be so alarming with reference to water supply, as one at any other time of the year, since it may be due to flies or people returning from vacations bringing typhoid with them.

Radio

D. G. Geiger, S.E.I.C., of Queen's University, gave a very interesting lecture on "Radio" at the meeting of the Kingston Branch on January 15th. Mr. Geiger first defined inductance, capacity and an oscillating circuit giving parallel cases in mechanics to make these principles clear. A receiving set was built up and different methods given to obtain the best results. The theory that in any substance there are numbers of free electrons or electrons that may be fairly easily freed from the atoms, and that these electrons constitute electric current, was explained, and this used to make clear the action of amplifier and detecter tubes.

Niagara Peninsula Branch

R. W. Downie, A.M.E.I.C., Secretary-Treasurer.

Members and their guests, to the number of about two hundred, gathered at the Adoniram hall, Niagara Falls, Ontario, on the evening of February 1st. Dancing was indulged in till a late hour, and a very enjoyable time was spent. To the dance committee, the social leaders of the branch, are due congratulations for the excellent way in which they planned and executed all the little details, which go to make a success of a function of this kind.

Dinner Meeting

The regular monthly dinner meeting, for the month of February, was held at the Welland Inn, St. Catharines, on February 12th.

Germain P. Graham, formerly of the Engineering Department of the city of Albany, N.Y., representing the Asphalt Association, spoke on "Asphalt". To a small but appreciative audience, composed of members of the branch, and interested members of the local municipal staffs, the speaker described the development of asphalt through the ages, showing the enormous strides which have been made in the last few years, in the preparation and use of asphaltic products. With particular reference to highway construction, the speaker showed an interesting collection of slides of Ontario roads, improved by various asphaltic treatments.

Lethbridge Branch

Geo. S. Brown, A.M.E.I.C., Secretary-Treasurer.

Another successful meeting was added to those held by the Lethbridge Branch on Saturday, January 26th. The speaker of the evening was Jno. H. Turner, M.E.I.C., consulting engineer, who read a valuable paper on "Mining in Southern Alberta". R. Livingstone, M.E.I.C., and J. B. de Hart contributed valuable discussions of Mr. Turner's paper.

The splendid manner in which the meeting was conducted by Chairman John Dow, M.E.I.C., and the feature of the community singing were commented upon by one of the visitors, A. L. Ford, M.E.I.C., district chief engineer, Dominion Water Powers Branch. Other visitors were Manager Quigley of the North American Collieries, Coalhurst and Mr. Kelly of the C.P.R. Wm. Meldrum and R. Lawrence contributed splendid solos.

Border Cities Branch

F. Jas. Bridges, A.M.E.I.C., Secretary-Treasurer.

The regular meeting of the Border Cities Branch was held in the Prince Edward hotel at seven o'clock.

The Financing of Public Utilities

The speaker of the evening, O. E. Fleming, K.C., was then introduced by Chairman J. E. Porter, M.E.I.C. Mr. Fleming chose as his subject "The Financing of Public Utilities".

In a few introductory remarks the speaker said that next to law as a profession, he considered engineering to be the most important and if there had not been any lawyers he would have been an engineer. The engineers of Canada are the men upon whom falls the responsibility of the future development of Canada, due to the vast stores of natural wealth yet undeveloped. It was the engineers who undertook to build the Canadian Pacific Railway across Canada, a feat which is one of the greatest of the world. An article, emanating from England, told of a representative of financial interests of Great Britain, visiting this country and on his return stated that Canada was destined to be the greatest gold-producing country of the world. It is therefore up to the engineers of Canada to develop the natural resources and they must appreciate the responsible burden they carry.

The speaker illustrated by two or three examples of how financial interests went about to finance these utilities. The engineer must be made to appreciate the fact that the getting of money by the financiers is based upon the report of the project as made by the engineer.

Several problems enter into the financing of public utilities. Among these are franchises, patents and goodwill rights. The development of water power is one of many public utilities that is promoted by financiers. Considering it as a commercial proposition the promotor first ascertains if it will have a good market. He then calls in the engineer to make a report to determine if it is feasible to develop the power at a price which will produce a profit to the investors. The engineer calculates the ultimate cost of the power by considering the cost of development and the cost of transmission. If the report is favourable, the financial man knowing the estimated cost and if it is marketable, then takes hold and prepares a prospectus. The proposition must be sufficiently attractive to start the issuing of bonds, which will take care of overhead expenses, capital and a sinking fund. The bonds, if issued say at the present-day market value of money, would yield 6 per cent. The project must show on the face of it that it is able (1) to take care of the overhead, (2) take care of the interest on the bonds, (3) take care of the interest on the preferred stock. In selling the preferred stock, probably 25 per cent or 50 per cent of common stock is also given, to make it attractive. The scheme is generally worked out so the holder of the common stock will get dividends after three or four years. A splendid example of the way stock of a public utility often increases in value is that of the Canadian Pacific Railway. Stock which originally had a value of 25 cents on the dollar and to-day is up around $3.80. The holder of the common stock takes most of the risk.

The speaker then stated two of the greatest public utilities to be developed in the present day are the St. Lawrence power and canal project and the by-product plant of the Ford Motor Company of Canada. If this latter project proves successful it will be a great public utility waiting to be floated.

Ths speaker then dealt with the effect of public ownership of public utilities on the financing of privately owned utilities. He discussed the proposed St. Lawrence power and canal project from various angles, dealing at some length with the scheme worked out by Mr. Harriman, president of the New England Power Company, as a result of a visit to Boston by delegates of the Deep Waterways Association. In conclusion, Mr. Fleming remarked that the canalization of the St. Lawrence would be the greatest project on the American continent, it would revolutionize freight rates, and the West would be able to reach the world ports.

Formal Ball

In the Prince Edward Hotel ballroom on the evening of Wednesday February 6th, the Border Cities Branch sponsored its first formal ball and judging from the noteworthy success of the affair it will be an annual event to be looked forward to by the members of the branch and their friends. The platform, where Shook's popular orchestra played, was artistically decorated with palms and ferns. The hotel ballroom has been a favourite spot for dances throughout the season and notwithstanding the many regular affairs being given at this time and also in spite of the short time the Entertainment Committee had in preparing for the event, the ballroom was well filled with a large and happy crowd.

The dancing commenced at 8.30 o'clock and continued until long after midnight. At 11 o'clock a delightful supper was served in the main dining room to the guests, and the tables were attractively centered with spring flowers. Handsome corsages were the favours for the ladies, which adorned the individual to be tables.

The Entertainment Committee which was responsible for the unqualified success of the ball was composed of A. J. M. Bowman, A.M.E.I.C., E. J. McIntyre, A.M.E.I.C., F. P. Flett, A.M.E.I.C., and K. E. Fleming, S.E.I.C. These members were given all possible assistance by the executive of the branch.

Montreal Branch

E. A. Ryan, A.M.E.I.C., Secretary-Treasurer.
W. H. Abbott, A.M.E.I.C., Branch News Editor.

Measurement of the Hydraulic Efficiency of a 43,000 h.p. Hydro-electric Unit

At the second meeting of the branch for 1924, held on January 17th, a very interesting paper was presented by W. R. Way, Jr.E.I.C., on the "Measurement of the hydraulic efficiency of a 43,000 h.p., hydro-electric unit". Mr. Way described a series of tests recently carried out at Shawinigan Falls in which two of the latest methods for measuring the flow of large quantities of water were applied. These methods are known as the pressure-time, or Gibson method, and the salt-velocity or Allen method. The paper dealt with the theories underlying each method and described tests and results obtained by using each method under similar conditions. The paper was illustrated by a number of interesting lantern slides. It is expected that this paper will be published in a future number of *The Journal.*

On January 24th, the branch had the pleasure of hearing a paper by C. F. Eveleth, chief engineer of the Warren Webster Company. Notwithstanding that a great many of the branch members were in Ottawa attending the annual meeting, the attendance at this branch meeting was above the average. The paper was very interesting and was well illustrated with lantern slides. A number of the members took part in the discussion which followed the paper, F. A. Combe, M.E.I.C., drawing attention to the difference in practice in heating in Canada and the United States and describing some investigations being made into the problem of district heating.

Over one hundred members of the branch and ladies journeyed to Ottawa to attend the annual meeting of *The Institute* held on January 23rd, and 24th, and were regally entertained by the Ottawa branch. It was found that Ottawa was not so arid as reputed, and that there was an oasis in 548.

The Financing of Water Power Projects

A. F. Nesbitt, president, Nesbitt, Thomson and Company, addressed a capacity audience at the regular weekly meeting of the branch on January 31st on "The Financing of Water Power Projects".

Mr. Nesbitt before dealing with the more strictly financial side of the subject, spoke of the great natural resources of Canada, which he considered from an industrial standpoint comprised three things, water power, timber limits and minerals. Of these he considered the most important was water power because on its development depended the development and exploitation of the others, and while the exploitation of these meant possible exhaustion the water power went on for ever.

Canada's present potential water power, he said, was from 18 million to 32 million horse-power, varying between the minimum and maximum flow of the rivers. He dealt also with the effect of the forest denudation through cutting and forest fires, which had a marked effect on the water flow.

It was also a remarkable fact that the provinces which have rich coal deposits were not rich in water power while the provinces lacking coal, such as Quebec and Ontario, were remarkably rich in hydro-electric possibilities.

Canada's water power development in 1923 was 3,228,000 horse-power or equal to 400 h.p., per thousand of population, Canada being in this respect only second to Norway. There was under construction this year a total development of 900,000 h.p. in Canada of which 600,000 h.p., was in the province of Quebec.

This hydro-electric development, he said, was essential to the progress of the Canadian pulp and paper industry as well as the mineral resources of the north lands.

On the financial side of the matter Mr. Nesbitt said that no Canadian hydro-electric company had ever defaulted on their bond interest. Practically all hydro-electric companies in Canada had been financed originally on first mortgage bonds, after which equities had been built up through surplus earnings and the sale of junior securities, such as preferred and common stock. A feature which he emphasized was that the business was largely one with customer owners, the stocks in several companies being largely held by consumers of the power.

It was essentially in the close relationship between engineering and financing that the success of hydro-electric development must be looked for. All financial houses handling such matters must of necessity have expert engineers to investigate, and advise and carry the development work through.

It was a particularly important feature of all this hydro-electric development, said Mr. Nesbitt, that the great proportion of the financing of these Canadian development companies both in the East and West had been done in Canada by Canadian investors. This had been the case so far and he hoped that it would continue, and that Canadian investors would continue to put their savings into this peculiarly Canadian enterprise. The investments and earnings should be kept in the hands of the people of this country, as it was one of the safest and soundest methods of developing the natural resources of the Dominion that existed.

At the conclusion of the paper a moving picture film was shown and the custom of serving refreshments was revived. This proved very popular and members lingered until late in the evening "to facilitate the acquirement and the interchange of professional knowledge among its members".

Executive Meeting

At a meeting of the Executive held on January 4th, the following appointments were made:—

Chairman, Railway Section, W. Walker, A.M.E.I.C.

Geo. R. McLeod, M.E.I.C., was appointed Chairman of a students' committee, with special instructions to encourage students to become interested in *The Institute.*

The following appointments were confirmed:—

Vice Chairman, Civil Section, J. B. D'Aeth, A.M.E.I.C.

Vice Chairman, Electrical Section, G. E. Templeman, A.M.E.I.C.

Vice Chairman, Industrial Section, K. O. Cameron, A.M.E.I.C.

Vice Chairman, Papers and Meetings Committee, J. S. Cameron, A.M.E.I.C.

The Decennial Responsibility of the Engineer.

The regular weekly meeting of the branch held on February 1st, was addressed by John T. Hackett, K.C., on "The Decennial Responsibility of the Engineer".

The meeting was well attended and numerous questions were asked Mr. Hackett at the close of his address.

Mr. Hackett opened his address by quoting from Article 1688 of the Civil Code which defines the responsibility of the contractor and the architect for the stability of buildings. He pointed out that in judgments based on this article the terms as given therein has been defined to cover a very wide range of interpretations, and that architect had been defined to cover engineers and designers and the term building covered every known type of structure.

The speaker referred to several cases in which engineers and contractors had been jointly sued for damage resulting from the failure of works and brought out the fact that extensions or repairs to existing structure or parts of structures, including such items as heating and sprinkler systems, were considered as buildings. He cited a case where a sprinkler system had been installed in an old building and due to the failure of an existing pipe, to which the new system had been connected, damage had been caused for which the contractor had been successfully sued by the owners of the buildings. The Court ruled that the contractor by making the pipe a part of his installation was responsible for its failure. Another case to which the speaker referred was the building of Christ Church Cathedral in Montreal on the foundations of the old church. The contractor in this case had built the church tower on an existing foundation and the tower had shown signs of failure. The contractor pleaded that the failure was due to the old foundation, but the Court ruled that the contractor by making the existing foundations a part of the new structure had assumed responsibility for the stability of the whole structure.

Mr. Hackett pointed out that the stability of all structures was directly or indirectly a matter of public interest and that the law protected the proprietor from his ignorance of engineering or construction, illustrating the principle by reference to the laws protecting a purchaser from misrepresentation on the part of a vendor.

The speaker closed his address by remarking that it was much to the credit of engineers in general and of Montreal in particular that so few failures had taken place, as, owing to the severe climatic conditions in Canada and the peculiar geological conditions in Montreal, their work was subjected to tests which might not be encountered in other localities.

Walter J. Francis, M.E.I.C., thanked the speaker for his address and mentioned incidentally a case in his experience in which the architect could not be held responsible for malfeasance on the part of the contractor; due to bad work being covered with plaster and mouldings. Mr. Francis remarked that in his opinion no suit would be taken against a contractor if it was known that he had no money and if the engineer also had no property no suit would be instituted at all. Referring to a remark of the speaker's that no engineer working on a salary had, to his knowledge, been held accountable for the failure of a structure, Mr. Francis thought that it was because there would have been no chance of collecting damages.

The Wonderland of Colour

A great number of members attended the weekly meeting on February 14th, to hear Dr. Leo E. Parizeau, radiologist of the Hôtel Dieu, Montreal, give an address on "The Wonderland of Colour". O. O. Lefebvre, M.E.I.C., the Chairman of the Montreal Branch, introduced the speaker.

Doctor Parizeau commenced by explaining the physiology of the eye and the mechanism for the perception of colour. He explained the phenomena of fatigue illustrating this by means of simple experiments, and spoke briefly on the subject of colour blindness. It was a remarkable fact that women were found to be less subject to colour blindness that men, but Doctor Parizeau thought that men, perhaps, might have a better appreciation of form. In dealing with the question of perspective the speaker said that it was generally believed that very young children did not see objects in proper perspective, but that the image appeared to them to be resting on or in the eye, this had been proven in the case of patients operated on for congenital cataract. No one with only one eye really saw objects in perspective, this being illustrated by the theory of the stereoscope. The speaker also spoke of "blind spots" and other shortcomings of the eye.

After going into the fundamental principles of colour, Doctor Parizeau gave a series of interesting demonstrations of the combination of various colours. He laid stress particularly on the laws of contrast of complementary colours and their practical applications.

It was a common belief among artists that the primary colours were red, yellow and blue, but Doctor Parizeau contended that these should be red, bluish-green and blue and showed various experiments to prove this contention.

Doctor Parizeau said that the question of proper lighting was not given the intention that it deserved, and that only in special cases such as Art Galleries were the services of an illuminating engineer called in. This was not as it should be as the question of proper lighting was of great importance.

The method of making plates for colour photography was explained and several examples of colour photography shown on the screen. A recent development in moving picture work was the taking of stereoscope pictures which when tinted, one red and the other green, and projected surimposed but slightly off coincidence gave the impression of perspective when viewed through glasses prepared with one red and one green eyepiece.

Owing to the lateness of the hour the speaker only spoke briefly on the "weight" of colours, the phenomena of "advancing" and "receding" colours and the practical application of the laws governing these.

The lecture was profusely illustrated with experimental demonstrations and exhibits of colour photography, and the clear explanations and interesting experiments together with the fluent presentation of the address held the large audience until late in the evening.

Moncton Branch

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

On Thursday evening, January 24th, the Moncton Branch held a banquet at the Barker House. D. L. Hutchinson, director for the Meteorological Observatory of St. John was the speaker of the evening; his subject being "Winds and Weather".

Mr. Hutchinson illustrated his lecture with lantern slides and explained that by taking barometric readings throughout the country each day a map could be plotted showing area of high and low pressure, centres of low pressure indicating storm centres and centres of high pressure generally indicating clear, fine weather. By daily observation of the direction in which these centres are travelling, it is possible to predict with considerable accuracy the weather for the ensuing 24 or 36 hours. Mr. Hutchinson humourously referred to the popular delusion that the actions of wild animals fortold the weather for months in advance, also that the phases of the moon were connected with the state of the weather.

At the conclusion of the address, a vote of thanks, moved by Professor McKiel, M.E.I.C., and seconded by C. S. G. Rogers, A.M.E.I.C., was extended to the speaker by the Chairman, F. O. Condon, M.E.I.C.

During the evening Miss Gertrude McLellan and Mr. A. Leger rendered several vocal selections which were much appreciated. Major McKie was the accompanist.

Ice Formation and Prevention

On Monday, February 4th, the members of the Moncton Branch had the honour of hearing an address on "Ice Formation and Prevention", delivered by Dr. Howard T. Barnes, of Montreal. The meeting was in the form of a banquet held at the Barker House. Prior to the lecture, Mrs. Harold N. Price and Mr. Thomas Stenhouse entertained the meeting with several solos which were greatly appreciated.

Dr. Barnes' subject covered such a large field that it was impossible for him to do more than touch briefly on each phase of it. He explained the formation and melting of ice as influenced by physical conditions, the delicate poising of the forces of nature, the hidden wonders of ice under the microscope, the various forms of natural ice formation, such as surface or fixed ice, frazil or needle ice, anchor or ground ice, the influence of ice on water power development, ice prevention methods and ice navigation.

The slides Doctor Barnes used to illustrate his subject were so descriptive that his audience had no difficulty at any time in following his remarks.

The branch feel that they are greatly indebted to headquarters for supplying so talented a speaker to the different branches, especially on a subject of such interest to every engineer on account of the difficulties they so often encounter with ice and its action.

Winnipeg Branch

P. Burke-Gaffney, A.M.E.I.C., Secretary-Treasurer.
James Quail, A.M.E.I.C., Branch News Editor.

The meetings that the Winnipeg Branch is holding are being well attented. The Paper's Committee is to be congratulated on the superior papers and addresses that are being given.

Composition and Matter

The Rev. Father Morton, who has addressed the Winnipeg Branch before, talked on the above subject to a large audience. Father Morton last appeared before the branch to talk to it on the Einstein theory. His clear sketch of that theory established his reputation with the members of *The Institute* here and those attending the meeting of January 3rd, came prepared for the clear outline of the subject the "Composition of Matter", that was drawn by the speaker.

Father Morton drew the attention of the audience to the fact that the engineer uses the properties of matter and materials daily and that as the engineer's knowledge of those properties increases his field enlarges and his efforts become more successful. To enable his audience to gain some idea of the different attitude now obtaining toward the properties of matter, the speaker made a comparison between those properties and two mathematical ideas, number and geometry. He stated that modern discovery had driven us to the conclusion that energy works by jumps, comparable to the manner in which conclusions are reached in using numbers. He went on to say that there had been evolved no less than thirty-two theories of matter; that theories with regard to matter were now being checked experimentally. He emphasized the refinements in experimentation that enabled work to be done with molecules as the object of inquiry. He referred briefly to Faraday's thesis that electricity is carried in ions in multiples and to Clarke-Maxwell's electro magnetic theory of light, which drew attention to the medium rather than to the carrier, thus leading up to the development of the X-rays and the discovery of radio active substances. It became possible to count the number of sparks caused by emanations from X-rays on a zinc sulphide plate. Wilson by passing rays through super-saturated air which caused drops to form by condensation on the ions, was able to photograph the individual ions and thus count them at his leisure. The speaker then dwelt on the theory of the electron, the fundamental negative charge with particular reference to the opposing views held by Thompson and Rutherford, viz. that the positive charge was spread all over, in one case, and that it formed a nucleus in the other. He paid a high tribute to the work of Rutherford, who is a Canadian. The latest developments seem to confirm Rutherford's hypothesis and it would appear that according to the grouping of the electrons around the nucleus so are the physical properties of matter. The speaker said that one might conclude from this that all mass is electricity; that knowing what mass is, it only remains for us to discover what electricity is.

Financing of Mining Enterprises

Prof. R. C. Wallace of the University of Manitoba gave a very impressive address on the above subject to a large audience at a meeting of the Winnipeg Branch, on Thursday, February 7th. His subject was considered with particular regard to the obtaining of capital for the development of Manitoba's mineral resources. From a chart Dr. Wallace indicated sixteen areas in the province which held out the possibility of becoming commercial mining districts. Out of these sixteen, three, at least, should develop into districts of major importance.

Dr. Wallace described the steps the prospector must take to find and interest capital in his prospect. He followed this by describing the type of deal into which prospector and capitalist might enter to mutual advantage. He divided the methods of developments and prospects into classes:

(1) The prospector-owner developes the property by his own work to success.

He indicated that this would probably not be profitably accomplished in the Manitoba deposits.

(2) Financing through stock company largely locally.

This method he pointed out has largely failed in this part of the country.

(3) Lease and option to outside capital.

This, he said, is the logical procedure in a great majority of cases.

Dr. Wallace expressed his opinion that sufficient home capital is not yet available by itself to develop and equip a mine or mines of any size. He suggested that for the present such home capital could perhaps be better employed in helping the prospector carry on by aiding him to do sufficient work on his claims to warrant the careful attention of large mining capital.

The meeting was fortunate in having H. A. Wentworth, consulting engineer of Boston present. At the request of the chairman, Mr. Wentworth spoke in discussion of Mr. Wallace's address. Mr. Wentworth has been giving close study to the mining possibilities of this immediate section of Canada for the past year.

Mr. Wentworth felt that Prof. Wallace was justified in his expectations that major mining properties would be found and that the prospectors are well advised in covering this district thoroughly. He said that in the case of the gold group some times $2,000., or $3,000., expenditure will make a showing of interest to capital; with copper as a rule, it would take several times that amount. Manitoba is unfortunate at the present in that the eyes of the mining world are focussed on north eastern Ontario and western Quebec. Mr. Wentworth stated that in his experience the greatest draw-back to any new mining field is usually "local capital", which is of such a nature, that it takes with the prospector a few $100., chances and then "sits" on its position to take undue advantage of it. *The Engineering Institute* and others of a similar standing can help the local industry or assist the prospector to determine the financial responsibility and mining knowledge and ability of those who attempt to do business with them.

Edmonton Branch

W. R. Mount, A.M.E.I.C., Secretary-Treasurer.

On February 14th, the third regular meeting of the branch, (1923-24 season), was held in the Board of Trade rooms.

The chairman, R. S. L. Wilson, A.M.E.I.C., welcomed on behalf of the branch C. D. MacKintosh, M.E.I.C., chairman of the Lethbridge Branch, who has recently transferred to Edmonton as superintendent of operation and maintenance, C.P.R., Edmonton.

Pigeon Lake Water Supply Scheme

The speaker of the evening, A. W. Haddow, A.M.E.I.C., city engineer, Edmonton, was then called upon to give his paper on the "Pigeon Lake Water Supply Scheme".

Mr. Haddow explained at the outset that his paper was solely a résumé of the many reports that had been submitted to the Edmonton city council, since the scheme had been first mooted.

The first report to be submitted was that of John Galt in November, 1909. Pigeon lake is approximately 45 miles south-west of Edmonton and has a catchment area of about 100 square miles, (37 square miles of water), and is at an elevation of 580 feet higher than Edmonton. This report shows the water to be good for domestic purposes and after certain measurements of actual run off had been tabulated, etc., a sufficient average flow of 18 million gallons per day were said to be available.

Following Mr. Galt, Alexander Potter submitted a report in October, 1910. This report did not recommend the scheme, largely for financial reasons.

About this time a water board was set up in Edmonton and, among other schemes, reported upon the Pigeon Lake project; "the doubtful features in connection with the Pigeon Lake supply, etc., etc.," appears in this report.

In August 1913 Messrs. Chipman and Power reported in a definite manner against the project and in January, 1913, Messrs. Francis, Lee and Ross recommended against it.

In going through these reports and other sources of information, the speaker brought out much interesting data and gave the financial estimates from same.

Much discussion subsequently brought forth more points of importance, being lead by B. J. Saunders, M.E.I.C., W. J. Cunningham of the city of Edmonton power and pumping plant made some interesting comparisons in giving a few cost figures.

Refreshments were served during informal discussion and the meeting terminated at 10.00 p.m.

Toronto Branch

J. A. Knight, A.M.E.I.C., Secretary-Treasurer.
L. W. Wynne-Roberts, A.M.E.I.C., Branch News Editor.

The Late Sir Sanford Fleming

Prof. Peter Gillespie, M.E.I.C., addressed the Toronto Branch meeting on January 24th, taking as his subject the life of the late Sir Sanford Fleming. Despite the fact that a large number of members were attending the annual meeting at Ottawa, the attendance at this meeting was very satisfactory and those who attended enjoyed a very instructive and entertaining lecture, illustrated by lantern slides. It was very evident that Prof. Gillespie had devoted much time to compiling his information. The resulting discussion, in which members who had been associated at one time or another with Sir Sanford's undertakings took part, was an added feature of interest.

"Of Canadian engineers," said Professor Gillespie, "the most outstanding as a man of affairs is perhaps Sandford Fleming, the product of a Scottish parish school who became a chancellor of a great university; Fleming the youthful surveyor who became chief engineer of the Intercolonial and the Canadian Pacific Railways, Fleming the founder of the Canadian Institute, promoter of standard time, advocate of parliamentary reform, apostle of an United Empire, scientist, plenipotentiary, litterateur, publicist, citizen".

Sanford Fleming was born in Kirkaldy, Fifeshire, in 1827, and after a short apprenticeship with John Sang, surveyor, came to Canada in 1845, arriving in Peterboro, where he obtained his first employment as a draughtsman with a local surveyor. He compiled and published maps of Peterboro and Cobourg, the lithographing having been done by his own hands, and after obtaining his commission as a surveyor of lands in 1849, made his home in Toronto.

Fleming's first large scale engineering undertaking was the completion of the construction of the Northern Railway between Toronto and Collingwood, the position of chief engineer of which he assumed in 1855 and retained until 1863. The second undertaking of magnitude was the location and construction of the Intercolonial Railway to connect Quebec with the maritime provinces. Professor Gillespie continued his remarks, outlining the great works, notable achievements, and sterling qualities of the late Sir Sanford Fleming. This paper will be published in full in a later issue of *The Journal.*

The Great Lakes and Some of the Structures thereon

On January 31st, Lieut.-Col. H. J. Lamb, D.S.O., M.E.I.C., supervising engineer for Ontario of the Department of Public Works delivered a very entertaining illustrated lecture on "The Great Lakes andsome of the Structures Thereon". As this paper is to be published in *The Journal,* no description will be given in this column, but it is desirable to comment upon the pleasure derived by the members present. The lecturer provided a wealth of detailed information, and had taken much care in the preparation of the slides which were shown.

The Transportation situation in Toronto

Speaking on the "Transportation Situation in Toronto", H. H. Couzens, general manager of the Toronto Transportation Commission addressed a well attended meeting on February 7th, and explained the engineering and constructional phases of the Commission's activities. Mr. Couzens remarked that many of the problems confronting the commission were engineering ones, and even the traffic problem with the study of traffic conditions such as distribution and regulation was conceded to be that of engineering.

The commission consists of three members and their first problem on assuming control of the Toronto Street Railway was, where to start and how to go about it, whether the rehabilitation should be carried out piecemeal or whole-heartedly. After due consideration, the commission came to the conclusion that reconstruction should proceed in a wholesale manner, and in support of this decision the following reasons were mentioned: — Rehabilitation on a large scale would cause a rapid restoration of the tracks and rolling stock; street car users would be inconvenienced for the minimum period of time; it would assist the city's growth; it would cause less disorganization to general business; it would mitigate unemployment and it would be the cheapest to the community as a whole in the long run.

The reconstruction could be divided into five main phases: The design of tracks; the rolling stock and busses; carhouses and yards; repair shops; and traffic routing. Mr. Couzens dealt with the first four and explained the reasons why certain standards in material and construction were adopted.

Regarding the design of tracks, Mr. Couzens stated that for an open track the low T rail is found to be the most economical, being both the lowest in tonnage and in price per ton. For heavy travelled streets the 122-pound grooved girder rail is adopted. Welded joints were favoured both on account of their cheapness and their strength. Figures were quoted stating that 17,000 seam welded joints had been made in Toronto, and that there had been no failure on new tracks or on old rails with new plates, and only 6 or 7 failures on old rails with old plates. These cracks were probably due to the fact that the rust had not been properly removed before welding. Tests made by the University of Toronto showed that the welds could be tested to 200,000 lbs. without failure, and tests made in other laboratories showed ultimate strength of from 350,000 to 850,000 lbs.

With regard to ties, the Commission were using wood ties, but as an experiment had used a small mileage of steel ties laid under very adverse conditions. Wood ties were preferred owing to their quietness of operation, resilience of track, same factor of safety as steel and the fact that they were cheaper. The particular kind of tie used depended upon cost, but soft wood ties were largely used; white oak ties were difficult to obtain.

Foundations to the tracks usually consisted either of crushed stone or concrete slabs, the latter being the standard adopted by the Commission. Many miles of crushed stone had been used in order to obtain guidance for the future. The main defect of crushed stone appeared to be difficulty of making satisfactory tunnels under the tracks for sewers, water connections, etc. The concrete base is 9" thick and consists of a 5:2½:1 mixture of concrete. Crushed stone foundations are usually 9" to 11" deep. Up to the present time 53½ miles of concrete slabs and 16¾ miles of crushed stone foundations have been laid.

The speaker remarked that the total track is 64 miles of which 44½ per cent has been rehabilitated. Extensions of 26 miles and yard tracks 18 miles, have been laid. 11½ miles of track have been partially restorated.

The average rate of progress per 24 hours during construction was said to be as follows: — Grading 1,200 feet; slab, 1,350 feet; paving base 1,480 feet, and paving 788 feet.

Mr. Couzens explained the features of the new type of rolling stock in use in Toronto, stating that 575 new cars were in operation. Whereas the average number of cars required during an 18-hour period, or base total, is 350, nearly 1,000 cars are required to take care of the peak loads during the rush hours. The particular advantages of the new rolling stock are smooth riding, wide doors, sanitary seats, no corners for dirt, door openings air operated, safety devices, dead man handle, lighting and shades, tail lights. The motors with trailers are capable of accelarating at the rate of 2 miles per hour per second. Ventilation is the best that can be obtained and it has been found that the air is changed 18 to 19 times per hour under actual operating conditions.

Three types of busses were used; double deck, single deck and trolley, the single deck being suitable for districts such as Rosedale. The trolley bus is slightly the cheapest in operating costs, with the single deck gasoline bus next. It was also pointed out that street car trailers are about one-third cheaper to operate than the motor cars. The motor cars cost about 31 cents per mile to operate, as compared with about 36 cents the cost of operation by a gasoline bus. The seating capacities of the various types of busses were, single decker, 29; double decker 51; trolley 29. Cars and trailers each seated 60 people.

Car house construction, which was illustrated by means of lantern slides, includes everything of the most modern type. Plans and estimates were prepared of alternative types of construction, and although slightly more expensive in initial cost, a standard reinforced concrete design was adopted. All frontages on car house property are held for resale. The car houses are designed to accommodate 25 per cent of the cars, and the average cost of car house construction ran about 21 to 22 cents per cubic foot; the average cost of office construction 27 cents per cubic foot. Expressed as a cost per car, car house construction cost $1,470 per car for building and $1,300 per car for machinery.

Student Competition

The Toronto Branch has instituted a competition among students attending the University of Toronto and has offered three prizes for the best papers on subjects relating to some branch of engineering. Four student competitors read their papers at the regular meeting on Thursday February 14th, and all were complimented upon the excellence of their subject matter. Each competitor was allowed twenty minutes in which to speak and was judged by a committee consisting of G. T. Clark, A.M.E.I.C., R. O. Wynne-Roberts, M.E.I.C., and A. M. Reid, S.E.I.C.

The judges awarded first prize to G. H. Rowat on "The Determination of Stress by the Photo-elastic Method", second prize to L. H. Burpee on "Power Development on the St. Lawrence River", and the third prize to H. A. MacIntosh on "Cause of Lack of Balance in Automobile Engines".

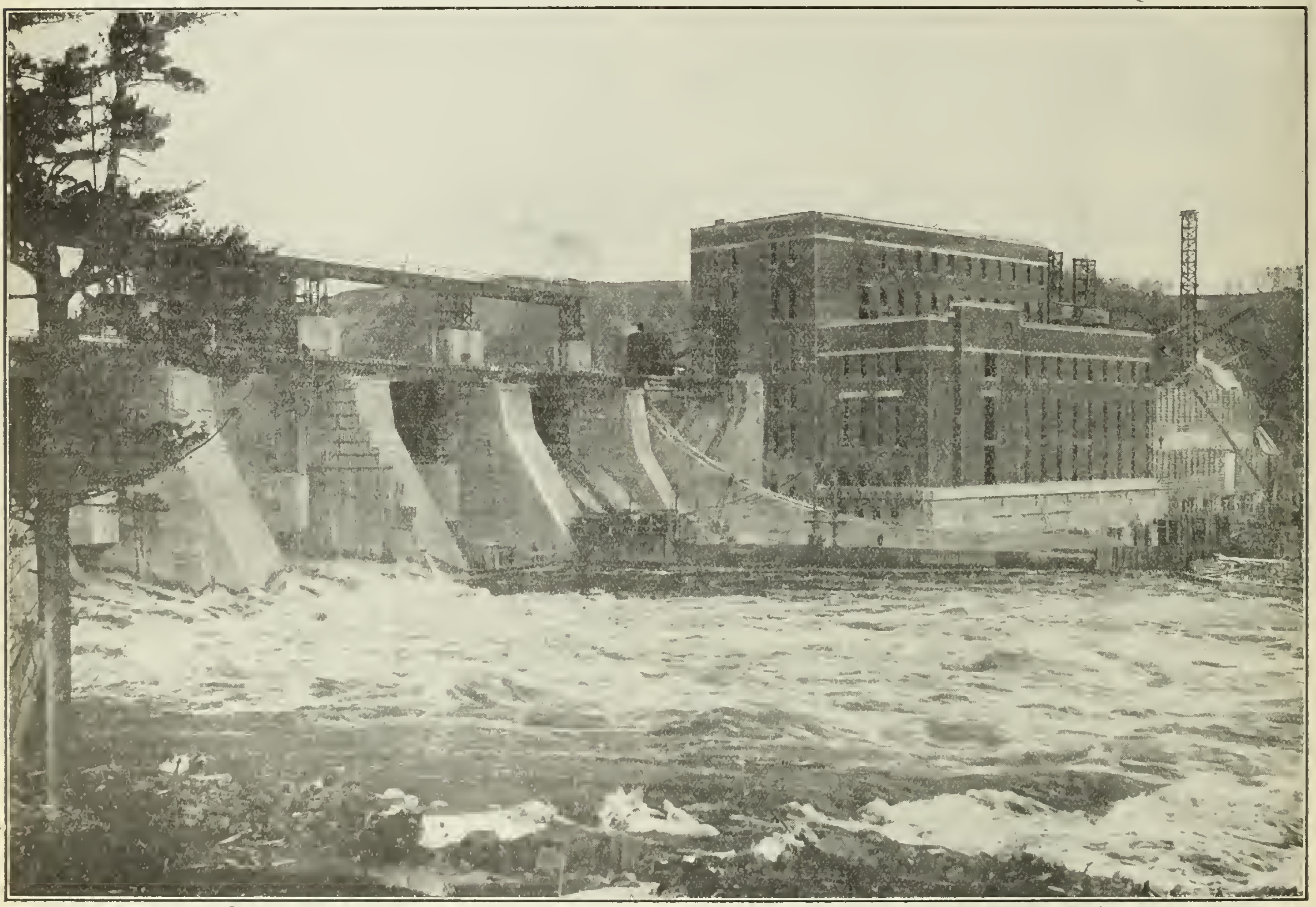
The Determination of Stress by the Photo-elastic Method

Mr. Rowatt delivered a very carefully prepared paper and stated in part that practical engineers have long appreciated the difficulty of interpreting the results of mechanical experiments and determining the nature of the fractures that occur in practice. Theoretical analysis is inadequate as it is applicable only to the simplest cases and to render it manageable even in common problems, assumptions must be made which are often of doubtful validity. To compensate for this factors of safety must be employed which are the result of long experience.

This is a great contrast to the operation of the photo-elastic method, which by a comparatively simple yet precise procedure gives accurate results whose value is far greater than that of years of experience. Research by this method into the exact distribution and value of stress in any given machine, tool or structural member is made possible by employing models cut out of sheet celluloid of a selected quality. These models are placed in a beam of polarized light and stressed as in practice. An image of the stressed model is shown in brilliant colours on a ground glass screen. These colours are a measure of the two principal stresses at any point and by means of a calibrated test member the value of this difference may be obtained directly.

By the use of a very fine extensometer designed by Prof. Colier of London University which will measure to one-millionth of an inch the lateral contraction at any point may be determined. This contraction is a measure of the sum of the principals of stresses. Having thus their sum and their difference, the individual stresses may be easily found.

This method was used by W. H. D. Clark and the writer to determine the stresses around the keyway in a 3-inch pinion 4 d.p. 20° involution. Owing to the short time at our disposal only the preliminary investigation of the distribution curves was performed and from these no definite valid conclusions can be drawn, but some interesting observations were made. For example in a pinion of this



La Gabelle Power House and Gates, December, 1923.

size the fit of the key and its shape is of considerable importance. Where the key was drawn in, the concentration of stress around the corner of the keyway is enormous, indicating that rounding the corner of the keyway would materially reduce this.

From Prof. Marn's experiments in 1912, he found that pinions of this size invariably break in a line running from the corner of the keyway to the nearest point on the contour. Our observations show that on this section only normal stress exists. Thus the failure of the pinion was not influenced by its shearing strength although it is on the shearing strength that its design was based. The whole field of engineering design is open to this method of determination of stress, the only limitation being that the problem must be one capable of representation in a model cut from a thin sheet of celluloid.

LaGabelle Power Development

Aided by some excellent lantern slides illustrating the progress of construction, and chalk sketches upon the blackboard, L. H. Burpee gave an interesting account of the LaGabelle development on the St. Maurice river. He traced the course of the St. Maurice river, rising in the Laurentian mountains and joining the St. Lawrence at Three Rivers, and the development of power along this waterway.

LaGabelle is about 13 miles from Three Rivers and 70 miles from Montreal by rail, and is situated at the foot of some rapids, at which point, by building a dam, a head of 60 feet is obtained. The river in most places is about 400 feet wide, but at LaGabelle the width increases to 800 feet, with a low point projecting from the west bank halfway across the valley. The location for the dam is at this low point, and by using such a site, the first half of the dam can be built on dry land, with temporary openings left in it for byepassing the river during the construction of the other half of the dam.

The dam consists of four sections, the power house itself, 370 feet long, being one, and the others comprising the sluice section 385 feet long, overflow or spillway section 530 feet long, and a bulkhead connecting the power house to the opposite side of the river. The sluice section is approximately the centre of the dam. There are six sluiceways, each one 50 feet wide; the sluiceways are separated by piers 15 feet wide, each having its nose perpendicular, and the downstream face is on a batter of 2:3. The depth of the sluices below the normal upstream water level varies, thus obtaining a range of six different discharges by only opening one gate. The overflow section is solid concrete from bedrock and has an average height of 37 ft. The upstream face is perpendicular and the downstream face is on a batter of 3:4. Three-foot piers are spaced every fifty feet along this section of the dam and these carry the bridge connecting the power house to the west side of the river. The power house will contain five 30,000 h.p., units and two regulating sluices. The turbines are on vertical shafts and are of the propellor type; three intake passages lead in to each turbine, each 14 feet wide, and are rectangular in cross-section. Since the head is only 60 feet, no penstocks are used, and the floor of the scroll case is only one foot lower than the floor of the upstream end of the intake passage. The draft tube is similar to that used at Queenston and has a centre cone. The bulkhead connecting the power house to the opposite side is 9 feet wide at the top and the downstream face is on a batter of 9:12.

The work was started in December, 1922, units one and two being built first. The forms used on these units were used again on Nos. 3 and 4, and an extra set had to be built for No. 5. The total concrete in the dam is about 130,000 cubic yards. The superstructure of the power house consists of steel framing and brick walls. The plant was built by the Shawinigan Engineering Company for the St. Maurice Power Company, both of which are connected with the Shawinigan Water and Power Company.

Cause of Lack of Balance in Automobile Engines

The third prize winner, Mr. MacIntosh considered he would make better headway by explaining his subject to his audience by means of chalk and the blackboard. He referred to the fact that whilst automobile engine design has become largely standardized, the original scheme of imposing the force of an explosion on a piston enclosed in a cylinder and transferring the linear force thus generated into a rotating one still obtained. The scheme contained certain inherent defects and one of the most serious and perhaps least understood of these is lack of balance. The impossibility of making the connecting rod very long in proportion to the stroke, gives to the piston an irregular motion which is really a variation in the acceleration of the piston at the two ends of the stroke. The acceleration is much greater at the outer dead centre than the inner, and the point of zero acceleration is not at mid stroke. When the piston is being accelerated upward there is an equal reaction downward in the crank shaft, and this is transmitted to the bearings and through them to the engine block. This rapidly alternating force tends to shake the engine as a whole in the direction of the piston movements and all parts transmitting the load have to stand up under this alternating stress.

Mr. MacIntosh explained the plotting of curves representing angular displacement of the crank shaft, the vertical components of acceleration of the crank pin, and indicates how in any engine having a known number of cylinders the situation regarding balance may be determined.

The disturbing effects may be overcome by a device known as the Lancaster secondary vibration damper which consists of two oppositively rotating weights, turning at twice engine speed and of such weight that their combined vertical component of force is equal and opposite to the combined secondary forces of the engine.

The questions of "torque recoil" and torsional vibration were touched upon by the speaker who unfortunately was not able to complete his address owing to his having exceeded his time limit.

Concrete Plant Layout

The last speaker of the evening was S. Hardcastle who took as his subject "Concrete Plant Layout". Mr. Hardcastle methodically divided his subject into its main divisions, and dealt with obtaining and handling of the cement and aggregate and described seven methods which are more or less standardized for satisfactory and economical mixing. He discussed these sections at some length, and was about halfway through his address when the Chairman ruled that the time limit was up.

"The members of the branch greatly appreciated the fact that the students were taking part," said Prof. T. L. Loudon, M.E.I.C., who, as chairman of the Students Relations Committee, acted as chairman for the evening, "and the older members sincerely trusted that the students would attend the meetings and take part in the discussions".

Cape Breton Branch

D. W. J. Brown, Jr.E.I.C., Secretary-Treasurer.

The February meeting was held in Sydney on the evening of the sixth, and was addressed by Dr. Howard T. Barnes, D.Sc., F.R.S., who is well known to most of the members of *The Institute*. His subject was "Ice Formation and Prevention". The meeting was open to the public and was well attended.

Dr. Barnes arrived in Sydney on the morning of the sixth and was met at the train by a committee of the executive. He was taken on a visit to the plant of the Dominion Iron and Steel Company, which unfortunately, owing to the strike at the mines of the Corporation, was partly closed down. The branch executive had the pleasure of dining with Dr. Barnes in the evening, at seven o'clock.

Dr. Barnes' address was a very interesting one and was thoroughly enjoyed by all who heard it. The efforts of those responsible for his visit to the maritime branches are greatly appreciated by the members of this branch, and it is to be hoped that this is not the last lecture which we will have the pleasure of hearing by men of Dr. Barnes' caliber.

Ottawa Branch

F. C. C. Lynch, Affiliate E.I.C., Secretary-Treasurer.

John A. Stiles, B.A.Sc., M.E.I.C., assistant chief commissioner, Boy Scouts' Association for Canada, addressed the members of the Ottawa Branch, at their luncheon at the Chateau, February 12th, on "The Young Engineer and Scouting".

The speaker, who was introduced by J. L. Rannie, M.E.I.C., chairman of the Ottawa Branch, stated that the Boy Scout movement was not known and appreciated as it should be in Canada. He brought to light the interesting fact that there were as many nations in scouting as there were weeks in the year, the total number of Scouts being two million and in Canada alone from fifty to sixty thousand Scouts and Clubs were enrolled. The qualifications necessary to become a Scout were enumerated and these included a knowledge of the composition of the Union Jack and how to fly it, certain knots, secret signs, the Scout law and the use of the staff.

Mr. Stiles also spoke of good turns performed daily by Scouts in a most unostentatious manner and signalled out the performance of a Western Troop in the role of Santa Claus as an example.

Proficiency badges were outlined and the important part they sometimes play in the selection of a proper vocation by their wearers was given due emphasis. What the scoutmaster got out of scouting was also summarized, leadership in the movement being characterized as a system of recreational education. Moreover it was pointed out that the scoutmaster worked in an atmosphere of energetic boyhood and was in a splendid position to develop what Kipling described as the "Man Touch".

Before concluding his address Mr. Stiles urged the engineers especially the young ones to become Scoutmasters as the engineering profession in particular realized how badly leaders were needed in the country and should recognize that the movement was the recruiting ground for the development of the requisites of leadership.

Canada's Arctic Expedition, 1923

Through the medium of the silver screen the story of Canada's 1923 Arctic Expedition was revealed to the public at the Victoria Memorial Museum on the evening of February 19th, by J. D. Craig, M.E.I.C., who was the officer in charge of the expedition, and who explained the various features of some forty-five hundred feet of film.

The itinerary of the expedition which was sent out under the auspices of the North West Territories and Yukon Branch, Department of the Interior, of which O. S. Finnie, M.E.I.C., is the director, was a most interesting one. Courtesies were exchanged with the Danish authorities at Godhavn, Greenland; MacMillan, the American explorer was encountered at Etah, Greenland; three Eskimos were tried for murder at Ponds Inlet, and a visit was made to Beechey island, where the Union Jack was once more hoisted over the cenotaph marking the site of the first winter headquarters of Sir John Franklin, R.N.

This memorial originally consisted of a marble tablet constructed in New York at the request of Lady Franklin, and conveyed to Godhavn by an American exploratory party. Capt. McClintock, R.N., removed it from Godhavn to its destination and some time ago Capt. Bernier built a concrete base for the slab and thus its permanency was assured.

Mr. Craig's lecture was under the joint auspices of the Ottawa Branch of *The Engineering Institute of Canada* and the Professional Institute of the Civil Service.

Calgary Branch

J. A. Spreckley, A.M.E.I.C., Secretary.

W. St. J. Miller, A.M.E.I.C., Branch News Editor.

On January 21st two interesting papers were read before an appreciative audience by F. G. Cross, A.M.E.I.C., and A. L. Ford, M.E.I.C., entitled "An automatic hydraulic regulator" and "Water power development in Canada", respectively.

Major Cross acknowledged that he was describing a very old principle, namely, the use of a spiral or transmission curve, but was applying it in a somewhat novel way. The illustrations he presented clearly showed the design and operation of a device to automatically regulate the flow of water through canals or ditches. The main feature of this regulator is the manner in which the floating element is connected to the radial gate through a cam, this being attained by means of a cable passing over and around the face of this cam and fastened to the lower edge of the gate. By the adjustment of two bolts in the web of the cam the relative positions of cam and radial gate can be changed at will.

This adjustment once fixed will assure that a constant flow is maintained through the opening under varying heads, or in other words, the idea of this device is to reduce the area of orifice to a degree equivalent to the discharge by an increasing head or vice versa. The speaker related the success that this device had maintained in practice on a small scale pointing out the advantages and possibilities of its general adoption.

Water Power Development in Canada

The paper delivered by Mr. Ford was elaborately illustrated with large scale diagrams which he carefully explained to those present. His presentation of the necessary statistics was done in such a manner as to hold the interest of his hearers.

A review of world conditions showed that Canada's position as a producer of hydro-electric power is second only to that of the United States, as shown by the following table, when dealing with those nations developing over 1,000,000 horse power. This was for the year 1920.

	Developed horse-power
United States	9,283,000
*Canada	2,418,000
France	1,400,000
Norway	1,350,000
Sweden	1,200,000
Italy	1,150,000
Switzerland	1,070,000
Germany	1,000,000
Japan	1,000,000

*Canada's water power installation at the end of 1923 had grown to 3,227,000 h. p.

Another interesting table showed comparatively the kilowatt hours per capita to be as follows:—

Switzerland	700
Canada	683
Norway	493
United States	472
Sweden	364
Union of South Africa	199
France	147
Germany	141
United Kingdom and Ireland	139

In comparing United States and Canada as at December, 1923, the speaker quoted figures given out by the Hydro-Electric Power Commission of Ontario.

	Canada	*U.S.A.*
Per capita output k.w. hrs.	683	472
Dwellers in electric lighted abodes in percentage of total population	37.1	36.8
Water power developed, horse power per 1,000 population	338	90
Hydro-electric plants, per cent of total	88.1	23.7
Fuel plants per cent of total	11.9	76.3

From these figures alone Mr. Ford emphasized very emphatically the unique position that Canada holds to-day in both developed and undeveloped water-power resources, and dwelt upon our progressiveness in this direction as compared with other countries. He figured that only about seven per cent of a total available water power supply had been utilized so far in the Dominion, the capital investment at the end of 1922 being $620,000,000. This sum was exclusive of electric railways.

Remarking on the beneficial effect that cheap water power must have on the future of Canadian industries he cited one instance in particular that evidenced conclusively the tremendous advance already made in this direction. In 1890 the export of wood pulp and paper from Canada was valued at $120, whereas to-day the annual export in these same products amounts to more than $100,000,000. He also referred to the extraordinary increase in the mining activities from the same cause and pointed out the influence such sources of power must have on future transportation problems in this country.

The following optimistic remarks by the speaker are interesting,—"The success of many typical Canadian industries and the future of many projects now under consideration, are vitally associated with cheap power facilities. This applies notably to the pulp and paper industry, the mining industry, the electro-chemical and electro-metallurgical industry and the flour milling industry".

"Finally, it may be said that Canada has very great water power resources and has already made gratifying progress in their development. Unexcelled electrical facilities have been provided for the general public as well as ample motive power for industry. Further, the resources as yet untouched, will fully provide for the country's requirements for many years to come, and the methods of investigation and control exercised by both federal and provincial governments guarantee that they will be developed efficiently and in the public interest."

R. S. Trowsdale, A.M.E.I.C., proposed a vote of thanks and commenting on the possibilities of the automatic regulator he emphasized the advance made in recent years with automatic control of electrical apparatus which in many cases had eliminated entirely the human element. He saw no reason why such a contrivance should not find a recognized place in control of water for irrigation purposes.

Luncheon to V. Meek, A.M.E.I.C.

A luncheon was given in the Tapestry room of the Hudson Bay Company on January 30th in honour of Chairman V. Meek, A.M.E.I.C., who has since left to take up his new position in the Irrigation Branch at Ottawa. Mr. Meek has been acting commissioner of Irrigation in Calgary for the last two and a half years. A. S. Dawson, M.E.I.C., acted as chairman, and following the lunch several short speeches were heard which were interspersed with some excellent vocal selections. The chairman fittingly expressed regret at losing Mr. Meek, regarding the transfer as a personal loss and a loss to the community in general. However, Ottawa would gain the services of a man who knew the west very thoroughly, which would be a valuable asset.

P. J. Jennings, M.E.I.C., conveyed the congratulations of several engineers who were not able to be present. He had known Mr. Meek for twelve years, ten of which were perhaps more as an acquaintance, but the last two as a very close friend. He felt the selection was a wise one as irrigation matters would be handled largely by a man who had gained his experience under western conditions. B. Russell, A.M.E.I.C., related some amusing incidents in his travels with Mr. Meek in past years. B. L. Thorne, M.E.I.C., also expressed regret at losing Mr. Meek, although they had not come into such personal touch as other engineers, due to the fact that his was a mining branch and not connected with irrigation work at all

William Pearce, M.E.I.C., our veteran irrigationist, was next to speak, and gave reminiscences of past knowledge of the guest. He had known his mother as a child and had been a school mate of his father fifty-nine years ago. Mr. Pearce said he believed in heredity and if Mr. Meek inherited his parents' characteristics he was bound to get on wherever he went. He felt that he would make a strong representative at Ottawa.

J. S. Tempest, M.E.I.C., was the last speaker and explained in a few words how valuable Mr. Meek would be to the cause of irrigation in particular when at Ottawa. He took the opportunity of explaining the combination of the three branches of the reclamation service, namely the water power, the irrigation, and the drainage branches. He said the plan at present is to lay stress on the question of settlement and colonization with resulting greater development of the areas now under irrigation. He referred to the enormous sums of money spent by the C.P.R., on irrigation works and that other companies were doing likewise, and that these latter were asking assistance from the government, and it was here that Mr. Meek's experience and judgment would prove of value to the powers that be in the capital city.

Halifax Branch

K. L. Dawson, A.M.E.I.C., Secretary-Treasurer.

The Queenston-Chippewa Power Development

At a meeting of the Halifax Branch on January 17th, H. G. Acres, M.E.I.C., chief hydraulic engineer of the Hydro-Electric Power Commission of Ontario, presented an address on "The Queenston-Chippewa Power Development". On this same evening the annual meeting of the Association of Professional Engineers took place in the "Green Lantern". In order that those present might have the opportunity of hearing Mr. Acres they adjourned their meeting at 8.15 p.m., and resumed it again at the close of the lecture in the Technical College.

Mr. Acres was introduced by Chairman C. H. Wright, M.E.I.C., who said that there was none better qualified to speak with authority on the Chippewa development than Mr. Acres, who had been connected with it from the inception of the idea, who had charge of the preparation of the plans and the hydraulic design, and who had been resident engineer on the job from its start to its completion.

Mr. Acres showed that the Chippewa-Queenston power development as constructed consisted of three main items: (1) the changing of the direction of flow of the Welland river for a distance of about four miles from its mouth, (2) the construction of a canal eight miles long to conduct the water from the Welland river to the forebay of the generating station at Queenston, (3) the construction of the power station itself with its generating machinery and accessories. He described in detail the intake works, the design and construction of the canal for eight miles from the Welland river and finally the forebay and power house. In his description he explained the proposed extension to the intake structure in case it becomes necessary to spread the suction, developed by the large quantity of water entering the intake, over a large area of surface outside the intake ports by means of long ducts with tapering slots in their tops, in such a way that its intensity will be as nearly as possible equal at all points of the area at the same time as it is so small that it will not overcome the buoyancy of the river ice. In giving the details of the generating equipment, Mr. Acres said that although the moving parts of the turbo-generators weigh about 800 tons there is no apparent vibration even when the gate is shut and the whole momentum dissipated in the very short period of twenty seconds. The overall efficiency of these units from water to switch board is 92 per cent when operating at full load and the average efficiency between the outputs of 30,000 and 60,000 horse-power is 90 per cent. The extent and magnitude of the development was very apparent in all the illustrations used. One picture showed a massive mechanical shovel which was operated by electric power, and used for removing the debris as it was left after the loosening of the earth and rock by the explosion of large "shots" of dynamite. The table on which it swung was fifteen feet above the ground. Its boom was ninety feet long and its bucket would hold ten tons. As Mr. Acres expressed its capacity for work, it was capable of placing thirty tons of dirt every two minutes on the roof of a seven-story building. At one time during construction thirty carloads of cement were being used each day.

When he had finished his illustrated lecture Mr. Acres showed two reels of film which traced the course of a motor boat from the intake on the Niagara river through the twelve miles of the altered river channel and the completed canal to the forebay of the power station. Discussion followed in which J. H. Winfield, M.E.I.C., D. W. Robb, M.E.I.C., C. H. Wright, M.E.I.C., K. H. Smith, M.E.I.C., and several others participated. A number of questions were asked which Mr. Acres answered by elaborating points to which he had referred to in his lecture. He gave as his estimate that less than 4 per cent of the water flowing in the Niagara river was being diverted around the falls for the purpose of generating electric power.

Our Interest as Engineers in Depreciation

At the second meeting held in the "Green Lantern" on February 7th, the speaker was F. A. Bowman, M.E.I.C., vice-president of *The Institute* representing the maritime provinces. His subject was "Our Interest as Engineers in Depreciation". Mr. Bowman's paper will be published in full in a later issue of *The Journal.*

The entertainment committee for this meeting was composed of W. J. DeWolfe, A.M.E.I.C., chairman, Professor W. P. Copp, A.M.E.I.C., and Professor R. L. Nixon, A.M.E.I.C. They provided an orchestra of Dalhousie University students, who led our group singing so that we enjoyed it as we have never done before. J. Johanson, S.E.I.C., sang several solos and the programme went with a bang generally.

Ice Formation and Prevention

In the meeting held in the assembly hall of the Nova Scotia Technical College on February 8th, we were joined by the Nova Scotian Institute of Science. F. R. Faulkner, M.E.I.C., and H. L. Bronson, Ph.D. were joint chairmen. Professor Howard T. Barnes, D.Sc., F.R.S., was the speaker, and his subject was "Ice Formation and Prevention".

Dr. Barnes said that just twenty-seven years ago he read a paper on the results of his investigations of ice up to that time before a meeting of the Royal Society held in Halifax. He described his early investigations on the St. Lawrence river and divided ice into three classes according to the manner in which it is formed. Surface or blue ice accumulates on the surface of the water in sheets; frazil or needle ice forms in rivers which are partly open and partly frozen; anchor ice accumulates on the beds of rivers. Using lantern slides profusely throughout his lecture he made plain the effect of the temperatures of the air and water upon the formation of ice. Among other things he said the following:

Anchor and Frazil Ice

The heat rays of the sun contain waves of short length which penetrate water and raise its temperature. Anchor-ice when formed is not very buyoyant, but as it accumulates it gets more and more so and tends to rise in the water like a balloon in the air pulling against the earth. When the sun is shining the heat rays tend to melt the anchor-ice increasing its tendency to rise. It is therefore very dangerous to attempt to cross a river in a boat with an accumulation of anchor-ice on its bed when the sun is shining. The anchor-ice has been known to rise under a boat rendering it helpless or impossible to steer and causing it and its occupants to be carried into a rapid or over a fall and lost.

Frazil ice forms very rapidly in disturbed water such as a rapid where the waves curl and the cold air is churned up with the flow. This can easily be seen in broken water. The sun has a tremendous influence on water temperature. To the long heat rays of an ordinary ncandescent lamp a sheet or film of water is more opaque than gutta-percha or lamp black. Therefore the temperature of water is greatly influenced by the sun as well as by the presence of ice. This was shown by a diagram of water temperature from lake St. Francis. At the beginning of the curve the temperature is just above freezing. As the heat of the sun increases later in the season more heat goes into the water through the ice. Ice being more transparent to heat rays than water, as soon as the ice passes out the temperature of the river rises very rapidly. When frazil ice is first formed in minute crystals in the water it is somewhat like mist in the air, it neither floats nor sinks. As it accumulates and the crystals enlarge, it gets more buyant and is carried by the current to the under side of the surface ice where it rises in the quieter water and forms hanging dams. It will sometimes fill up the track of an icebreaker. Solid blue ice is often raised several feet by frazil-ice underneath. The frazil-ice may accumulate to such a depth and form a dam that may block the whole channel of a river. If there is a channel beneath through which the water may flow it forms an ice bridge. Formations may be 90 feet deep, and cause very serious floods. Such a formation chokes the Cedar rapids channel of the St. Lawrence river every winter and makes it take the Ottawa channel on the upper side near St. Anne de Bellevue at the extreme west end of the island of Montreal, then the St. Anne rapids are reversed. It does not take more than six or seven days of keen weather to cause this change and the backing up of the waters of the St. Lawrence to flow around the upper end of Isle Perrot. In Russia measurements were made on the Neva river near Petrograde to determine the contour of the bottom of the ice and the amount of free water. Frazil ice formations in the St. Lawrence form bridges of such strength that for several winters they were used to run trains across instead of using the Victoria bridge. In this way the railroad avoided the toil on the bridge. One season the traffic was prolonged too late and the engine was lost through a hole in the ice. If there were no artificial breaking up of the ice bridges in the lower stretches of the St. Lawrence by the government ice breakers great ice jams would occur and cause floods. It is the same on the Neva as on the St. Lawrence, and pictures of floods on both rivers were shown. Typical scenes in Three Rivers before the ice breakers were put to work, showed uprooted trees, and overturned farm houses. In the early days of the Montreal harbour, the sheds were taken from wharves every fall, boards numbered, and assembled in spring like a Chinese puzzle. As a result of the work of the ice breakers, the value of farm lands has increased along the shore. Buildings on the harbour front in Montreal are now permanent. It is practically impossible for an ice boat to make progress in an ice "shove", and gun powder and dynamite are of very little use. Anchor-ice starting from the bottom and fastened to the rocks may grow to the surface and become solidified by spray or fog. River fog is formed on the surface of the river on very cold days when the temperature of the water is higher than that of the atmosphere. Anchor-ice will grow on large rocks in swift rapids below the surface even when the current is so rapid that small rocks would be dislodged from the same position. An experiment was performed by filling a basket with rocks and bottles so that it would sink to the bottom of a channel just below a dam overflow. In order that it might not be lost a rope was attached to it. Next morning sufficient anchor-ice had fastened itself to the rope, basket, rocks and bottles that it rose to the surface. In this district it is said that a fisherman never worries if he loses an anchor in the autumn for he knows that he will find it coated with anchor-ice and floating in the winter.

Surface Ice.

The growth of surface-ice was measured for several years on lake Francis. During December and January the ice gradually grows until it reaches a constant thickness after which it remains constant until March when it gradually grows thinner until it rots away in the spring. The ice reaches a limiting thickness and then melts because the sun gets higher and shines longer each day as the winter advances. The rays penetrate the ice to the water beneath, and the water temperature rises a little, so that some heat is thus supplied to the ice and balances the heat lost from its surface. When the thickness decreases to one half its maximum, the ice usually is so rotten that it breaks up quickly in a storm or high wind. Under average winter conditions, in a given district, it is therefore to be expected that the thickness of ice will be always a certain fixed amount. The growth of ice is shown to be influenced by the average temperature of the air and the average temperature of the water. The average temperature of the air will depend on the weather conditions in any season, and the average temperature of the water will depend on the heat of the sun, the heat coming from the river bed by conduction from the earth, and springs or tributaries. Ice formed by the slow conduction of heat from the under surface of the ice is the purest thing that nature provides. When melted in sterilized dishes it will form water which is soft, clear and absolutely sterile. Even if there were any bacteria left alive at the end of the freezing process they could not stand any length of storage. This ice is always very clear and transparent. While I do not advocate for use ice cut from the surface of a stream known to be polluted, I should feel perfectly safe in using it myself providing I had the opportunity of examining it first.

The shape of ice crystals is shown by the water formed in a block of ice when a ray of heat passes through it. These crystals are similar to snow crystals and possess many shapes but everything in them will be six or twelve sided. Sometimes several of the faces are suppressed and a triangular form obtained. Pictures taken by Wilson A. Bentley from his collection of over 4,000 different snow crystals were shown.

Several good pond-ice pictures were shown. When ice grows by conduction the axis of the crystals is always vertical to the freezing surface because heat is best conducted off in this direction. As freezing progresses air is separated from the water, and when the water beneath the ice is quiet this air collects and may be included, unless it is brushed off in some way, and appears as layer of white ice. Rapid freezing usually causes the air to be frozen in the ice. When they meet a small space is left in the ice. Charts were shown illustrating how temperature of water above freezing will influence the thickness of the ice. Should the water temperature rise to .02 degrees C. the air would have to be very much colder to produce the same thickness of ice.

Ice Prevention.

Ice prevention methods are founded on the charts which were shown giving the region of possible ice formation or non-formation under stated air and water temperatures. The crushing strength of ice was determined with axis vertical and equals 400 pounds per square inch and gives a fracture which is needle-like, approximately the same at right angles to axis, but fracture differs. Expansion cracks on top of the ice were found not to go through but are formed on the bottom or top of an ice sheet. If the water temperature is constant a decrease in the temperature of the air will cause the ice sheet to contract on the top and buckle downwards giving rise to cracks in the top. If the air temperature goes higher the top part of the ice sheet will expand giving rise to cracks in the bottom. These cracks in the top will drift full of snow or rain and freeze solid, the cracks in the bottom fill with water and freeze solid. Both result in permanent expansion which will exert 400 pounds per square inch, on any structure in the way of its expansion. This expansion is the cause of big relief cracks in the surface ice of lakes. Expansions of 3 feet 6 inches were shown.

The ice breakers of Finland have the bow cut back and a propellor inserted underneath the prow to suck the water away from under the ice and help the weight of the prow crush the ice in front. The sides are bowed out to open up a path for a ship to pass through. These ice breakers make temporary channels. No bow propellor on the ice breakers on the St. Lawrence river could be used on account of the frazil dams. Instead the bow is lifted by weight in the stern to make the boat ride over and crush the ice. These ice breakers would be more efficient if steam jets are used in the bow to disintegrate the frazil-ice. The Lady Grey is very efficient as an ice breaker. Running full speed ahead through the open water of the channel it runs up on the ice crushing some as its speed grows slower, finally it stops, backs up, and runs at the field again and yet again. Ice breakers alone can never hope to establish winter navigation on the St. Lawrence river, until the river is treated as a great ship canal.

A slight temperature above freezing, only a few hundredths of a degree, is necessary to prevent the formation of surface-ice. In one case a cement plant discharging 8 cubic feet of water per second into a river of 4,000 cubic feet flow prevents the formation of ice for a ong distance below. In fact its effect can be traced for two miles. This is the effect of one part in 500. Charts were shown illustrating this.

Because of the freezing of the tributaries and absence of the ordinary run off in winter it is impossible to get the amount of power which can be obtained from a given source in summer. Pictures of penstocks and canals, filled or partially filled with frazil were shown. Modern design of power houses is eliminating such stoppages. It is still an open question as to whether a power river should be allowed to freeze over in winter time or not. but this can be determined by the character of the river above the development.

Thermometer design.

In the design of a thermometer for the determination of these small temperature differences occurring in the water of lakes and rivers or in the ocean it must be arranged that the indications must be as quick as possible. The change in temperature must be recorded accurately just when it occurs. A sudden change must be recorded immediately.

Icebergs.

Location of icebergs in the Atlantic ocean is very important. Iceberg ice is always fresh and the water from this ice has less density than the sea water. Remaining on the surface the absorption of the sun's heat causes the temperature to rise and this may be traced to a long distance. The salt water coming to the iceberg at the surface is cooled and sinks down the side of the iceberg, continually eating away until the iceberg becomes top heavy and overturns.

Isothermal lines around bergs show the effect of the berg on the temperature of the ocean surface for several miles. These isothermal lines are not circles but are distorted due to the effect of wind and tide.

ANNOUNCEMENT OF MEETINGS

Further information may be secured from the secretaries of the various branches, whose addresses will be found under "Officers of Branches" on page 118 of *The Journal.*

SASKATCHEWAN BRANCH:—
Secretary-Treasurer, D. A. R. McCannel, A.M.E.I.C.

Mar. 12th. Annual Meeting and Social Evening.
Mar. 28th. Address being arranged for.
Apr. 11th. Address on "Highway Construction in Saskatchewan", by H. R. MacKenzie, A.M.E.I.C., chief engineer, Saskatchewan Department of Highways, Regina, Sask.

ST. JOHN BRANCH:—
Secretary-Treasurer, W. J. Johnston, A.M.E.I.C.

Mar. 20th. Address on "Electric Transmission Economics and their Relation to Rate Fixation", by Budleigh Faraday, commercial manager, New Brunswick Power Company.
Apr. 17th. Address on "Concrete in Sea Water", by A. G. Tapley, A.M.E.I.C., Public Works of Canada, St. John, N.B.

VICTORIA BRANCH:—
Secretary-Treasurer, E. P. Girdwood, M.E.I.C.

Mar. 8th. A visit to The Dominion Observatory Sannich Vancouver Island. By courtesy of Dr. J. S. Flaskett.
Mar. 20th. A dinner in honour of Fraser S. Keith, M.E.I.C., our General Secretary.
Mar. 26th. Address on "Moveable Bridges", by E. E. Brydone-Jack. M.E.I.C., supervising district engineer, Public Works Department of Canada, Western Provinces, Victoria, B.C,

WINNIPEG BRANCH:—
Secretary-Treasurer, P. Burke-Gaffney, A.M.E.I.C.

Mar 6th. Address on "Corrosion of Metals", by Professor J. W. Shipley, Ph.D.
Mar. 20th. Address on "Forestry", by Colonel Stevenson.
Apr. 3rd. Address on "Electric Steam Boilers", by Mr. De Kermor
Apr. 17th. Reports of committees.

Recent additions to the Library

Technical Books.

Presented by Chapman and Hall, Limited.
Marine Engineering Practice, by Engineer-Commander F. J. Drover, R.N.

Presented by John Wiley & Sons, Inc.
The Elements of Railroad Engineering, by William G. Raymond, C.E., LL.D., Eng. D. Fourth Edition, Revised.
Measurement, Compression and Transmission of Natural Gas, by Lester Clyde Lichty.

Presented by E. & F. N. Spon, Limited.
The Gyroscope: Its Practical Construction and Application, by P. P. Schilovsky.
Rotary and Other Converters, by W. S. Ibbetson, B.Sc.

The Keefer Building in Montreal

A notable achievement in building construction is that of the Keefer Building at the corner of St. Catherine and Mackay streets in Montreal. The site on which this building now stands was taken over by the contractors on July 15th, 1923, and the concrete structure was completed within one hundred days from that date, while by November tenth the contractors were successful in completing the roof of the building thus permitting them to continue the interior work during the winter months. It is now announced that the building is ready for occupation which is only slightly over seven months after the site was taken over.

The building occupies a ground area of 103 feet by 122 feet and has a height of 130 feet above the street. The lower floor is arranged for stores while the nine storeys above are for offices. The skeleton of the building is of reinforced concrete with the lower two storeys of Benedict stone with brick fill, while above the second storey there is brick facing with terra cotta fill.

Particularly favourable results have been secured from a lighting point of view, the building having three open exposures, one on St. Catherine street, one on Mackay street, and one on a lane, in addition to which there is a 28 foot by 28 foot court. The contractors are the Thompson Starrett Company, Limited, represented by Rodney Miller, superintendent, and Gordon Thom, engineer, while the architects are Ross and MacDonald with C. P. Henwood as superintendent representing both the architects and owners and Walter J. Armstrong, M.E.I.C., in charge of the engineering work carried out by the architects' engineering department.

The property on which this building has been erected is the last piece of a twelve-acre lot, purchased by the late Hon. Thomas Mackay about 1828. This property was left by the late Mr. Mackay to one of his daughters, who was the wife of the late Thomas C. Keefer, C.M.G., first president of the Canadian Society of Civil Engineers, Honorary Member of the Institution of Civil Engineers, and president and Honorary Member of the American Society of Civil Engineers.

The family, in whose possession this property still remains, has for many years occupied a most prominent place in the engineering profession in Canada. The late Thomas C. Keefer, C.M.G., Hon. M.E.I.C., was the first president of *The Institute* in 1887, in the days when it was the Canadian Society of Civil Engineers. Ten years later he was again elected president in 1897. His brother, the late Samuel Keefer, M.E.I.C., was councillor in 1887 and president of *The Institute* in 1888, while his nephew, the late G. A. Keefer, M.E.I.C., was councillor for five years, 1889, 1890, 1897, 1905 and 1907. His son, C. H. Keefer, M.E.I.C., president of the Keefer Building Company was councillor in 1892, 1893 and 1903.

The board of directors of the new building includes the following:— C. H. Keefer, M.E.I.C., president, T. C. Keefer, A.M.E.I.C., vice-president, Allan Keefer, George Ross, A. G. Cooper, J. Keefer Fleming and Charles O. Wood, A.M.E.I.C., secretary-treasurer.

The New Keefer Building, Montreal

OTHER SOCIETIES NEWS

The Association of Professional Engineers of Nova Scotia

The annual meeting of the Association of Professional Engineers of Nova Scotia, was held on January 17th, 1924. The meeting took the form of a supper meeting at which sixty members of the Association were present. The following are the officers of the Association for the year 1924:—

President .... A. R. Chambers, M.E.I.C., New Glasgow, N.S.
Vice-President ...... F. R. Faulkner, M.E.I.C., Halifax, N.S.
Secretary-Treasurer and Registrar .... W. P. Morrison, M.E.I.C., P.O. Box 225, Halifax, N.S.
Councillors: .... R. P. Donkin, Halifax, N.S.
A. F. Dyer, A.M.E.I.C., Halifax, N.S.
R. W. McColough, A.M.E.I.C., Halifax, N.S.
G. D. McDougall, M.E.I.C., Sydney, N.S.
K. H. Smith, M.E.I.C., Halifax, N.S.
C. H. Wright, M.E.I.C., Halifax, N.S.
W. P. Morrison, M.E.I.C., Halifax, N.S. *(Ex-Officio)*
C. E. W. Dodwell, Hon.M.E.I.C., Halifax, N.S. *(Ex-Officio)*
*J. L. Allan, M.E.I.C., Dartmouth, N.S.
*T. J. Brown, M.E.I.C., Halifax, N.S.
*F. W. W. Doane, M.E.I.C., Halifax, N.S.
*F. H. Sexton, Halifax, N.S.
*D. W. Robb, M.E.I.C., Amherst, N.S.
*L. H. Wheaton, A.M.E.I.C., Halifax, N.S.
‡T. J. Locke, Halifax, N.S.
‡W. A. Winfield, M.E.I.C., Halifax, N.S.

*Appointed by the Lieut.-Governor in Council.
‡To be appointed.

Registration of Members.

Civil 179; mechanical 46; mining 19; electrical 13; chemical 1; total 258.

The Association of Professional Engineers of the Province of New Brunswick

The officers of the Association for the year 1924:—

President .... G. G. Murdoch, M.E.I.C., St. John, N.B.
Vice-President ...... F. O. Condon, M.E.I.C., Moncton, N.B.
Secretary-Registrar .. J. A. W. Waring, A.M.E.I.C., asst. engr., C.P.R., St. John, N.B.
Councillors:
St. John District .. Harry F. Bennett, A.M.E.I.C., St. John, N.B.
H. Phillips, M.E.I.C., St. John, N.B.
Moncton District . J. D. McBeath, M.E.I.C., Moncton, N.B.
H. W. McKiel, M.E.I.C., Sackville, N.B.
Chatham District . R. J. Sandover Sly, A.M.E.I.C., Campbellton, N.B.
Fredericton District .... E. O. Turner, A.M.E.I.C., Fredericton, N.B.

Registration of Members.

Civil 142; electrical 10; mechanical 7; chemical 1; civil and mining 1; civil and mechanical 4; civil, mechanical and mining 1; civil, electrical and mechanical 2; electrical and mechanical 1; total 169.

The Association of Professional Engineers of the Province of Manitoba

The officers of the Association for the year 1924—

President .... A. J. Taunton, A.M.E.I.C., Winnipeg, Man.
Vice-President ...... C. Harry Fox, A.M.E.I.C., Winnipeg, Man.
Secretary-Treasurer and Registrar .... P. Burke-Gaffney, A.M.E.I.C., 406 Fashion Craft Bldg., Winnipeg, Man.
Councillors: .... F. H. Martin, M.E.I.C., Winnipeg, Man.
N. M. Hall, M.E.I.C., Winnipeg, Man.
J. W. Sanger, A.M.E.I.C., Winnipeg, Man.
J. W. Porter, M.E.I.C., Winnipeg, Man.

CORRESPONDENCE

Some Observations Regarding Relations Between the the Junior and his Superior

Eugenia, Ontario, January 29th, 1924.

The Editor,
The Engineering Journal —

In view of the fact that the number of junior and student members of *The Institute* is increasing, and since the majority of articles in this Journal and others of a technical nature, are invariably beyond the comprehension of our embryo engineers, and thus do not in any way tend to hold their interests in the profession in the way those interests should be held, I feel it a duty to attempt to dispense some information that I hope will touch responsive chords, not only among the junior members of *The Institute* but also among their superiors; to the juniors, to the extent that they may derive benefit therefrom, and to the superiors to the extent that they may contribute occasional informatory articles for the perusal, study, and possible consequent betterment of the future members of the profession.

From my experience, I have learned that the average young man who joins an engineering or survey party, does so for one of several reasons, which might be enumerated as follows:—

(1) He wants a job, and does not particularly care what it is.

(2) He wants the position because he has made up his mind to become an engineer.

(3) He is attending university, and is studying engineering and desires a position for the experience during vacation, for the money, or for both reasons.

(4) He has a friend, who has a friend, who is in a position to get him a job.

Considering these various reasons, individually:—

The man who just wants a job

This young chap may have looked at the idea from the viewpoint of the agreeable nature of the work, which viewpoint he often finds to his sorrow, has been very superficial, and to the fact that there does not seem to be very much to do or know.

As a general rule, this type of man never rises above the rank of chainman, unless perhaps he has a high school education and is not averse to using his mathematical training when called upon, in making simple computations. His interest, otherwise latent, might easily be stimulated in this way. Again, lacking education, this type of man quite frequently shows himself to be the possessor of an inherent knack of knowing what is wanted, of doing it, and doing it right. If such be the case, he is invariably a find, and it is to the chief's welfare and advantage to take an interest in him, and in showing that interest by giving him jobs requiring his practical mind, and of minor responsibility. Loyalty to his chief and that means to the job, is not the least of his assets.

The man who has decided to follow engineering

This young man, one usually finds as a superlative form of No. 1, and I can safely say that 75 per cent of this type make a fairly recognizable success up to a certain point, beyond which if they desire to proceed, they must enter class No. 3.

The distance of that point from the starting point, is dependent firstly upon the magnitude of his desire to learn all there is to learn and his willingness to dig in on his own, both in the field and after hours; and secondly, it is dependent on the amount of stimulation his interest receives from his superiors.

Generally speaking, this type of young man has the practical mind, will show initiative and stick-to-it-iveness. This is evidenced by the fact that he has at least made the decision and acted upon it.

Unfortunately, he is usually in a position that precludes the possibility of a university course. If the chief takes the interest he should in him, he can help in the following ways: He will gladly explain any problem of which the junior might require interpretation and understanding, enlighten him regarding qualifications necessary for university, and assist him to attain those qualifications, or recommend a correspondence course. Let him use some of his own initiative, of course, in his researches, because on that initiative depends to a great extent, the distance he will go.

I have always found that a man who has taken a correspondence course, and seen it through, is a good man to have around, and it can be deduced that he should be, because he has had sufficient initiative and application to work without any pushing influence other than his own ambition, furthermore, he has had the advantage of studying while working and thus getting a proper perspective on the relation between his studies and their practical application.

The university student in a vacation job

Those who can be included in this category are the ones of course, who deserve obviously first consideration when positions of minor importance or even somewhat better positions are to be filled. He will probably not require so much attention from his superior, primarily because he has already embarked, and is well on his way, and secondly, because invariably he is sufficiently interested to own a desire to apply his theoretical education in the field and to progress.

The main thing for the superior to realize in this case, should be a desire to impress upon the junior the necessity of a harmonious relation between the theoretical and the practical, and that either alone is decidedly a failure.

It is also advantageous to the superior to recommend a diversity of occupations covering various branches of engineering both in field and in office, for a few years after graduation, in order to acquire as much general experience as possible before selection of a special branch of the profession.

The superior should also feel it incumbent upon himself to inculcate a desire in the junior, and lend assistance thereto, to become junior or student members of engineering societies; subscribe to at least one engineering periodical, read and digest the articles, not forgetting the advertisements which present a liberal education in themselves; to study all plans which might come under his eyes; and to become conversant with systems in use with especial reference to relations between the head office, and the field office, and the making of reports. Furthermore, the junior should be given, when opportunity offers, responsible assignments, and he should be made to feel that responsibility.

The man who is paying his own way through college has learnt the value of a dollar, and is, in the majority of cases, the man who will go farthest, because he has what might be termed a vested interest in his own welfare.

The job grafter

Sometimes it is necessary, owing to the inexorable law of supply and demand, for the embryo engineer to obtain employment in this manner, but it is not to be recommended, except it be necessary as stated above, on account of the obligations it might entail to both the friend and himself, and it has a tendency to prevent the development of that independent personality so necessary for success in any occupation. If, however, the junior has other than the serious reason for being employed, and does not realize and appreciate the obligations entailed, he will, in most cases not only be a drag on the organization, but a deterrent influence on the other members individually.

The only way to treat this type, should this latter assumption be the case, is to absolutely impress on him the fact as to who is in command, and force him to realize that orders are given to be obeyed. The other members of the staff who are interested in their work will see that his share is performed by himself, or he will soon realize that he has obtained the unenviable position of the "goat". This realization will either make him or show him up.

Summarizing now, and adding a few further general observations for the consideration of both the superior and the junior: — When a man graduates, he knows nothing except how to study, and it is advisable to keep in practice. A junior engineer's value to his employer is commensurate with his ability, interest in his work, and efforts to progress. It is to the superior's welfare to stimulate the junior along these lines, but the junior should show the predominating desire, and certainly a reciprocating appreciation of his superior's efforts to assist him. A junior should realize that "tempus does fugit", and also that industry, courtesy and honesty are better than "politics". The greatest incentives towards success are harmony, co-operation, resourcefulness, conscientious effort, and study.

A well known roadway engineer once said that good roads depended chiefly on drainage, more drainage, and still more drainage. Good engineering depends on checking, checking again, and checking still a third time. Be sure you are right, and then go ahead. Nothing lies like figures.

An engineer's hours are from twelve midnight to twelve midnight, with no overtime, and a lot depends on the grace and alacrity with which he accepts this ruling when required.

The best way to stimulate interest in the junior's mind is by putting him on his responsibility, but on occasional raise is also very important. The responsibility makes him feel his part in the organization, and the raise shows that the employer appreciates his efforts. A junior engineer will readily feel his own individuality, show his best personality, and exert his initiative if the recompense is commensurate with his efforts, attainments, and results achieved, and the magnitude of that pecuniary recompense to the employee, should vary directly as the appreciation of, and value to the employer.

If the above observations, more or less random, will in any way tend towards a better understanding between the chief and his subordinates, then something has been accomplished, and I trust the reading hereof, will be at least of some small interest to the junior members of the profession, an interest in whom, I deem very advisable, if the engineering profession is to reach that standing, which, in the eyes of the public, now that legislation and organization are a realization, we all hope for, and which it justly merits.

A. D. HUETHER, B.A.Sc., A.M.E.I.C.

Preliminary Notice

of Applications for Admission and for Transfer

February 18th, 1924.

The By-laws now provide that the Council of the Institute shall approve, classify and elect candidates to membership and transfer from one grade of membership to a higher.

It is also provided that there shall be issued to all corporate members a list of the new applicants for admission and for transfer, containing a concise statement of the record of each applicant and the names of his references.

In order that the Council may determine justly the eligibility of each candidate, every member is asked to read carefully the list submitted herewith and to report promptly to the Secretary any facts which may affect the classification and election of any of the candidates. In cases where the professional career of an applicant is known to any member, such member is specially invited to make a definite recommendation as to the proper classification of the candidate.*

If to your knowledge facts exist which are derogatory to the personal reputation of any applicant, should be promptly communicated.

Communications relating to applicants are considered by the Council as strictly confidential.

The Council will consider the applications herein described in March, 1924.

Fraser S. Keith, Secretary.

*The professional requirements are as follows:—

Member shall be at least thirty-five years of age, and shall have been engaged in some branch of engineering for at least twelve years, which period may include apprenticeship or pupilage in a qualified engineer's office, or a term of instruction in a school of engineering recognized by the council. The term of twelve years may, at the discretion of the council, be reduced to ten years in the case of a candidate for election who has graduated from a school of engineering recognized by the council. In every case the candidate shall have held a position in which he had responsible charge for at least five years as an engineer qualified to design, direct or report on engineering projects. The occupancy of a chair as a professor in a faculty of applied science or engineering, after the candidate has attained the age of thirty years, shall be considered as responsible charge.

An Associate Member shall be at least twenty-seven years of age, and shall have been engaged in some branch of engineering for at least six years, which period may include apprenticeship or pupilage in a qualified engineer's office or a term of instruction in a school of engineering recognized by the council. In every case a candidate for election shall have held a position of professional responsibility, in charge of work as principal or assistant, for at least two years. The occupancy of a chair as an assistant professor or associate professor in a faculty of applied science of engineering, after the candidate has attained the age of twenty-seven years, shall be considered as professional responsibility.

Every candidate who has not graduated from a school of engineering recognized by the council, shall be required to pass an examination before a board of examiners appointed by the council. The candidate shall be examined on the theory and practice of engineering with special reference to the branch of engineering in which he has been engaged. This examination may be waived at the discretion of the council if the candidate has held a position of professional responsibility for five or more years.

A Junior shall be at least twenty-one years of age, and shall have been engaged in some branch of engineering for at least four years. This period may be reduced to one year, at the discretion of the council, if the candidate for election has graduated from a school of engineering recognized by the council. He shall not remain in the class of Junior after he has attained the age of thirty-three years.

Every candidate who has not graduated from a school of engineering recognized by the council, or has not passed the examinations of the first year in such a course, shall be required to pass an examination in the following subjects: geography, history (that of Canada in particular), arithmetic, geometry, euclid (books I, IV and VI), trigonometry, algebra up to and including quadratic equations.

A Student shall be at least seventeen years of age, and shall present a certificate of having passed successfully an examination equivalent to the final examination of a high school or the matriculation of an arts or science course. He shall either be pursuing a course of instruction in a school of engineering recognized by the council, in which case he shall not remain in the class of student for more than two years after graduation; or he shall be receiving a practical training in the profession, in which case he shall pass an examination equal to that prescribed for admission to the grade of Junior in the foregoing section and he shall not remain in the class of Student after he has attained the age of twenty-seven years.

An Affiliate shall be one who is not an engineer by profession but whose pursuits, scientific attainments or practical experience, qualify him to co-operate with engineers in the advancement of professional knowledge.

The fact that candidates give the names of certain member as references does not necessarily mean that their applications are endorsed by such members.

FOR ADMISSION

BREEN—JOSEPH MELVILLE, of 173 Wright Avenue, Toronto, Ont. Born at Toronto, April 23rd, 1896; Educ., B.A.Sc. Univ. of Toronto, 1921; Prelim. D.L.S. Exams. 1915; 1916-19, overseas, Can. Engrs.; two summers on harbour walls for Toronto Harbor Commn.; one summer with E. A. James of Toronto; 1921, inspr. and instr'man., Toronto Harbour Commn.; 1922, estimator, inspr. and instr'man., roadways dept., City of Toronto; Dec. 1922 to date, roadways engr. for Ontario, with Canada Cement Company, Ltd., Toronto, Ont.

References: F. S. Keith, H. S. Van Scoyoc, C. A. Scott, J. S. Galletly, C. H. Mitchell, M. A. Stewart.

BROCK—REGINALD WALTER, of Vancouver, B.C. Born at Perth, Ont., Jan. 10th, 1874; Educ., M.A. 1895, LL.D., 1921, Queen's Univ.; Post-graduate work, Heidelberg Univ.; 1896, exploration, Geol. Survey of Canada; 1898, geologist in charge, B.C. explorations; 1902-07, professor, Queen's Univ.; 1907-14, director, Geological Survey, Deputy Minister, Dept. of Mines, Ottawa; 1904-05, examination of various mines as arbitrator to determine basis on which they should enter Consolidated Mining and Smelting Co.; 1907, represented Ont. govt. in determining value of ore extractor from Right of Way mine by LeRoy Mining Co.; 1914 to date, dean, faculty of applied science, University of British Columbia, Vancouver, B.C.

References: G. A. Walkem, W. G. Swan, C. Brakenridge, C. H. Mitchell, A. E. Foreman.

CHETWYND—GEORGE ROWLAND, of Regina, Sask. Born at Greenwich, England, July 1st, 1886; Educ., short course, engineering, London University, 1902; Oxford and Cambridge Senior Exams. (local); 1902-04, pupil to Jas. Mausergh & Sons, consltg. engrs., London, England; Also four years with same firm as asst. engr.; 1907, asst. res. engr., Carlisle Water Works, constrn.; 1907-08, Birmingham Water Works, constrn.; 1909-11, asst. res. engr., Derby Corporation Sewage Works; 1912-14, (Canada) Civil Supernumerary Establishment R.C.E., M.D. No. 10, Winnipeg; 1914-19, overseas; 1919-22, R.C.E. Division Officer, M.D. No. 10; Nov. 1922 to date, District Engineer Officer, M.D. No. 12, Regina, Sask.

References: J. L. R. Parsons, H. F. H. Hertzberg, A. Macphail, S. R. Parker, J. N. deStein.

CUNNINGHAM—WILLIAM JOHN, of 10619-99th Avenue, Edmonton, Alta. Born at Altrincham, England, Aug. 29th, 1886; Educ., pupil, Altrincham Tech. Sch., and ap'tice pupil to M. C. Caldwell, A.M.I.E.E.; 1901-07, ap'tice and asst. engr., Altrincham Electric Supply Co., central stn., erecting and repairing engines, boilers and elec. machinery, bench machine shop; 1907 (July-Dec.), fitting and erecting, elec. assembly shop, Allis-Chalmers Bullock Ltd., Montreal; 1908-12, electr'n. and asst. chief engr., power house and substations, City of Calgary; 1912-15, and 1919 (Apr.-Dec.), asst. supt. in charge during constrn. of 10,000 K.W. steam plant, City of Calgary; 1915-18, Ministry of Munitions, H.M.S. Valiant & Royal Gun Factory, Naval and Field Ordnance, fitting, assembly and inspection; Jan. 1st, 1920 to date, supt., power and pumping plants, City of Edmonton, Alta.

References: C. A. Robb, A. W. Haddow, C. J. Yorath, R. S. Trowsdale, E. W. Bowness, G. W. Craig.

KEATING—REGINALD VICTOR HAMILTON, of Thorold, Ont. Born at Penetanguishene, Ont., Oct. 25th, 1879; Educ., studying struct'l. engr., I.C.S. (expects to finish course within a year); 1902, rodman, Can. Nor. constrn.; 1904-06, rodman on surveys and constrn. at Fort Frances and International Falls, Minn.; 1907-10, asst. engr. on constrn. of dams and power houses at Fort Frances and International Falls, Minn. Res. engr. on constrn. of Nakoda branch, Minnesota and International Rly.; 1908, acted as engr. on water and sewer extensions for the town of Fort Frances; 1910-12, in charge all field work — dams, power houses, and paper mills, also International Bridge at Fort Frances, Ont. and International Falls, Minn.; 1916, in charge of dock and power house constrn., Shelter Bay, Que.; 1917 (May-Oct.), asst. supt. on constrn., Prov. Paper Mills, Port Arthur; 1917-18, res. engr. on ore dock and coal dock, Ojibway, Ont., for the Steel Corpn. of Canada; From Aug. 1918 in charge of design and constrn. of docks, power houses and shipping plant for pulpwood at Shelter Bay and Franquelin, Que., and at present making surveys and flow measurements for power development on Outardes River, Que., for Ontario Paper Co. Ltd., Thorold, Ont.

References: E. F. Considine, F. Y. Harcourt, G. P. Brophy, F. S. Lazier, E. C. Little.

KELLY—EDWARD ARTHUR, of 1249-6th Avenue A South, Lethbridge, Alta. Born at Sarnia, Ont., July 1st, 1889; Educ., Univ. of Toronto, 1911; 1907-11, constrn. dept., C.P.R.; 1911 to date with C.P.R. as follows: — 1911-14, res. engr., on constrn., 1915-19, divn. engr., mtce of way, 1919-21, res. engr., constrn., 1921-22, asst. engr., constrn. and location, 1922-23, roadmaster, 1923-24, asst. engr., constrn., at present from Kipp, Alta., to Little Bow River.

References: W. A. James, H. R. Miles, J. G. Sullivan, J. R. C. Macredie, T. Lees.

MARTIN—FRANK DUKE, of Cumberland, B.C. Born at Hartlepool, Durham, England, April 26th, 1894; Educ., B.C. Corr. School, and I.C.S.; 1919-23, surveyor's asst., Canadian Collieries, Cumberland; 1923 (Jan.-Oct.), compassman and chainman, Esary Timber Co. Ltd., Bowser, B.C.; Oct. 1923 to date, mining work, with Canadian Collieries, Cumberland, B.C.

References: J. W. B. Blackman, J. R. Cosgrove, A. D. Creer, T. H. White, G. Scott, W. G. Swan.

ROBINSON—ARTHUR HERBERT ASHBURNER, of Ottawa, Ont. Born at Peterborough, Ont., July 29th, 1873; Educ., B.A.Sc. Univ. of Toronto, 1898; Previous to graduation on various surveys as rodman and instr'man.; 1898-99, with J. W. Evans, mining and civil engr., Sudbury, Ont., in charge of assay office and lab.; 1899-1900, fellow in chemistry, Sch. of Prac. Science, Toronto; 1900 (summer), geologist, Ont. Govt. exploration party; 1900-01, fellow in mineralogy, Sch. of Prac. Science, Toronto; 1901 (summer) prospecting for Iron ore with the United States Steel Corpn.; 1901-02, fellow in mineralogy, Sch. of Prac. Science, Toronto; 1902 (summer), chemist, investigating sewage disposal at Berlin, Ont., Ontario Board of Health; 1903-05, chief surveyor and asst. to the gen. mgr., Intercolonial Coal Mining Co., Westville, N.S.; 1905-06, res. engr., Arizona Copper Co., Morenci, Ariz.; 1906-07, inspr. of mining claims for the Ontario Govt.; 1907-11, chief inspr. of mining claims for the Ontario Govt. at Cobalt; 1911 to date, mining engr., Mines Branch, Dept. of Mines, Ottawa. From 1915 engr. in charge of magnetometer survey and investigation of iron ore resources, and at present, mineral technologist.

References: H. S. Carpenter, M. B. Weekes, E. J. Boswell, E. Maybee, J. W. Evans, J. McLeish, L. H. Cole.

SALTMAN—FRED EVERETT, of Halifax, N.S. Born at Mader's Cove, N.S., Nov. 14th, 1887; Educ., B.Sc., Dalhousie Univ. 1922. At present taking elec. engrg. at N.S. Tech. College; 1904-06, taught in public schools; 1906-07, attended Maritime Business College, Halifax; 1907-14, bookkeeper with a hardware firm in Halifax; 1914-16, on garrison duty at Halifax; 1916-19, overseas with C.F.A.; 1919-22, attended Dalhousie Univ.; Summers 1920-23, with N. S. Highway Board.

References: W. F. McKnight, F. R. Faulkner, D. W. Munn, R. W. McColough, E. F. T. Handy

SHELDRAKE—LORIMER SPARHAM, of Jordan River, Vancouver Island, B.C. Born at Lakefield, Ont., August 4th, 1886; Educ., 1918-19, railroad engrg. course, D.S.C.R., Sch. of Technology, Calgary, (equiv. to 2nd year univ.); Railroad engrg. on C.P.R. since building of double track from Winnipeg to Fort William, 1904, (rodman and topog'r.); 1914-18, overseas; 1919, transitman on mtce. of way, C.P.R., Portage La Prairie Divn.; April 1922 to date, engr. for the Canadian Puget Sound Lumber & Timber Co. of Victoria, B.C., located and supervised constrn. 8 miles railroad in Cowichan Lake Dist., and at present locating approx. 23 miles from Sooke to Jordan River, B.C.

References: J. G. Reid, G. W. Coburn, W. A. James, D. Livingston, J. A. H. Christie.

STARK—JAMES TOD, of 209 Notre Dame Street, St. Lambert, Que. Born at Glasgow, Scotland, July 3rd, 1889; Educ., Glasgow Technical College. Prof. Assoc. Surveyor's Instn. Gr. Britain, 1914. Qualified as Fellow, 1921; 1905-10, ap'ticeship in burgh engr's. office, Partick, Glasgow. Also one year asst. in same office; 1911-14, surveyor, Inland Revenue, Land Valuation Dept., in charge of all surveys, plans and ordnance maps for Lanarkshire B District, incl. half area of city of Glasgow; 1914-19, active service with Royal Engrs.; 1919, resumed duty with Land Valuation Dept.; At present asst. in office of Malcolm D. Barclay, A.M.E.I.C., civil engr. and land surveyor, Montreal.

References: A. W. Smith, M. D. Barclay, R. O. Stewart, R. J. Anderson, J. Whitelaw, L. E. Schlemm.

STEEL—WILLIAM ARTHUR, of 190 Carling Avenue, Ottawa, Ont. Born at Caselton, Ont., Nov. 3rd, 1890; Educ., B.A.Sc. Univ. of Toronto, 1915; 1 year, Belleville plant, Canada Cement, Company, on gen. elec. repair and mtce. work; 2 years on substation (H.T.) constrn., Seymour Power Co. and Midland Constrn. Co. (Smith Kerry & Chace); 2 years on elec. and mech. shop testing for Smith, Kerry & Chace; 9 mos. suptg. elec. constrn. on Healey Falls power house, Midland Constrn. Co.; 1 year plant test and switchboard installation, Nor. Ontario Power Co.; 1916-19, overseas, Lieut.; Signal officer 4th Can. Divn., France, 1916-18, Officer i/c radio communication for the Can. Corps, France, from March 1918 to June 1919; At present, tech. officer for the Royal Canadian Corps of Signals, Ottawa, Ont.

References: A. G. L. McNaughton, C. H. Mitchell, P. Gillespie, C. R. Young, T. R. Loudon, J. R. Cockburn.

TAKER—FRANK OLIVER, of Timmins, Ont. Born at Magdalen Islands, Que., Oct. 10th, 1899; Educ., diploma in land surveying, N.S. Tech. Coll. Studying civil engrg. I.C.S.; 1920 (season), N.S. Highway Board; 1923 (summer), with J. Canning, O.L.S. Cochrane, Ont.; One and a half years with the Hollinger Consolidated Gold Mines Ltd., Timmins, Ont. (At present surveyor on engrg. staff).

References: R. H. Reid, J. A. Denovan, J. W. Roland, F. R. Faulkner, W. J. Bishop.

TRUEMAN—JAMES COBDEN, of 721 Shuter Street, Montreal, Que. Born at Chatham, England, Nov. 28th, 1900; Educ., B.Sc., Univ. of Man. 1923; 1918, rodman, C.P.R.; 1919, rodman, C.N.R.; 1919 (Sept.-Dec.), instr'man., C.P.R.; 1920 (Jan.-Apr.), field dftsman., rly. location, C.P.R.; 1921 (summer), bridge inspr., Manitoba Good Roads; 1922 (summer), rodman, Fraser Brace Co., Great Falls, Man.; 1923 (summer), instr'man., rly. mtce., C.M. & St. P. Rly., Mason City, Id.; At present, post graduate work, McGill University, Montreal.

References: J. N. Finlayson, H. M. MacKay, E. S. Kent, P. C. Kirkpatrick, E. P. Fetherstonhaugh, W. M. Scott.

WILSON—JAMES MOIR, of Lachine, Que. Born at Lachine, Que., Oct. 31st, 1891; Educ., B.Sc. McGill Univ., 1922; 1912-13, with C.P.R.; 1914, rodman, Can. Govt. Rlys. at Levis; 1914-19, overseas; 1922 (June-Sept.), topographical asst., Can. Geol. Survey at Fort William; 1922-23, asst. engr. on location and constrn. of highways, Northern Development Branch, at Fort William; 1923 (Sept.-Nov.), asst. on constrn., C.P.R. at Ville Marie, Que.; Nov. 1923 to Jan. 1924, asst. to G. C. Perkins, on hydro-electric scheme, at St. Paulin, Que.; Not employed at present.

References: D. C. Tennant, J. Robertson, E. C. Kirkpatrick, J. Colin Kemp, G. C. Perkins.

FOR TRANSFER FROM CLASS OF ASSOCIATE MEMBER TO MEMBER

PICKARD—KENNETH STOCKTON, of Sackville, N.B. Born at Sackville, N.B., May 9th, 1889; Educ., B.Sc. (Mech. Eng.), McGill Univ. 1913; 1907-12 (summers), on various constrn. works, surveys, etc.; 1913-16, engr. in charge constrn. rock work, Prince Edward Island Co., ferry terminals, Cape Tormentine, N.B., for Sackville Freestone Co. Ltd., sub-contracts from O'Brien Doheny & Co.; 1916-18, supt. of stores and shipping for engrg. dept., divn. of gauges and standards, Imperial Ministry of Munitions, under Capt. R. J. Durley; 1918-19, Lieut. Can. Rly. Troops, Service in Canada only; 1919 to date, private practice, at present engaged in making plans and investigations for Hollingsworth & Whitney Ltd., of Canada paper mfgs.

References: C. H. Wright, C. C. Kirby, W. J. Francis, F. B. Brown, W. G. Mitchell, R. J. Durley, C. M. McKergow, J. D. McBeath.

FOR TRANSFER FROM CLASS OF JUNIOR TO HIGHER GRADE.

CROSSING—WILLIAM BERKLEY, of Winnipeg, Man. Born at Frome, Somerset, England, April 2nd, 1893; 3 years Bath College, England, 1906-09. 1 year private tutor, 1909-10. Matric. Univ. of Bristol, 1910, and one year at Bristol Univ. 1 year Univ. of Man. 1914; 1910-14, rodman, pile inspr., topog'r., dftsman., location and constrn., C.P.R.; 1914-19, overseas; 1919-22, instr'man, 1922-23, dftsman., 1923-24, res. engr., and from Jan. 11th, 1924 to date, transitman on location, C.P.R.

References: W. A. James, J. G. Sullivan, C. Flint, J. G. Reid, C. H. Larson, D. A. Livingston, L. Pierard, H. W. Tye.

MORRISEY—THOMAS SYDNEY, of 85 Church Hill, Westmount, Que. Born at St. John, N.B., Aug. 30th, 1890; Educ., Diploma of Grad. R.M.C. 1910; 1911, topog'r., rly. survey for B. & M. Rly.; 1912, asst. engr., Montreal Harbour Commnrs.; 1913, prin. asst. to Mr. A. D. Swan, accompanied him to Antofagasta, Chile, in connection with harbour development. Later in office on designs for Vancouver harbour development, etc.; 1914-19, overseas, France, England, Siberia. Lieut.-Col. Awarded D.S.O., Order of the Rising Sun (Japan), Czecho-Slovak War Cross; 1920-21, managing director, Anglo-Canadian Wire Rope Co. Ltd.; 1921 to date, engaged in private work in connection with industrial engineering, chiefly investigating by-product coke processes in England.

References: C. H. Mitchell, J. S. Dennis, J. M. R. Fairbairn, A. D. Swan, T. W. Harvie.

REID—JOHN HERBERT, of 90 Cedar Street, Halifax, N.S. Born at Seattle, Wash., U.S.A., Aug. 27th, 1890; Educ., B.Sc. (E.E.), McGill Univ. 1916; 1910-12, elec. constrn. city of Grand Forks, B.C.; 1912-13, elec. mtce., Granby Mining Smelting & Power Co., Grand Forks, B.C.; 3 years military service; 1919-20, students engrg. course, Can. Gen. Elec. Co., Peterborough; 1920-21, asst. designing engr., A.C. generator section, engrg. dept., Can. Gen. Elec. Co., Peterborough; 1921-22 (6 mos.), asst. constrn. engr., Can. Gen. Elec. Co.; 1921 to date, asst. prof. of elec. engrg., Nova Scotia Technical College, Halifax, N.S.

References: F. R. Faulkner, W. F. McKnight, J. F. Lumsden, C. H. Wright, B. L. Barns.

VANCE—JAMES ALFRED, of 197 Light Street, Woodstock, Ont. Born at Oxford County, Ont., May 8th, 1892; Educ., 3rd year faculty of app. science, Univ. of Tor., 1911-14; 1910-14 (vacations), asst. in charge of erection of steel and concrete highway bridges for Hamilton Bridge Works Co. Ltd., also 5½ mos. in 1917, struct'l. dftsman; 1914-19 (except 5½ mos. in 1917), general contractor, designing and erecting steel and concrete highway bridges, dams, etc.; 1919 to date, general contractor, designing and bldg. reinforced concrete work (particularly bridges and dams), struct'l. steel (particularly highway bridges), and general bldg. with special reference to dairy plants.

References: W. Storrie, E. H. Darling, F. J. Ure, H. A. Brazier, G. Hogarth.

FOR TRANSFER FROM CLASS OF STUDENT TO HIGHER GRADE.

FRY—JOHN DAWSON, of Montreal, Que. Born at Montreal, March 17th, 1901; Educ., B.Sc. McGill Univ. 1923; 1919 (summer), machine shop work, Thos. Davidson & Co., Montreal; 1920 (summer), tech. dept., Price Bros. & Co. Ltd., Kenogami, Que.; 1921 (summer), dftsman and asst., McDougall, Pease & Friedman, Consulting Engrs., Montreal, and from Aug. 1922 to date, asst. engr. with same firm, heating, ventilating and mechanical equipment of bldgs.

References: G. K. McDougall, E. R. Pease, F. J. Friedman, J. C. McDougall, C. R. Creighton.

PERRITON—DOUGLAS E., of Westmount, Que. Born at Montreal, Que., Jan. 16th, 1897; Educ., B.Sc. McGill Univ., 1922; 1916 (6 mos.), production, Imperial Munitions Board; 1917 (6 mos.), dftsman., Dominion Bridge Co.; 1918, pilot, R.F.C.; 1919 (6 mos.), mech. designer, P. Lyall & Sons; 1920-21, asst. inspr., Grand Trunk Arbitration; May 1922 to date, checker, Dominion Bridge Co., Lachine.

References: D. C. Tennant, A. Peden, C N. Monsarrat, P. L. Pratley, A. R. Roberts.

WHITFORD—JOSEPH ARTHUR HUGH, of 289 Union Street, Moncton, N.B. Born at Bridgewater, N.S., July 22nd, 1899; Educ., I.C.S.; 1914-15 (summers), rodman, N.S. Prov. Highways; 1917-19, overseas. C.F.A.; 1919 (March-June), rodman and dftsman. for S. E. March, engr. for town of Bridgewater; 1919-21, rodman for L. H. Robinson, division engr., C.N.R., Bridgewater; 1921 to date, dftsman. on bldg. design in chief engr's office, C.N.R., Moncton.

References: A. F. Stewart, H. J. Crudge, F. O. Condon, M. J. Murphy, C. S. G. Rogers, P. B. Duff, J. G. Dryden.

WILLIAMS—STEPHEN, of 294 N. Christina Street, Sarnia, Ont. Born at Toronto, Ont., Jan. 6th, 1900; Educ., B.A.Sc. Univ. of Toronto, 1922; Grad. R.M.C., 1920; During summer vacations, surveying with Toronto Harbour Commn., ap'tice, machine shop, John Inglis Co., holter-up, Dominion Shipyards, Toronto, lathe hand, machine shop Chapman Double Ball Bearing Co., Toronto; 1922 (Apr.-July), instr'man, Toronto Harbour Commn.; 1922 (July-Oct.), surveying with Ontario Dept. of Public Highways; At present dftsman, Imperial Oil Refineries, Ltd., Sarnia, Ont.

References: C. D. Dean, H. V. Thompson, W. V. Taylor, C. B. Leaver, C. H. Mitchell, T. R. Loudon, W. J. Smither.

ZEALAND—EDWARD LAMPORT, of St. Joseph d'Alma, Que. Born at Hamilton, Ont., May 14th, 1898; Educ., B.A.Sc. Univ. of Toronto, 1922; R.M.C., 1915-17; 1920 (summer), rodman, rly. constrn. survey party, C.N.R., near Ste Ursule, Que.; 1921 (June-Sept.) and June 1922, dfting, estimating quantities, and instrument work, Dept. Public Highways, Ontario; 1917-19, Lieut., Can. Cavalry; 1922 (July-Oct.), instr'man. and concrete inspr., constrn. small bridges and a wharf for Bruce Divn., Ontario lines, C.P.R.; May 1923 to date, junior engr., office and field work, on dam and power house constrn., Quebec Development Co. Ltd., St. Joseph d'Alma, Que.

References: C. E. Bush, V. A. G. Dey, H. G. Cochrane, J. P. Chapleau, C. E. Legris, P. Gillespie.

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A

ABRASIVE WHEELS

Diamonds for Dressing. Selection and Use of Diamonds for Dressing Grinding Wheels, W. H. Robinson. Machy. (Lond.), vol. 23, no. 585, Dec. 13, 1923, pp. 321-324, 3 figs. Author explains general practice in handling this work, and presents original information on use of trueing diamonds.

AERONAUTICAL INSTRUMENTS

Air-Speed Indicators. Measurement of Air Speed in Aeroplanes, C. J. Stewart. Jl. of Sci. Instruments, vol. 1, no. 2, Nov. 1923, pp. 43-50, 7 figs. Discusses methods adopted to determine value of this speed while in air; principles governing air speed indicator design.

Revolution Counter. An Improved Revolution Counter, B. K. Johnson. Flight, vol. 15, no. 50, Dec. 13, 1923, p. 752, 3 figs. Describes optical instrument for observing behavior of objects revolving at high speed (such as airplane propellers) besides actually recording their speed of rotation.

AERONAUTICS

Progress. Some Aspects of Aeronautical Progress, F. H. Sykes. Roy. Aeronautical Soc.—Jl., vol. 27, no. 156, Dec. 1923, pp. 606-617. Notes on design, research, experiment and operation.

AIR PUMPS

Edwards. The Edwards Air Pump, C. L. Grabham. Commonwealth Engr., vol. 11, no. 3, Oct. 1, 1923, pp. 109-110, 1 fig. Describes pump used in steam-power installations for removing condensed steam and air from condenser and delivering water to hot well where it is handled by feed pumps; pump with 14-in. barrels, 12-in. stroke, single-acting, at 150 r.p.m. will handle 45,000 lb. steam per hour from a surface condenser.

AIRPLANE ENGINES

Cylinder Calculation. Aero-Engine Cylinder Calculations. Practical Engr., vol. 68, no. 1920, Dec. 13, 1923, pp. 333-335, 6 figs. Deals with cooling of water-cooled and air-cooled cylinders; calculation of volume of combustion chamber, valves and ports, stress in cylinder walls, and stress in bolts securing cylinder foot to crankcase.

AIRPLANE PROPELLERS

Direct and Geared Drives. Relative Efficiency of Direct and Geared Drive Propellers, W. S. Diehl. Nat. Advisory Committee for Aeronautics—Report, no. 178, 1923, 9 pp., 3 figs. Shows relative values of various direct and geared drives.

Reed. The Reed Duralumin Airscrew. Aeroplane, vol. 25, no. 21, Nov. 21, 1923, p. 510, 1 fig. Consists of a single plate of duralumin of a thickness of up to 1½ in. cut or pressed out to developed blade plan, shaped to required blade sections, and then twisted to required pitch angles throughout its length.

AIRPLANES

Guide Cables. Leader Cable Systems for Steering of Aeroplanes. Flight, vol. 15, no. 52, Dec. 27, 1923, pp. 782-785, 9 figs. Brief explanation of principles involved and apparatus used in Loth guide cable. From paper by M. Loth read before Instn. Aeronautical Engrs.

Light. The English Light Plane Meeting and Its Lessons (Der englische Wattbewerb für Kleinflugzeuge und seine Lehren), G. Lachmann. Zeit. für Flugtechnik u. Motorluftschiffahrt, vol. 14, nos. 23-24, Dec. 27, 1923, pp. 165-172, 11 figs. Describes airplanes and their engines, performances and conclusions therefrom.

Oscillations in Steady Flight. The Small Angular Oscillations of Airplanes in Steady Flight, F. H. Norton. Nat. Advisory Committee for Aeronautics—Report, no. 174, 1923, 8 pp., 5 figs. Investigation carried out to provide data concerning small angular oscillations of several types of airplanes in steady flight under various atmospheric conditions; of use in design of boom sights and other aircraft instruments.

Struts. Compressive Strength of Tapered Airplane Struts, Viktor Lewe. Nat. Advisory Committee for Aeronautics—Tech. Notes, no. 171, Dec. 1923, 8 pp., 1 fig. Methods for ascertaining value of n in Euler's simplified formula for compressive strength of tapered airplane struts, by estimating from curves and by calculation. Translated from Technische Berichte, vol. 3, no. 7.

ALCOHOL

Automobile Fuel. The Carburetion of Alcohol, A. W. Scarratt. Sugar, vol. 25, no. 12, Dec. 1923, pp. 662-663. Factors necessary to successful use of alcohol in combustion engines.

ALLOYS

Aluminum. *See Aluminum Alloys.*

Zinc-Copper, X-Ray Analysis of. X-Ray Analysis of Zinc-Copper Alloys, E. A. Owen and G. D. Presto. Physical Soc. Lond. Proc., vol. 36, Pt. 1, Dec. 15, 1923, pp. 49-66, 5 figs. Account of results obtained in study of zinc-copper series.

ALUMINUM

Charges in. Charges of Foreign Matter in Aluminum (Fremdstoffeinschlüsse im Aluminium), J. Czochralski. Zeit. für Metallkunde, vol. 15, no. 10, Oct. 1923, pp. 273-283, 33 figs. Oxidic, carbide, phosphide and sulphide charges and charges of metallic sodium; metallographic characteristics; influences of mechanical properties. Research work of committee for aluminum and light alloys of German Metallographical Soc.

Corrosion and Cleansing. Recent Observations Regarding the Corrosion, Cleansing, and Protection of Aluminum, H. A. Gardner. Am. Soc. Mech. Engrs.—advance paper, for meeting Dec. 3-6, 1923, 2 pp., 2 figs. Experimental investigations; cleansers for aluminum alloys; results of corrosion tests on aluminum and aluminum alloys.

ALUMINUM ALLOYS

Analysis. Contributions to the Quantitative Determination and Separation of Aluminum (Beiträge zur quantitativen Bestimmung und Trennung des Aluminiums), G. Jander and B. Weber. Zeit. für angewandte Chemie, vol. 36, no. 75, Dec. 3, 1923, pp. 586-590, 1 fig. Describes method of analysis for aluminum alloys by which it is possible to separate quantitatively the aluminum from the other alloy components.

Salt-Water Corrosion, Resistance to. Resistance of Various Aluminum Alloys to Salt-Water Corrosion, D. Basch and M. F. Sayre. Am. Soc. Mech. Engrs.—advance paper, for meeting Dec. 3-6, 1923, 4 pp., 3 figs. Results of tests of 24 different compositions under conditions analogous to service on shipboard, showing that corrosion troubles hitherto experienced have been due to use of unsuitable alloys.

AMMONIA

Equilibrium. The Ammonia Equilibrium, A. T. Larson and R. L. Dodge. Am. Chem. Soc.—Jl., vol. 45, no. 12, Dec. 1923, pp. 2918-2930, 3 figs. Computation of equilibrium values and constants, calculation of percentage of ammonia at equilibrium for temperature range of 200-1000 deg. and pressure range of 10-100 atmos.

ARMATURES

Wave-Wound, Connecting of. Connecting Wave-Wound Armatures, E. C. Parham. Nat. Engr., vol. 27, no. 12, Dec. 1923, pp. 592-596, 9 figs. Characteristics of wave-wound or series-connected armatures and methods to be used for their proper connection; rules of thumb for determining proper spacing; possible connections and consequences of making wrong connections.

ASH HANDLING

Power Stations. Ash Disposal, G. F. Zimmer. Electrician, vol. 91, no. 2380, Dec. 28, 1923, pp. 721-725, 5 figs. Details of appliances now used in power stations.

AUTOMOBILE ENGINES

Air-Cooled. The Future of the Air-Cooled Car, V. W. Pagé. Sci. Am., vol. 130, no. 1, Jan. 1924, pp. 22-23 and 71, 7 figs. Engineering and operating facts that call for its most serious consideration.

Design. Petrol Engines, A. T. J. Kersey. Instn. Mech. Engrs.—Proc., vol. 1, no. 3, 1923, pp. 493-506 and (discussion) 507-510, 8 figs. Discusses problems of design, including elimination of noise and vibration; freedom from breakdowns; accessibility for examination, adjustments and renewals; flexibility; economy in fuel consumption; reduction in weight and space occupied per h.p.; and low cost of production.

Heavy-Oil. The Bagnulo Engine (Der Bagnulo-Motor), Della Porta. Motorwagen, vol. 26, nos. 32-33 and 34, Nov. 20-30 and Dec. 10, 1923, pp. 460-461 and 481-483, 7 figs. Details of engine, developed by Italian engineer, which works only with heavy oil without addition of benzol or gasoline.

Misuse and Efficient Application. The Misuse of the Internal Combustion Engine, and Suggestions for Its More Efficient Application, L. Murphy. Automobile Engr., vol. 13, no. 184, Dec. 1923, pp. 409-415, 10 figs. Outlines limitations of variable-ratio method as means of economically transmitting output of gasoline engine to road wheels, and discusses possible alternatives.

Radiator Non-Freeze Solutions. Non-Freeze Solutions for the Radiator. Motor Transport (N.Y.), vol. 29, no. 9, Dec. 1, 1923, pp. 304-305 and 308, 4 figs. Common difficulties with alcohol and glycerine solutions and suggested remedies; raising of boiling point of alcohol solutions important; pooling purchases proves economical.

AUTOMOBILE FUELS

ALCOHOL. *See Alcohol.*

CRANKCASE-OIL DILUTIONS. Crankcase-Oil Dilution, E. F. Hallock. Soc. Automotive Engrs.—Jl., vol. 14, no. 1, Jan. 1924, pp. 57-62. Presents tabular data to show how end points have risen since 1910, together with data showing effects of various percentages of fuel dilution with relation to Staybolt viscosities and pour points of high-grade oils; points out that contamination, not dilution, necessitates oil drainage; use of heavier-bodied oils decried; how to avoid crankcase dilution, and oil sludging; proper oil specification.

HEAVY OILS. Heavy Oils for Automobile Engines (Schwerölbetrieb bei Kraftwagen), Erwin Aders. Maschinenbau, vol. 2, no. 20, July 13, 1923, pp. G220-G224, 12 figs. Discusses difficulties in use of heavy oils and measures for combating them.

AUTOMOBILES

ALL-WHEEL FUNCTIONING. All-Wheel Functioning. Motor Transport (Lond.), vol. 37, no. 982, Dec. 24, 1923, pp. 823-824, 3 figs. Demonstration of possibilities of an experimental chassis having four wheels driven, braked, steered and independently sprung.

ELECTRIC. Storage-Battery-Driven Cars (La traction sur route par accumulateurs), Jean Boës. Revue Générale de l'Electricité, vol. 14, nos. 23 and 24, Dec. 8 and 15, 1923, pp. 905-916 and 967-988, 55 figs. Gives statistical data to show use of storage-battery cars, both for passengers and trucks, in all civilized parts of world; author deplores that this type of traction is practically unknown in France and points to America as country with widest use of such vehicles; gives number of comparative cost figures for gasoline-driven and electric cars, showing considerable saving for electric car. Bibliography.

ELECTRICAL-EQUIPMENT REPAIRS. The Engineer's Duty in Simplifying Electrical-Equipment Repairs, J. W. Tracy. Soc. Automotive Engrs.—Jl., vol. 14, no. 1, Jan. 1924, pp. 11-12. Selection and application of apparatus is stated to be starting point in simplifying repairs to electrical equipment; notes on maintenance of repair-parts stock; dissemination of technical information and explicit service instructions for new apparatus.

REPAIR SERVICE. How Engineers Can Co-operate to Make Flat-Rate Service a Success, J. Willard Lord. Soc. Automotive Engrs.—Jl., vol. 14, no. 1, Jan. 1924, pp. 20-22. Points out need of co-operation of engineering and maintenance; development of special tools; reduction of parts expense; price of repair parts.

Providing the Engineer with Service Data, O. T. Kreusser. Soc. Automotive Engrs.—Jl., vol. 14, no. 1, Jan. 1924, pp. 63-67 and 73, 2 figs. Tendencies of industry; maintenance troubles; field information; recording service data; co-operation between factory and service men.

TRANSMISSIONS. Variable Transmission, G. Constantinesco. Automobile Engr., vol. 13, no. 184, Dec. 1923, pp. 396-400, 3 figs. Critical consideration of problem.

AVIATION

COMMERCIAL POSSIBILITIES. The Commercial Possibilities of the Airplane, Archibald and Donald R. Black. Am. Soc. Mech. Engrs.—advance paper, for meeting, Dec. 3-6, 1923, 5 pp., 6 figs. Estimates of capital required for financing air lines and of cost of their operation; presents curves showing very rapid drop in operating costs with increased operations; possible further increases; gives figures showing that night air service could practically eliminate competing night-letter telegraph services for distances up to 1,200 miles; concludes that large-scale operations will bring airplane into direct competition with extra-fare train.

B

BALANCING

PROBLEMS. Problems of Balancing (Auswuchtfragen), H. Hort. Maschinenbau, vol. 2, nos. 25-26, Sept. 29, 1923, pp. G271-G277, 18 figs. Describes new static and dynamic balancing machines; practical aspects for balancing.

BEACH EROSION

CAUSES AND CURE. Beach Erosion: Its Causes and Cure, H. C. Ripley. Am. Soc. Civ. Engrs.—Proc., vol. 50, no. 1, Jan. 1924, pp. 13-18, 1 fig. Explains principal causes of beach erosion and accretion and determines principles which control these actions; gives two examples, one in France and other in Brazil, where works have been constructed that illustrate principles enunciated and confirm conclusion reached.

BEAMS

REINFORCED-CONCRETE. The Strength of Short Concrete Beams, J. B. Macphail. Concrete & Constructional Eng., vol. 18, no. 12, Dec. 1923, pp. 800-801. Describes tests made on reinforced-concrete beams loaded on spans of less than four times their depths.

BEARING METALS

CAR BEARINGS. Investigation of Bearing Metals for Railway Practice (Untersuchung über Lagermetalle für den Eisenbahnbetrieb), J. Karafiat. Zeit. des Oesterr. Ingenieur- u. Architekten-Vereines, vol. 75, nos. 33-35, Aug. 31, 1923, pp. 219-231, 2 figs. Investigation of bearing alloy consisting of tin, copper, antimony and lead.

BEARINGS

ANTI-FRICTION. Journal Boxes with Anti-Friction Bearings, O. R. Wikander. Ry. Mech. Engr., vol. 98, no. 1, Jan. 1924, pp. 33-35, 3 figs. Discusses possible standardization of ball and roller bearings for railway cars.

JOURNAL, PAD SYSTEM APPLIED TO. The Pad System Applied to Journal Bearings, Johnstone-Taylor. Am. Mach., vol. 60, no. 1, Jan. 3, 1924, pp. 9-10, 4 figs. Design of bearings constructed on pad system and their advantages.

SUSPENDED. Progress in Transmission Construction (Fortschritte im Transmissionsbau), F. Wilcke. Praktischer Maschinen-Konstrukteur, vol. 56, nos. 36-37, Sept. 18, 1923, 4 pp., 8 figs. Describes latest type of Flender suspension bearings with ring lubrication, and Flender friction coupling, and points out their advantages.

BEARINGS, ROLLER

SPHERICAL. The Solution of the Railway Bearing Problem through the SKF Spherical Roller Bearing (Die Lösung der Eisenbahnlagerfrage durch das SKF sphärische Rollenlager), F. Nussbaum. Zeit. des Oesterr. Ingenieur- u. Architekten-Vereines, vol. 75, nos. 33-35, Aug. 31, 1923, pp. 208-218, 16 figs. Notes on rolling resistance of railway cars; tests with spherical roller and other bearings; load capacity of ball and roller bearings; details of spherical rolling bearings and saving in coal effected by their use.

BELTING

LEATHER. How to Select, Install and Care for Leather Belting, C. O. Streeter. Belting, vol. 23, no. 6, Dec. 1923, pp. 39-42, 3 figs. Description of best methods of securing efficient power transmission through leather belting; principles of power transmission.

Instructions for Making Leather Belts Endless, L. W. Arny. Nat. Engr., vol. 27, nos. 9 and 11, Sept. and Nov. 1923, pp. 413-416 and 543-546, 18 figs. Procedure in making joints in different kinds of belts; different kinds of cement and their application; tools required and how to use them; lubrication of belts.

BLAST FURNACES

LININGS. Reducing Lining Disintegration, H. E. Townsend. Iron Trade Rev., vol. 75, no. 3, Jan. 17, 1924, pp. 232-234, 2 figs. After two linings high in iron oxide had failed prematurely, a third lining low in iron oxide satisfactorily withstood disintegration on same furnace during 12-month campaign.

BOILER FEEDWATER

HEATING. Economy Characteristics of Stage Feedwater Heating by Extraction E. H. Brown and M. K. Frewry. Am. Soc. Mech. Engrs.—advance paper, for meeting Dec. 3-6, 1923, 29 pp., 15 figs. Authors point out influence of each possible factor in computations, present practical method for computing extraction cycles, and deal with various factors affecting turbine-room economy.

TEMPERATURE, INCREASING. Effect of Increased Feed Water Temperature, J. R. Darnell. Power Plant Eng., vol. 28, no. 2, Jan. 15, 1924, pp. 131-132. Boiler efficiency is not increased by raising feedwater temperature; effect is to give boiler less work to do.

BOILER FURNACES

AIR PREHEATERS FOR. Air Preheaters in Factories (Der Lufterhitzer in der Wärmewirtschaft des Fabrikbetriebes), L. Finckh. Wärme, vol. 46, no. 18, May 4, 1923, pp. 185-188, 3 figs. Increasing heat economy of factory through diverting flow of heat by means of air preheater; describes air preheater and its operation and gives results of official test.

ARCH DESIGN. Suspended Arches Gaining in Favor. Power Plant Eng., vol. 28, no. 1, Jan. 1, 1924, pp. 38-41, 10 figs. Proper ignition and combustion demand careful consideration of arch design; construction details.

DAMPERS. The Venetian Blind Damper. Eng. & Boiler House Rev., vol. 37, no. 5, Dec. 1923, p. 156, 1 fig. Describes damper, designed to overcome defects of ordinary sliding damper, in form of a Venetian blind having a number of movable horizontal shutters which can be adjusted with ease to regulate draft within very fine limits.

DESIGN. Furnace Construction. Power Plant Eng., vol. 28, no. 1, Jan. 1, 1924, pp. 35-37, 4 figs. Notes on proportions, special baffling, arches and linings.

GRATES. Rocking and Dumping Grates. Power Plant Eng., vol. 28, no. 1, Jan. 1, 1924, pp. 44-47, 11 figs. Principles of operation with general description and details of makes.

OIL BURNERS. Burning Boiler Oil. Power, vol. 58, nos. 6, 8 and 10, Aug. 7, 21 and Sept. 4, 1923, pp. 209-211, 290-292 and 367-369, 24 figs. Aug. 7: Describes various types of burners. Aug. 21: Steam atomizers. Sept. 4: Mechanical burners.

Furnace Design Important in Burning Oil. Power Plant Eng., vol. 28, no. 1, Jan. 1, 1924, pp. 63-66, 11 figs. Furnace volume and amount of combustion air important factors; types of oil burners.

TURBINE. The Modern Turbine Furnace. Eng. & Boiler House Rev., vol. 37, nos. 5 and 6, Dec. 1923, and Jan. 1924, pp. 149-150 and 152 and 198-200, 8 figs. Scientific principles underlying design and working of most modern type of steam-jet furnace as represented by installation of Turbine Furnace Co., Ltd, London.

WOOD-WASTE-BURNING. Furnaces for Burning Wood Refuse. Power Plant Eng., vol. 28, no. 1, Jan. 1, 1924, pp. 68-70, 7 figs. Difficulties encountered in burning refuse from woodworking plants and principles governing furnace design.

BOILER OPERATION

DRAFT REGULATION. Draft and Its Relation to Combustion, R. S. Hawley. Combustion, vol. 9, no. 6, Dec. 1923, pp. 456 and 462. Points out that amount of draft which given boiler should have is dependent upon conditions of load, overload, type of furnace, grate and boiler, and kind and nature of fuel used.

INSTRUMENTS FOR. The Value of Instruments for High-Grade Boiler-Room Operation, H. H. Bates. Power, vol. 58, no. 25, Dec. 18, 1923, pp. 988-989. Discusses use of instruments, including summary of boiler conditions and their symptoms or characteristics as indicated by meters.

BOILER PLANTS

BOSTON ELEVATED RY. Plant of the Boston Elevated Railway Co. Combustion, vol. 9, no. 6, Dec. 1923, pp. 466-469, 5 figs. Details of two new Babcock & Wilson cross-drum boilers installed in South Boston plant, under which are installed two new Frederick super-station stokers of 13 retorts each.

ECONOMICS. Boiler-Plant Economics, N. E. Funk and F. C. Ralston. Am. Soc. Mech. Engrs.—advance paper, for meeting, Dec. 3-6, 1923, 46 pp., 24 figs. Determination of rational formula for expressing boiler-plant performance; shows how this formula may be applied, and discusses question of operating at minimum cost.

IMPROVEMENTS. Improvements in Steam Practice as Accomplished at Lukens Steel Company, G. D. Spackman. Assn. Iron & Steel Elec. Engrs., vol. 5, no. 12, Dec. 1923, pp. 659-679 and (discussion) 679-693, 8 figs. Describes changes made and savings effected.

BOILERS

CRACKS. Boiler-Plate Cracks and Means of Preventing Them (Blechschäden an Dampfkesseln und Mittel zu ihrer Verhütung), F. Loch. Zeit. des Vereines deutscher Ingenieure, vol. 67, no. 50, Dec. 15, 1923, pp. 1114-1116, 5 figs. Cause of crack formation in rivet seams of boilers; recommendations for testing of boiler plate; rivet tests and confirmation of correctness of maximum pressures in hydraulic riveting established by Bach and Baumann; improved vertical-tube boilers.

DEVELOPMENTS 1923. Boilers and Boiler Auxiliaries. Power, vol. 59, no. 1, Jan. 1, 1924, pp. 6-9. Foreign designs for high pressure; use of electric boilers increasing; developments in radiant heat; large combustion space favoured; economy of stage bleeding; new instruments.

EQUIPMENT. Boiler Equipment. Power Plant Eng., vol. 28, no. 1, Jan 1, 1924, Includes following articles: Description of Standard Types of Water Columns, Steam Gages, Fusible Plugs, Safety Valves, Steam Outlet Valves and Blowoff Valves, pp. 73-76, 9 figs.; Types and Details of Safety Valves, pp. 76-79, 10 figs.; Steam Outlet and Blowoff Valves, pp. 79-85, 22 figs.

FEEDING. The Ideal Boiler Feeding and Its Realization (Die ideale Kesselspeisung und ihre Verwirklichung), H. Schierenbeck. Archiv für Wärmewirtschaft, vol. 4, no. 12, Dec. 1923, pp. 209-212, 9 figs. Disadvantages of usual methods; basic principles for automatic regulation of boiler feeding; advantages of regulator and field of application.

HORIZONTAL RETURN TUBULAR. Horizontal Return Tubular Boilers. Power Plant Eng., vol. 28, no. 1, Jan 1, 1924, pp. 19-21, 2 figs. Due to influence of standardization selection depends largely upon boiler-shop practice. See also article entitled, Setting the Horizontal Return Tubular Boiler, pp. 21-23, 4 figs.

IGNITION ARCHES IN. Ignition Arches in Flame Tube Boilers (Die Einwirkung von Zündgewölben in Flammrohrkesseln), M. Schimpf. Glückauf, vol. 59, no. 47, Nov. 24, 1923, pp. 1057-1059, 2 figs. Gives test data relating to a Lancashire-type boiler with 100.5-sq. m. heating surface and 3.23-sq. m. grate area; it was found that addition of three ignition arches reduced amount of smoke formed and increased efficiency of boiler by 6.4 per cent.

INJURIES TO. Boiler Damages (Kesselschäden), R. Baumann. Zeit. des Vereines deutscher Ingenieure, vol. 67, no. 50, Dec. 15, 1923, pp. 1109-1113, 21 figs. Discusses possible causes of boiler damage, with regard to materials, construction and operation, and taking into consideration too rapid development of boilers for continually increasing pressures (temperatures) and larger dimensions; problem of life of boiler.

Mercury-Vapor. Mercury Boiler in Successful Operation. Power Plant Eng., vol. 28, no. 2, Jan. 15, 1924, pp. 136-138, 5 figs. Combination mercury and steam cycle shows remarkable savings at Hartford Elec. Light Co. plant.

Parts, Strength of. Strength of Boiler Parts. Power Plant Eng., vol. 28, no. 1, Jan. 1, 1924, pp. 30-34, 6 figs. Strength of riveted joints; welded joints; heads and stays in boiler shells; boiler tubes; steam nozzles.

Piping. Boiler Piping Arrangements. Power Plant Eng., vol. 28, no. 1, Jan. 1, 1924, pp. 86-88, 4 figs. Feedwater, blowoff, drip and drain safety valve and steam piping. See also article entitled, Safety First Should be Feature of Boiler Piping, pp. 88-89, 2 figs.

Testing Cones. The Need of an Efficient Boiler Testing Code, David Brownlie. Eng. & Boiler House Rev., vol. 37, no. 5, Dec. 1923, pp. 143-144 and 147. Deals with main points, both in criticism of existing codes and from point of view of suggestions for a new code.

Vertical, Tubular. Adaptability of Vertical Tubular Boilers. Power Plant Eng., vol. 28, no. 1, Jan. 1, 1924, pp. 24-26, 5 figs. Suited for installations where compactness and low first cost are of prime importance.

Waste-Heat. Waste-Heat Boilers, C. H. Bamber. Gas World, vol. 79, no. 2056, Dec. 15, 1923, pp. 546-550 (includes discussion). Discusses validity of some of the claims made for these boilers; waste-heat versus solid fuel, or convection versus radiation; design; water-tube boiler for waste heat; fire-tube boiler; heat available from vertical retorts; chimney temperature and natural draft; etc. Paper read before Manchester and District Jr. Gas Assn.

BOILERS, WATER-TUBE

Construction. Water-tube Boilers, C. C. Pounder. Mech. World, vol. 74, nos. 1916, 1918, 1921, 1927 and 1930, Sept. 21, Oct. 5, 26, Dec. 7 and 28, 1923, pp. 178, 212-213, 360, 358-359, and 405, 16 figs. Characteristics and construction of different types.

Standard American. Details of Standard Water-Tube Boilers. Power Plant Eng., vol. 28, no. 1, Jan. 1, 1924, pp. 7-18, 36 figs. Descriptions and illustrations showing best practice of modern American design and construction.

BONUS SYSTEMS

Practical Application. Applying the Bonus System to Diversified Operations, Chas. E. Bassett. Indus. Management (N.Y.), vol. 67, no. 1, Jan. 1924, pp. 47-51, 5 figs. Practical wage-incentive plant.

BRAKES

Air. The Evolution of Air Brakes for Steam Road Service, G. Terwilliger. New England R. R. Club, Dec. 11, 1923, pp. 179-190 and (discussion) 190-207. History and principal operating advantages incident to the various stages of development.

BRASS

Finishes. Popular Surface Finishes for Brass. Metal Industry (Lond.), vol. 23, no. 26, Dec. 28, 1923, pp. 577-578. Notes on "primrose", satin, oxidized silver, and irridescent finish.

BRIDGE DESIGN

Standards. A Comparison of the American and European Bridge Standards, P. H. Chen. Assn. Chinese & Am. Engrs.—Jl., vol. 4, no. 6, June 1923, pp. 5-8.

BRIDGES

Construction. General Construction of Bridges, J. F. Hawkins and C. G. Mitchell. Surveyor and Mun. and County Engr., vol. 64, no. 1664, Dec. 7, 1923, pp. 463-465, 1 fig. Deals with common types of new bridges of varying spans; necessity for care in reinforced concrete construction; comparison of steel and reinforced-concrete bridges. Paper presented at conference held in connection with Public Works, Roads and Transport Congress.

BRIDGES, HIGHWAY

Concrete. Detroit Belle Isle Bridge a Reinforced Concrete Cantilever Structure. Concrete, vol. 23, no. 6, Dec. 1923, pp. 213-216, 5 figs. Reinforced-concrete double-cantilever structure which is second of its type to be built in United States; length is 2,193.5 ft. and there are 19 spans and a shore span.

Fire Prevention. Fire Prevention in Highway Bridges. Eng. World, vol. 23, no. 6, Dec. 1923, pp. 350-352, 1 fig. Report of a co-operative committee representing fire protection, highway bridge construction, lumber, creosoting and public interest, bringing out important factors governing fire hazard in timber bridge construction.

Lift. Design and Construction of Highway Lift Bridge Over Mystic River at Mystic, Conn., Wm. G. Grove. Mun. & County Eng., vol. 65, no. 6, Dec. 1923, pp. 262-264. Is of Brown Balance Beam type, a new type; main lift a through plate girder span 84 ft. 8 in. center to center end bearings. resting on piers 88 ft. center to center.

Wind Bracing, Calculation. The Calculation of the Upper Frame Wind Bracing in a Reinforced-Concrete Bridge with Suspended Roadway (Die Berechnung des oberen Rahmenwindverbandes bei einer Eisenbetonbogenbrücke mit angehängter Fahrbahn), W. Nakonz. Bautechnik, vol. 1, nos. 51 and 52, Nov. 30 and Dec. 7, 1923, pp. 488-490 and 491-493, 22 figs. Calculation of frame-shaped wind bracing of bridge described in previous issue of same journal.

BRIDGES, RAILWAY

Earthquake Damage. Earthquake Damage to Japanese Government Railways, Mitsuo Nawa. Eng. News-Rec., vol. 91, no. 26, Dec. 27, 1923, pp. 1047-1051, 15 figs. Initial injury to 68 bridges most due to failure of piers and abutments; steel structures, rigidly braced, offered greatest resistance to shock.

BUILDING CONSTRUCTION

Fireproof. Estimating the Cost of Fireproof Construction, C. F. Dingman. Contract Rec. & Eng. Rev., vol. 37, no. 50, Dec. 12, 1923, pp. 1169-1173. Practical data that will enable contractor to figure on hollow tile, gypsum or concrete and tile fireproofing.

BUILDINGS

Earthquakes, Resistance to. Earthquake Characteristics and Building Resistance, R. E. J. Summers. Eng. News-Rec., vol. 91, no. 26, Dec. 27, 1923, pp. 1044-1047, 7 figs. Summary of basic laws and constants deduced from measurements of earthquake motions, and checked by observation of damage done by recent severe earthquakes.

BUSES

Trolley. Trolley Omnibus System in Wolverhampton (Eng.). Tramway & Ry. World, vol. 54, no. 30, Dec. 20, 1923, pp. 318-322, 15 figs. Advantages of adopting trolley omnibus system of traction on Wednesfield route; details of chassis of bus adopted, which was designed to carry load of 5 tons including car body.

C

CABLES, ELECTRIC

Shearing Stress. The Effect of Shearing Stress on the Span Calculations of a Suspended Cable, Takashi Ohtsuki. Instn. Elec. Engrs.—Jl., vol. 61, no. 323, Oct. 1923, pp. 1079-1086, 2 figs. Presents complete equation of suspended cable, taking into account its density, elasticity and rigidity, and determines extent to which effect of shearing stress should be considered for span calculations.

CALORIMETERS

Throttling. The Throttling Calorimeter, Thos. M. Gunn. Power, vol. 58, no. 26, Dec. 25, 1923, pp. 1023-1024, 2 figs. Simple explanation of how it works, how it is used, and how it is made.

CAR LIGHTING

Efficient. Railway Car Lighting, G. E. Hulse. Illuminating Eng. Soc.—Trans., vol. 18, no. 8, Oct. 1923, pp. 748-762. Limitations encountered in problem of supplying illumination to cars; means of lighting; standardization of car illumination; coach-lighting tests of 1913; arrangement of fixtures for various types of cars, and resulting illumination; types of glassware used and efficiency of installation with this glassware.

CARS, REFRIGERATING

Insulation, Economic Thickness. The Economical Thickness of Insulation in Refrigerator Cars, Arthur J. Wood and Phil. X. Rice. Am. Soc. Mech. Engrs. —advance paper, for meeting, Dec. 3-6, 1923, 18 pp., 9 figs. Discusses factors which must be taken into account in finding proper thickness of insulation; use of alignment charts to readily determine answers to problems involving many variables, by aid of which one may determine not only common thickness of insulation but also saving which would result from adoption of correct thickness compared with any other thickness; economy of using regranulated cork or air spaces in some constructions; outlines means of approximating external surface temperatures and notes results of tests on proofs, sides, and floors as effected by direct sunlight and color of paint.

CAR WHEELS

Chilled-Iron. Making Car Wheels in Railroad Shops. Ry. Jl., vol. 29, no. 12, Dec. 1923, pp. 24-27, 6 figs. Describes work done in foundry of Norfolk & Western shops at Roanoke, Va., in making chilled cast-iron car wheels.

Steel, Wrought. Wrought Steel Wheels for Car and Tender Service, A. Knapp. Car Foremen's Assn. of Chicago—Proc., vol. 18, no. 3, Dec. 1923, pp. 19-22, 25-28 and (discussion) 28, 31-32, 35-36, 39-40 and 43-44. Outline of directions being prepared to issue to N.Y. Central Lines to assist car and motive-power departments to conform to recommendations of Am. Ry. Assn. referring to maintenanee of wrought-steel wheel tread and flange contours; use of new wheel gage.

CARBON DIOXIDE

Properties. Properties of Carbon Dioxide, Chas. H. Herter. Refrig. World, vol. 58, nos. 9 and 10, Sept. and Oct. 1923, pp. 13-16 and 36, and 13-15, 1 fig. Latest tables on CO_2, and explanation thereof.

CARS, FREIGHT

Logging, Steel-Frame. 50-Ton Capacity Steel Frame Logging Car. Ry. Rev., vol. 73, no. 24, Dec. 15, 1923, pp. 853-854, 4 figs. Design for Trinity County Lumber Co. embodies original feature in arrangement of metal, bunks and stakes.

Production Statistics, 1923. Freight Car Increase Breaks All Records. Ry. Age, vol. 76, no. 1, Jan. 5, 1924, pp. 87-93, 1 fig. Railroads devoted 39 per cent of all 1923 capital expenditures to freight cars; gives table of orders in 1923 for service in United States.

CARS, PASSENGER

Production Statistics, 1923. Large Progress in Passenger Car Acquisitions. Ry. Age, vol. 76, no. 1, Jan. 5, 1924, pp. 83-86, 1 fig. Orders less than in 1922 but otherwise largest since 1916; production largest since 1917; gives table of orders in 1923 for service in United States.

Sleepers. New Canadian National Sleeping Cars. Ry. Mech. Engr., vol. 98, no. 1, Jan. 1924, pp. 27-30, 5 figs. Also Ry. Age, vol. 76, no. 2, Jan. 12, 1924, pp. 189-190, 5 figs. Distinctive floor plan arrangement; frame and exterior of steel; interior finished with wood.

CASE-HARDENING

Localized. Local Surface Hardening. English Mechanics, vol. 118, no. 3064, Dec. 14, 1923, p. 297, 4 figs. Makes reference to one or two existing practical methods of local case-hardening, and describes Vickers local hardening process.

Methods and Applications. Case-Hardening (Ueber Einsatzhärtung), H. Graefe. Maschinenbau, vol. 2, no. 23, Aug. 22, 1923, pp. B265-B274, 26 figs. Properties of charge; alloyed and unalloyed material; testing charge powder; packing; testing of inserted pieces; practical examples.

CAST IRON

Mass Effect. Cast Iron and Mass Effect, O. Smalley. Metal Industry (Lond.), vol. 23, nos. 24 and 25, Dec. 14 and 21, 1923, pp. 541-542 and 561-565, 10 figs. Discusses time factor for various sections of cast iron to solidify under known conditions; effect of chemical composition on solidity; penetrating power of gray cast iron; relation between chemical and structural changes as effected by time and temperature; adoption of some simple standard of solidity; effect of design on strength in normal castings; and rate of running to mass effect and its possibilities and limitations in application to manufacture of solid castings without risers. Abridgement of paper read before Int. Convention of Foundrymen in Paris.

Physical Tests. Physical Tests for Grey Iron, J. Shaw. Engineering, vol. 116, no. 3024, Dec. 14, 1923, pp. 755-756, 2 figs. Discuss inadequacy of present-day analyses. Paper read before Sheffield Assn. of Metallurgists and Met. Chemists.

CASTINGS

Centrifugal. Centrifugal Casting Machines Now a Reality, A. W. Cowper. Can. Foundryman, vol. 14, no. 12, Dec. 1923, pp. 24 and 26. Deals with aspects of centrifugal casting process as applied to production of cast iron castings.

Large, Breaking up. Breaking up Large Castings. Practical Engr., vol. 68, no. 1920, Dec. 13, 1923, pp. 328-329, 2 figs. Hints on use of explosives for breaking up large castings for scrap, for demolishing concrete foundations and other massive material. Abstracted from booklet issued by Nobel Industries.

CEMENT

Alumina. The Actual Uses of Alumina Cements, Ed. C. Eckel. Concrete, vol. 23, no. 61, Dec. 1923, pp. 217-218. Record of jobs; actual utilization of alumina cement for works where its strength and rapid hardening were determining factors in its selection and use.

CENTRAL STATIONS

Desuperheater and Attemporator. Desuperheater and Attemporator, H. W. Brooks. Power, vol. 58, no. 25, Dec. 18, 1923, pp. 992-993, 5 figs. Special feature of remodeled Batavia electric-railroad plant.

Improvements. Advances in Power Station Practice, E. M. Hollingsworth. Instn. Elec. Engrs.—Jl., vol. 62, no. 324, Dec. 1923, pp. 31-36. Survey of improvements in application of higher steam pressures and temperatures; more satisfactory treatment and heating of feedwater; increased speed of turbo-generators for given output; and stages reheating of steam. Chairman's address.

Oil-Engine Electric-Light. An Efficient Oil Engine Light Plant, Ray C. Burrus. Power, vol. 58, no. 26, Dec. 25, 1923, pp. 1016-1020, 7 figs. Describes municipally owned electric-light plant at South River, N.J.

Reheating. Reheating in Central Stations, W. J. Wohlenberg. Am. Soc. Mech. Engrs.—advance paper, for meeting Dec. 3-6, 1923, 25 pp., 19 figs. Discusses influence of amounts of energy added in reheating, number of reheating stages, and points in expansion at which reheating should begin; comparison of reheating, regenerative, and combination cycles combining both reheating and bleeding stages; it is shown that reheating properly applied may lead to higher efficiencies than bleeding; and also that combination cycles give promise of realization in practice of appreciably higher efficiencies than would be the case for other cycles investigated.

Remodeling. Remodeling Electric Railway Plant at Batavia, Illinois, H. W. Brooks. Power, vol. 58, no. 18, Oct. 30, 1923, pp. 678-682, 6 figs. Plant installed 22 years ago was modernized and all equipment put in such good operating conditions as to effect reduction in coal consumption of 20 per cent and maintenance costs by same ratio.

Sites, Selection of. The Best Site for a Power Station, Alex. Russell. Instn. Elec. Engrs.—Jl., vol. 62, no. 324, Dec. 1923, pp. 12-13, 1 fig. Points out that in considering best site for power station it is helpful to know position of site for which copper required for feeder mains would be a minimum; other factors which must be taken into account. Part of inaugural address.

Waukegan, Ill. New Waukegan Power Station. Power, vol. 59, no. 3, Jan. 15, 1924, pp. 80-86, 11 figs. First unit of 250,000-kw. base-load plant; boilers designed for 400 lb. and 700 deg.; a. c. stoker drive arranged for 400 speeds; coal-handling and feedwater systems; data on mechanical and electrical equipment. See also Power Plant Eng., vol. 28, no. 2, Jan. 15, 1924, pp. 119-126, 8 figs.

CHAIN DRIVE

Sprockets. Remedying Faults in Sprockets, John S. Watts. Machy. (N.Y.), vol. 30, no. 5, Jan. 1924, pp. 350-351, 2 figs. Effect of changing pitch of driver and of follower; advantages gained by change in pitch; improved sprocket design.

CHIMNEYS

Calculation. The Static Calculation of Steel Chimneys for Factories (Die statische Berechnung eiserner Fabrikschornsteine), P. Stephan. Praktischer Maschinen-Konstrukteur, vol. 56, nos. 32-33 and 34-35, Aug. 21 and Sept. 4, 1923, 2 and 4 pp., 9 figs. Gives two examples of numerical calculation.

CHROME STEEL

Hardness. Secondary Hardness in Austenitized High Chromium Steels, Edgar C. Bain. Am. Soc. Steel Treating—Trans., vol. 5, no. 1, Jan. 1924, pp. 89-101 and (discussion) 101-105, 14 figs. Summary of hardness measurements made with Rockwell hardness tester on four grades of high-carbon, high-chrome steel with variety of quenches and series of draws; sample tools made from these steels in which secondary hardness had been developed after having been quenched austenitic gave results in cutting speed between that of carbon steel and high-speed steel.

CIRCUIT BREAKERS

High-Voltage. High-Voltage Circuit Breakers, A. W. Copley. Am. Inst. Elec. Engrs.—Jl., vol. 43, no. 1, Jan. 1924, pp. 17-18. Describes circuit breakers, manufactured for service Southern Cal. Edison Co., with high rupturing capacity and designs following closely standard designs for more moderate voltages.

Oil Type. 44,000 Volt Outdoor Oil Breakers. Elec. Times, vol. 64, no. 1675, Nov. 22, 1923, p. 547, 2 figs. Describes automatic circuit breakers manufactured in England for Canada.

COAL

Carbonization. Low-Temperature Gasification and Industrial Heating. Iron & Coal Trades Rev., vol. 107, no. 2911, Dec. 14, 1923, pp. 885-887. Abstract of paper submitted by W. Beswick and A. T. Grisenthwaite before Cleveland Instn. Engrs. Typical low-temperature carbonization processes and their results; comparison with producers; gasification plants; describes new process of Power-Gas Corporation, a combination of low-temperature production of by-products with gasification process in one operation, and its special application to industrial heating, particularly to steel works.

Low-Ash Coking. New Source of High-Grade Coking Coal, H. M. Chance. Iron Age, vol. 112, no. 26, Dec. 27, 1923, pp. 1713-1714, 1 fig. Discovery calculated to make available large reserves of low-ash coal from practically every coking coal district; sand-flotation process consists in production of heavy-gravity liquid, termed "fluid mass", by agitating definite mixture of any suitable comminuted solid, such as sand, and water.

Purchasing and Inspection. An Effective Method for Keeping Fuel Costs within Bounds, G. Milton Levy. Factory, vol. 32, no. 1, Jan. 1924, pp. 40-42, 2 figs. It has been found that by compositing coal by shippers, it is possible to determine quality of coal shipped from various mines and when unsatisfactory, shipments from that mine can be cancelled; presents chart showing results of this inspection over period of year.

Relative Steaming Values. Value of Coke, Anthracite, and Bituminous Coal for Generating Steam in a Low-Pressure Cast-Iron Boiler, J. Blizard, J. Neil and F. C. Houghten. U. S. Bur. Mines, Technical Paper 303, 1922, 56 pp., 22 figs. Description of tests carried out, and results obtained, to determine relative steaming values of coke, anthracite, and bituminous coal when burned in a low-pressure boiler, and fired by hand in fairly large quantities at a time; to separate heat losses and examine them; to determine change in efficiency with method of firing fuel and manipulation of draft dampers, with rate of evaporation, and with various fuels burned; and to determine other factors affecting operation of boiler.

Testing. Classification and Testing of Coal, C. H. Chester. Gas World, vol. 79, no. 2053, Nov. 24, 1923, pp. 472-476, 14 figs. Constituents of coal; methods of carrying out the various tests; results of tests made. Paper before Yorkshire Jr. Gas Assn. See also Gas Jl., vol. 164, no. 3158, Nov. 12, 1923, pp. 517-522, 14 figs.

COAL HANDLING

Conveyors. Coal-Conveyors, W. G. Burt. Min. Inst. Scotland—Trans., vol. 44, Part 4, Oct. 13, 1923, pp. 136-138 and (discussion) 138-142. Details of working costs and conditions of Blackett and shaker or jigger conveyors, which are of constant-delivery type, and of Thomson conveyor, which is of intermittent-delivery type.

Loading Plants. Modern Coal-Loading Plants (Neuzeitliche Kohlenverladeanlagen), G. Fiala. Maschinenbau, vol. 2, no. 24, Sept. 15, 1923, pp. G264-G267, 7 figs. Describes new type of automatic plant for boiler coaling with automatic unloading bucket, counterweight and electric control, and points out its advantages over older types.

Piers. Electrically-Operated Coal Pier of Western Maryland Railway Co. Eng. World, vol. 23, no. 6, Dec. 1923, pp. 359-363, 8 figs. Construction data; operation of pier, including equipment.

Steam-Generating Station. Coal Handling at Zilwaukee, H. F. Eddy. Elec. World, vol. 82, no. 26, Dec. 29, 1923, pp. 1314-1316, 3 figs. Avoidance of great investment and costly attendance governed; selection and arrangement of coal-handling equipment.

COAL MINES

Power Costs. Power Costs in Coal Mining, E. B. Stavely. Coal Industry, vol. 6, no. 12, Dec. 1923, pp. 496-499, 3 figs. Factors which must be considered in figuring cost of power; method of determining cost of supplying electrical energy to coal mines.

Ventilation. Distribution of Air in Metal-Mine Ventilation With Especial Reference to Flexible Tubing Methods, D. Harrington. U. S. Bur. Mines, Reports of Investigations, Serial No. 2551, Dec. 1923, 11 pp. Advantages and disadvantages of methods used to distribute air in metal mines; description and performance of flexible tubes used; health consideration requiring air circulation at working faces; financial economies effected by use of tubing.

COAL MINING

Thin Seams. Best Method of Opening and Working a Thin Seam 22 Inches Thick to Produce 4,500 Tons per Week. Iron & Coal Trades Rev., vol. 107, no. 2912, Dec. 21, 1923, pp. 932-933, 8 figs. Discusses method of working, and maintenance.

COAL STORAGE

Advisability of. Is Coal Storage Worth While? Power, vol. 59, no. 2, Jan. 8, 1924, pp. 42-44, 7 figs. Points out that regular systematic, large-scale storage of coal by consumers during seasons of low consumption is public's largest opportunity and responsibility in solving coal problem.

Bituminous Coal. The Storage of Bituminous Coal, W. L. Abbott. Indus. Management (Lond.), vol. 10, no. 11, Nov. 29, 1923, pp. 313-314. Notes on degradation of coal due to weather and handling, and means of preventing it. Author advises shutting down of superfluous coal mines.

Economical Systems. Some Methods of Storing Coal. Power, vol. 59, no. 3, Jan. 15, 1923, pp. 96-98, 6 figs. Discusses several low-priced systems of coal handling and storing.

COMBUSTION

Products, Properties of. Properties of the Products of Combustion, Rich. Brown. Combustion, vol. 9, no. 6, Dec. 1923, pp. 451-455, 5 figs. Presents charts for computation of temperature, excess air, B.t.u., weight, volume, and components of gas analysis.

COMPRESSED AIR

Use in Speeding Production. Compressed Air Speeds Superheater Production, F. A. MacLean. Can. Machy., vol. 30, no. 26, Dec. 27, 1923, pp. 132-133, 5 figs. Special applications of this medium in Montreal plant prove its value wherever an adaptable, cheap, and reliable form of power is required.

CONCRETE

Aggregates. Recent Developments in the Study of Concrete Aggregates, H. C. Boyden. Rock Products, vol. 26, no. 25, Dec. 15, 1923, pp. 17-19. Relation of characteristics of aggregate to strength of concrete; importance of modulus of fineness and water ratio.

CONCRETE CONSTRUCTION, REINFORCED

Reinforcement Required, Determination of. Shortcuts for Solving Problems in Concrete Design, R. P. Marquardsen. Eng. & Contracting (Buildings), vol. 60, no. 6, Dec. 26, 1923, pp. 1327-1330, 5 figs. Method for finding amount of steel reinforcement required at any section of a retaining wall, arch, or other concrete structure of rectangular cross-section, subject to combined axial and bending stress.

CONDENSERS, ELECTRIC

Static. Installation and Operation of Static Condensers, P. T. Vanderwaart. Assn. Iron & Steel Elec. Engrs., vol. 5, no. 12, Dec. 1923, pp. 694-696 and (discussion) 696-700. Points out that static condenser is cheaper than synchronous condenser in sizes and voltages usually required in industrial plants, although it costs more to install; notes on selection and use of static condensers.

CONDENSERS, STEAM

Defects. Condenser Troubles. Mar. Engr. & Nav. Architect, vol. 47, no. 556, Jan. 1924, pp. 31-32, 4 figs. Consideration of defects common in condensers, and effect of application of metallic packing.

CONDUITS

Pressure. The Pressure Conduit Problem, Development and Present Status in Theory and Practice (Ueber das Entwicklung und gegenwärtiger Stand in Theorie und Praxis), W. Effenberger. Oesterr. Ingenieur- u. Architekten-Vereines, vol. 75, no. 42-43, Oct. 26, 1923, pp. 269-280, 15 figs. Calculation of conduit lining; the Spuller Lake conduits as example for economically correct valuation of special conditions; remarks on economic and safe design of supply conduits. See also article entitled, Geological Discussion of Pressure Conduit Problem (Geologische Bemerkungen zum Druckstollenproblem), O. Ampferer, pp. 283-285, 4 figs.

CORROSION

Electro-Chemical Chacracter. The Electro-Chemical Character of Corrosion, Ulick R. Evans. Inst. Metals—advance paper, no. 5, for meeting Sept. 10-13, 1923, 44 pp., 4 figs. Prediction of electro-chemical corrosion from potential measurements; experimental demonstration of electro-chemical character of corrosion.

COST ACCOUNTING

Capital Requirements and Control. The Story Told by the Financial and Operating Statements, J. H. Bliss. Management & Administration, vol. 7, no. 1, Jan. 1924, pp. 25-30. Author takes typical financial statement and analyzes it so as to show wide range of essential information that can be drawn from its figures.

Industrial. Industrial Cost Accounting for Executives, Paul M. Atkins. Am. Mach., vol. 59, nos. 14 and 16, Oct. 4 and 18, 1923, pp. 513-517 and 591-594, 11 figs. Oct. 4: Recording product and improvement costs; checking distribution and summaries of items of cost. Oct. 18: Mechanical-labour-saving devices; reason for use of adding, calculating and tabulating machines, and schedule sheet.

CRANES

Lifting. Locomotive Lifting Cranes (Lokomotiv-Hebekrane), F. Scheuermann. Glasers Annalen, vol. 93, no. 10, Nov. 15, 1923, pp. 113-115, 9 figs. Design and construction of cranes constructed by Demag Duisburg, Germany.

RUNWAY. A Reinforced-Concrete Crane Runway, with Steel Travelling Crane (Eine Eisenbetonkranbahn mit Stahlkonstruktionslaufkran), C. Commentz. Beton u. Eisen, vol. 22, no. 16, Aug. 20, 1923, pp. 205-209, 12 figs. Describes crane runway built for material-storage section of shipyard in Hamburg, for unloading of ship plates and sections from railway cars and ships, and loading on cars of shipyard railway.

CUPOLAS

CHARGING. The Foundry Cupola and Mechanical Charging, A. A. Leardet. Foundry Trade Jl., vol. 28, no. 384, Dec. 27, 1923, pp. 539-543, 11 figs. Chemical action which takes place in cupola under blast; early forms of cupolas; steam jet cupolas; receivers; coke consumption; blast and tuyeres; blowing apparatus; hot-blast cupolas.

CUTTING TOOLS

OVERHANG AS AFFECTING SHOP COSTS. How the Overhang of Tools Affects Shop Costs, Chas. F. Henry. Am. Mach., vol. 60, no. 1, Jan. 3, 1924, pp. 17-19, 9 figs. Examples from modern railway shops that can apply elsewhere as well; preventing vibration lengthens life of tools.

D

DAMS

SILT ELIMINATION. Reconstruction of Hell Gate Dam to Eliminate Silt. Eng. News-Rec., vol. 91, no. 26, Dec. 27, 1923, pp. 1055-1058, 6 figs. Silt deposits from Montana smelter and mines controlled by new low-level sluice gates; replacing eroded wall difficult; mat protection placed in front of wall.

DIES

PROGRESSIVE. Progressive Dies for Piercing, Bending and Blanking, I. Bernard Black. Machy. (N.Y.), vol. 30, no. 5, Jan. 1924, pp. 371-372, 5 figs. partly on p. 373. Describes "follow" and "progressive" die employed to produce locating bracket used in electrical device.

DIESEL ENGINES

FUEL VALVE. A New Solid Injection Fuel Valve. Practical Eng., vol. 67, no. 1875, Feb. 1, 1923, p. 63, 1 fig. New type of fuel valve invented by A. F. Van Amstel of Holland.

HYDRO-ELECTRIC PLANTS. Put the Diesel Engine in the Hydro-Electric Business, A. Büchi. Oil Engine Power, vol. 1, no. 12, Dec. 1923, pp. 574-581, 5 figs. Study of use of Diesel engines in hydro-electric undertakings.

MCINTOSH & SEYMOUR. An American Built Diesel Engine, Peter Bain. Am. Shipg., vol. 17, no. 12, Dec. 1923, pp. 42-47, 8 figs. Details of 2,250-hp. engine of vertical, single-acting, 4-cycle, crosshead type, being built at Auburn plant of McIntosh & Seymour Corp.

REPAIRING. Overhauling a Diesel Engine, M. S. Howard. Power Plant Eng., vol. 28, no. 2, Jan. 15, 1924, pp. 139-141, 7 figs. Where to look for wear and how to handle repair work.

ECONOMIC STATUS. The Economic Status of the Diesel Engine, L. H. Morrison. Am. Soc. Mech. Engrs.—advance paper, for meeting, Dec. 3-6, 1923, 8 pp., 9 figs. Points out advantages possessed by Diesel for industrial plants and lower fixed charges due to elimination of obsolescence charges required with steam plants; recovery of waste heat in exhaust; attention is called to fact that such recovery will often provide all process hot water needed.

DRAINAGE

STORM-WATER DRAINS. The Distribution of Intense Rainfall and Some Other Factors in the Design of Storm-Water Drains, F. A. Marston. Am. Soc. Civ. Engrs.—Proc., vol. 50, no. 1, Jan. 1924, pp. 19-46, 12 figs. Data showing area covered by excessive rainfall of short duration based on measurements made in Boston Metropolitan Dist., New Orleans, La., and Cambridge, O.

DRILLING MACHINES

DEVELOPMENT. Fifty Years Development in Drilling Machines. Machy. (N.Y.), vol. 30, no. 5, Jan. 1924, pp. 352-354, 2 figs. Comparison between early and present-day designs of upright and radial drilling machines.

DRYDOCKS

ST. JOHN, N.B. The World's Largest Drydock Opened at St. John, N.B. Can. Ry. & Mar. World, no. 310, Dec. 1923, pp. 602-606, 3 figs. Describes Courtenay Bay harbour development and drydock and ship repairing plant; construction data. From paper read before Eng. Inst. Canada, St. John branch.

E

EDUCATION, ENGINEERING

RELATION TO INDUSTRY. The Engineer as a Leader in Industry, O. S. Lyford. Eng. Education, vol. 14, no. 4, Dec. 1923, pp. 156-158, 4 figs. Shows interrelationship between engineering schools and industries and need for co-operation of the two organizations interested in development and successful functioning of leadership in industry; survey of situation; suggests groundwork for an educational-industrial structure.

ELASTICITY

PLASTICITY AND. Plasticity and Elasticity, E. C. Bingham. Franklin Inst.—Jl., vol. 197, no. 1, Jan. 1924, pp. 99-115, 9 figs. Notes on varieties of flow; stress-time curves; stress-drain diagram; rigidity; resiliance and restitution; elastic after-effect.

THEORY. Contributions to the Theory of Elasticity (Beiträge zur ebenen Elastizitätstheorie), Karl Wolf. Zeit. für technische Physik, vol. 4, no. 10, 1923, pp. 375-379, 5 figs. Notes on stress distribution in an arch.

ELECTRIC CONDUCTORS

CYLINDRICAL, INDUCTANCE COEFFICIENTS OF. The Inductance Coefficients of Cylindrical Conductors, Alex. Russell. Instn. Elec. Engrs.—Jl., vol. 62, no. 324, Dec. 1923, pp. 9-12, 6 figs. Solution of problems in which it is supposed that current is uniformly distributed over cross-sections of cylinders. Part of inaugural address.

ELECTRIC CURRENTS

LEAKAGES. Electric Strays, C. F. Raphael. Elec. Times, vol. 64, no. 1677, Dec. 6, 1923, pp. 597-598. Discusses leakage of return current from rails of tramways and railways; leakages from, and faults on, electric light and power mains; leakages from electric light and power installations in buildings.

ELECTRIC FURNACES

FERRO-VANADIUM MANUFACTURE. Manufacture of Ferro-Vanadium by Electric Furnace, E. Kilburn Scott. Engineer, vol. 136, no. 3546, Dec. 14, 1923, pp. 636-637, 6 figs. Describes electric furnace installed by Vanadium Corp. of America in Peruvian mine.

SALT-BATH. The Electric Salt-Bath Furnace in Workshop Practice (Der elektrische Salzbadofen im Werkstättenbetriebe), K. Hilse. Werkstattstechnik, vol. 17, no. 22, Nov. 15, 1923, pp. 625-632, 10 figs. Principle of furnace; use of melted salt for electric heat resistance and at same time for heat conduction and storage; advantages of electric salt-bath furnace; design and operation; advantages of two new processes; regulation and measurement of bath temperature.

ELECTRIC GENERATORS

LEAKAGE FLUX. The Leakage Flux Between Parallel Pole-Cores of Circular Cross-Section, B. Hague. Instn. Elec. Engrs.—Jl., vol. 61, no. 323, Oct. 1923, pp. 1072-1078, 4 figs. Draws attention to formulas and curves from which permeance of leakage paths can be found with high accuracy, results being derived by simple mathematical methods.

WIND-DRIVEN. Wind-Driuen Generators, W. Stirling. Instn. Elec. Engrs.—Jl., vol. 61, no. 323, Oct. 1923, pp. 1096-1099, 4 figs. Describes various sources of power for generation of electricity in small quantities; former objections to wind-power sets are stated, and it is shown how these have been overcome; actual results of plant are given for period from July to December.

ELECTRIC LAMPS

MERCURY-VAPOUR. A Self-Exhausting Mercury-Vapour Lamp, H. P. Waran. Jl. of Sci. Instruments, vol. 1, no. 2, Nov. 1923, pp. 54-56, 1 fig. Brief description of lamp requiring only a filter pump or other rough pump to exhaust it, the high vacuum in arc space being sucked by itself not only to start with but periodically during use as well, by use of regeneration principle.

ELECTRIC LOCOMOTIVES

SPEED TESTS. Speed Tests of New Electric Locomotives. Ry. Rev., vol. 73, no. 23, Dec. 8, 1923, pp. 818-820, 2 figs. Experimental runs on track equipped with recording instruments determines riding qualities at high speed.

ELECTRIC MOTORS

COMMUTATION. A New Method of Developing the Commutation Theory (Ein neuer Weg zum Ausbau der Kommutierungstheorie), L. Dreyfus. Archiv für Elektrotechnik, vol. 12, no. 5, Oct. 31, 1923, pp. 398-427, 24 figs. Basic equations taking into consideration brush contact voltages; brush potential curve; significance and aims of new commutation theory.

ELECTRIC MOTORS, A.C.

POLE-CHANGING. The Nature of the Magnetic Field Produced by the Stator of a Three-Phase Induction Motor, with Special Reference to Pole-Changing Motors, F. J. Teago. Instn. Elec. Engrs.—Jl., vol. 61, no. 323, Oct. 1923, pp. 1087-1096, 14 figs. Effect of symmetrical super-distributed coils, using one coil side per slot, and using two coil sides per slot; symmetrical coils with and without initial super-distribution in pole-changing motors; changes in magnetizing current; effect of saturation in iron parts of circuit.

ELECTRIC RAILWAYS

CURRENT-FLOW VALUES DETERMINATION. A New Method of Determining Correct Values of Current Flow for Electric Railway Distribution Systems, C. E. Schutt. Elec. Traction, vol. 19, nos. 8, 10 and 11, Aug., Oct. and Nov. 1923, pp. 422-425, 568-570 and 607-611, 12 figs. Describes new method which enables operator to be sure of results without building of models; describes fundamental solution of a simple loop; the method as applied to specific problems of Kansas City Rys.; application to street-railway return circuit.

TECHNICAL PROBLEMS. Electric Traction, Geo. Gibbs. Am. Ry. Eng. Assn.—Bul., vol. 25, no. 259, Sept. 1923, 86 pp., 35 figs. Electric traction on lines with much traffic; production and transmission of energy; type of current; locomotives and motor cars; electric systems used; installation and operating costs; some factors controlling selection of system; synopsis of important installations. Report made to Int. Ry. Assn., Ninth Congress, Rome, Italy, 1922.

ELECTRIC TRANSMISSION LINES

HIGH-TENSION. Modern High-Tension Power Transmission Lines, W. Dreyer. Eng. News-Rec., vol. 92, no. 1, Jan. 3, 1924, pp. 8-10, 3 figs. Problems in design of towers; economy of transmission at high voltage offsets greater construction costs; loads, spacing of towers, and costs of transmission lines.

POWER LIMITATIONS. Power Limitations of Transmission Systems, R. D. Evans and H. K. Sels. Am. Inst. Elec. Engrs.—Jl., vol. 43, no. 1, Jan. 1924, pp. 45-51, 8 figs. Discussion of methods of calculation, maximum power limits, and practical operating limit; analytical development upon which discussion is based.

SPECIFICATIONS. Railroad Specifications for Electric Light, Power Supply and Trolley Lines Crossing Railways. Am. Ry. Eng. Assn.—Bul., vol. 25, no. 258, Aug. 1923, pp. 9-81, 36 figs. Specifications covering overhead, underbridge and underground crossings; clearances, loading, wires and cables, insulators, insulator pins and conductor attachments, crossarms, strength of supporting structures, wood poles, steel structures, guys; etc.; specifications for galvanizing or sherardizing on iron and steel.

SUPERPOWER SYSTEMS. Superpower Transmission, P. H. Thomas. Am. Inst. Elec. Engrs.—Jl., vol. 43, no. 1, Jan. 1924, pp. 3-17, 6 figs. Economies and limitations of transmission system of extraordinary length.

ELECTRIC WELDING

RAILWAY SHOPS. Electric Welding in Railway Shops, Juan St. Cere. Ry. Jl., vol. 29, no. 12, Dec. 1923, pp. 30-31. Shows what has been accomplished with electric-welding process in plant of N. Y. C.'s Depew shops.

ELECTRIC WELDING, ARC

FLUXES. Fluxes and Their Functions in Electric Arc Welding, J. Caldwell. Am. Welding Soc.—Jl., vol. 2, no. 12, Dec. 1923, pp. 27-31 and (discussion by C. J. Holslag) 31-32. Character of a weld; fluxes in steel manufacture; fluxes and their functions in arc welding; flux-covered electrodes for arc welding.

RAIL BONDS. Arc Welded Rail Bonds, C. F. Gailor. Am. Welding Soc.—Jl., vol. 2, no. 12, Dec. 1923, pp. 7-17, 10 figs. History; character of bonds; use of molds; carbon arc welding; metallic arc welding; process in applying bonds to head of rail; procedure in applying base bonds; tests.

ELECTRONS

EMISSION. Electronic Emission. Electrician, vol. 91, no. 2378, Dec. 14, 1923, pp. 659-660, 2 figs. Hull's phenomenon investigated by Coetz. Based on article in Rysikalische Zeit.

ELEVATORS

VARIABLE-VOLTAGE CONTROL. Variable Voltage Control Systems as Applied to Electric Elevators, E. M. Bouton. Am. Inst. Elec. Engrs.—Jl., vol. 43, no. 1, Jan. 1924, pp. 52-63, 16 figs. Conclusions in favour of variable-voltage over rheostatic-control system, with regard to speed, acceleration and retardation, speed control and regulation, efficiency and economy of power consumption, maintenance, and safety.

ENGINEERS

PUBLIC OBLIGATIONS. The Engineer: His Abilities and His Public Obligations, John L. Harrington. Mech. Eng., vol. 46, no. 1, Jan. 1924, pp. 31-34. Need of engineer in Government; shortcomings of present educational system; engineer and transportation problems; engineer and public business; licensing and status of engineering profession.

EVAPORATION

COMPRESSION VS. MULTIPLE-EFFECT. Compression Evaporation (Ueber Kompressionsverdampfung), W. Genseke. Wärme, vol. 46, no. 12, Mar. 23, 1923, pp. 123-126, 5 figs. It is shown that compression evaporation is by no means superior to multiple-effect arrangement; introduction of heat pump is of value when a given temperature must be maintained in evaporation process; turbo and radiation compressors are particularly adapted to drive.

MULTIPLE-EFFECT. Fundamental Principles of Multiple Effect Evaporation, Hugh K. Moore. Chem. & Met. Eng., vol. 29, nos. 26 and 27, Dec. 24 and 31, 1923, pp. 1141-1147, 2 figs., and 1190-1192, 8 figs. Dec. 24: Effects on evaporator designs and operation of heat conductivity, temperature levels and temperature differences. Dec. 31: Analysis of relation of heat conductivity to temperature differences in evaporating waste sulphite liquor.

EVAPORATORS

REFRIGERATING PLANTS. Evaporating Systems for Refrigerating Plant, Wm. F. Davis. Power, vol. 58, no. 26, Dec. 25, 1923, pp. 1028-1029. Discusses details of evaporator design; evaporators in several units; purifying refrigerant; testing for water in system. Paper read before Nat. Assn. Practical Refrig. Engrs.

EYEBOLTS

STANDARDS FOR. Report of the German Industrial Standards Committee (Normenausschuss der Deutschen Industrie). Maschinenbau, vol. 3, no. 1, Oct. 11, 1923, pp. N1-N4, 4 figs. Proposed standards for eyebolts and nuts.

EXPLOSIVES

LIQUID-OXYGEN. Liquid Oxygen Explosives—Further Facts, A. James. Eng. & Min. Jl.—Press, vol. 116, no. 23, Dec. 22, 1923, pp. 1062-1066, 3 figs. Study of energy evolved by various combustibles that may enter into their composition.

F

FANS

ELECTRIC DRIVE FOR. Electric Drive for Centrifugal and Propeller Fans, Gordon Fox. Coal Industry, vol. 6. no. 12, Dec. 1923, pp. 503-507, 3 figs. Characteristics of fans operated at various percentages of rating with curves showing pressure, velocity heads, horsepower required and efficiencies.

FERRO-ALLOYS

DEVELOPMENTS 1923. Ferro alloy Developments in the Past Year, Rob. J. Anderson. Iron Age, vol. 113, no. 1, Jan. 3, 1924, pp. 94-97. Market conditions and results of metallurgical research; growing field of special alloys.

FIREBRICK

MALLEABLE-IRON FURNACE BUNGS. The Behavior of Fire Brick in Malleable-Iron Furnace Bungs, H. G. Schurecht and H. W. Douda. Am. Ceramic Soc.—Jl., vol. 6, no. 12, Dec. 1923, pp. 1232-1241, 7 figs. Investigation conducted to study requirements of fireclay and bodies used for firebrick in malleable-irons furnace bungs; describes tests made on complete bungs holding 40 sample brick in malleable-iron furnace bungs with 20 different firebrick, and results obtained.

FLIGHT

HORIZONTAL CURVILINEAR. Airplanes in Horizontal Curvilinear Flight, H. Kann. Nat. Advisory Committee for Aeronautics—Tech. Notes, no. 174, Jan. 1924, 25 pp., 12 figs. Gives simple method of calculation, and indicates method for determining area of aileron and rudder surfaces. Translated from Technische Berichte, vol. 3, no. 7.

INVERTED. The Manœuvres of Inverted Flight, R. M. Hill. Roy. Aeronautical Soc.—Jl., vol. 27, no. 156, Dec. 1923, pp. 569-602 and (discussion) 602-605, 11 figs. Definition of inverted flight; reasons for investigation; nature of experiment; methods of attaining inverted position; effect of controls in inverted flight; resuming normal flight; the slow roll; the inverted spin; possibilities of inverted loop; conclusions.

SOARING. The "Mystery" of Soaring Flight, W. H. Sayers. Aeroplane, vol. 25, nos. 20 and 21, Nov. 14 and 21, 1923, pp. 488 and 508. Discusses results of observations made by E. H. Hainkn, and especially his paper read before Instn. Aeronautical Engrs., Nov. 9, dealing with noise and color changes, descending current theory, dust, contour and convection currents, gulls and steamers, turbulence, etc.

Wind Energy and the Aeroplane. Aeroplane, vol. 25, no. 25, Dec. 19, 1923, p. 586. Energy of gusts; meaning of indicated air speed; effect of rapid wind variations; alternating vertical winds; possibilities of using wind energy for flight.

FLOTATION

INTERFACIAL TENSION EQUILIBRIA. Certain Interfacial Tension Equilibria Important in Flotation, W. H. Coghill and C. O. Anderson. U. S. Bur. Mines, Technical Paper 262, 1923, 55 pp., 22 figs. partly on supp. plate. Discusses equilibrium of interfacial tension forces of two liquids and a gas, and surface-tension phenomena of a solid, a liquid, and a gas in contact; angle of contact and edge effect.

FLOW OF FLUIDS

ROUGH PIPES. Flow Resistance in Rough Pipes (Strömungswiderstand in rauhen Rohren), K. Fromm. Zeit. für angewandte Mathematik u. Mechanik, vol. 3, no. 5, Oct. 1923, pp. 339-358, 30 figs. Results of tests to investigate influence of roughness of pipe wall on pressure head in connection with flow of liquids through rough pipes.

The Measurement of Hydraulic Roughness (Die Messung der hydraulischen Rauhigkeit), L. Hopf. Zeit. für angewandte Mathematik u. Mechanik, vol. 3, no. 5, Oct. 1923, pp. 329-339, 6 figs. Account and results of tests; discusses two kinds of roughness; notes on empirical formulas of hydraulics.

FLOW OF STEAM

MEASUREMENT. The Measurement of Steam Through Orifices (Die Messung des Wasserdampfes durch Blenden), R. Geipert. Zeit. für angewandte Chemie, vol. 36, no. 66, Oct. 3, 1923, pp. 492-494, 5 figs. Describes method for measuring volume of flowing steam which is said to be accurate, simple and almost free of cost.

FLOW OF WATER

DISCHARGE COEFFICIENTS. Determining Discharge Coefficients for Flow of Water in Short Pipes, O. W. Boston. Chem. & Met. Eng., vol. 30, no. 2, Jan. 14, 1924, pp. 56-59, 5 figs. Short method for determining loss of head for water flowing in pipes which may be readily applied in other cases of fluid flow.

MEASUREMENT. The Salt Velocity Method of Water Measurement, Chas. M. Allen and Edwin A. Taylor. Mech. Eng., vol. 46, no. 1, Jan. 1924, pp. 13-16 and 51, 7 figs. Describes new method and outlines its theory and development; apparatus and methods of computation used in laboratory and field tests; claims of method for high degree of accuracy and reliability. (Abstract.)

PIPES. Flow of Water in Short Pipes, O. W. Boston. Am. Soc. Mech. Engrs.—advance paper, for meeting, Dec. 3-6, 1923, 12 pp., 5 figs. Presents method employed by author in determining frictional resistance or loss of head for water flowing in pipes; it is believed that this method can be made use of in work of this nature at great saving in time where tests in quantities are made for comparative analysis; values for coefficient of discharge of short tubes of diameters from 1 to 8 in., inclusive, are computed and tabulated for heads up to 7 ft.

Velocity of Flow in Pipes, Eric Crewdson. Engineer, vol. 136, no. 3546, Dec. 14, 1923, pp. 635-636, 1 fig. Results of salt-method readings.

FLUE-GAS ANALYSIS

TESTING APPARATUS. Testing Flue Gases (En ny rökgasprovare), Folke K. G. Odqvist. Tecknisk Tidskrift (Allmänna Avdelningen), vol. 53, no. 46, Nov. 17, 1923, pp. 357-358, 2 figs. Describes new flue-gas tester made by German concern, fundamental principle of which is based on difference in transmission of heat by different gases.

FORGINGS

DESIGN. The Economical Construction of Forgings (Wie muss der Konstrukteur konstruieren, um eine wirtschaftliche Herstellung von Schmiedestücken zu erzielen?), M. Rinno. Maschinenbau, vol. 2, no. 24, Sept. 15, 1923, pp. G260-G262, 29 figs. Shows correct and incorrect designs and gives directions which should be followed in design of forge pieces for different forging processes.

FOUNDRIES

CAST-IRON BORINGS AND TURNINGS UTILIZATION. The Briquetting and Use of Cast-Iron Borings and Turnings, J. Alex. Gardner. Foundry Trade Jl., vol. 28, no. 382, Dec. 13, 1923, pp. 501-505, 10 figs. Early attempts; results of melting experiments; production data; drying process; results of mechanical tests; blast control.

MOULDING-MACHINE PRACTICE. A Discussion on Pressure-Moulding Machine Practice. Foundry Trade Jl., vol. 28, no. 382, Dec. 13, 1923, pp. 511-513. Discussion following paper read by A. S. Beech on "Continental Foundry Practice". Deals with venting casserole moulds, pattern plate making, venting and pressing, British and Continental sand, factors in speed of working, railway chair making, etc.

TRANSPORT IN. Foundry Transport (Das Giesserei-Transportwesen), K. Zapf. Maschinenbau, vol. 3, no. 1, Oct. 11, 1923, pp. B1-B7, 8 figs. Delivery of raw materials and fuels to storage places; charging of cupolas; transport of liquid iron to foundry, and of moulding material to sand-dressing machines; transport of patterns from storage room to foundry; transport of slag; etc.

FOUNDRY EQUIPMENT

PNEUMATIC TOOLS. Growing Importance of Compressed Air in the Foundry, R. G. Skerrett. Compressed Air Mag., vol. 28, no. 12, Dec. 1923, pp. 703-710, 30 figs. How compressed air and pneumatic tools make it possible for skilled man to do more work without overtaxing himself and unskilled man much good work which he could not do without these up-to-date aids.

FUELS

COST DETERMINATION. Plotting Relative Cost of Various Fuels, R. I. Wynne-Roberts. Can. Engr., vol. 45, no. 25, Dec. 18, 1923, pp. 589-592, 3 figs. Graphic charts showing relation between different fuels as to relative cost for same service; method of deriving and preparing graphs, and how to apply them in practice.

OIL. *See Oil Fuel.*

PULVERIZED COAL. *See Pulverized Coal.*

REFUSE. Modern Viewpoints for the Construction of Refuse Power Plants, H. Marcard. Eng. Progress, vol. 4, no. 11, Nov. 1923, pp. 237-240, 5 figs. Discusses development in Germany, and processes and plants for burning refuse of low heating value.

RELATIVE ECONOMY. The Fuel of the Future—What Shall It Be? I. Ginsberg. Am. Gas Jl., vol. 118, no. 26, and vol. 119, nos. 10, 13, 20, 24 and 27, June 30, Sept. 8, 29, Oct. 20, Nov. 17 and Dec. 8, 1923, pp. 557-561; 193-196 and 204-205; 253-257 and 264; 457-461; 545-547 and 556-558; and 609-611 and 621-623, 3 figs. Classification of fuels and discussion of properties of each and supplies in United States, to determine best fuel for universal usage; properties of a universal fuel; analysis of losses that occur in combustion of fuel; comparison of combustion efficiency of gas, coke and coal; definition of units; shows that gas is most economical fuel from standpoint of utilization of its inherent fuel value.

FURNACES, INDUSTRIAL

RECUPERATORS. Recuperation—A New Design, E. R. Posnack. Fuels & Furnaces, vol. 1, no. 8, Dec. 1923, pp. 643-645, 3 figs. Describes recuperator designed by author, composed of an arrangement of standardized units so as to be flexible and adaptable to any size of installation; is of hollow tile and can be assembled to form independent air and gas flues.

FURNACES, FORGING

LOW-GRADE FUEL. Forging Furnaces (Der Schmiedeofen), J. Pitscheder. Werkstattstechnik, vol. 17, no. 22, Nov. 15, 1923, pp. 637-640, 5 figs. Requirements of furnace for economical consumption of fuel and for use of low-grade fuel; describes type of furnace which is said to meet all these demands.

G

GARBAGE DISPOSAL

INCINERATION. The Disposal of Garbage by Incineration in Charleston, W.Va. Am. City Mag., vol. 29, no. 6, Dec. 1923, pp. 595-597, 4 figs. Describes first installation of Balmer refuse destructor in United States, which has been in operation since Sept. 1923; capacity 70 tons garbages and miscellaneous refuse daily, which is divided between two batteries of three furnaces each.

GAS ENGINES

PRE-IGNITION. Pre-Ignition in Gas Engine. Practical Engr., vol. 68, no. 1921, Dec. 20, 1923, pp. 339-340, 3 figs. Some troubles and worries met with in electrical power-house, Napier, New Zealand, and manner in which they were overcome.

SILENCING. Silencing Gas Engines, A. Rutherford. Practical Engr., vol. 68, no. 1919, Dec. 6, 1923, pp. 312-313, 4 figs. Divides method for silencing gas engines into two classes, namely, those which employ means whereby gas is expanded, or cooled, and those which aim at maintaining constant flow of gas at any reasonable velocity.

Waste-Heat Utilization. Tests on a Gas-Engine-Driven Generator Set with Waste-Heat Utilization (Betriebsversuche an einer Gasdynamomaschine mit Abhitzeverwertung), M. Steffes. Archiv für Wärmewirtschaft, vol. 4, no. 12, Dec. 1923, pp. 213-217, 16 figs. Gas consumption and steam production for the effective kilowatt-hour; heat balance of gas engine and waste-heat boiler; air of combustion and consumption of cooling water under different engine loads.

GAS PRODUCERS

Design, Improvements in. Modern Gas Producers (Sur la gazéification et les gazogènes industriels), L. Maugé. Revue Industrielle, vol. 53, nos. 24 and 25, Nov. and Dec. 1923, pp. 357-363 and 397-400, 9 figs. Deals with basic action of gas producers and describes latest improvements in producers and in processes for recuperation of hydro-carbons and ammonia; chemical equations for complete and partial combustion of carbon (to CO and CO2), together with corresponding heats of formation; characteristics of suction and pressure gas producers; typical modern designs.

Wood as Fuel. The Use of Wood in Gas Producers, C. Saxton. Am. Ceramic Soc.—Jl., vol. 6, no. 12, Dec. 1923, pp. 1219-1223. Suggests possibility of using wood as source of gas supply for melting of glass and firing of clay products; comparative results actually obtained with same plant using coal and wood.

GAS TURBINES

Theory. Gas Turbines, J. Deschamps. Engineer, vol. 136, no. 3546, Dec. 14, 1923, pp. 646-647. Observations based on series of articles published in previous issues of same journal.

GEAR CUTTING

Helical Gears. Gear Cutting, R. J. McLeod and T. E. Calderwood. Inst. Mar. Engrs.—Trans., Dec. 1923, pp. 388-410 and (discussion) 410-419, 14 figs. Authors state that tool determines shape of tooth, while machine determines spacing which depends upon master or main dividing wheel of machine; dividing wheel should be as large and as accurate as possible and no additional complication will compensate for initial errors; point out that special feature of "Sykes" machines is that dividing wheels are always larger in diam. than largest gear the machine will cut, so that there is always pro-rata reduction of initial errors.

GEARS

Machining. Machining Change-Gears, A. Clegg. Mech. World, vol. 74, nos. 1925 and 1928, Nov. 23 and Dec. 14, 1923, and vol. 75, no. 1931, Jan. 4, 1924, pp. 318-319, 366-367, and 2-3, 7 figs. Notes on machining change-gear blanks. Deals with handling, chucking, boring, turning, cutting speeds and feeds for both turning and boring, number of cuts that can proceed, simultaneously, etc.

Spiral. Spiral Gearing, Henry E. Merritt. Machy. (Lond.), vol. 23, nos. 579, 580, 583 and 586, Nov. 1, 8, 29 and Dec. 20, 1923, pp. 147-148, 177-179, 273-274 and 393-395, 15 figs. Nov. 1: Relation between shaft angle and spiral angles; end thrust. Nov. 8: Nomenclature and fundamental relations; velocity and force diagrams. Nov. 29: Circle diagrams for spiral angles, axial and transverse forces, and tooth and diameter ratios. Dec. 20: Efficiency, tooth reaction, and design diagrams.

Standardization. Proposed Standardization of Gearing. Machy. (N.Y.), vol. 30, no. 5, Jan. 1924, pp. 374-377, 6 figs. Abstract of report before Am. Gear Mfrs.' Assn.

Teeth, Specially Shaped. The Production of Specially Shaped Gear Teeth, H. E. Stacey. Machy. (Lond.), vol. 23, no. 584, Dec. 6, 1923, pp. 296-299, 5 figs. Milling-machine and hobbing-machine methods; tool design and construction; hob-tool method; method of setting hobbing machine; practical examples.

Tooth Shape and Contact. The Shape of Teeth and Period of Contact on Involute Gears (Zahnform und Eingriffsdauer von Evolventen-Zahnrädern), H. Fischer. Maschinenbau, vol. 2, no 21, July 26, 1923, pp. G247-G251, 9 figs. Tables and formulas for calculation of tooth shape and period of contact.

Tooth-Shape Standardization. Desiderata for the Standardization of Tooth Shape of Change Wheels (Gesichtspunkte für die Normung der Zahnform von Satzrädern), K. Kutzbach. Maschinenbau, vol. 2, no. 21, July 26, 1923, pp. G233-G240, 16 figs. Calculation of length of contact of gearing and degree of covering with rectilineal face toothing; degree of covering in pure zero gears.

GOVERNORS

High-Speed Steam Engines. The Governing of High-Speed Steam Engines. Power Engr., vol. 19, no. 214, Jan. 1924, pp. 25-27, 3 figs. Notes advocating expansion or cut-off governors, stating case according to experience of W. Sisson & Co.

GRAPHITE

M.M.S.A. Report. Report of the Sub-Committee on Graphite. Min. & Metallurgical Soc. of American, vol. 16, no. 5, Bul. 162, Sept. 1923, pp. 140-148, 1 fig. General discussion of world's reserves of crystalline graphite and probable amorphous graphite and conditions governing their exploitation; graphite with reference to general principles relating to international disposition of minerals.

H

HAMMERS

Pneumatic. A Simple Pneumatic Hammer for Large and Small Forge Shops (Ein einfacher Lufthammer für die Gross- und Kleinschmiede), G. Bock. Werkstattstechnik, vol. 17, no. 22, Nov. 15, 1923, pp. 632-637, 28 figs. Describes patented Vulkan hammer, in which single oscillating plate serves as valve gear.

HARDNESS

Testing Methods. Hardness Tests Research, Instn. Mech. Engrs.—Proc., vol. 1, no. 3, 1923. Includes following papers: Static Indentation Tests, R. G. C. Batson, pp. 401-422, 10 figs. Relation between Width of Scratch and Load on Diamond in the Scratch Hardness Test, G. A. Hankins, pp. 423-449, 17 figs. and (discussion) pp. 449-487, 12 figs.

HEAT

Conversion of Work into. How to Make Use of Unused Heat with Aid of Power (Wie kann man mit Hilfe von Kraft ungenutzte Wärme nutzbar machen?), J. Kaiser. Zeit. des Bayerischen Revisions-Vereins, vol. 27, nos. 20 and 21-22, Oct. 31 and Nov. 30, 1923, pp. 153-156 and 162-164, 6 figs. Discusses most expedient manner of converting work into heat; theory of process and its application.

HEAT STORAGE

Apparatus for. The Storage of Steam (Die Spiecherung von Dampf zum Ausgleich von Feuerungs- und Verbrauchsschwankungen), Ludwig Heuser. Wärme, vol. 46, nos. 22, 23 and 24, June 1, 8 and 15, 1923, pp. 234-236, 247-249 and 257-260, 20 figs. Discusses general aspects in storage of energy, various storage methods and accumulator designs, and certain special applications with accumulator designs most suitable therefore.

HEAT TRANSMISSION

Principles. Notes on Heat Transmission, D. M'Kerracher. Gas Jl, vol. 164, no. 3162, Dec. 19, 1923, pp. 778-779. What heat is; general principles underlying its mechanism; physical definition of conduction, convection, and radiation.

Theory. Fire and Heat (Le feu, la chaleur), Ch. Roszak. Chaleur & Industrie, vol. 4, nos. 38 and 41, June and Sept. 1923, pp. 515-518 and 624-631. Discusses important aspects of fuel economy and of heat transmission in connection with it.

Tubes. Heat Transmission through Tubes under Variable Temperatures of Liquids (Wärmedurchgang durch Röhren bei veränderlichen Flüssigkeits-temperaturen), H. de Grahl. Wärme, vol. 46, nos. 46 and 47-48, Nov. 23 and 30, 1923, pp. 499-502 and 512-513, 9 figs. Results of experimental investigation; results show that coefficient of transmission is much better with parallel than with counter current.

HEAT TREATING

Principles and Applications. Heat Treating—Its Principles and Applications, Chas. H. Fulton, Hugh M. Henton and Jas. H. Knapp. Iron Trade Rev., vol. 73, nos. 14, 16, 18, 20, 22, 24 and 26, Oct. 4, 18, Nov. 1, 15, 29, Dec. 13 and 27, 1923, pp. 943-946 and 950; 1099-1102, 3 figs.; 1240-1244, 12 figs.; 1369-1372, 11 figs.; 1483-1486 and 1493, 4 figs ; 1603-1607, 4 figs.; and 1728-1731, 2 figs.; Oct. 4: Steel and other commercial iron products. Oct. 18, Nov. 1 and 15: Structure of iron and steel. Nov. 29, Dec. 13 and 27: Relation of structure to physical properties.

HEATING, ELECTRIC

Industrial. Electric Heating in Industry (Die Elektrowärme in der Industrie), Fr. Jordan. Elektrischer Betrieb, vol. 21, no. 23, Dec. 10, 1923, pp. 249-252, 7 figs. Application of electric-arc, induction and resistance furnaces in chemical, metallurgical and technical industries, for room heating, etc.

Progress. The Progress in Electrical Heating in the Last Decade (Der Fortschritt der elektrischen Heiztechnik im letzten Jahrzehnt), E. Zeulmann. Elektrotechnik u. Maschinenbau, vol. 41, no. 48, Dec 2, 1923, pp. 689-696, 13 figs. Review of most important developments, including electrode boiler, storage, heaters, air heaters, improvements in room heating, etc.; electric heating of industrial machinery and its advantages.

HEATING, HOT-AIR

Large Building. Heating a Seven-Acre Building with Warm-Air. Sheet Metal Worker, vol. 14, no. 24, Dec. 21, 1923, pp. 891-893, 5 figs. Describes system installed in Am. Roy. Exposition Bldg at Kansas City, with seating capacity of 15,000.

Ventilation and. Ventilation and Warm-Air Heating, G. A. Voorhees. Sheet Metal Worker, vol. 14, nos. 3 and 7, Mar. 2 and Apr. 27, 1923, pp. 81-82 and 249-250, 3 figs. Mar. 2: Relation of temperature to ventilation. Apr. 27: Circulation of air as it affects ventilating efficiency of a warm-air heating plant.

HEATING, HOT-WATER

Piping and Fittings Problems. Problems Affecting Hot Water Piping and Fittings in Heating Plants, S. H. Woodbridge. Heat. & Vent. Mag., vol. 20, no. 12, Dec. 1923, pp. 45-47, 3 figs. With special reference to gravity two-pipe systems with overhead supply and to equalization of water flow through riser and drop piping.

HELIUM

Use in Dirigibles. The Use of Helium in Dirigibles, G. A. Crocco. Int. Aeronautics, vol. 1, no 4, Nov. 1923, pp. 214-215. Calculates annual gas consumption of a dirigible and total tonnage of airships that can be supplied with limited American production of helium.

HIGH VOLTAGES

Phenomena. High-Voltage Phenomena, F. W Peek, Jr. Franklin Inst.—Jl., vol. 197, no. 1, Jan. 1924, pp 1-44, 29 figs. Results of author's research work at voltages up to 1,000,000 volts above ground, 1,500,000 single-phase and 1,000,000 3-phase 60-cycle root mean square values; corona laws established at lower voltages were checked as well as spark-over values of needle gaps, sphere gaps, line insulators and other typical electrodes.

HOISTS

Mine. Novel Application of Dynamic Braking on Large Slope Hoist, R. W. McNeill. Coal Age, vol. 25, no. 2, Jan. 10, 1924, pp. 35-39, 8 figs. Peculiar requirements of hoisting and lowering speeds under widely different loads while handling coal, supplies and men necessitates unusual type of control; success of installation at Shenandoah, Pa., proves efficacy of plan.

HOUSES

Concrete, Duo-Slab Construction System. The "Duo-Slab" System of Cottage Construction. Concrete & Constructional Eng., vol. 18, no. 12, Dec. 1923, pp. 792-799, 14 figs. Is essentially a system for mass production of houses on a unit system, although unit can be varied to suit any design; wall is formed of pre-cast slabs laid on edge one above another with a vertical space between each tier of slabs which is filled in with concrete poured on site, thus binding all slabs together at their ends.

HOUSING

Industrial Village. Industrial Village on Sound Basis. Iron Age, vol. 113, no. 1, Jan. 3, 1924, pp. 9-14, 14 figs. Developments of village established by Kinkora Works of John A. Roebling's Sons Co.; houses for employees only; providing activities outside mill; caring for workers' savings; community services.

HYDRAULIC TURBINES

Double-Wheel Horizontal. Large Turbines at Swedish Hydro-Electric Stations, F. Johnstone-Taylor. Elec. Times, vol. 64, no. 1677, Dec. 6, 1923, pp. 593-594, 3 figs. Describes large double-wheel horizontal units installed at large power station.

Governor-Pump Operation. Power Supply for Governor Pumps, Ralph Brown. Power, vol. 59, no. 3, Jan. 15, 1924, pp. 92-93, 2 figs. Describes economical system of governor-pump operation.

Low Falls. Hydraulic Turbines for Low Falls, F. Johnstone-Taylor. Power Engr., vol. 19, no. 214, Jan. 1924, pp 5-7, 4 figs. Describes low-fall Francis turbine; new types of runner; the hydraucone; Banki turbine.

Pelton Wheels. The Genesis of the Pelton Wheel, A. T. Parsons. Am. Mach., vol. 60, no. 2, Jan. 10, 1924, pp. 61-63, 7 figs. How forty-miner and his need for mining equipment developed machine business in San Francisco; modern methods of building large hydraulic turbines.

Raanaasfoss Station, Norway. Turbines at Raanaasfoss Power Station, Hallgrim Thoresen. Can. Engr., vol. 45, nos. 25 and 26, Dec. 18 and 25, 1923, pp. 581-585 and 601-606, 19 figs. Details of hydro-electric power development near Christiania, Norway; six turbines giving total output of 72,000 hp. at 40-ft. head and 107 r.p.m., and a water consumption of 3,200 cu. ft. per sec.; details of Voith turbines; efficiency test; apparatus for measuring water volume.

HYDRO-ELECTRIC DEVELOPMENTS

California. Pit River Hydro-electric Power Development, C. W. Geiger. Nat. Eng., vol. 27, no. 12, Dec. 1923, pp. 584-586, 2 figs. General description of latest additions to Pacific Gas & Elec. Co.'s system; details of problems faced in construction of plant.

Fundamental Problems. The Fundamental Problems of Hydro-electric Development, John R. Freeman. Mech. Eng., vol. 46, no. 1, Jan. 1924, pp. 1-10 and (discussion) 10-12 and 39, 2 figs. Notes on change and progress; costs of hydro vs. steam; change of method in solving problems of development; interconnection of power systems; value of water-power site; centralizing vs. scattering industries; education in public relations. Discussion includes following contributions: Study of Hydro-electric Possibilities, J. P. Hogan; Water-Power Costs vs. Steam-Power Costs, Geo. A. Orrok; Interconnection of Power Systems, H. W. Buck.

Norway. To Build Three High-Head Power Plants in Norway, E. Svangöe. Eng. New-Rec., vol. 92, no. 3, Jan. 17, 1924, pp. 106-107, 2 figs. Heads up to 3,000 ft.; stream flow to be supplemented by storage; many miles of tunnels.

Oregon. Oak Grove Power Project on Clackamas River, W. A. Scott. Eng. World, vol. 23, no. 6, Dec. 1923, pp. 333-337, 11 figs. Construction progress made on hydro-electric project of Portland Ry., Light & Power Co. of Portland, Ore.

United States, 1923. Hydro-Electric Development Shows Unprecedented Activity. Power, vol. 59, no. 1, Jan. 1, 1924, pp. 12-16, 8 figs. Over 2,000,000 horsepower of new hydro-electric plants and extensions to old installations, in projects of 10,000 hp. and larger, were completed during 1923 or are now under construction in United States.

HYDRO-ELECTRIC PLANTS

Accumulating Plant. Hydro-electric Accumulating Plant of the Firm "Manufactures Hartmann et Fils", Münster, Alsace (Hydroelektrische Akkumulierungsanlage der Firma Manufactures Hartmann et Fils, Münster i. Els.), E. Rabner. Siemens-Zeit., vol. 3, no. 11, Nov. 1923, pp. 499-506, 11 figs. Details of hydro-electric storage plant, built by firm of Locher, Zurich; electrical equipment supplied by Siemens-Schuckert Works.

Canada. An Important Northern Power Plant, H. L. Sanborn. Elec. News, vol. 32, no. 23, Dec. 1, 1923, pp. 58-60, 6 figs. Hydro-electric development of Abitibi Power & Paper Co.; notes on water control, switching control, transmission lines, substations, and mill feeders.

Hydraulic Machinery. Hydro-electric Plant and Hydraulic Machinery (Wesserkraftanlagen und Wasserkraftmaschinen), A. Budau. Zeit. des Oesterr. Ingenieur- u. Architekten-Vereines, vol. 75, nos. 31-32, Aug. 10, 1923, pp. 186-197, 18 figs. High-pressure plants: older and more recent hydro-electric-plant arrangements; corrosion and its prevention; Pelton vs. Francis turbine. Medium-pressure plants: Esibe control method; ice difficulties. Low-pressure plants: development of high-speed turbines; Storek-Kaplan turbine; horizontal and vertical shaft; modern draft tubes; pros and cons of high-speed turbine.

Miniature. A Miniature Water-Power Installation, D. C. Miller. Elec. Rev., vol. 93, no. 2405, Dec. 28, 1923, pp. 969-971, 6 figs. An 85-volt 550-watt capacity plant.

Sweden. Power Station at Forshuvudforsen (Bergslagets nya Kraftwerk vid Forshuvudforsen), M. Serrander. Teknisk Tidskrift (Väg- och Vattenbyggnadskonst), vol. 53, no. 43, Oct. 27, 1923, pp. 145-155, 27 figs. New power station in Dalälven in Sweden, built by Stora Kopparbergs Aktiebolag, is arranged for three units, each of 8,000 hp., two of which are already in operation; water wheels are constructed for 83⅓ r.p.m., at which they are warranted to have efficiency of 86 per cent for water consumption of 60 cu. m. per sec.; generators are rated at 6,500 kva., 11,000 volts and 50 cycles.

I

IMPACT TESTING

Notched-Bar Tests. Notch Action in Upsetting Test (Ueber Kerbwirkungen beim Stauchversuch), G. Sachs. Stahl u. Eisen, vol. 43, no. 52, Dec. 27, 1923, p. 1587, 3 figs. Tests on cast-iron specimens; relations between notch diameter and breaking load.

Theory and Practice of the Notched-Bar Test (Theorie und Praxis der Kerbschlagprobe), P. Fillunger. Schweizerische Bauzeitung, vol. 82, nos. 21 and 22, Nov. 24 and Dec. 1, 1923, pp. 265-268 and 284-289, 18 figs. Impact process is divided into four impact periods, each of which is discussed; experimental examination of theory.

INDUSTRIAL MANAGEMENT

Factories. Rational Works Management in Factories, J. A. Davenport and J. I. Emery. Indus. Management (Lond.), vol. 9, nos. 9, 10, 11, 12, 13, and vol. 10, nos. 1, 2, 4, 5, 9 and 12, May 3, 17, 31, June 14, 28, July 12, 26, Aug. 23, Sept. 6, Nov. 15 and Dec. 13, 1923, pp. 259-260, 261-294, 323-325, 355-356, 387-389, 3-4, 37-40, 93-94, 119-120, 270-272, and 326-327, 9 figs. May 3: Need for sound organization and sane administration. May 17: Factory personnel. May 31 and June 14: Scope and limitations of works management. June 28 and July 12: Scientific management. July 26: Standardization. Aug. 23: Labour-saving devices. Sept. 6: Inspection methods. Nov. 15: Training. Dec.: Payment by results.

Production and Sales, Co-ordination. Co-ordination of Production with Sales for Oil Companies, E. G. Reynolds. Management & Administration, vol. 7, no. 1, Jan. 1924, pp. 85-89, 2 figs. Setting production schedule; adjustment of estimated production and sales; interpretation of revised quota; types of records necessary to execute plan; regulation of refinery operations.

Purchasing. The Science of Buying Material, P. M. Atkins. Indus. Management (N. Y.), vol. 67, no. 1, Jan. 1924, pp. 19-23. Notes on purchasing agent's contribution to smooth production flow.

Scientific. The Art of Management, O. Sheldon. Taylor Soc.—Bul., vol. 8, no. 6, Dec. 1923, pp. 209-214. A British point of view.

Statistical Methods in Business. The Present Status of Statistical Research in the Administration of Business, C. L. Sweeting and D. K. Pfeffer. Taylor Soc.—Bul., vol. 8, no. 6, Dec. 1923, pp. 215-218. Results of authors' attempt to ascertain extent to which precise statistical procedure are being used as aids in stabilization of business; compilation of answers to questionnaire.

INDUSTRIAL RELATIONS

Economic Courses for Employees. Increased Industrial Acquaintanceship. Iron Age, vol. 113, no. 3, Jan. 17, 1924, pp. 211-214, 5 figs. Progress in 1923 in relations with employees at plant of Bridgeport Brass Co., Bridgeport, Conn.; courses in economics to explain business problems; service club; pensions to superannuated employees; group insurance plan.

Scientific Management and Labor. Two pioneer Papers on Industrial Relations, Rob. G. Valentine. Taylor Soc.—Bul., vol. 8, no. 6, Dec. 1923, pp. 225-236, 1 fig. Reprint of following articles: Scientific Management and Organized Labor; and The Progressive Relation between Efficiency and Consent, published originally in 1914 and 1915, respectively.

INSULATION, ELECTRIC

Armature. Gaseous Ionization in Built-up Insulation, J. B. Whitehead. Am. Inst. Elec. Engrs.—Jl., vol. 43, no. 1, Jan. 1924, pp.19-25, 5 figs. Continuation of tests described in previous paper, extending to wider range of type of armature insulation; results.

High-Voltage. High-Voltage Insulation, J. L. R. Hayden and Chas. P. Steinmetz. Am. Inst. Elec. Engrs.—Jl., vol. 43, no. 1, Jan. 1924, pp. 36-43, 2 figs. Notes on air as dielectric; liquid and solid dielectrics; mechanism of thermal breakdown of dielectric as third-class conductor; mechanism of disruption due to mechanical instability and by chemical deterioration; ionization; time lag of insulation. (Abridged.)

INTERNAL COMBUSTION ENGINES

Constant-Compression. The Essentials of a Successful Constant-Compression Engine, C. E. Sargent. Soc. Automotive Engrs.—Jl., vol. 14, no. 1, Jan. 1924, pp. 5-10, 9 figs. It is shown that constant-compression engines in which throttling is eliminated are feasible in construction; permit admitting of inert gas at less that full load during first part of induction stroke and of burnable gas during last part; describes new type developed to prove that engine could be designed to maintain constant compression and mean effective pressure commensurate with load.

Cooling, Influence of. The Influence of Cooling of Internal-Combustion Engines on Efficiency (Der Einfluss der Kühlung der Verbrennungsmaschinen auf die Leistung), W. Schlaebter. Maschinenbau, vol. 2, no. 20, July 13, 1923, pp. B241-B243, 8 figs. Discusses influence of cooling losses and measures for reducing them and increasing efficiency of engine.

Heat Losses. Heat Losses in Internal-Combustion Engines (Die Wärmeverluste in Verbrennungsmotoren), H. Schmolke. Wörme, vol. 46, no. 45, No. 9, 1923, pp. 489-491. Review of latest investigations of temperature, heat absorption and heat transmission in gas engines.

Heat Transmission in. Heat Transmission in Internal-Combustion Engines (Der Wärmeübergang in der Verbrennungskraftmaschine), Wilhelm Nusselt. Forschungsarbeiten auf dem Gebiete des Ingenieurwesens, no. 264, 1923, 79 pp., 15 figs. Discusses measurement of power of reflection of internal spherical surface; theory of heat radiation of hot gases; calculation of heat radiation based on tests; tests and their results; comparison with earlier tests and study of play of piston.

Temperature and Thermal Stresses. The Course of Temperature and Thermal Stresses in Internal-Combustion Engines (Temperaturverlauf und Wärmespannungen in Verbrennungsmotoren), G. Eichelberg. Forschungsarbeiten auf dem Gebiete des Ingenieurwesens, no. 234, 1923, 46 pp., 24 figs. on supp. plates. Deals with temperature of gases and heat transmission; course of temperature and thermal stresses in cylinder walls.

See also Airplane Engines, Automobile Engines, Diesel Engines, Gas Engines, Oil Engines.

IRON

Carbonizing with Oxy-Acetylene Flame. Surface Hardening with Oxy-Acetylene Flame, J. F. Springer. Ry. Mech. Engr., vol. 98, no. 1, Jan. 1924, pp. 36-37. Points out that torch process will mark out for itself field sharply defined and superior to its competitors; limitations of oxy-acetylene carbonizing; main advantages of torch process; experiments on cast steel.

IRON AND STEEL

Corrosion. The Corrosion of Iron and Steel, J. Newton Friend. Chem. Trade Jl. & Chem. Engr., vol. 73, no. 1909, Dec. 21, 1923, p. 734. J. N. Friend's colloid theory. Abstract of paper read before Hull Chem. & Eng. Soc., Dec. 11, 1923.

IRON CASTINGS

Bearing Brackets. Practical Problems of Casting and Patternmaking (Praktische Betriebsfragen aus der Giesserei und Modelltischlerei). Giesserei-Zeitung, vol. 20, no. 24, Nov. 15, 1923, pp. 463-466, 6 figs. Deals with cast-iron bearing brackets for electric machines, their casting faults, causes and preventions.

Hardness, Causes of. Physical Factors. Affect Iron, J. H. Hopp. Automotive Industries, vol. 50, no. 1, Jan. 3, 1924, pp. 11-12. Hard castings ascribed to chemical content in many cases are due to causes other than metal; shrinkage alleviated by proper gates and risers. (Abstract.) Paper before Chicago Foudrymen's Club.

Shrinkage and Cavities. Shrinkage and Cavities in Iron Castings, Engineering, vol. 116, no. 3026, Dec. 28, 1923, p. 809. Study of relations between formation of cavities in cast iron and composition and pouring temperatures of material. (Abstract.) Translated from Stahl u. Eisen, Sept. 27.

Titanium in. Titanium in Gray Iron Castings (Ueber Titan im Grauguss), E. Piwowarsky. Stahl u. Eisen, vol. 43, no. 49, Dec. 6, 1923, pp. 1491-1494, 7 figs. Critical discussion of earlier tests and works on influence of titanium; account of author's tests and results.

IRON METALLURGY

Developments 1923. Iron and Steel Metallurgy in 1923, C. E. MacQuigg. Iron Age, vol. 113, no. 1, Jan. 3, 1924, pp. 77-78 and 91-93. Review of literature on developments in fuels and furnaces, iron and steel, alloys and castings; value of research. Bibliography.

L

LATERITE

Origin, Distribution, and Composition. The Origin, Distribution and Composition of Laterite, C. O. Swanson. Am. Ceramic Soc.—Jl., vol. 6, no. 12, Dec. 1923, pp. 1248-1260. A peculiar clay formed by decomposition of different kind of rocks, under conditions yielding aluminum and iron hydroxides. Discusses different theories of origin, chemical process of laterization, and geographic distribution.

LATHES

Balance and Cutting Tests. Investigation of Turning (Die Untersuchung der Dreharbeit), H. Klopstock. Werkstattstechnik, vol. 17, nos. 23 and 24, Dec. 1 and 15, 1923, pp. 645-654 and 666-672, 44 figs. Calculation of balance of lathe; law of cutting process; development of new cutting form; analysis of cutting process.

LIFTING MAGNETS

Types and Applications. Load-Lifting Equipment for Cranes (Die Lastaufnahmemittel der Krane), R. Hänchen. Mashinenbau, vol. 3, no. 1, Oct. 11, 1923, pp. G1-G2, 4 figs. Types and main uses of lifting magnets.

LIGHTING

Street. The Lighting of Streets and Highways, S. C. Rogers. Eng. & Contracting (Roads & Streets), vol. 60, no. 6, Dec. 5, 1923, pp. 1177-1180. Outline of principles and practice. Paper at Am. Soc. for Mun. Improvements annual convention, Nov. 13, 1923.

LIME

Hydrating Plants. Latest in Lime Hydrating Plants. Rock Products, vol. 26, no. 26, Dec. 29, 1923, pp. 65-72, 21 figs. Describes plant of Palmer Lime & Cement Co., York, Pa.

PLANTS. Lime Plant with Unusual Features, C. A. Breskin. Rock Products, vol. 26, no. 26, Dec. 29, 1923, pp. 96-101, 16 figs. Describes new 6-kiln plant built for John Herzog & Son, Forest, Ohio, having may labor-saving devices; pivoted bucket carrier and pneumatic draw shears are features.

LOCOMOTIVES

ELECTRIC. *See Electric Locomotives.*

50-PER CENT CUT-OFF. The Fifty Per Cent Cut-Off Locomotive, W. F. Kiesel, Jr. N. Y. R. R. Club, vol. 34, no. 1, Dec. 1923, pp. 7138-7151, 6 figs. Describes locomotive which in expansion ration approximates compound locomotive, in uniformity of torque practically equals three-cylinder locmotive, and in simplicity of parts is same as ordinary two-cylinder locmotives; advantages, and tests made.

FREIGHT-TONNAGE RATINGS. Locomotive Freight Tonnage Ratings, W. U. Appleton. Can. Ry. & Mar. World, no. 310, Dec. 1923, pp. 565-569, 5 figs. Discusses the two main factors governing correct tonnage rating for a specified subdivision, viz., drawbar pull exerted by locomotive, and resistance of train, and the minor factors influencing these.

HEAVY FREIGHT. Heavy 2-10C-2 Type Locomotive, B. & O. R. R. Ry. Rev., vol. 73, no. 25, Dec. 22, 1923, pp. 889-890, 1 fig. Locomotive designed to combine speed capacity of road's Mikado-type heavy road engine with exceptional hauling capacity.

MIKADO. Canadian National Mikado Type Locomotive, C. E. Brooks. Ry. Mech. Engr., vol. 98, no. 1, Jan. 1924, pp. 6-9, 7 figs. Belpaire fireboxes and extended side sheets reduce troubles from bad water in Western Canada.

PERFORMANCE. Some British Locomotive Performances, J. T. Burton-Alexander, Engineer, vol. 136, no. 3548, Dec. 28, 1923, pp. 684-685. Account of runs on British railways which date back to about 20 years ago.

PRODUCTION STATISTICS, 1923. Record-Breaking Increase in Motive Power. Ry. Age, vol. 76, no. 1, Jan. 5, 1924, pp. 77-82. Gives table of locomotive orders for 1923 for service in United States.

STEAM-TURBINE. The Steam Turbine as Locomotive Drive (Die Dampfturbine als Lokomotivantrieb), U. R. Ruegger. Schweizerische Bauzeitung, vol. 82, no. 23, Dec. 8, 1923, pp. 299-303, 9 figs. Discusses most important types of steam-turbine locomotives including Ramsay, Zoelly and Ljungström llocomotives.

10-WHEEL. Pennsylvania Ten-Wheel Passenger Locomotive. Ry, Mech. Engr., vol. 98, no. 1, Jan. 1924, pp. 16-18, 3 figs. Class G5S, new design for local passenger service with 68-in. drivers, develops 41,328-lb. tractive force.

LUBRICANTS

RAILROAD ENGINE GREASES. The Manufacture of Railroad Engine Greases, H. L. Kauffman. Ry. Mech. Engr., vol. 98, no. 1, Jan. 1924, pp. 13-14. Discusses materials and processes entering into production of these lubricants.

LUBRICATING OILS

TESTING. A New and Universal Method of Testing Lubricating Oil (Eine neue einfache 7nd universelle Schmierölprüfweise), H. Dallwitz-Wegner. Petroleum. vol. 19, no. 35, Dec. 10, 1923, pp. 1247-1253, 9 figs. Describes improved method of measuring capillary properties.

LUBRICATION

BEARINGS. Oil and Bearing Tests in Machine Laboratory of the German National Physico-Technical Institute (Ueber Oel-und Lagerversuche im Maschinenlaboratorium der Physikalisch-Technischen Reichsanstalt), V. Vieweg. Glasers Annalen, vol. 93, no. 10, Nov. 15, 1923, pp. 111-113, 6 figs. Describes optical method of investigating film formation of lubricating medium in a bearing.

The Lubrication of Bearings (Die Schmierung von Oellagern), A. Michels. Zeit. des Vereines deutscher Ingenieure, vol. 67, no. 49, Dec. 8, 1923, pp. 1100-1103, 17 figs. Study of theory of lubrication; so-called equation of Osborne Reynolds is derived according to Sommerfeld method, from which conclusions are drawn for production of bearings.

JOURNAL. A Graphical Study of Journal Lubrication, H. S. S. Howarth. Am. Soc. Mech. Engrs.—advance paper, for meeting, Dec. 3-6, 1923, 16 pp., 19 figs. Visualizes characteristics of oil film and pressures within it for journal completely surrounded by its bearing; influences of clearance and viscosity upon journal friction are quantitatively shown by means of chart that can readily be used for designing bearings.

LUMBER

SIZE AND GRADE STANDARDIZATION. Standardized Sizes and Grades for Lumber. Contract Rec. & Eng. Rev., vol. 37, no. 48, Nov. 28, 1923, pp. 1125-1127. Recommendations formulated by committee, covering standard lumber classification, standard grade names and classifications, standard yard lumber sizes, method of lumber measurement, standard shipping weights and shipping and other provisions, which it is anticipated will be accepted by the industry.

M

MACHINE TOOLS

ADJUSTMENTS. Adjustments ln Machine Tools, F. Horner. British Machine Tool Eng., vol. 2, no. 24, Nov.-Dec. 1923, pp. 719-724, 12 figs. Discusses class of adjusting devices that deals with the various movements essential to operation of a machine and brings slides, tables, spindles, heads, steadies, and other elements into suitable positions, and the various points that arise in connection therewith.

DEVELOPMENTS 1923. Machine Tool Developments in 1923. Machy. (Lond.), vol. 23, no. 585, Dec. 13, 1923, pp. 345-376, 48 figs. Review of year's progress, featuring principal improvements in machine-tool design.

Principal Developments in Shop Equipment, L. C. Morrow. Am. Mach., vol. 60, no. 3, Jan. 17, 1924, pp. 81-111, 213 figs. Semi-annual résumé of machines, tools and accessories described in Shop Equipment News section of this journal during last six months of 1923. See also Index of Manufacturers, pp. 112-114.

PLATE AND BAR-WORKING. Plate and Bar-working Tools. Machy. (Lond.), vols. 22 and 23, nos. 561, 562, 564, 565, 567, 568, 570, 572, 574, 578, 581, 582 and 587, June 28, July 5, 19, 26, Aug. 9, 16, 30, Sept. 13, 27, Oct. 25, Nov. 15, 22 and Dec. 27, 1923, pp. 389-395, 429-437, 511-516, 541-547, 589-593, 637-639, 695-699, 765-769, 829-832, 104-107, 211-214, 241-244 and 409-413, 162 figs. Their application to shipyard, boiler, and tank work; locomotive and car building; girder and structural work; steel-works operation; hydraulic plate stretching; plate-bending rolls; flanging operations; trimming, girder milling, and plate-edge plading.

SAFETY DEVICES. Accident Prevention in the Machine Tool Industry. (Unfallverhütung in der Werkzengmaschinenindustrie), H. Pfennig. Maschinenbau, vol. 3, no. 2, Oct. 25, 1923, pp. B9-B10, 5 figs. Describes special protective deviced for a lathe, and safety devices for planing machines. See also article by G. Puschmann, entitled, Modern Safety Devices for Punching Machines, pp. B10-B12, 4 figs.; Safety Devices for Woodworking Machines, R. Heinel, pp. B12-B13; and Modern Safety Devices for Agricultural Machines, L. Hofer, pp. B13-B14, 3 figs.

STANDARDIZED PARTS. The Constructive Development of Standardized Machine Parts (Der konstruktive Aufbau genormter Maschinenteile), H. Lasswitz. Maschinenbau, vol. 3, no. 4, Nov. 22, 1923, pp. B22-B24, 8 figs. Discusses factors which influence constructive development.

MACHINERY

FOUNDATIONS. Machinery Foundations. Power Engr., vol. 19, no. 214, Jan. 1924, pp. 10-11. Notes on foundations for steam engines, tubo-alternators and heavier kinds of pumping plant.

MACHINING METHODS

DEFECTS, OVERCOMING. Overcoming Defects in Machining Raw Materials, T. H. Turner. Can. Machy., vol. 30, no. 25, Dec. 20, 1923, pp. 20:23. In considering the various types of defects, such as one encounters during machining of ferrous materials, uses to which finished product will be put must be borne in mind.

MAPPING

AERIAL PHOTOGRAPHY. Aerial Photography An aid to Better Map Making, Gerard H. Matthes. Eng. News-Rev., vol. 92, no. 1, Jan. 3, 1924, pp. 25-27. Explains uses to which engineer can put bird's-eye, mosaic and line maps in revivifying and bettering map making.

The Making of Greater New York's Air Map. Aviation, vol. 16, no. 1, Jan. 7, 1924, pp. 16-17, 1 fig. Planes flew 3,000 mi. and photographed 625 sq. mi. on largest city mapping project ever attempted.

MATERIALS

TESTING. Experimental Arrangements for Determination of Oscillating Strength of Materials (Versuchsanordnungen zur Bestimmung der Schwingungsfestigkeit von Materialien), O. Föppl. Maschinenbau, vol. 2, no. 25-26, Sept. 29, 1923, pp. G278-G280, 8 figs. Discusses different testing methods for duration tests. and compares advantages and disadvantages.

MATERIALS HANDLING

PNEUMATIC CONVEYING. The Pneumatic Conveying of Materials, M. W. Potts. Indus. Management (N. Y.), vol. 77, no. 1, Jan. 1924, pp. 9-15, 10 figs. Present state of development; principles involved; special problems encountered.

METAL WORKING

FAULTS, OVERCOMING. Correcting Faults in Metal-Working, F. Horner. English Mechanics, vol. 118, no. 3065, Dec. 21, 1923, pp. 310-311, 3 figs. Discusses common faults arising in engineering machine work and their remedies.

METALWORKING

MECHANICAL ENGINEERING AND MANAGEMENT. The Mechanical Engineering of Management in the Metalworking Trades, Rob. T. Kent. Am. Soc. Mech. Engrs.—advance paper, for meeting, Dec. 3-6, 1923, 3 pp. Good mechanical engineering is shown to be essential to good management; application of engineering principles to design of product, arrangement of plant, and selection of equipment and methods.

METALS

COLD WORKING. Alteration in Metal Structure by Cold Working (Ueber Strukturänderungen in Metallen durch Kaltbearbeitugn), M. Polanyi. Zeit. für Physik, vol. 17, no. 1, July 30, 1923, pp. 42-53. A new consideration is introduced, namely that, with cubical lattices, different possible gliding directions can compete with one another; explains structures of metal foils.

DIFFUSION OF HYDROGEN THROUGH. The Diffusion of Hydrogen Through Metals, H. G. Deming and C. Hendricks. Am. Chem. Soc.—Jl., vol. 45. no. 12, Dec. 1923, pp. 2857-2864, 2 figs. Describes apparatus for studying rate of diffusion of gases through definitely measureable areas of sheet metal at definite, uniform temperatures.

HEAT TREATMENT. The Heat Treatment of Metals, E. Pull. Machy. Market, nos. 1208 and 1209, Dec. 28, 1923 and Jan. 4, 1924, pp. 27-28 and 25-26, 3 figs. Definitions of words and phrases in general use in connection with annealing, hardening and tempering.

PROPERTIES AT ELEVATED TEMPERATURES. Mechanical Properties of Metals at Elevated Temperatures, D. H. Ingall. Metal Industry (Lond.), vol. 23, no. 24, Dec. 14. 1923, pp. 531-532. Users' and Manufacturers' requirements; critical temperature; significance of viscous condition. Abstract of paper read before Birmingham Met. Soc.

TWIN CRYSTALLITE FORMATION IN. Twin Crystallite Formation in Certain Metals and Alloys (Ueber Zwillingsbildung in einigen Metallen und Legierungen), A. Schrader and E. Wiess. Zeit. für Metallkunde, vol. 15, no. 10, Oct. 1923, pp. 284-285, 3 figs. Twin crystallite formations in copper, brass, and bronze as proof of a previous strain with subsequent annealing.

MINES

SURVEYING. Three-Wire Methods for Shaft Survey, H. C. Jenkins. Min. Mag., vol. 29, no. 6, Dec. 1923, pp. 337-341, 6 figs. Discusses application of method employing three wires.

MOTOR-TRUCK TRANSPORTATION

INTERURBAN MOVEMENTS, ALLOCATION OF TRUCK IN. Motor Transportation, L. W. McIntyre. Ry. Club of Pittsburgh—Proc., vol, 22, no. 8, Sept. 27, 1923, pp. 173-188 and (discussion) 188-200. Indicates necessity for study of motor transportation as a possible means of further improving present transportation facilities. Comparison of rail and truck rates; comparison of tonnage and distance hauled; discussion of whether "short haul" is unprofitable to railways; terminal practice and costs; regulation.

MOTOR TRUCKS

ELECTRIC. General Design and Urban Performance of Electric Trucks, J. G. Carroll. Soc. Automotive Engrs.—Jl., vol. 14, no. 1, Jan. 1924, pp. 23-29 and (discussion) 29-30 and 35, 12 figs. Considerations that influence design and location of motors and various methods by which their control is effected; details of construction and factors that determine selection of best type of drive; examination of requirements of delivery systems operating over city routes shows that electric truck is capable of meeting pratically all demands of mileage, topographical conditions and speed; points out its advantages.

O

OIL ENGINES

CYLINDER HEADS. Designing Oil Engine Cylinder Heads, R. Hildebrand. Oil Engine Power, vol. 1, no. 12, Dec. 1923, pp. 603-607, 8 figs. Discusses cause of cracked cylinder head; how crack can be detected; when cylinder head must be replaced by new one; what causes blowing of gasket between head and cylinder.

HEAVY-OIL. Some Considerations Affecting the Choice of a Heavy-Oil Engine, G. Porter. Diesel Engine Users Assn. (Lond.), no. 37, 30 pp. (includes discussion). Paper read at meeting on Nov. 16, 1923. Principal types available; fundamental principles; fuel oils; fuel consumption; conditions affecting combustion; particulars of design; cooling water; lubrication; costs.

SOLID-INJECTION. Observations on the Solid-Injection Engine, P. H. Schweitzer. Power, vol. 59. no. 3, Jan. 15, 1924, pp. 90-91. Writer believes a flatter combustion line would be desirable, provided it would not lead to after-burning; better control of fuel injection as to spray action and accurate delivery in quantity and timing might lead to this end.

SOLID-INJECTION. The Solid-Injection Oil Engine, H. F. Shepherd. Am. Soc. Mech. Engrs.—advance paper, for meeting, Dec. 3-6, 1923, 7 pp., 28 figs. Presents most pertinent facts on development of engine from former hot-surface unit and points out influence of combustion-chamber design, spray angle and velocity, atomization, detonation, and other problems confronting oil-engine designer.

TORSIOGRAMS AND VIBROGRAMS OF. Torsiograms and Vibrograms of Oil Engines. Motorship, vol. 9, no. 1, Jan. 1924, pp. 28-31, 45 figs. Simple instruments facilitate exploration of machinery for critical periodic stresses.

OIL FUEL

EFFICIENT USE. Efficient Use of Liquid Fuel, H. A. Anderson. Foundry, vol. 52, no. 1, Jan. 1, 1924, pp. 29-30. Type of burners and amounts of air and oil pressure influence economical application of fuel oil; use of insulating brick and grade of fuel contributing factors.

OIL WELLS

DRILLING. Measuring Depth Accurately in Rotary Well Drilling, A. G. Wolf. Eng. & Min. Jl.-Press, vol. 116, no. 26, Dec. 29, 1923, pp. 1122-1123, 3 figs. How to determine thickness of strata and other data for recording in log.

ORE HANDLING

COSTS. Ore Handling Costs, Walter Burr. Assn. Iron & Steel Elec. Engrs., vol. 5, no. 12, Dec. 1923, pp. 701-703 and (discussion) 704-705. Summary of cost of handling ore with modern ore bridge used in connection with three blast furnaces.

OXY-ACETYLENE WELDING

LOCOMOTIVE REPAIR SHOPS. Wedling in Locomotive Repair Shops, F. E. Rogers. Welding Engr., vol. 8, no. 12, Dec. 1923, pp. 19-24, 19 figs. Particulars regarding the various oxy-acetylene welding operations employed in locomotive repair shops. Paper presented at Chattanooga Regional Mtg. of Southern Local Section of A.S.M.E.

P

PACKINGS

LEATHER. Type of Leather Packings—Their Care and Use, R. C. Moore. Belting, vol. 23, no. 6, Dec. 1923, pp. 44, 46 and 48, 12 figs. Describes most common forms; four dimensions indicate complete size; correct and incorrect installations.

PAPER

ANALYSIS. Rapid Analysis of Paper, Paper vol. 33, nos. 7, 8 and 9, Dec. 6, 13 and 20, 1923, pp. 5-8, 7-9 and 19 and 6-7. Method for quickly determining constituents of a paper sample for purposes of duplication. Translated from Moniteur de la Papeterie Fraçnaise.

PAPER MANUFACTURE

BEATING. The Beating Problem. Paper Mill, vol. 4%, no. 48, Dec. 1, 1923, pp. 14, 16, 18 and 38. Discussion at meeting of London Division of Technical Section of Papermakers' Assn., dealing with adjustable backfall, hydration and dehydration, clearing arms or bangers, types of beaters, refiners, etc.

IMPROVEMENTS. Improvements in Fine Papermaking, I. Gordon. Paper, vol. 33, no. 7, Dec. 6, 1923, pp. 3-4 and 20. While process remains practically unchanged many refinements have been introduced which tend to improve produce and lower cost.

PAPER MILLS

LOAD REGULATING VALVE. Combination Operating and Load Regulating Valve for Pulp Grinders, Paper Trade Jl., vol. 77, no. 23, Dec. 6, 1923, p. 48, 1 fig. Describes Nekoosa valve, which consists of a combination of ordinary grinder valve and an auxiliary valve through which a high pressure operates to control load when pockets are being filled.

STEAM TURBINE APPLICATION. Steam Turbines in Pulp and Paper Mills, A. C. Darling. Paper, vol. 33, no. 9, Dec. 20, 1923, pp. 10-12, 2 figs. Application of steam turbo-generators in manufacture of pulp and paper; discussion of various types and advantages of each. *See Paper Trade Jl., vol. 77, no. 24, Dec. 13, 1923, pp. 36-69, 4 figs.*

SIZING TESTS. Sizing Tests for Paper, M. L. Caust. Paper, vol. 33, no. 10, Dec. 27, 1923, pp. 3-5, 2 figs. Review of the different tests available for determination of sizing quality of paper; some results of experience with Valley tester.

SODA LIQUOR TREATMENT, SPENT. Treatment of Spent Soda Liquor, G. K. Spence. Paper, vol. 33, no. 10, Dec. 27, 1923, pp. 7-10. Washing, evaporation and burning liquor for recovery of soda; leaching black ash, causticizing carbonate liquor and disposing of lime sludge.

SULPHITE MILL CALCULATIONS. Some Sulphite Mill Calculations, W. P. VanArsdel. Paper, vol. 33, no. 10, Dec. 27, 1923, pp. 6. Collection of formulas and graphs which will assist in designing apparatus on calculating results of tests.

PHOTO-ELASTICITY

RESEARCHES. Photo-Elastimetric Researches on Mechanical Engineering Problems, E. G. Coker. Instn. Mech. Engrs.—Proc., vol. 1, no. 3, 1923, pp. 489-491. (Abstract.)

PIPE, STEEL

BENDING. Pipe Bending by Machinery, C. R. H. Bonn. Machy. (Lond.), vol. 23, nos. 584, 585 and 587, Dec. 6, 13 and 27, 1923, pp. 313-315, 333-334 and 418-421, 43 figs. Points out advantages and disadvantages of cold bending by machines, and discusses conditions which must be fulfilled by ideal pipe-bending machine.

PRESSES

SAFETY APPLIANCES. Modern Safety Devices for Plate and Metalworking Machines (Neuzeitliche Unfallschutzverrichtungen an Blech- und Metallbearbeitungsmaschinen), A. Herb. Maschinenbau, vol. 3, no. 2, Oct. 25, 1923, pp. G7-G10, 5 figs. Points out need of protective devices for presses, shears, etc.; and describes design and operation of some of these devices.

PRESSWORK

PRESSED STEEL, APPLICATION OF. The Development of Modern Stamping Practice, W. W. Galbreath and J. R. Winter. Mech. Eng., vol. 46, no. 1, Jan. 1924, pp. 17-19, 6 figs. Early uses of pressed metal; pressed steel in automobile field; replacement of cast-iron parts by pressed steel; various applications of prssed steel. (Abridged.)

PRODUCER GAS

WASTE WOOD AS SOURCE. Gasification Plants for Waste Products, Eng. Progress, vol. 4, no. 11, Nov. 1923, pp. 229-231, 3 figs. Describes wood gasification plants constructed by Motorenfabrik Deutz with idea of producing valuable tar oil besides generating power.

PULLEYS

STANDARDS. Practical Application of Standards for Pulleys (Einf&hrung der Riemenscheibenormen in die Praxis), W. Patzke. Maschinenbau, vol. 3, no. 4, Nov. 22, 1923, pp. B28-B31, 7 figs. Purposes of pulley standardization; introduction of standards; examples from practice at W&lfel Steel Works; influence of workshop tolerances on accuracy of speeds; faults of described system are said to be few in comparison with advantages.

PULVERIZED COAL

BOILER FIRING. Application of Pulverized Coal to Boilers. Power Plant Eng., vol. 28, no. 1, Jan. 1, 1924, pp. 71-72, 2 figs. Preparation of fuel; storage of dry pulverized coal; importance of furnace design; ash removal facilitated by water screens; safety rules.

CHEMICAL WORKS. Fuel Economy in Chemical Works, H. W. Hollands and C. Elliott. Chem. Trade Jl. & Chem. Engr., vol. 73, no. 1910, Dec. 28, 1923, pp. 761-763, 6 figs. Deals with expenditure, coal, and efficient combustion of coal, and examines possibilities of employing pulverized fuel firing, in light of experience that is now available.

DEVELOPMENTS. Developments in the Use of Pulverized Coal, Chas. Longenecker. Power Plant Eng., vol. 28, no. 2, Jan. 15, 1924, pp. 127-130, 2 figs. Many installations have shown that pulverized coal can be burned with high degree of efficiency.

LOCOMOTIVE FIRING. Pulverized-Coal Firing for Locomotives (Zur Frage der Brennstaubfeuerung für Lokomotiven), H. de Grahl. Glasers Annalen, vol. 93, no. 11, Dec. 1, 1923, pp. 119-126, 22 figs. Advantages and disadvantages of pulverized-coal firing; suggestion for improvements in pulverizing fuel and durability of construction material.

POWER PLANTS. Tests of a Powdered-Coal Plant, H. Kreisinger, J. Blizard, C. E. Augustine and B. J. Cross. U. S. Bur. Mines, Technical Paper 316, 1923, 22 pp., 10 figs. Report of investigations at power plant of St. Joseph Lead Co., Rivermines, Mo.; tests comprised 2 boiler tests, 6 dryer tests, and 8 mill tests.

PULVERIZERS. A British Unit Pulverizer for Coal and Other Materials. Power Engr., vol. 19, no. 214, Jan. 1924, p. 16, 2 figs. Features of design of Vickers-Griffin self-contained coal pulverizer, which enables small users of coal to adopt powdered-fuel firing economically.

UTILIZATION, GERMANY. The Status of Pulverized-Coal Firing in Germany (Stand der Kohlenstaubfeuerung in Deutschland), G. Bulle. Wärme, vol. 46, no. 19, May 11, 1923, pp. 199-202, 7 figs. Field of application; technical features of pulverized-coal furnaces; practical results and conclusions.

PUMPING PLANTS

DIESEL-DRIVEN. A Novel Diesel Pumping Plant, F. J. Dixon. Power Engr. vol. 19, no. 214, Jan. 1924, pp. 23-24, 1 fig. Diesel-driven ombination of bore-hole- and force-pump, without reservoir, erected at Somerford by So. Staffordshire Waterworks Co.

IRRIGATION. Construction of the Thomas Point Pumping Plant. Reclamation Rec., vol. 14, no. 11-12, Nov.-Dec. 1923, p. 324, 2 figs. Deals with pumping plant situated on main canal of Lower Yellowstone irrigation project, in Montana and North Dakota, providing means for irrigating approximately 2,400 acres land; built to pump water from main canal into lateral LL, difference in water surface being 31 ft.

MINES. Features That Should be Embodied in the Design of Plunger and Centrifugal Pumps. Coal Age, vol. 25, no. 1, Jan. 3, 1924, pp. 11-14, 3 figs. Mining Congress committee suggest standards which should govern construction of pumps in coal mines, not for gathering water but for its delivery to surface.

STEAM VS. DIESEL-DRIVEN. Comparative Running Costs of Steam and Diesel Driven Pumping Plants, K. B. Woodd Smith. Diesel Engine Users Assn.—paper read at meeting Oct. 5, 1923, 17 pp. (including discussion), 1 fig. Comparison shows economies to be effected by substitution of Diesel for Steam-driven pumps in water works where pumping is continuous throughout 24 hr.

PUMPS

SLIPPAGE DETERMINATION. A Simple Method of Determining Pump Slippage, J. E. Pierce. Eng. & Contracting (Water Works), vol. 60, no. 6, Dec. 12, 1923, pp. 1226-1227, 2 figs. Describes method used in determining slippage of one of the main pumps of Roanoke Water Works Co. Roanoke, Va.; instruments used were Pitot tube, manometer and counter of engines.

PUMPS, CENTRIFUGAL

INSTALLATION. Installation of Centrifugal Pumps, J. Rosbloom. Ariz. Min. Jl., vol. 7, no. 14, Dec. 15, 1923, pp. 7-8 and 46, 8 figs. Discusses correct and incorrect methods of attaching suction piping.

TURBINE-DRIVEN. A Steam Turbine Waterworks Set. Power Engr., vol. 19, no. 214, Jan. 1924, pp. 17-19, 2 figs. Describes plant erected to meet special circumstances at Oakfield Road pumping station, Clifton.

PYROMETERS

OPTICAL, SMOKED GLASSES IN. The Use of Smoked Glasses in Optical Pyrometrical Measurements (Ueber den Gebrauch von Rauchgläsern bei optisch-pylometrischen Messungen), F. Hoffmann. Zeit. für Physik, vol. 17, no. 1, July 30, 1923, pp. 1-22, 6 figs. Works out corrections in case of two Jena smoked glasses Nos. F3815 and F7839 in combination with Jena red filter F4512 when used in Holborn-Kurlbaum pyrometer.

R

RADIOTELEPHONY

RECEIVERS. A Three-Valve Receiver, P. R. Coursey. Wireless World, vol. 13, nos. 9 and 10, Nov. 28 and Dec. 5, 1923, pp. 271-276 and 315-317, 13 figs. Tuning is simplified by simultaneous adjustment of aerial and tuned anode circuits. Describes principles; details for constructing inductances and setting up condensers; method of wiring; operating instructions.

RADIOTELEGRAPHY

SIGNALING. Spectroradiometric Analysis of Radio Signals, C. Snow. U. S. Bur. Standard, Scientific Papers, No. 477, Oct. 22, 1923, pp. 231-261, 2 figs. Develops method of spectrum analysis which may be applied to study of interference-producing quality of a given sending station.

TRANSMISSION MEASUREMENTS. Radio Transmission Measurements on Long Wave Lengths, H. H. Beverage and H. O. Peterson. Inst. Radio Engrs.—Proc., vol. 11, no. 6, Dec. 1923, pp. 661-673, 6 figs. Describes method of measuring strength of received signals, both as to theory and apparatus employed.

TRANSMITTERS. Commercial Radio Tube Transmitters, W. R. G. Baker. Inst. Radio Engrs.—Proc., vol. 11, no. 6, Dec. 1923, pp. 601-659, 63 figs. Describes tube transmitters for output from 500 watts to 20 kw., and for continuous-wave and interrupted continuous-wave telegraphy and telephony; discusses essential elements of such transmitters; data on characteristics of various power tubes and rectifiers, and statement relative to expectation of life of tube.

WAVES, STATIONARY. Stationary Waves on Free Wires and Solenoids, A. Press. Inst. Radio Engrs.—Proc., vol. 11, no. 6, Dec. 1923, pp. 675-677, 1 fig. Production of stationary waves on systems having distributed electrical constants is mathematically treated.

RAILS

BONDS, WELDING OF. Welded Rail Bonds, H. H. Febrey. Am. Welding Soc.—Jl., vol. 2, no. 12, Dec. 1923, pp. 18-24, 4 figs. Discusses flame weld bonds and arc weld bonds.

LOW-CARBON. Low Carbon Rails Show Less Transverse Fissures, C. W. Gennet, Jr. Ry. Age, vol. 76, no. 2, Jan. 12, 1924, p. 186, 1 fig. Results of tests show that tendency for fissures to develop increases with carbon content of steel.

TRANSVERSE FISSURES. Study of Transverse Fissures Broadened. Ry. Age, vol. 75, no. 25, Dec. 22, 1923, p. 1169. Bur. of Standards and Interstate Commerce Commission join roads and mills in investigations.

RAILWAY CONSTRUCTION

ONTARIO. Recent Developments on the Temiskaming and Northern Ontario Railway, S. B. Clement. Eng. Jl., vol. 7, no. 1, Jan. 1924, pp. 12-20, 12 figs. Development of Northern Ontario and its natural resources with extension of railway. *See also Contract Rec. & Eng. Rev., vol. 37, no. 49, Dec. 5, 1923, pp. 1145-1148, 2 figs.*

RAILWAY MOTOR CARS

BENZOL. Benzol Rail Cars (Benzolmechanische Eisenbahn-Triebwagen), H. Johannsen. Verkehrstechnik, vol. 40, nos. 46-47, Nov. 23, 1923, pp. 409-411, 2 figs. Gives results of trial runs of railway motor cars built by Deutsche Werke A.-G., described in previous issue of same journal.

DEVELOPMENT. Development of Railroad Motor Car. Eng. & Contracting (Railways), vol. 60, no. 6, Dec. 19, 1923, pp. 1304-1306. Present practice and requirements for gasoline and gasoline-electric driven cars on rails. Appendix to report of special committee of U. S. Chamber of Commerce.

RAILWAY OPERATION

RUNNING OF TRAINS, DETERMINATION OF. Graphical Determination of Running of Trains, C. Fiala. Int. Ry. Congress Ass.—Bul., vol. 5, no. 12, Dec. 1923, pp. 1081-1086, 5 figs. Calculations of moving of a train. From journal of Soc. of Czecho-Slovakian Engrs. & Architects, Technicky Obzob, 1922.

STATISTICS, 1923. Railway Statistics for Nineteen Twenty-three, J. H. Parmelee. Ry. Age, vol. 76, no. 1, Jan. 5, 1914, pp. 46-49, 3 figs. Summary of achievement; new equipment; record freight traffic; operating efficiency; financial results; operating revenues; employees and their wages.

TRAIN CONTROL. Automatic Train Control Installation Completed. Ry. Rev., vol. 73, no. 25, Dec. 22, 1923, pp. 899-904, 8 figs. Chicago Rock Island & Pac. is first railroad to complete installation; outline of method of operation under system as installed.

RAILWAY SHOPS

WASTE-RENOVATING PLANT. Waste Renovating Plant at Beech Grove, Ind. Ry. Rev., vol. 73, no. 26, Dec. 29, 1923, pp. 931-935, 10 figs. Description of plant for reclaiming journal-box packing and process employed under a contract on output basis with Cleveland Cincinnati Chicago & St. Louis Ry.

RAILWAY SIGNALING

CONSTRUCTION, 1923. Signal Construction Shows Marked Increase, K. E. Kellenberger. Ry. Age, vol. 76, no. 1, Jan. 5, 1924, pp. 59-68. Remote-control switch installations grow in favor work proposed for 1924; statistics on automatic block signals and interlocking plants installed in 1923.

SIGNALS, TYPES OF. Railway Signalling, C. W. Parker. Can. Ry. Club—Proc., vol. 22, no. 8, Nov. 1923, pp. 21-26 and (discussion) 26-30. Deals with signals for path or track on which train has to travel, consisting generally as follows: "Stop," "Caution" or "Proceed;" different types.

RAILWAY TRACK

RAIL-CONVEYING MACHINE. Plate laying with the Anderson Rail Conveyor. Ry. Gaz., vol. 39, no. 23, Dec. 7, 1923, pp. 719-721, 5 figs. Account of track-laying work carried out on Bengal-Nagpur Ry. in India with aid of a simple machine invented by A. T. D. Anderson, Assistant Engr., Bengal-Nagpur Ry., and description of machine.

RAILWAYS

ECONOMICS. Some Fundamentals in Transportation Economics, N. D. Ballantine. St. Louis Ry. Club—Proc., vol. 28, no. 8, Dec. 14, 1923, pp. 160-168.

WATER SUPPLY. Railroad Water Supply, E. F. Mason. Central Ry. Club—Proc., vol. 31, no. 5, Nov. 1923, pp. 1431-1436 and (discussion) 1436-1453. Sources of supply, and treatment of waters for use in locomotives; water storage; upkeep and maintenance of pumps; etc.

RECTIFIERS

MERCURY-VAPOR. Rectifiers and Rectifier Installations (Gleichrichter und Glenchrichteranlagen), H. Odermatt. Schweiz. Elektrotechischer Verein—Bul., vol. 14, no. 12, Dec. 1923, pp. 657-670, 21 figs. Describes design and operation of mercury-vapor rectifiers and their most important auxiliary parts and points out their advantages in comparison with other transformers.

REFRACTORIES

ELECTRIC FURNACES. Electric Furnace Refractories, R. C. Gosrow. Chem. & Met. Eng., vol. 29, no. 27, Dec. 31, 1923, pp. 1181-1185. Practical suggestions for construction of lining walls, hearths and roofs that will enable electric-furnace operator to obtain maximum refractory service.

REFRIGERANTS

ETHYL CHLORIDE. Thermal properties of Ethyl Chloride. Cold Storage, vol. 26, no. 309, Dec. 20, 1923, pp. 456-458, 1 fig. Food Investigation Board on C. F. Jenkin's experiments.

REFRIGERATING MACHINES

CO_2 COMPRESSORS. Ten-Ton Refrigerating CO_2 Compressors. Engineering, vol. 116, no. 3024, Dec. 14, 1923, p. 738, 1 fig. Machine is of twin-cylinder single-acting vertical type, with capacity of 10 tons of refrigeration per 24 hr. and is driven by 20-b.hp. electric motor which runs at 400 to 500 r.p.m.

REFRIGERATING PLANTS

CONDENSERS AND BRINE COOLERS. Condensers and Brine Coolers, J. C. Goosman. Ice & Refrigeration, vol. 65, nos. 1, 2, 3, 4 and 5, July, Aug., Sept., Oct., and Nov. 1923, pp. 13-15, 74-76, 133-134, 195-197 and 259-262, 9 figs. Their characteristics, temperature differences and ranges, coefficients of heat transfer, and surface requirements; steam condensers; double-pipe coolers and condensers; speeds of media; mean temperature difference; CO_2 condensers; pressure-heat-content diagram for CO_2; Mollier diagram; research on CO_2 properties; total condenser work in B.t.u.

REFRIGERATION

AMMONIA CHARTS. Refrigeration and the Ammonia Chart, David L. Fiske. Ice & Refrigeration, vol. 65, nos. 4, 5 and 6, Oct., Nov. and Dec. 1923, pp. 204-206, 265-267 and 363-365, 11 figs. Describes capacities and efficiencies of refrigeration systems; cycles of operation with different condenser and evaporation pressures; coefficients of performances; wet and dry compression; constants of cycles; theoretical and practical considerations; clearance in compressors; calculation of compressors with and without clearance; excessive clearance; test data on effect of clearance.

RESEARCH

INDUSTRIAL. The Function and Scope of Industrial Research, A. R. M. Fleming. Indus. Management (Lond.), vol. 10, no. 13, Dec. 27, 1923, pp. 356-357. Abridgement of paper read at Regent Street Polytechnic (Lond.), under auspices of Industrial League and Council.

NAT. RESEARCH COUNCIL, WORK OF. Work of the National Research Council, Vernon Kellogg. Science, vol. 58, nos. 1505 and 1506, Nov. 2 and 9, 1923, pp. 337-341 and 362-366. Statement of activities for year July 1, 1922—June 30, 1923. See also Nat. Research Council, Reprint & Circular Series, No. 49, 1923, 16 pp

RIVERS

CURRENT RETARDS. Current Retards on American Rivers. Engineer, vol. 136, no. 3548, Dec. 28, 1923, pp. 689-691, 8 figs. Discusses tendency of several large silt-bearing or muddy rivers in western part of United States toward shifting their channels erratically and cutting away their banks from time to time, with disastrous effects; remedial methods.

DIVERSION OF WATER FROM GREAT LAKES. Chicago's Diversion of Water from the Great Lakes. Eng. News-Rec., vol. 92, no. 1, Jan. 3, 1924, pp. 28-31. History of one of noted cases of water diversion with state, national and international complications which is once more subject of possible litigation, federal legislation, and international agreement.

ROLLING MILLS

SHEET MILLS. Detroit's New Automobile Sheet Plant. Iron Age, vol. 113, no. 1, Jan. 3, 1924, pp. 50-53, 8 figs. Features of works of Michigan Steel Corp. include short hauls to and from rolls and quick drying of washed sheets.

ROADS

ASPHALT BASE CONSTRUCTION. Asphalt Base. Asphalt Assn., Circular No. 27. Two papers presented at Conference on Asphalt Paving held in Denver, Colo., Aug. 21-22, 1923: Use of Asphalt Concrete in Pavement Bases, by Chris. P. Jensen, pp. 1-12, discussing early history of asphalt, present day tendencies. accelerated tests and service record, etc.; and Asphalt Paving Adjacent to and Between Car Tracks, by John A. Griffin, pp. 13-16, 1 fig., discussing bituminous base and asphalt wearing surface.

BATES EXPERIMENTAL. Results of the Bates Road Experiments During 1922 With Special Reference to Asphalt Pavements, Prevost Hubbard. Asphalt Assn., Circular No. 22, 8 pp. 4 figs. Arbitrary standards of pavement design. Investigations relating to Bates Road experiments; outline of Bates road experiments; asphalt pavements on waterbound base; asphalt pavements on Portland cement concrete base; comparison of asphalt and Portland cement concrete sections. Presented at Mass. Inst. Tech., May 18, 1923.

ROAD, CONCRETE

SURFACE CHECKING. Checking of Concrete Road Surface, G. A. MacDonald. Contract Rec. & Eng. Rev., vol. 37, no. 50, Dec. 12, 1923, pp. 1174-1179, 10 figs. Results of investigations by Ontario Highways Dept., leading to conclusion that absorbtive bases, rich mixtures, and a large width-depth ratio are detrimental; well wetted subgrades and burlap covers offset checking.

PAVEMENT REINFORCMENT. Concrete Pavement Reinforcement Logically Designed, Geo. D. Burr, C. Older and A. T. Goldbeck. Eng. News-Rec., vol. 92, no. 2, Jan. 10, 1924, pp. 78-81, 2 figs. Design for King County roads based on Bates Road, Pittsburg Road, and Arlington tests; discussed by engineers of Bates Road and chief of tests of Bur. of Pub. Roads.

SMOOTHNESS CONTROL BY VIALOG. New York Adopts Vialog Test for Smoothness Control. Eng. News-Rec., vol. 92, no. 2, Jan. 10, 1924, pp. 74-76, 3 figs. Instrument attached to automobile inscribes graphs of and adds up irregularities in road surface travelled over. Includes following articles: Smoothness Requirements in New York, F. S.Greene; Vialog Operation and Graphs, H. Dunbar; Discussion of Smoothness Surveys, furnished by Bur. of Roads, N.Y.

ROADS, MACADAM

PENETRATION AND SURFACE TREATED. Penetration and Surface Treated Macadam Roads, K. I. Sawyer. Eng. & Contracting (Roads & Streets), vol. 60, no. 6, Dec. 5, 1923; pp. 1187-1189. Method of construction and maintenance in Marquette County, Mich. Paper presented at Mich. State Good Roads Assn. annual convention, Nov. 7, 1923.

ROAD CONSTRUCTION

SAND AND GRAVEL PLANT. Movable Sand and Gravel Plant for Road Builders, R. E. Boehck. Highway Engr. & Contractor, vol. 9, no. 6, Dec. 1923, pp. 39-40, 2 figs. Describes plant whose every feature was designed with expectation that it will be moved once or twice during season.

SWAMP. Swamp Road Building Among the Indiana Sand Dunes, H. M. Herald. Eng. News-Rec., vol. 92, no. 2, Jan. 10, 1924, pp. 58-60, 4 figs. Dragline half-floating on soft marsh land builds parallel muck dikes and fills between them with sand.

METHODS AND COSTS. Business and Engineering of Road Construction. Eng. News-Rec., vol. 92, no. 3, Jan. 17, 1924, pp. 112-116, 2 figs. Contains abstracts of following papers read before Am. Road Bldrs. Ass.: Traffic Surveys, Methods and costs, Geo. E. Hamlin; Simplified Practice—A Service to Road Builders, R. M. Hudson; Sand-Asphalt Road Construction Methods and Cost, E. R. Olbrich; Highway Traffic Accidents—Classification and Causes, N. M. Isabella.

ROADS, GRAVEL

TAR SURFACE. Tar Surface Treatments Preserve Gravel Roads, J. T. Donaghey. Eng. News-Rec., vol. 92, no. 2, Jan. 10, 1924, pp. 70-73. 3 figs. Economical where traffic exceeds 300 vehicles; method of application important.

S

SAND, MOLDING

PREPARATION AND TESTING. The Preparation and Testing of Moulding and Core Sands, E. M. Currie. Foundry Trade Jl., vol. 28, no. 382, Dec. 13, 1923, pp. 498-500, 5 figs. Chemical aspect of sand; mechanical testing; mixing; tempering; sharp sand and binders; oil sand mixers.

SANITATION

ENGINEERING PROBLEMS. Present Status of Sanitary Engineering; Suggestions for Objects and Aims of the Sanitary Engineering Division, H. P. Eddy. Am. Soc. Civ. Engrs.—Proc., vol. 50, no. 1, Jan. 1924, pp. 3-18, 1 fig. Deals with problems of water supply and purification; sewerage, drainage, sewage disposal and disposal of industrial wastes; refuse collection and disposal; air supply and purification; etc.

SCREW THREADS

STANDARDS. The New Screw Thread Standard, Ralph E. Flanders. Am. Mach., vol. 59, nos. 5, 9, 12, 14, 16 and 26, Aug. 2, 30, Sept. 20, Oct. 4, 18 and Dec. 27, 1923, pp. 167-169, 327-328, 441-442, 501, 506, 589-590 and 939-942, 10 figs. History of National Screw Thread Commission and A.E.S.C. sectional committee; terminology and definition from report; explanation of various terms used; considerations affecting clearances and methods of gaging. Fine and coarse-thread series; elimination of unnecessary threads. Condensed tables of dimensions for different classes of fits; fine and coarse threads; numbered and fractional sizes. Principles employed in specifying tolerances. Provisions for special threads and its in Screw Thread Report of A. E. S. C. tables and charts showing tolerances.

SCREWS

WOOD, COLD HEADING OF. The Cold Heading of Wood Screws, A. K. Hamer. Forging—Stamping—Heat Treating, vol. 9, no. 12, Dec. 1923, pp. 511-512, 6 figs. Advantage and disadvantage of basic and Bessemer wires; carbon steel 0.90 to 1.00 per cent superior to alloy steel for header dies using special design fixture.

SEWAGE DISPOSAL

ACTIVATED SLUDGE. Experiments with Activated Sludge. Contract Rec. & Eng. Rev., vol. 37, no. 49, Dec. 5, 1923, pp. 1160-1162. Results of six-months' operation of test plant at Hertford, Eng.; provided valuable data regarding aerating action and sludge content. Paper read before Assn. Mgrs. of Sewage Disposal Works.

TREATMENT. The Operation and Care of Sewage-Treatment Plants, S. Pinel. Iowa State College of Agriculture and Mechanic Arts Official Pub., vol. 22, no. 14, Bul. 58, 38 pp., 28 figs. Deals with present conditions in Iowa, screens, grit chambers, septic and Imhoff tanks, dosing chambers, siphons, contact beds, trickling filters, sand filters, activated-sludge treatment, ordinary plant tests, etc., recommendations on operation.

SHAFT SINKING

WATER-BEARING STRATA, THROUGH. New Method of Sinking Through Water-Bearing Strata. Colliery Guardian, vol. 126, no. 3287, Dec. 28, 1923, pp. 1612-1613, 3 figs. Describes Pickett concrete shell system.

SHAFTS

FOUNDATION VIBRATIONS, INFLUENCE OF. The Influence of Foundations on the Critical Behavior of High-Speed Shafts (Die Einwirkung des Fundaments auf das kritische Verhalten raschumlaufender Wellen), B. Blaess. Maschinenbau, vol. 2, nos. 25-26, Sept. 29, 1923, pp. B281-B283, 3 figs. Numerical Investigation. See also article by H. Gerb, entitled, The Transmission of Machine-Foundation Vibrations in the Earth, pp. B283-B284.

SHEET-METAL WORKING

SCIENTIFIC ASPECTS. Science for the Sheet Metal Worker, Thos. Newton. Sheet Metal Worker, vol. 14, nos. 7, 9, 13, 17, 19, 21 and 24, Apr. 27, May 25, July 20, Sept. 14, Oct. 12, Nov. 9 and Dec. 21, 1923, pp. 251-252 and 276, 330-332, 493-494, 646-647 and 667, 719-720, 789 and 816, and 899-900 and 925, 3 figs. Deals with chemistry, physics and metallurgy. Matter; physical and chemical changes; chemical affinity; elements; compounds; chemical action; influence of heat and light; etching of copper and brass; hydrogen and its properties; water gas; oxygen; ozone; combustibles and supporters of combustion; atomic theory; chemical symbols and formulas; etc.

SMOKE ABATEMENT

METHODS. Smoke Abatement, O. Monnett. U. S. Bur. Mines, Technical Paper 273, 1923, 31 pp., 18 figs. partly on supp. plates. Determination of atmospheric impurities; composition of pure air; nature of atmospheric pollution; effect of atmospheric pollution upon health, vegetation, and property; possibilities atmospheric pollution upon health, vegetation, and property; possibilities of smoke abatement; domestic smoke problem; industrial smoke; locomotive smoke; smoke ordinances.

SPEED INDICATORS

STROBOSCOPIC. The Stroboscopic Speed Indicator. Practical Engr., vol. 67, no. 1874, Jan. 25, 1923, pp. 49-50, 3 figs. Describes Crompton-Robertson stroboscopic vibrator having two similar vibrating bars clamped to base, and electromagnet arranged so that it can set bars in state of vibration, motion of one of bars interrupting electrical circuit at

SPRINGS

AUTOMOBILE. New Springs for Automobiles (Neue Fedrung für Kraftwagen). Ad. König. Motorwagen, vol. 26, nos. 29-30 and 32-33. Oct. 20-31 and Nov. 20-30, 1923, pp. 436-437 and 464-466, 6 figs. Points out shortcomings of automobile springs commonly used; and describes new system of springs and chassis developed by firm of Sorge & Sabeck.

STADIUMS

TYPES. Stadia, Roi L. Morin. Am. Architect, vol. 124, nos. 2431 and 2432, Oct. 24 and Nov. 7, 1923, pp. 365-373 and 412-416, 11 figs. Oct. 24: Describes Franklin Field Stadium, Univ. of Pa., a U-shaped stadium for general college athletics. Nov. 7: Yankee Stadium (N. Y. Am. League Baseball Club), largest baseball park.

STANDARDIZATION

GERMANY. An Example of Standardization in German Industry, G. Leifer and H. Goller. Mech. Eng., vol. 46, no. 1, Jan. 1924, pp. 54-55, 3 figs. Notes on manner in which standardization is practised in the "Wernerwerk," a Siemens & Halske factory employing 18,000 men and producing electrical machinery, illustrating very close co-operation existing between German industry and the German Industrial Standard Committee (DIN).

STANDARDS

GERMAN N. D. I. REPORTS. Report of the German Industrial Standards Committee (Normenausschuss der Deutschen Industrie). Maschinenbau, vol. 2, no. 21, July 26, 1923, pp. N140-N150, 11 figs. Proposals for standards of tangential grooves, drive, flat, hollow and gib-headded keys, gib-headed flat and hollow keys. hexagonal bolts with point, etc.

Report of the German Industrial Standards Committee (Normenausschuss der Deutschen Industrie). Maschinenbau, vol. 3, no. 3, Nov. 8, 1923, pp. N9-N18, 20 figs. Proposals for standards of hexagonal steel and iron, flat drawn steel, hollow flat steel, and cutting steels. Proposed standards for overhead countershafts, hand chisel and cutting steels.

Report of the German Industrial Standards Committee (Normenausschuss der Deutschen Industrie). Maschinenbau, vol. 3, no. 4, Nov. 22, 1923, pp. N19-N24, 6 figs. Proposals for indicator cocks. Proposed standards for bushes, ball bearings, indicator screw plugs, open d. c. generators, transformers, gear transmissions for standardized electric motors, clamps and slip rings for electric machines, etc.

STEAM

HIGH-PRESSURE. Investigations of the Properties of Steam at High Pressures (Die bisherigen Forsehungen uber die Eigenschaften des Wasserdampfes bein hohen Spannungen), H. Schmolke. Wärme, vol. 46, no. 23, June 8, 1923, pp. 243-246, 1 fig. Compares values of heat of evaporation and volume of saturation at high pressures found by Schüle and Eichelberg by means of extrapolation, and shows advantages of German research over English works in same field.

TABLES, FORMULATION OF. A Calorimetric Method of Surveying the Behavior of Steam. N. S. Osborne. Am. Soc. Mech. Engr.—advance paper. for meeting, Dec. 3-6, 1923, 3 pp. Describes elements of method forming basis of experimental program on properties of steam upon which Bur. of Standards is at present engaged.

STEAM ENGINES

LUBRICATION. Recriprocating Steam Engines. Lubrication, vol. 9, no. 11, Nov. 1923, pp. 122-128, 6 figs. Details in connection with internal and external lubrication.

TYPES AND SELECTION. The Control of Power Production, Chas. L. Hubbard. Factory, vol. 31, no. 6, Dec. 1923, pp. 750-754 and 788, 10 figs. Steam-engine types and their selection.

UNIFLOW. Action of Uniflow Engine Governor Eccentrics, W. Turnwald. Power, vol. 59, no. 3, Jan 15, 1924, pp. 94-96, 8 figs. Effect of excessive lead at light loads; types of governor eccentrics and influence on lead; variation of lead with change in cut-off.

STEAM PIPES

INSULATION. The Influence of Steam Utilization on the Most Economical Strength of Insulation (Der Einfluss der Dampfverwertung auf die wirtschaftlichste Isolierstärke), J. S. Cammerer. Archiv für Wärmewirtschaft, vol. 4, no. 11, Nov. 1923, pp. 197-200, 1 fig. Discusses methods of measuring heat insulation of pipe lines.

STEAM POWER PLANTS

ECONOMY. Economics of Plant Management and the Choice of Fuel, W. Polakov. Nat. Engr., vol. 27, no. 12, Dec. 1923, pp. 588-591, 6 figs. Factors affecting efficiency; data on what can be accomplished by modern methods in average plant.

HIGH PRESSURE, REHEATING AND REGENERATING. High Pressure, Reheating, and Regenerating for Steam Power Plant, C. F. Hirshfeld. Am. Soc. Mech. Engrs. —advance paper, for meeting Dec. 3-6, 1923, 49 pp. 31 figs. Discuss relative thermal and investment costs involved in modern turbo-generator station, as determined by consideration of steam pressures from 200 to 1220 lb. per sq. in. steam temperatures of 700 and 800 deg. Fahr., and six different cycles of operation in which reheating and regenerating are involved in various degrees.

MERCURY VAPOR-STEAM SYSTEM. Binary Fluid System Using Mercury Vapor Expected to Cut Power Costs, P. M. Heldt. Automotive Industries, vol 50, no. 1, Jan. 3, 1924, pp. 20-21. Gen. Elec. Co. responsible for development of new method which bids fair to result in more economical utilization of fuel; efficiency obtained by recovering some of latent heat.

PROCESS STEAM. Process Steam as a Power Plant Product, Miles Sampson. Textile World, vol. 65, no. 1, Jan. 5, 1924, pp. 81-82 and 85, 3 figs. Points out that in mill finishing its own goods, process steam may become principal product of power plant; factors in problem of maintaining adequate steam supply at pressures demanded and economically balancing this load with power requirements.

STEAM TURBINES

BLADES. Steam Turbine Blading, J. C. Read. Instn. Elec. Engrs.—Jl., vol. 61, no. 323, Oct. 1923, pp. 1109-1114, 5 figs. Review of present position. Deals with causes and effects of corrosion and erosion; form of blade passage in impulse and reaction machines, and energy losses occurring in blading; methods of tapering blades; details of stresses; types of blade fastenings, lacing and shrouding; methods used for obtaining large exhaust area; vibration and its causes; method of correcting for effect of centrifugal force; methods of manufacture by milling and drop forging.

CONTROL, HYDRAULIC RELAY FOR. Turbine Controlled by Temperature or Pressure. Power Plant Eng., vol. 28, no. 2, Jan. 15, 1924, pp. 162-163, 2 figs. Describes hydraulic relay device which will transmit impulses from thermostat or pressure diagram to distance and at same time magnify power of these impulses so that they will control turbine governor with positiveness

HIGH-PRESSURE. High Pressures and High Superheats in Modern Steam-Power Plant Practice, W. G. Noack. Mech. Eng., vol. 46, no. 1, Jan. 1924, pp. 40-42, 5 figs. Describes Brown-Boveri turbine for high-pressure steam, which consists of high-pressure or series turbine, and low-pressure turbine designed for ordinary steam pressures. Translated from published by Brown, Boveri & Cie, Baden, Switzerland.

LUBRICATION. Steam Turbine Lubrication. Lubrication, vol. 9, no. 11, Nov. 1923, pp. 129-132; 5 figs. Factors affecting selection of lubricants; characteristics pertinent to the oil.

NOZZLES. Second Report of the Steam-Nozzles Research Committee. Instn. Mech. Engrs.—Proc., vol. 1, no. 3, 1923, pp. 311-348 and (discussion) 349-395, 23 figs. It is believed that results represent first attempt to carry out on full-size scale systematic investigation into efficiency of steam-turbine nozzles; discusses use of impulse method for obtaining thrust of steam at exit of nozzle; use of superheat on both sides of nozzle; variation in initial superheat; use of commercial nozzles and of Callendar's steam tables; caculation of heat drop.

PRINCIPLE OF OPERATION. The Control of Power Production, Chas. L. Hubbard. Factory, vol. 32, no. 1, Jan. 1924, pp. 27-29, 64, 66, 68 and 70, 23 figs. Principles of steam-turbine operation.

STEEL

AUTOMOBILE. Automobile Sheet Steel Specifications, H. M. Williams. Am. Soc. Steel Treating—Trans., vol. 5, no. 1, Jan. 1924, pp. 82-88. Salient factors in connection with chemical and physical specifications and inspection of sheet steel for automotive and other similar industrial purposes; tentative specifications of Gen. Motors Co. on cold-rolled strip steel and sheet steel, including physical and chemical tests applied to these materials.

BASIC AND ACID, COMPARATIVE INVESTIGATIONS. Comparative Investigations of Basic and Acid Steel with the Aid of Research Values (Vergleichende Untersuchungen von basischem und saurem Stahl mit Hilfe der Grosszahlforschung), F. Schmitz. Stahl u. Eisen, vol. 43, no. 50, Dec. 13, 1923, pp. 1536-1539. Compilation of strength and analytical values of 200 basic and 200 acid hearth-furnace steel specimens; recommendations for further research.

CALORIZING. Use of Aluminum to Prevent Steel Corrosion, A. V. Farr. Chem. & Met. Eng., vol. 29, no. 27, Dec. 31, 1923, pp. 1188-1189. This process, called calorizing, consists in alloying surface of steel with aluminum.

CHROME. *See Chrome Steel.*

HIGH-SPEED. *See Steel, High-Speed.*

IDENTIFICATION AT BIN. How to Identify Nickel and Other Steels at the Bins, H. C. Knerr. Automotive Industries, vol. 49, no. 25, Dec. 20, 1923, pp. 1253-1254. Sparks from emery wheel give indications as to carbon content and certain alloys such as chromium and tungsten; simple chemical test for indicating presence of nickel is easily applied.

TESTS. The Chemical, Metallographical and Physical Testing of Steel (in Bars) [Die chemische, metallographische und physikalische Prüfung von Stahl (in Stangenform)., H. Graefe. Maschinenbau, vol. 2, no. 24, Sept. 15, 1923, pp. G257-G260, 6 figs. Points out that tensile tests for testing of steel are often inadequate and additional chemical metallographical and physical tests are necessary; how such tests should be conducted.
See also Iron and Steel.

STEEL, HEAT TREATMENT OF

ELECTRIC-FURNACE. Electrical Energy Economical for Heat Treating, E. F. Collins. Am. Soc. Steel Treating—Trans., vol. 5, no. 1, Jan. 1924, pp. 67-81, 3 figs. Reviews relative cost data in operation of electric and fuel-fired furnaces, poiuting out that electrical heating is economical and comparable to fuel heating; discusses heat generation, heat conservation, and methods of electric heat transmission and delivery to charge.

PERMANENT MAGNETS. Investigation of the Treatment of Steel for Permanent Magnets, R. L. Dowdell. Am. Soc. Steel Treating—Trans., vol. 5, no. 1, Jan. 1924, pp. 27-65, 17 figs. Deals with various treatments of tungsten, chromium, cobalt-chrome and miscellaneous magnet steels in order to give them greatest permanent; explains simple but accurate testing apparatus for bar magnets; compares new type of coercive force called open-circuit with usual coercive force; gives magnetic saturation curves, and natural and artificial aging curves for different treatments.

SALT BATHS. Salt Baths and Containers for Hardening, Sam Tour. Am. Soc. Steel Treating—Trans., vol. 5, no. 1, Jan. 1924, pp. 7-19 and (discussion) 19-26, 7 figs. Discusses salt baths for heating of steel tools and parts and gives simple method of desulphurizing salt bath; decarburizing effects of chloride salt batbs at 1600 deg. fahr., upon materials being treated; photomicrograpbs of steels heated in various types of salt baths; principles in regard to design of furnaces.

STEEL, HIGH-SPEED

CAST TOOLS. Casting High Speed Steel Tools, J. M. Quinn. Iron Trade Rev., vol. 75, no. 3, Jan. 17, 1924, pp. 226-230, 6 figs. Methods and theories by two firms manufacturing tools cast to approximate size and shape; how properties of tools can be controlled.

High-Speed Steel for Cast Tools, J. M. Quinn. Iron Age, vol. 112, no. 26, Dec. 27, 1923, pp. 1711-1712, 4 figs. Electric melting practice, proportioning and bandling charge; molds and heat treatment.

STEEL MANUFACTURE

CHEMICAL DISSOCIATION. Importance of Dissociation of Chemical Compounds in Steel Making, J. Kent Smith. Chem. & Met. Eng., vol. 30, no. 2, Jan. 14, 1924, pp. 49-50. Observations on use of carbonless alloys for introducing alloying metal into steel show significance of chemical dissociation to metallurgists.

STEEL WORKS

DEVELOPMENTS, 1923. Increase Mill Capacity in 1923, John D. Knox. Iron Trade Rev., vol. 74, no. 1, Jan. 3, 1924, pp. 50-53. Decline in open-hearth-furnace which began six years ago, is checked; sheet and strip mills lead in construction of new rolling units; extensive additions proposed.

FIRE PROTECTION. Fire Protection in Foundries and Steel Plants, James M. Woltz. Safety Eng., vol. 46, no. 4, Oct. 1923, pp. 194-197. Plant maps showing every fire hazard and every means of protection a necessity; likewise a carefully selected and well trained fire brigade; all apparatus should be inspected regularly.

FUEL-CONSUMMING EQUIPMENT. Economical Use of Fuel in tbe Steel Plant, H. C. Seibert. Assn. Iron & Steel Elec. Engrs., vol. 5, no. 11, Nov. 1923, pp. 621-644 and (discussion) 644-657. Author seeks to show that saving may be realized by improving principal fuel-consuming equipment; presents data in form of heat balance and fuel rates for principal primary and auxiliary fuel-consuming equipment now employed in steel plants; on basis of this date, he discusses thermal efficiency, principal heat losses and means by which improvements may be effected.

STOKERS

CHAIN-GRATE. A New Balanced Draugbt Stoker. Eng. & Boiler House Rev., vol. 37, no. 5, Dec. 1923, pp. 147-148, 2 figs. Describes chain-grate stoker with eight speeds, and draft and control at any point of grate, designed by Babcock and Wilcox, Ltd.

HAND. Hand Stokers Reduce Operating Labor. Power Plant Eng., vol. 28, no. 1, Jan. 1, 1924, pp. 47-49, 9 figs. Field of application; general description of action; details of construction of different makes.

MECHANICAL. Mechanical Stokers and Details of Furnaces for Special Fuels. Power Plant Eng., vol. 28, no. 1, Jan. 1, 1924, pp. 50-51. Utilization of mechanical stokers for burning coal in lump form and of special furnaces for burning pulverized coal, fuel oil and gas minimizes fluctuations in firing conditions and results in increased economy.

SPEED CONTROL. Drive and Speed Control of Mechanical Stokers. Power Plant Eng., vol. 28, no. 1, Jan. 1, 1924, pp. 52-55, 8 figs. Speed-controlling devices are often actuated by air-supply mechanism to give eorrect proportioning of air to fuel.

TYPES. Mecbanical Stokers for the Power Plant. Power Plant Eng., vol. 28, no. 1, Jan. 1, 1924, pp. 56-62, 24 figs. Descriptions of stoker types which meet requirements of present-day steam production.

STRAIGHTENING MACHINES

TYPES. Reeling and Straightening Machines, W. H. A. Robertson, Machy. (Lond.), vol. 23, nos 575, 577 and 579, Oct. 4, 18 and Nov. 1, 1923, pp. 21-24, 81-84, and 150-151, 20 figs. Describes types of machines for straightening material after it has been hot or cold worked.

STRESSES

MECHANICAL AND ELECTRICAL. The Danger of Fracture through Mechanical and Electrical Stress of Solid Bodies (Die Bruchgefahr bei mechanischer und bei elektrischer Beanspruchung fester Korper), W. Kummer. Schweizerische Bauzeitung, vol. 82, no. 20, Nov. 17, 1923, pp. 253-255, 4 figs. The danger of fracture from electric stress and mechanical stress in single and in double-axis state of stress; development of stress diagram.

DISTRIBUTION IN ROTATING PINIONS. Stress Distribution in Rotating Gear Pinions as Determined by the Photoelastic Method, P. Heymans and A. L. Kimball, Jr. Am. Soc. Mecb. Engrs.—advance paper, for meeting Dec. 3-6, 1923, 2 pp. Results of scientific study undertaken by Gen. Elec. Co. for development of superior electric-railway motor pinions; object of work was to find out effect of rotation of pinion on maximum stress for different speeds of rotation; results from preliminary observations.

STREETS

DESIGN. Design of Streets and Construction of Pavements, E. R. Conant. Eng. & Contracting (Roads & Streets), vol. 60, no. 6, Dec. 5, 1923, pp. 1174-1176. Present practice of cities. From report of Committee on Street and Sidewalk Design presented at Am. Soc. for Mun. Improvements convention.

STRIKES

FUTILITY OF LOCKOUTS AND. The Futility of Lockouts and Strikes, P. Ogilvie. Taylor Soc.—Bul., vol. 8, no. 6, Dec. 1923, pp. 219-224. Deals with settlement of disputes.

STRUCTURAL STEEL

GUSSETS, STRESS IN. Investigation of Stress in Gussets of Steel Framework (Beitrag zur Spannungsuntersuchung an Knotenblechen eiserner Fachwerke), Th. Wyss. Forschungsarbeiten auf dem Gebiete des Ingenieurwesens, no. 262, 1923, 101 pp., 113 figs. partly on supp. plates in separate pamphlet. Investigation of stresses in steel frameworks, with special regard to gussets, within limit of elasticity, in order to obtain bases for their dimensioning and shape; details of test apparatus, results of tests and conclusions.

SUPERHEATERS

SECTIONAL. A New Sectional Superheater. Power Engr., vol. 19, no. 214, Jan. 1924, p. 24, 2 figs. Describes sectional modification of Adamson-Cruse accumulator-superheater.

SURVEY, ANALYSIS OF. Super Power, or Super Promises E. Douglas. Nat. Engr., vol. 27, no. 12, Dec. 1923, pp. 758-583. A common-sense analysis of recent superpower survey. Statistics are often misleading unless they are carefully analyzed; on a basis of coal conservation private plant is still logical choice for majority of services.

SURVEYING

FOREST. Aerial Timber Cruising, E. Wilson. Int. Aeronautics, vol. 1, no. 1, Aug. 1923, pp. 12-19, 7 figs. Actual results obtained by lumber company's air service; engineers and aerial photography; accuracy of maps made from aerial photographs; how air surveys are made; estimating timber from air; 12,000 sq. m. air mapped in northern Ontario past season and 20,000 this year.

T

TAR

LOW-TEMPERATURE. Low-Temperature Tar from Bituminous Coal J. J. Morgan. Chem. & Industry, vol. 42, no. 49, Dec. 7, 1923, pp. 1178-1182, 4 figs. Processes for low-temperature carbonization composition of carbocoal tar from bituminous coal; constitution of compounds in carbocoal tar; low-temperature tars from other processes.

RECOVERY FROM BOILER FURNACES. Tar Recovery from Steam Boiler Furnaces, H. Gerdes. Eng. Progress, vol. 4, no. 11, Nov. 1923, pp. 231-233, 4 figs. Recovery and utilization of tar as practiced heretofore; describes new process for recovery from boiler furnaces; test results; efficiency of process.

TEMPERATURE MEASUREMENTS

INSTRUMENTS. The Control and Measurement of Temperatures. Indus. Management (Lond.), vol. 10, no. 11, Nov. 29, 1923, pp. 203-304 and 306, 5 figs. Describes different types of temperature measuring instruments.

TELEPHONY

HIGH-FREQUENCY ALONG POWER LINES. Communication Over 140,000-Volt Line, C. A. Boddie. Elec. World, vol. 82, no. 25, Dec. 22, 1923, pp. 1259-1262, 8 figs. Duplex automatic installation on power lines of Consumers' Power Co., between Jackson and Battle Creek, Mich.; details of high-frequency apparatus used; how installation is handled by load dispatches under operating conditions.

WAVE-SHAPE SPECIFICATION. The Specification of Wave-shape, Alex. Russell. Instn. Elec. Engrs.—Jl., vol. 62, no. 324, Dec. 1923, pp. 13-16, 1 fig. Discusses application of graphical methods to oscillogram of E. M. F. wave in order to test its departure from sine shape. Part of inaugural address.

TUBES

CUTTING-OFF MACHINE FOR. Designs New Cutting-Off Machine, E. W. Mikaelson. Iron Trade Rev., vol. 74, no. 2, Jan. 10, 1924, ppl 173-176, 6 figs. Limited floor space is required for new unit which cuts off and reams tubing up to 14-in. diam. at rate of one a minute; automatic feeding mechanism provided.

TURBO-GENERATORS

MANUFACTURE. Extreme Variety Versus Standardization, J. H. Van Deventer. Indus. Management (N. Y.), vol. 67, no. 1, Jan. 1924, pp. 36-46, 11 figs. Turbine-generator production at Cen. Electric Co.'s plant at Schenectady.

V

VACUUM TUBES

PROGRESS. Vacuum Tube Progress, A. W. Hull. West. Soc. Engrs.—Jl., vol. 28, no. 12, Dec. 1923, pp. 558-572, 12 figs. Classification of electron tubes; new developments in electron emmission X-L. filaments;Keno-pliotron; pliodynatron detector; axitron; critical voltages for tungsten filament at 2500 deg. K.

RADIATRONS. Recent Developments in High Vacuum Receiving Tubes—Radiatrons, Model UV-199 and Model UV-201-A, J. C. Warner. Inst. Radio Engrs.—Proc., vol. 11, no. 6, Dec. 1923, pp. 587-599, 10 figs. Gives operating characteristics of radiatrons, together witb general considerations which determined their design; discusses method of rating receiving tubes (in place of mutual conductance) when appreciable undistorted output is required, as for loud speaker operation.

THREE-ELECTRODE. Alkali Vapor Detector Tubes, Hugh A. Brown and Chas. T. Knipp. Am. Inst. Elec. Engrs.—Jl., vol. 43, no. 1, Jan. 1924, pp. 26-32, 17 figs. Describes unusual and very desirable results obtained on priming tungsten filament three-electrode vacuum tubes with alloy of potassium and sodium when such tubes are used as detectors of radio-frequency currents in receiving circuits.

VENTILATION

REQUIREMENTS AND AIR-TESTING METHODS. Aerology for Amateurs and Others, E. V. Hill. Heat. & Vent. Mag., vol. 20, nos. 1. 2, 3, 4, 5, 9, 10 and 12. Jan. Feb., Mar., Apr., May, Oct., Nov. and Dec. 1923, pp. 35-39 and 49, 44-47, 43-44-, 37-40, 43-45, 50-53, 39-41, and 52-55, 32 figs. Evolution of modern ventilation and its effect on present and future practice; known factors that determine suitability of air conditious to human body, their relationship and relative importance, and instruments and methods found best adapted for testing and studying same.

VIBRATIONS

MACHINERY. The Damping of Machine Vibrations (Ueber Dampfung von Maschinenschwingungen), D. Thoma. Maschinenbau, vol. 3, no. 4, Nov. 22, 1923, pp. G14-G16, 4 figs. Discusses damping through radiation with aid of practical examples.

VISCOSIMETERS

Michell. New Instrument Developed to Show True Body of Oils, R. W. A. Brewer. Automotive Industries, vol. 49, no. 25, Dec. 20, 1923, pp. 1244-1245, 5 figs. Method devised for obtained real comparison of viscosity quickly and easily without calculations; device is of cup and ball type, and its use in large number of tests is said to have resulted in great saving of time.

VOCATIONAL TRAINING

Machinists. A Worth While Vocational Training School, H. P. Armson. Can. Machy., vol. 30, no. 26, Dec. 27, 1923, pp. 126-138, 2 figs. Features of educational program of new Collegiate Inst. at St. Catharines, Ont., for giving future machinists well-rounded knowledge of their trade.

State Regulations. Vocational Education and Training. Monthly Labor Rev., vol. 17, no. 6, Dec. 1923, pp. 186-190. New apprenticeship regulations in New South Wales; vocational guidance in Brussels; vocational and other educational training by employers in Finland.

W

WASTE HEAT

Utilization. New Aspects of Waste-Heat Utilization (Neue Gesichtspunkte auf dem Gebiete der Abhitzeverwertung), H. Heller. Gas- u. Wasserfach, vol. 66, nos. 46 and 47, Nov. 17 and 24, 1923, pp. 672-674 and 683-686, 7 figs. Deals with certain problems of waste-heat utilization and discusses modern types of waste-heat installations. Influence of waste-heat boiler on chimney draft; chimney vs. induced draft, Ansbach waste-heat intallation; waste-heat boiler with induced draft; hot-water supply from waste heat.

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Social Insurance and. Workmen's Compensation and Social Insurance. Monthly Labor Rev., vol. 17, no. 6, Dec. 1923, pp. 163-170. Recommendations of American Federation of Labor; invalidity insurance in Denmark.

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X

X-RAYS

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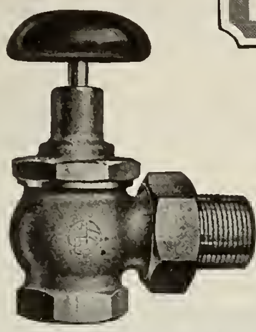

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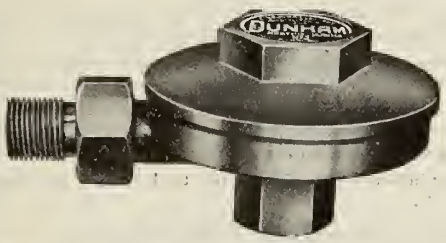

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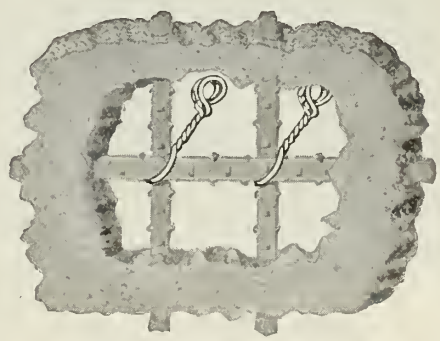

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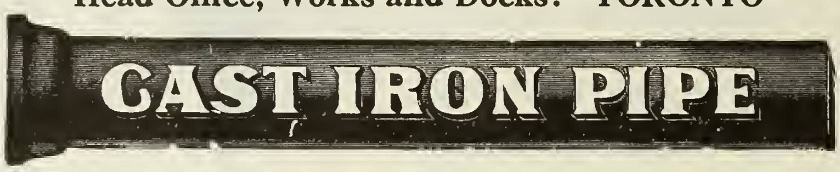

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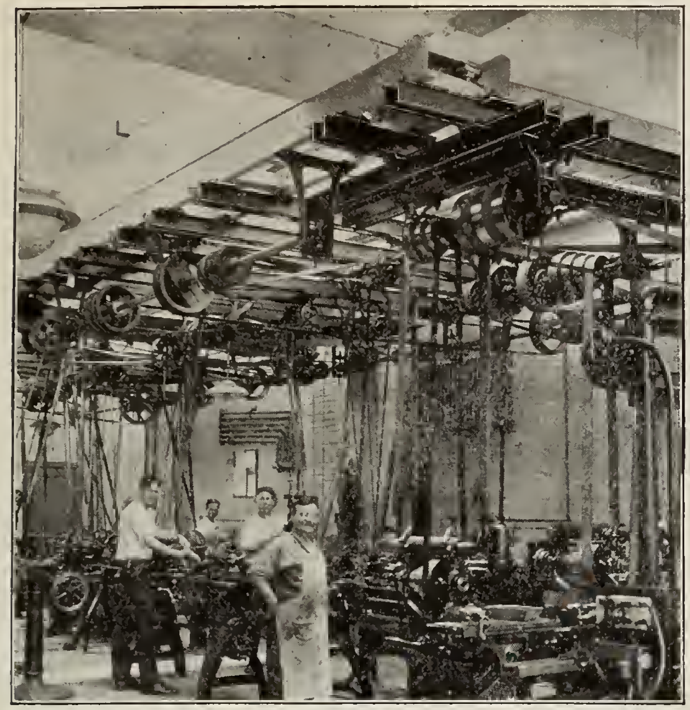

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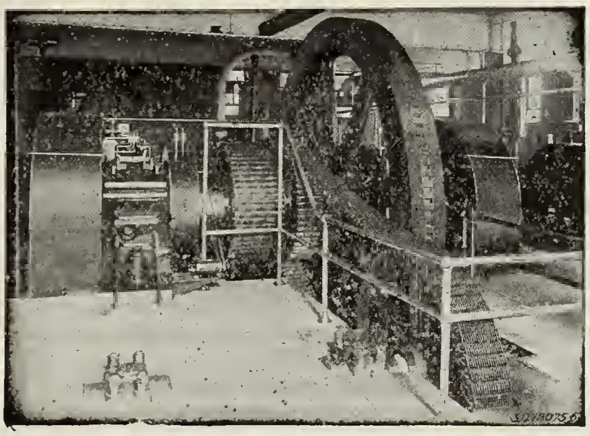

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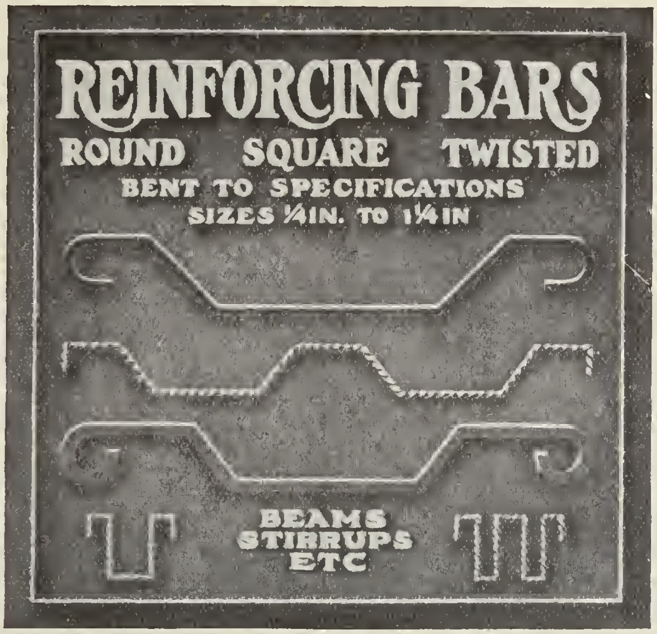

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Rail Joint Co., of Canada, Ltd.
Insulation, Fibre and Celoron:
Diamond State Fibre Co., of Canada, Ltd.
Insulators, Porcelain:
Dominion Insulator & Mfg., Co. Ltd.

J

Joints, Filler Paving:
Barrett Co., Ltd.

K

Kerosene:
Imperial Oil Ltd.

L

Ladder Steps, Steel:
Irving Iron Works Co.
Lathes:
John Bertram & Sons Co., Ltd.,
Leaders, Pile Drivers:
Industrial Works.
Lightning Arrestors:
Canadian General Electric Co., Ltd.
Dominion Engineering Agency Ltd.
Lighting Equipment, Industrial and Street:
Canadian General Electric Co., Ltd.
Line Materials:
Dominion Insulator & Mfg. Co., Ltd.
N. Slater Co., Ltd.
Locomotives:
F. H. Hopkins & Co., Ltd.
Mussens Ltd.
Locomotive Cranes:
Industrial Works.
Locomotives, Electric:
Canadian General Electric Co., Ltd.
Canadian Westinghouse Co., Ltd.
Hydro Salvage Syndicate.
Lubricating Oils & Greases:
Imperial Oil Ltd.

M

Machine Tools:
John Bertram & Sons Co., Ltd.,
Machinery:
Canadian Fairbanks-Morse Co., Ltd.
Hydro Salvage Syndicate.
Charles Walmsley & Co., (Canada), Ltd.
Machinery, Special:
Dominion Engineering Works, Ltd.
Mandrels:
Pratt & Whitney Company of Canada, Ltd.
Marine-Machinery:
William Kennedy & Sons, Ltd.
Material Handling Plants:
Canadian Mead-Morrison Co., Ltd.
Canadian Vickers Ltd.
Link-Belt Ltd.
Mussens Limited
Merchant Bars:
British Empire Steel Corp., Ltd.
Metal Lath:
Trussed Concrete Steel Co. of Canada, Ltd.
Milling Cutters:
Pratt & Whitney Co., of Canada, Ltd.
Milling Machines:
John Bertram & Sons Co., Ltd.,
Mining Machinery:
William Kennedy & Sons. Ltd.
Motors:
Canadian Fairbanks-Morse Co., Ltd.
Dominion Engineering Agency Ltd.
Motors, Electric:
Canadian General Electric Co., Ltd.
Canadian Westinghouse Co. Ltd.
Motor Oils:
Imperial Oil Ltd.

N

Nails:
British Empire Steel Corp., Ltd.

O

Oil Burning Equipment:
Combustion Engineering Corp., Ltd.
Oil Purifiers, Centrifugal:
De Laval Steam Turbine Co.

P

Paints, Acid Resisting:
Dominion Paint Works, Ltd.
Paints, Anti-Corrosive:
Dominion Paint Works, Ltd.
Paints, Concrete:
Dominion Paint Works, Ltd.
Paints, Damp-proof:
Dominion Paint Works, Ltd.
Paints, Graphite:
Dominion Paint Works, Ltd.
Paints, Machinery:
Dominion Paint Works, Ltd.
Paints, Metal Protectives:
Barrett Co., Ltd
Dominion Paint Works, Ltd.
Paper Mill Machinery:
Dominion Engineering Works, Ltd.
Charles Walmsley & Co., (Canada), Ltd.
Paving and Paving Materials:
Dominion Tar & Chemical Co., Ltd.
Penstocks:
Canadian Des Moines Steel Co., Ltd.
Canadian Vickers Ltd.
Engineering & Machine Works of Canada, Ltd.
Horton Steel Works, Ltd.
Pile Drivers:
Industrial Works.
Pinions:
Hamilton Gear & Machine Co.
Jones & Glassco, Reg'd.
Pipe:
Canadian Des Moines Steel Co., Ltd.
Pipe Coils:
Superheater Co., Ltd.
Pipe, Concrete:
Canada Lock Joint Pipe, Ltd.
Jno. E. Russell Co., Ltd.
Pipe Couplings, Union
Dart Union Co., Ltd.
Pipe Fittings:
Crane Ltd.
Pipe, Lead:
Steel Co. of Canada, Ltd.
Pipe Lines:
Canadian Des Moines Steel Co., Ltd.
Pipe, Lock Joint:
Canada Lock Joint Pipe, Ltd.
Pipes, Cast Iron:
Canada Iron Foundries, Ltd.
Gartshore-Thomson Pipe and Foundry Co., Ltd.
General Supply Co., of Canada, Ltd.
National Iron Corp., Ltd.
Pipe Lock Bar:
General Supply Co., of Canada, Ltd.
Pipes, Reinforced Concrete:
Jno. E. Russell Co., Ltd.
Pipes, Wrought Iron:
Crane Ltd.
Planing Machines, Metal:
John Bertram & Sons Co., Ltd.,
Plate Rolls:
John Bertram & Sons Co., Ltd.,
Plates, Brass and Copper:
Openshaw & Bennett, Ltd.
Plates, Steel:
British Empire Steel Corp., Ltd.
Canadian Vickers Ltd.
Hamilton Bridge Works Co., Ltd.
Vulcan Iron Works, Ltd.
Plumbing Material:
Crane Ltd.
Posts, Indicator:
Jenkins Bros., Ltd.
Porcelain, Insulators:
Dominion Insulator & Mfg. Co., Ltd.
Pot Heads:
G. & W. Electric Specialty Co.
Power Apparatus:
Northern Electric Co., Ltd.
Power Plant Equipment
Combustion Engineering Corp., Ltd.
Babcock-Wilcox & Goldie-McCulloch Co., Ltd.
Canadian Vickers Ltd.
Midwest Canada Limited.
Presses, Hydraulic:
John Bertram & Sons Co., Ltd.,
Propellor Wheels:
Canadian Vickers Ltd.
Wm. Kennedy & Sons, Ltd.
Publishers:
John Wiley & Sons, Inc.
Renouf Publishing Co.
Pulleys:
Canadian S.K.F. Co., Ltd.
Dodge Manufacturing Co., Ltd.
Pulleys, Fibre:
Diamond State Fibre Co. of Canada, Ltd.
Pulp Grinders:
Engineering & Machine Works of Canada, Ltd.
Charles Walmsley & Co., (Canada), Ltd.
Pulp Mill Deckers:
Engineering & Machine Works of Canada, Ltd.
Pulp Mill Machinery:
William Hamilton Co., Ltd.
Pulp Pumps:
DeLaval Steam Turbine Co.
Pulpwood Machinery:
Canadian Mead-Morrison Co., Ltd.
Canadian Vickers Ltd.
Charles Walmsley & Co., (Canada), Ltd.
Pulverized Fuel Systems:
Combustion Engineering Corp., Ltd.
Under-Feed Stoker Co., of Canada, Ltd.
Pump Governors:
Under-Feed Stoker Co., of Canada, Ltd.
C. A. Dunham Co., Ltd.
Pump Valves:
Jenkins Bros., Ltd.

Purchaser's Classified Directory

Pumps:
Canadian Fairbanks Morse Co Ltd.
Dominion Engineering Works, Ltd.
General Supply Co., of Canada, Ltd.
Jones & Glassco, Reg'd.
Mussens Limited
Charles Walmsley & Co., (Canada), Ltd.
Pumps and Condensers.
Babcock-Wilcox & Goldie-McCulloch Co., Ltd.
Pumps, Centrifugal:
De Laval Steam Turbine Co.
Laurie & Lamb.
Pumps, Hydraulic:
Taylor Stoker Co., Ltd.
Pumps Oil,
Taylor Stoker Co., Ltd
Punches and Punch Dies:
Pratt & Whitney Company of Canada, Ltd.
Punches and Shears:
John Bertram & Sons Co., Ltd.,

R

Radiator Valves:
Jenkins Bros., Ltd.
Radio Receiving Sets:
Marconi Wireless Telegraph Co. of Canada, Ltd.
Northern Electric Co., Ltd.
Rail Bonds:
Dominion Insulator & Mfg., Co. Ltd.
Rail Joints:
Rail Joint Co., of Canada, Ltd.
Rail Saw (Portable):
Industrial Works.
Rails:
F. H. Hopkins & Co., Ltd.
Railroad Spikes:
Steel Co., of Canada, Ltd.
Railway Ties:
Canadian Tie & Lumber Co., Ltd.
Railway Equipment:
Canadian General Electric Co., Ltd.
Rawhide Pinions:
Hamilton Gear & Machine Co.
Rawlplugs:
Dominion Engineering Agency Ltd.
Reamers:
Pratt & Whitney Co., of Canada, Ltd.
Receptacles, Fibre:
Diamond State Fibre Co., of Canada, Ltd
Recording Instruments:
Combustion Engineering Corp., Ltd.
Refrigerating Machinery:
Taylor Stoker Co., Ltd.
Reinforcing Steel:
Burlington Steel Co., Ltd.
Midwest Canada Limited.
Trussed Concrete Steel Co., of Canada, Ltd.
Reservoir Fittings:
Guest & Chrimes, Ltd.
Rivets:
British Empire Steel Coro., Ltd.
Road Oils & Preservatives:
Barrett Co., Ltd.
Road Rollers:
Dominion Insulator & Mfg. Co., Ltd.
Mussens Limited
Roofing, Prepared:
Barrett Co., Ltd.
Rolling Mill Rolls:
Canadian Steel Foundries Ltd
Roofs, Built up. Felt & Pitch:
Barrett Co., Ltd.
Rope Wheel:
Dodge Manufacturing Co., Ltd.
Rope. Wire:
Dominion Wire Rope Co., Ltd.
Mussens Limited
Rubber Goods, Mechanical:
Jenkins Bros., Ltd.

S

Safes:
Goldie & McCulloch Co., Ltd.
Sash, Steel:
Canadian Metal Window & Steel Products, Ltd.
Trussed Concrete Steel Co., of Canada, Ltd.
Sawmill Chains:
Link-Belt Ltd.
Sawmill Machinery:
William Hamilton Co., Ltd.
Scales:
Canadian Fairbanks-Morse Co., Ltd.
Screening Equipment:
Canadian Vickers Ltd.
Charles Walmsley & Co., (Canada), Ltd.
Link-Belt, Ltd.
Mussens Limited
Series Cut Outs:
G. & W. Electric Specialty Co.
Sewage & Constructural Articles:
Guest & Chimes Ltd.
Sewer Pipe:
Canada Lock Joint Pipe, Ltd.
Jno. E. Russell Co., Ltd.
Shaft Couplings, Flexible:
DeLaval Steam Turbine Co.
Shaftings:
Dodge Manufacturing Co., Ltd.
Shafting, Anchorage:
Midwest Canada, Ltd.
Sheets:
Steel Co., of Canada Ltd.
Sheating:
Barrett Co., Ltd.
Shingles, Prepared Asphalt:
Barrett Co.. Ltd.
Skip Hoists:
Canadian Mead-Morrison Co. Ltd.
Combustion Engineering Corp., Ltd.
Link-Belt Ltd.
Mussens Limited
Smoke Stacks:
Canadian Vickers Ltd.
Combustion Engineering Corp., Ltd.
Engineering & Machine Works of Canada, Ltd.
Horton Steel Works, Ltd.
Sodas:
Nichols Chemical Co., Ltd.
Speed Reducers, Gear:
Hamilton Gear & Machine, Co.
Springs:
B. J. Coghlin Co., Ltd.
Sprinkler Tanks:
Horton Steel Works, Ltd.
Stair Steps, Safety:
Irving Iron Works Co.
Steel Head Frames:
Hamilton Bridge WorksCo., Ltd.
Steam Heating Specialties:
C. A. Dunham Co., Ltd.
Steam Shovels,
F. H. Hopkins & Co., Ltd
Mussens, Ltd
Steam Traps:
C. A. Dunham Co., Ltd
Steel Plate Construction:
Horton Steel Works, Ltd.
Steel Rails:
British Empire Steel Corp., Ltd.
teel Sections:
Midwest Canada Limited.
Stokers:
Combustion Engineering Corp., Ltd.
Under-Feed Stoker Co., of Canada, Ltd.
Waterous Engine WorksCo., Ltd
Stokers, Side-feed:
Combustion Engineering Corp., Ltd.
Under-Feed Stoker Co., of Canada, Ltd.
Stokers, Under-feed:
Combustion Engineering Corp., Ltd.
Taylor Stoker Co., Ltd.
Under-Feed Stoker Co., of Canada, Ltd.
Stone Crushers:
General Supply Co., of Canada, Ltd.
Mussens Limited
Structural Steel:
Algoma Steel Corporation, Ltd.
British Empire Steel Corp., Ltd.
Canadian Bridge Co., Ltd.
Canadian Des Moines Steel Co., Ltd.
Canadian Vickers Ltd.
Hamilton Bridge Works Co., Ltd.
Standard Steel Constrn. Co., Ltd.
Vulcan Iron Works, Ltd.
Superheaters:
General Supply Co., of Canada, Ltd.
Superheater Co., Ltd.
Surveying Instruments:
J. Frank Raw Co., Ltd.
Switchboards, Power Lighting:
Canadian General Electric Co., Ltd.

T

Tanks, Cylindrical:
Horton Steel Works, Ltd.
Tanks, Oil:
Horton Steel Works, Ltd.
Tanks. Steel:
Canadian Vickers Ltd.
Engineering & Machine Works of Canada, Ltd.
Horton Steel Works, Ltd,
E. Leonard & Sons. Ltd.
Tanks, Steel, Water Supply:
Canadian Des Moines Steel Co., Ltd.
Taps:
Pratt & Whitney Co., of Canada, Ltd.
Tar:
Barrett Co., Ltd.
Testing Apparatus:
Guest & Chimes Ltd.
Tools, Small:
Pratt & Whitney Co., of Canada, Ltd.
E. Leonard & Sons, Ltd.
Tools, Wrecking:
Industrial Works.
Track Tools:
B. J. Coghlin Co., Ltd.
Tractors:
Mussens Limited
F. H. Hopkins & Co., Ltd.
Transfer Tables:
Industrial Works.
Transformers, Lighting & Power:
Canadian General Electric Co., Ltd.
Transmission Machinery:
Dodge Manufacturing Co., Ltd.
Link-Belt Ltd.
Trolley Materials:
Dominion Insulator & Mfg. Co., Ltd.
Turbines:
General Supply Co., of Canada, Ltd.
Turbines, Steam:
DeLaval Steam Turbine Co.
Turbo Generators, A.C.:
DeLaval Steam Turbine Co.
Turbo Generators, D.C.:
DeLaval Steam Turbine Co.

U

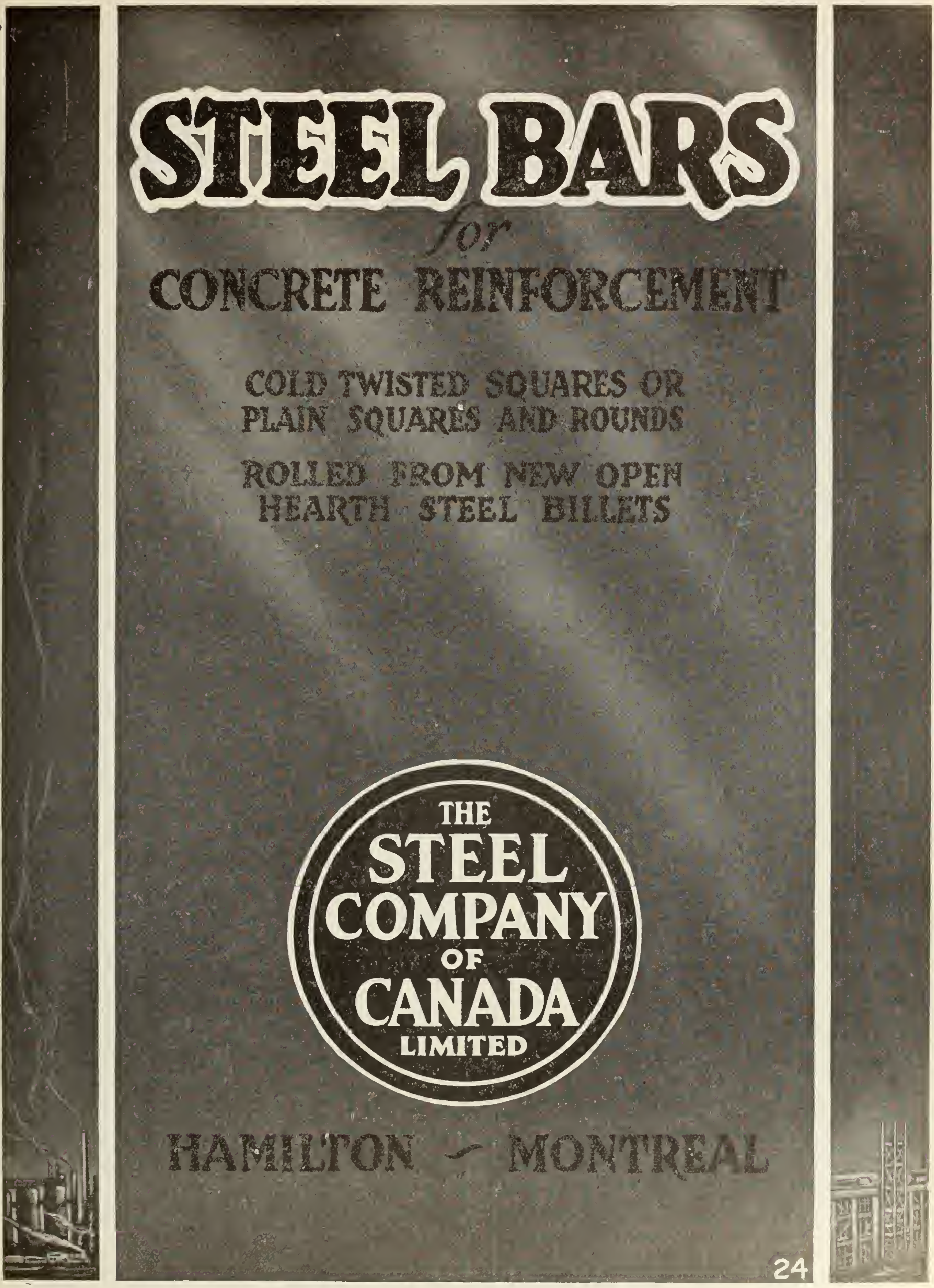
Underfeed Stokers:
Combustion Engineering Corp., Ltd.
Taylor Stoker Co., Ltd.
Union Pipe Couplings:
Dart Union Co., Ltd.

V

Valve Boxes:
Jenkins Bros., Ltd.
Valve Files:
Jenkins Bros., Ltd.
Varnishes, Acid Resisting:
Dominion Paint Works, Ltd.
Varnishes, Insulating:
Dominion Paint Works, Ltd.
Valves:
Canadian Fairbanks-Morse Co., Ltd.
Crane Limited.
C. A. Dunham Co., Ltd.
Dominion Engineering Works, Ltd.
Guest & Chrimes, Ltd.
Jenkins Bros., Ltd.
Kerr Engine Co., Ltd.
Valves, Automatic Cut-off:
Under-Feed Stoker Co., of Canada, Ltd.
Valves, Regulating:
C. A. Dunham Co., Ltd.
Under-Feed Stoker Co., of Canada, Ltd.
Valves, Relief:
Under-Feed Stoker Co., of Canada, Ltd.
Venturi Meters:
General Supply Co., of Canada, Ltd.

W

Washers, Fibre:
Diamond State Fibre Co., of Canada, Ltd.
Water Meters:
Guest & Chrimes, Ltd.
Neptune Meter Co., Ltd.
Water Pipe:
Canada Lock Joint Pipe Co.,Ltd.
Waterproofing:
Barrett Co., Ltd.
Dominion Tar & Chemical Co., Ltd.
Water Power Plant Machinery:
Canadian Vickers Ltd.
Wm. Kennedy & Sons, Ltd.
Water Softening Plants:
Laurie & Lamb:
Water Transmission:
Canada Lock Joint Pipe, Ltd.
Water Supply, Pipes:
Canada Lock Joint Pipe, Ltd.
Waterworks Constructional Articles:
Guest & Chimes Ltd.
Welding Outfits, Electric:
Canadian General Electric Co., Ltd.
Canadian Westinghouse Co.,Ltd.
Dominion Insulator & Mfg. Co., Ltd.
Wharf Cranes:
Industrial Works.
Wheels, Fibre:
Diamond State Fibre Co., of Canada. Ltd.
Canadian Mead-Morrison Co., Ltd.
Winches:
Taylor Stoker Co., Ltd.
Wire:
British Empire Steel Corp., Ltd.
Steel Co., of Canada, Limited.
Wire Mesh:
Trussed Concrete Steel Co., of Canada, Ltd.
Wire Rope:
Dominion Wire Rope Co., Ltd.
F. H. Hopkins & Co., Ltd.
Wires and Cables:
Northern Electric Co., Ltd.
Wood Grapples:
Industrial Works.
Wood Preservations:
Barrett Co., Ltd.
Dominion Tar & Chemical Co., Ltd.
Woodruff Key Cutters:
Pratt & Whitney Company of Canada, Ltd.
Worm Gear:
Hamilton Gear & Machine Co.
Link-Belt Ltd.
Wrecking Cranes:
Industrial Works.
Wrecking Tools:
Industrial Works.


STEEL BARS
for
CONCRETE REINFORCEMENT
COLD TWISTED SQUARES OR
PLAIN SQUARES AND ROUNDS
ROLLED FROM NEW OPEN
HEARTH STEEL BILLETS
THE
STEEL
COMPANY
OF
CANADA
LIMITED
HAMILTON ~ MONTREAL
24

TENDERS

DEPARTMENT OF RAILWAYS AND CANALS

ST. PETER'S CANAL

NOTICE TO CONTRACTORS

SEALED TENDERS, addressed to the undersigned and marked "Tender for Improving North Entrance to the St. Peter's Canal" will be received at this office until 12 o'clock noon on Friday, March 14th, 1924.

Plans, specification and form of contract to be entered into can be seen on and after this date at the office of the Chief Engineer of the Department of Railways and Canals, Ottawa, at the office of the Superintending Engineer, Ontario-St. Lawrence Canals, Cornwall, Ontario, and at the office of the Canal Overseer, St. Peter's, N.S.

The work consists principally of Submarine Earth and Rock Excavation, and Crib work.

An accepted bank cheque on a chartered bank of Canada for the sum of $6,500.00, made payable to the order of the Minister of Railways and Canals, or War Loan Bonds of the Dominion of Canada to the same amount, or War Loan Bonds and cheques if required to make up the difference, must accompany each tender, which sum will be forfeited if the party tendering declines entering into contract for the work at the rate stated in the offer submitted.

The cheque or bonds thus sent in will be returned to the respective contractors whose tenders are not accepted.

The cheque or bonds of the successful tenderer will be held as security or part security, for the fulfilment of the contract to be entered into.

The lowest or any tender not necessarily accepted.

By order,
J. W. PUGSLEY,
Secretary.

Department of Railways and Canals,
Ottawa, February 20th, 1924.

Tenders for Municipal Supplies

Tenders will be received by the undersigned up to

Saturday noon, March 8th, 1924,

for the season's supply of Road oil, Bituminous material, Castings, Stone, Gravel, Sand and Sewer pipe. Forms and Specifications supplied on request.

S. SHUPE,
City Engineer,
Kitchener, Ont.

TOWNSHIP OF ETOBICOKE

Tenders for Sewers in Long Branch Area

Sealed tenders, properly marked and addressed to the Township Clerk, for laying approximately twelve miles of sewers varying in size from 9 inches to 48 inches, will be received up to noon,

Monday, March 10th, 1924,

The corporation will supply sewer pipe.

Plans and specifications may be seen at the office of the consulting engineers:

W. J. GARDHOUSE, Reeve
STEPHEN BARRATT, Township Clerk,
Islington, Ontario.

JAMES, PROCTOR & REDFERN, Limited,
Consulting Engineers,
36 Toronto Street,
TORONTO.

Tenders for Steel Bridge

Tenders will be received by the undersigned until 2 o'clock,

Monday, March 10th, 1924,

for the construction of a Steel Bridge over the Thames River, concession 2 and 3, in the Township of Fullarton, County of Perth.

A marked cheque representing 10% of the contract price must accompany each tender.

Plans, specifications, etc., may be seen at my office, Fullarton, or at the engineer's office, Mitchell.

R. H. POMEROY,
Clerk of Fullarton,
Fullarton P.O.

DEPARTMENT OF TRADE AND COMMERCE, CANADA

Grain Elevator, Edmonton Alberta

NOTICE TO CONTRACTORS

Sealed tenders for the construction of a reinforced concrete grain elevator superstructure will be received at Ottawa, Ontario, until noon of

Wednesday, March 19th, 1924,

Tenders should be sent in an opaque sealed envelope marked "Tender for Grain Elevator" and addressed to the Deputy Minister, Department of Trade and Commerce, Ottawa.

A lump sum tender for the work is desired.

An accepted bank cheque for Fifty Thousand Dollars ($50,000.00) made payable to the Minister of Trade and Commerce must accompany each tender, which sum will be forfeited if the party tendering declines to enter into a contract for the work on the terms stated in his tender. The cheque of unsuccessful tenderers will be returned. The cheque of the successful tenderer will be retained as security for the due fulfilment of the contract to be entered into, or cheque may be replaced with equivalent par value of bonds of the Dominion of Canada.

Plans, specification, and all necessary informations regarding the proposed work may be obtained from C. D. Howe & Company, Consulting Engineers, Whalen Building, Port Arthur, Ontario. Deposit of One Hundred Dollars ($100.00) is required for plans and specifications, deposit to be returned on return of plans and specifications in good condition.

The lowest or any tender will not necessarily be accepted.

By Order,
JAS. G. PARMELEE,
Acting Deputy Minister.

Department of Trade and Commerce,
Ottawa, February 19th, 1924.

Members are urged to consult The Journal's advertising pages.

NOTICE TO CONTRACTORS

Extension of Time

The time for receiving tenders for the supply of Tar, Road Oil and Asphalt has been extended three weeks. Tenders for above materials will now be received until 12 o'clock noon on **Tuesday, March 18th, 1924.**

S. L. SQUIRE
Deputy Minister of Highways.
Department of Public Highways,
Ontario,
Toronto, February 25th, 1924.

NOTICE TO CONTRACTORS

Extension of Time

The time for receiving tenders on Contracts 1051 to 1080 has been extended two weeks. Tenders on the above list of contracts as advertised **February 4th, 1924,** will now be received until 12 o'clock noon on **Tuesday, March 18th, 1924.**

S. L. SQUIRE,
Deputy Minister of Highways.
Department of Public Highways,
Ontario,
Toronto, February 25th, 1924.

CITY OF BRANTFORD

Tenders for Pumps and Motor

Sealed tenders, addressed to Ald. C. S. Moyer, Chairman Board of Works, care of the City Clerk, Brantford, will be received until 5 p.m.,

Thursday, March 13th, 1924,

for the supply and installation of Two Direct Connected Vertical Centrifugal Pumps, with motors, and switch board equipment for the Bellview Sewerage Pumping Station.

Plans and specifications may be obtained from the City Engineer.

The lowest or any tender not necessarily accepted.

F. P. ADAMS,
City Engineer.
C. S. Moyer,
Chairman Board of Works.

Notice to Contractors

Seperate sealed tenders, marked "Tender for Contract No. ——", will be received by the undersigned until 12 o'clock noon on Tuesday, March 18th, 1924, for the following work on the Provincial Highways:

Contract No.		Mileage
	ASPHALT PAVEMENT	
1019	Jock River northerly	2.3
	CRUSHED STONE CONCRETE PAVEMENT	
1052	In the easterly limits of Cornwall	0.95
	WASHED GRAVEL CONCRETE PAVEMENT	
1021	Oshawa to Bowmanville (alternative)	7.8
1022	New Hamburg to Shakespeare (alternative)	6.2
1050	Lambeth to Delaware	6.5
	BITUMINOUS PENETRATION PAVEMENT	
1023	Foxboro Village	0.6
	MACADAM ROADWAY	
1024	Alfred easterly (including 2 miles of grading)	5.5
1025	Alfred to top of hill at Plantagenet	4.9
1026	From 2 miles west of Lancaster westerly	2.2
1027	Innisville southerly (including grading)	2.9
1028	From 1.4 miles south of Caledonia southerly	3.0
1029	Belleville westerly	6.0
1021	Oshawa to Bowmanville (alternative)	7.8
1022	New Hamburg to Shakespeare (alternative)	6.2
1030	Hamilton to the Filter Beds	1.3
	SURFACE TREATMENT OF MACADAM ROADS	
1031	Aurora northerly to Holland Landing	5.1
1032	Napanee to Odessa	11.7
1033	Kingston to Odessa	10.5
1034	Cornwall easterly	9.5
1035	L'Orignal westerly	5.3
1036	Perth to Smith's Falls	11.8
1037	Cooksville northerly	4.9
1038	Mitchell to Sebringville	7.2
1039	Mount Hope to Caledonia	5.7
1040	Woodstock easterly	6.9
1041	Dunnville westerly to Canboro west limits	9.0
1042	North Cayuga Township	12.6
1043	Haldimand Line to Nelles Corners	10.2
1044	Chambers Corners easterly to Welland	8.1
1045	St. Catharines to Mennonite Church	7.8
1046	Hagersville northerly	2.0
	GRADING	
1047	Dublin to Mitchell	5.0
1048	Seaforth westerly	1.5
1049	Clinton East	1.0
	BRIDGES	
1081	Caledon Bridge, Snelgrove Bridge and Culverts north of Brampton.	

Contractors may tender on each contractor and are not obliged to tender on both alternatives where noted.

Plans, specifications, information to bidders, tender forms and tender envelopes may be obtained on and after Tuesday, February 26th, 1924, at the office of the undersigned or from the following Resident Engineers:

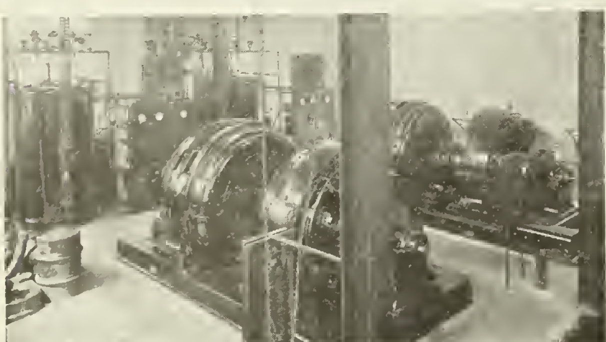
C. H. Nelson, Ottawa; C. A. Robbins, Brockville; J. M. Empey, Port Hope; G. G. Greig, Toronto; H. E. Macpherson, Durham; A. N. Fellowes, Grimsby; G. A. Downey, Stratford; D. W. Bews, London.

A marked cheque for $1,000.00, payable to the Minister of Public Works and Highways, Ontario, or a Guaranty Company's Bid Bond for a similar amount, must be attached to tenders for pavements and macadam, and for tenders on grading and surface treatment the above conditions to apply, but the amount of bond or cheque required is $500.00. A Guaranty Company's Contract Bond for 50% of the amount of the tender will be furnished by the Contractor to the Department when Contract is signed, with the exception of the Surface Treatment of Macadam Roads on which contracts no Contract Bond is required. Maintenance Bonds for 25% of the total of tender and extension of work, if any, of pavement contracts shall be furnished to the Department when Contract is signed.

All bonds must be made out on Departmental Forms. The lowest or any tender not necessarily accepted.

S. L. SQUIRE,
Deputy Minister of Highways.
Department of Public Highways, Ontario.
Toronto, February 18th, 1924.

INDEX TO ADVERTISERS



PROFESSIONAL CARDS

ALGOMA STEEL CORPORATION LIMITED

SAULT STE. MARIE, ONTARIO

THE ALGOMA STEEL CORPORATION LIMITED

announce to their customers and the Canadian trade that they can supply American Standard Sections of BEAMS and CHANNELS up to and including 15", all standard sections of ANGLES from 6" x 6" down to 1¼", ZEE BARS for car builders and general purposes; small and large ROUNDS, SQUARE and FLAT BARS. The quality of the product is already well known to the trade, and is exclusively steel made by the Open Hearth process, and can be furnished in all grades from the softest rivet stock to high carbon special spring material.

MARK OF ALGOMA O.H. QUALITY

+++

Order from us and you will get both quality and prompt service. A trial is convincing.

+++

Our extensive warehouse facilities ensure prompt delivery.

DISTRICT SALES OFFICES:

Open Hearth - Alloy Steels

Chrome-Vanadium,
Chrome-Nickel,
Nickel-Steel

All of these steels we supply in Hot Rolled Bars or Billets.

++

WE ALSO FURNISH

Blooms, Billets, Slabs, Structural Steel, Merchant Bars, Concrete Reinforcing Bars,

++

STEEL RAILS, Open Hearth quality, all sections from 12 lbs., to 105 lbs., per yard.

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Angle Bars, 100% Joints, Continuous Standard Joints, Steel Tie Plates

PIG IRON

Basic, Foundry, Malleable,

++

Sulphate of Ammonia
Sulphuric Acid Nitre Cake

606 McGill Building, Montreal,
1428 Bank of Hamilton Building, Toronto

SPECIAL REPRESENTATIVES:

New Brunswick and Prince Edward Island,
Walter J. Smith, P. O. Box 707, St. John, N.B.
Nova Scotia: F. J. Owen Connolly, The Maritime Trust Building, 91 Hollis St., Halifax, N.S.

Warrenite-Bitulithic
Lansing Road
York County

Asphalt Surface Treatment
Russell Road
Carleton County

Asphalt Macadam
Richmond Road
Carleton County

First for County Roads

The wide diversity of types of Asphalt surfaces is of special importance in the development of improved County roads. Asphalt enables the selection of a road fully capable of meeting local traffic requirements, and permits a progressive programme that yields greater mileage without heavy financial outlay.

Where traffic is moderate, a gravel road, maintained by Asphalt Surface Treatments, will give many years of good service. Later, a macadam surface laid over the gravel and with similar maintenance, will add several more years to the life of the road. Then if conditions permit a higher type of Asphalt surface, this can be laid over the previous road without any economic loss of the previous work.

IMPERIAL
Asphalt
PRODUCTS

Even where traffic demands the immediate construction of Asphalt Macadam, Asphaltic Concrete or Sheet Asphalt, the financing is just as easy, because of the long life and excellent traffic features of these pavements.

Write for full particulars and literature on Asphalt for road construction and maintenance.

Imperial Oil Limited

ROAD ENGINEERING DEPARTMENTS AT

Toronto Vancouver Montreal

THE

ENGINEERING JOURNAL

THE JOURNAL OF THE ENGINEERING INSTITUTE OF CANADA

"TO FACILITATE THE ACQUIREMENT AND INTERCHANGE OF PROFESSIONAL KNOWLEDGE AMONG ITS MEMBERS, TO PROMOTE THEIR PROFESSIONAL INTERESTS, TO ENCOURAGE ORIGINAL RESEARCH, TO DEVELOP AND MAINTAIN HIGH STANDARDS IN THE ENGINEERING PROFESSION AND TO ENHANCE THE USEFULNESS OF THE PROFESSION TO THE PUBLIC"

THE ENGINEERING INSTITUTE OF CANADA FOUNDED 1887

APRIL 1924

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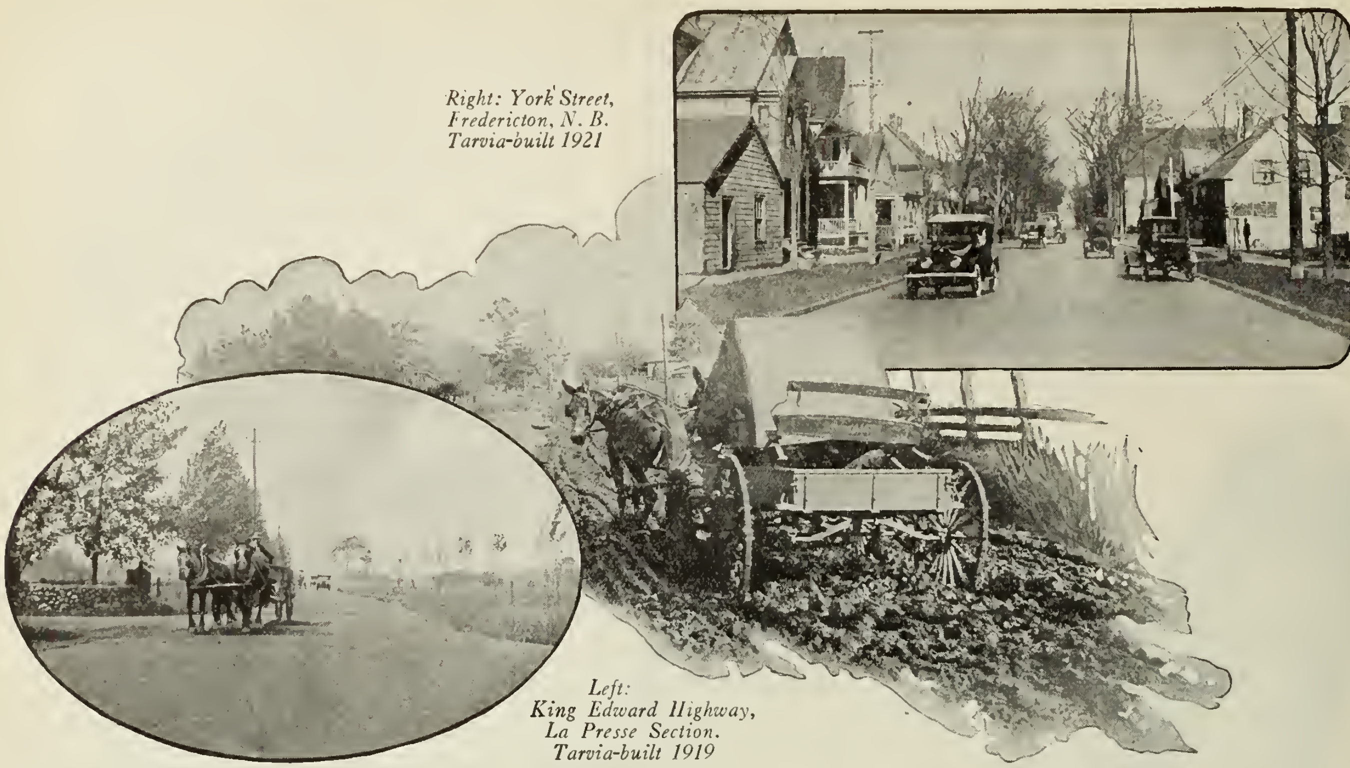
AT 176 MANSFIELD STREET, MONTREAL

Vol. VII No. 4



Right: York Street, Fredericton, N. B. Tarvia-built 1921

Left: King Edward Highway, La Presse Section. Tarvia-built 1919

How did Your Roads Come through the Winter?

DID the Spring thaw turn your roads into swamps of sodden mud—roads often impassable—always hard going? Why not have smooth, firm, dustless and mudless highways 365 days of the year—Tarvia-built roads.

The cost? Thousands of Tarvia streets and roads have proved to taxpayers that, for the money spent, Tarvia gives more miles of good roads and the most years of satisfactory road service.

Moreover a Tarvia Road will not wave, roll or rut. And because of its granular surface a Tarvia Road will remain skid-proof.

Every paving requirement—construction, repair or maintenance—can be met with Tarvia.

The Barrett Company
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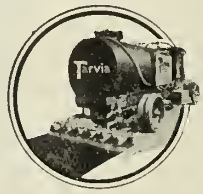
MONTREAL TORONTO WINNIPEG
VANCOUVER ST. JOHN, N. B. HALIFAX, N. S.

Tarvia
For Road Construction Repair and Maintenance



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Diamond Fibre has proved its superiority to other materials in the manufacture of

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Switch bars
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WHILE the silent qualities of Celoron Gears make for increased efficiency by reducing the wear and tear on the human element, their mechanical qualities reduce production costs through the longer and more satisfactory service they give. Let us show you why this is so.

Condensite Celoron and Diamond Fibre are supplied in Sheets, Rods, Tubes, Fish Paper or in parts machined to specifications.

DIAMOND STATE FIBRE COMPANY OF CANADA
LIMITED

TORONTO

McCracken Concrete Sewer-Pipe being laid on Newlands Avenue, Hamilton, Ontario. November 13th, 1923

This is What

ONTARIO'S LEADING ENGINEERS

Say about McCracken Sewer Pipe

MORE than 32 Ontario Towns and Cities have tested and proven the advantages of McCracken Sewer Pipe for sewerage systems. The list is constantly increasing. This increase can be attributed to but one thing—the realization by municipal engineers that McCracken ideally combines the features most desired in Sewer Pipe.

Following are a few of many letters on file offering the strongest kind of evidence that McCracken is unsurpassed by any other Sewer Pipe.

Mr. H. W. Paterson,
Engineer
Walkerville, Ont., Says:
"We laid three miles of McCracken Pipe in 1920 and Sewers are in excellent condition. We will be calling upon you shortly for four miles of additional pipe."

Mr. J. R. Stewart,
Town Engineer,
Renfrew, Ont., Says:
"Last year we laid down over 8000 ft. of Concrete Sewer Pipe and it has given satisfactory results. I prefer CONCRETE tile, as I find every pipe is true to shape."

Write for complete information and quotations

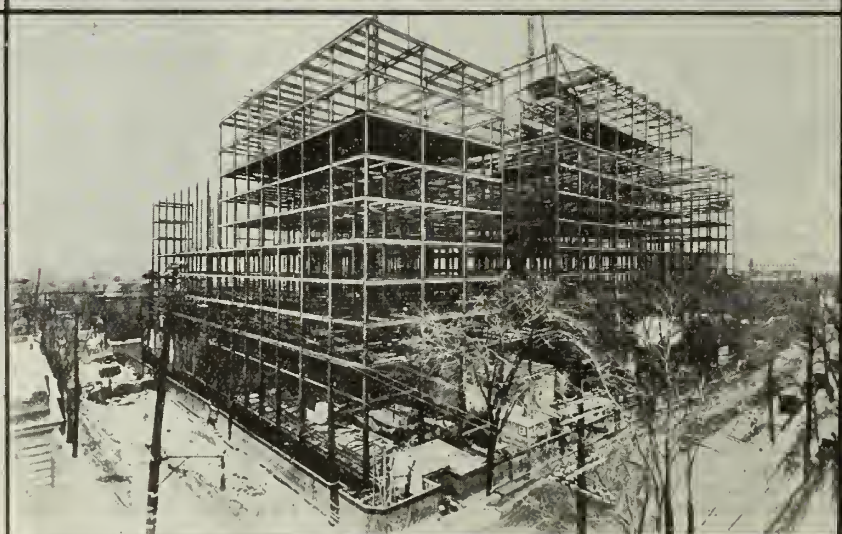
JNO. E. RUSSELL COMPANY, LIMITED

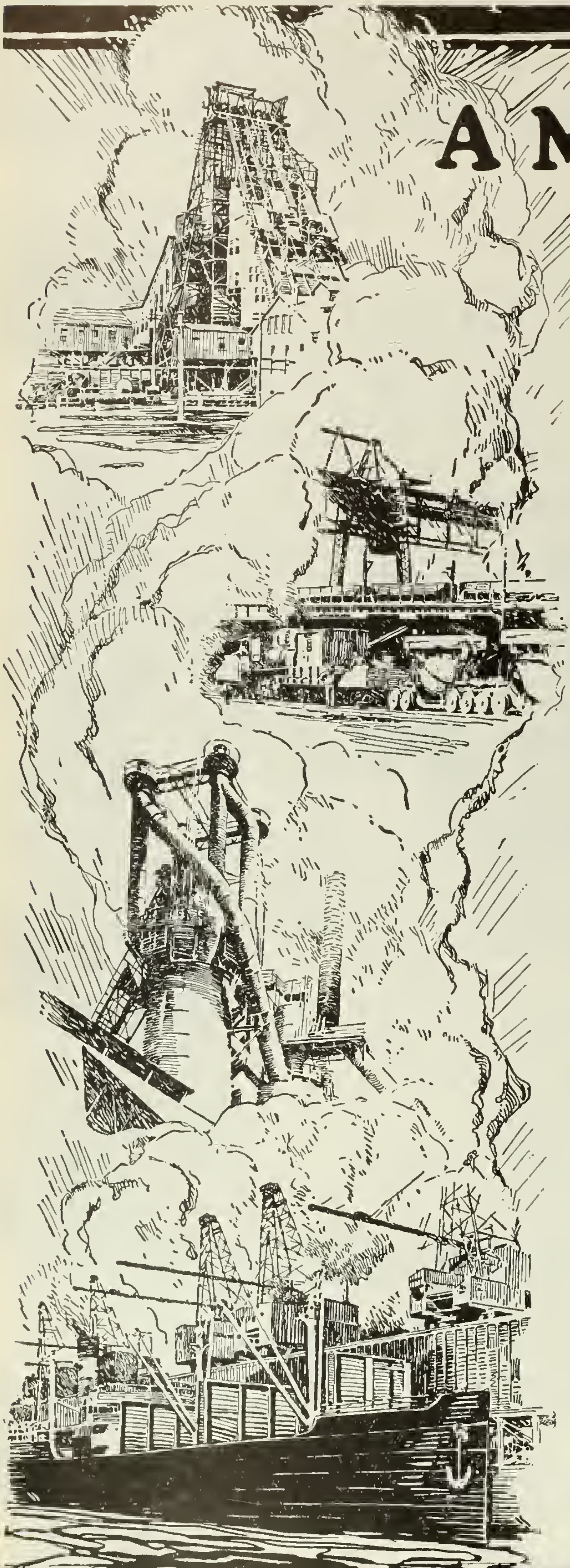
General Sales Agents

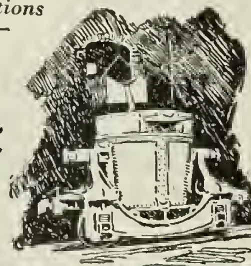
Reford Building, Bay & Wellington Sts. Toronto

McCRACKEN SEWER PIPE

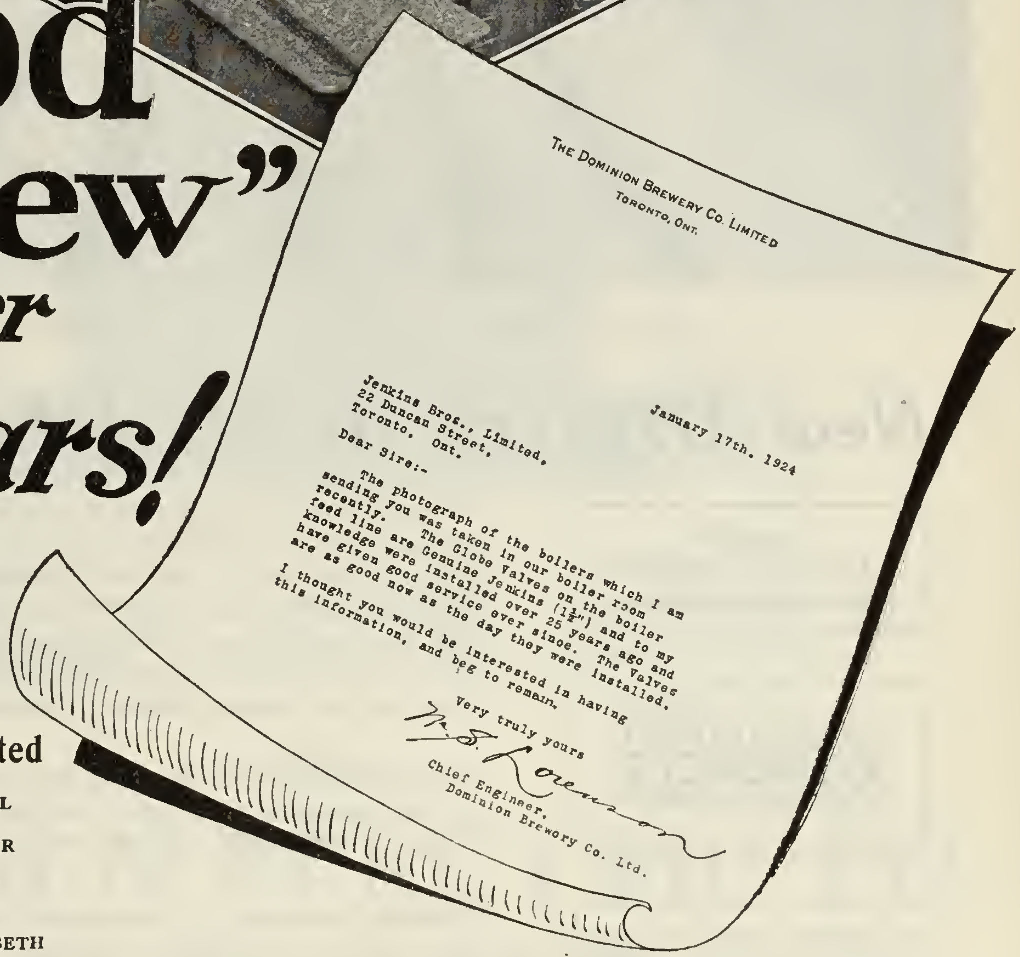
"The Pipe That Endures"







"Good as New" *after* 25 Years!



THE DOMINION BREWERY CO. LIMITED
TORONTO, ONT.

January 17th. 1924

Jenkins Bros., Limited,
22 Duncan Street,
Toronto, Ont.

Dear Sirs:-

The photograph of the boilers which I am sending you was taken in our boiler room recently. The Globe Valves on the boiler feed line are Genuine Jenkins (1½") and to my knowledge were installed over 25 years ago and have given good service ever since. The Valves are as good now as the day they were installed.

I thought you would be interested in having this information, and beg to remain,

Very truly yours

Chief Engineer,
Dominion Brewery Co. Ltd.

THE Chief Engineer of the Dominion Brewery Co., Limited, bears testimony to the fact that JENKINS VALVES are truly *"The Valves with Value."*

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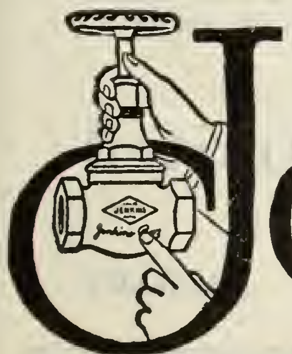
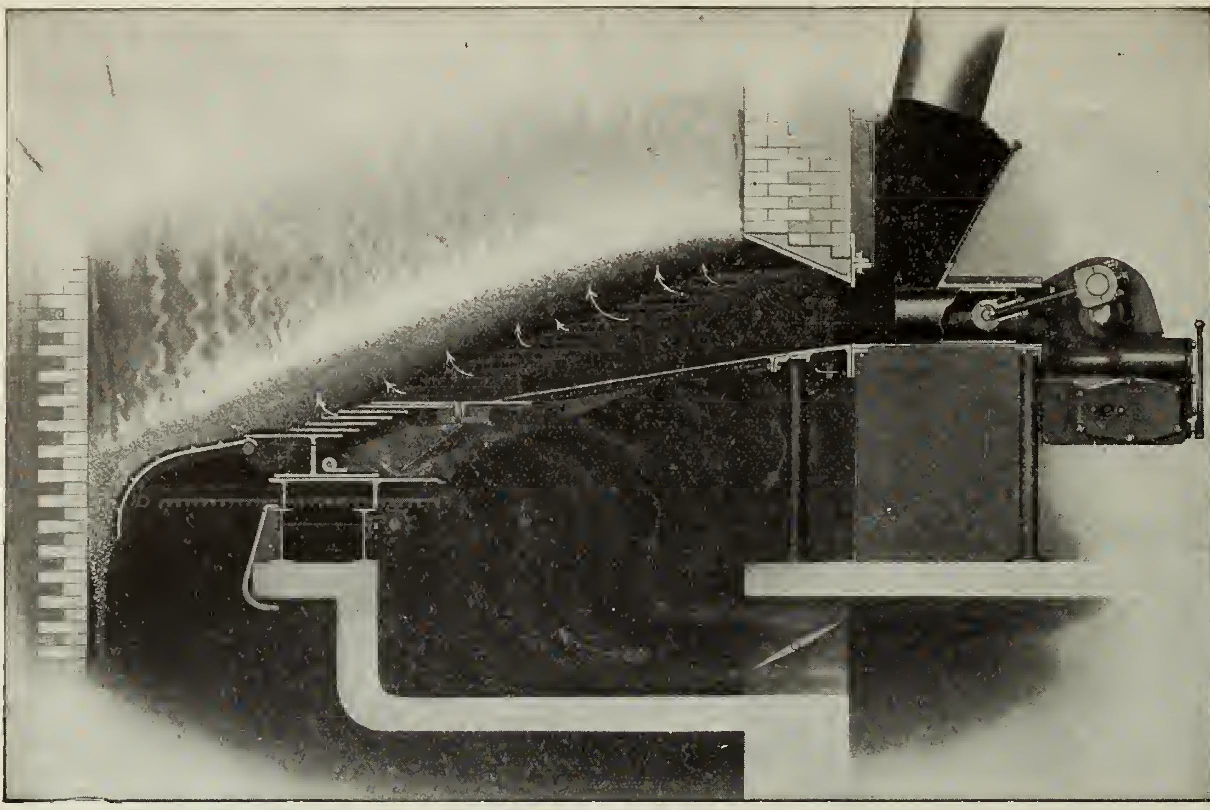


Always marked with the "Diamond"

Jenkins Valves

SINCE 1864



THE CONVEYOR TUYERES

— or moving grates of the "Riley", shown above, are distinctive. While admitting air at the proper place, they convey the coal towards the dump at any rate desired, distributing it evenly and keeping the fuel bed porous. The rocker dump continuously discharges the ash.

Alta. and West Sask.: Mr. J. Twomey, Camrose, Alta.

Man. and East Sask.: W. Hicks & Co. Winnipeg.

Quebec: Cleaton Co. (Can.) Ltd. Montreal, Que.

The UNDER-FEED STOKER COMPANY OF CANADA LTD.

RILEY — JONES — MURPHY

Riley Stokers Cut 36 Men off Haverhill's Payroll

"Riley" Underfeed Stokers under four 2400 h. p. Heine Boilers, replacing smaller boilers at the Haverhill Boxboard Co., cut 36 men off the payroll, and reduced the amount of fuel burned by 10 tons daily — a yearly saving in fuel and labor of over $52,000. The Haverhill plant is shown opposite.

This shows what "Riley" Stokers can do for plants where power is generated by old, out-of-date handfired methods. They not only cut labor costs 50 to 75% but lower fuel costs 10 to 15%. The saving soon pays for the remodelling — and then piles up in profits. Peak loads of over 300% of rating can be met easily, and many "Riley" Stokered plants are operating continuously at 250%.

Don't you want the story of greater saving and more dependable operation? Then ask for the Riley Catalog — no obligation, of course.

UNDER-FEED STOKER CO., OF CANADA, LTD.

150 King Street West, Toronto

"Jones" Stokers "Riley" Stokers "Murphy" Automatic Furnaces

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STEEL BARS
for Concrete Reinforcement
COLD TWISTED SQUARES OR
PLAIN SQUARES AND ROUNDS
ROLLED FROM NEW OPEN
HEARTH STEEL BILLETS
THE
STEEL
COMPANY
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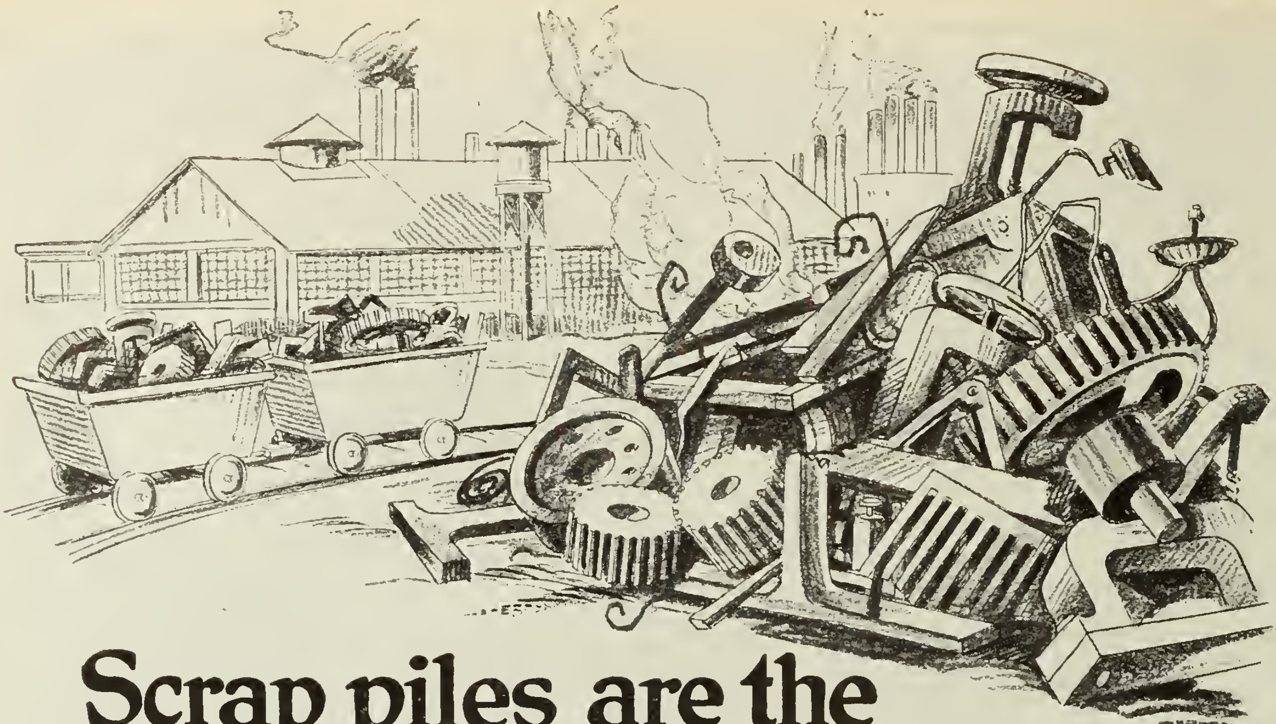
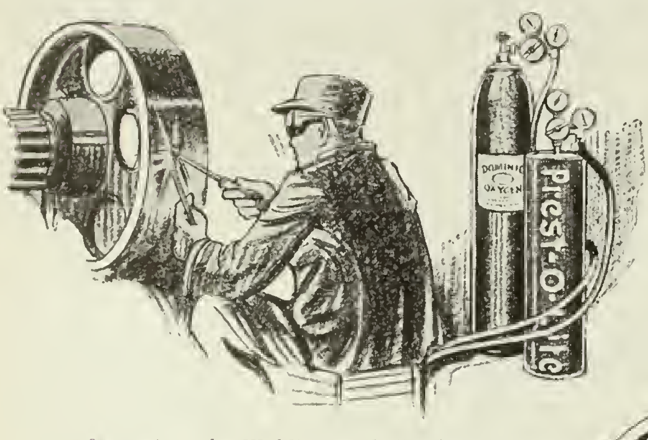


Scrap piles are the Graveyards of profits

THE day of discarding expensive machine parts to the scrap pile, because of a break, worn spot, or other defect, is past. This practice, which is wasteful and profit-reducing, should no longer be tolerated in modern business.

The development of the oxy-acetylene process of welding has saved hundreds of thousands of dollars annually in material and time.

There are few instances where a broken machine part cannot be welded at a fraction of the cost of a new part.



Dominion Oxygen and Prest-O-Lite Dissolved Acetylene give best results in welding and cutting.

We supply gases of the highest purity in modern leak-proof cylinders and ship your order immediately from the nearest of our nine distributing points. And further, our welding engineers will gladly show you how the oxy-acetylene process will save time and money in your plant. We invite your enquiry.

Operating the Welding and Cutting Gas Division of

Prest-O-Lite Company of Canada, Limited.

Dominion OXYGEN

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General Offices:
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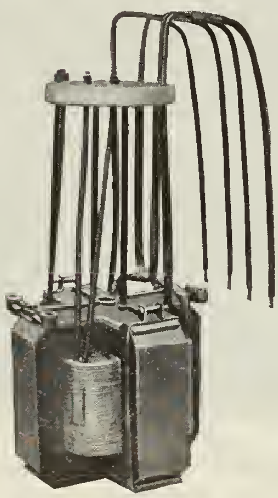
The March of Progress

Great advances have been made in the electrical industry during the past twenty-five years; everywhere old principles, more efficiently applied, and new devices mark man's progress. Nowhere is this more noticeable than in Transformer development. The

1904

Type "H" Form "K"

is a distinct advance in Transformer design. The cruciform, distributed core provides great mechanical strength. The coils are protected against distortion, during short circuit, by the outside legs which form a rigid support, thus insuring long life and uninterrupted service.



Always specify Type "H"
—your guarantee of quality

1924

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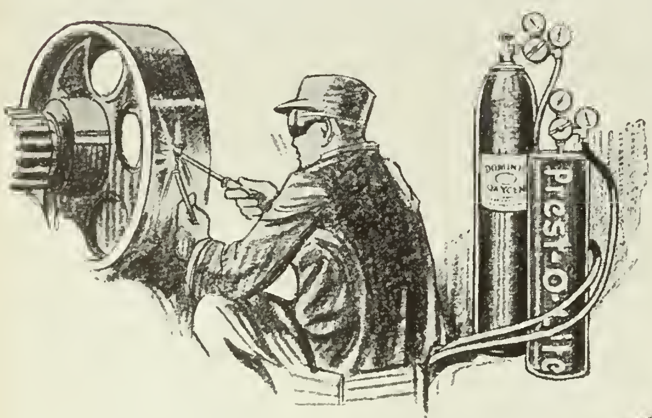

Dominion Oxygen and Prest-O-Lite Dissolved Acetylene give best results in welding and cutting.

We supply gases of the highest purity in modern leak-proof cylinders and ship your order immediately from the nearest of our nine distributing points. And further, our welding engineers will gladly show you how the oxy-acetylene process will save time and money in your plant. We invite your enquiry.

Operating the Welding and Cutting Gas Division of

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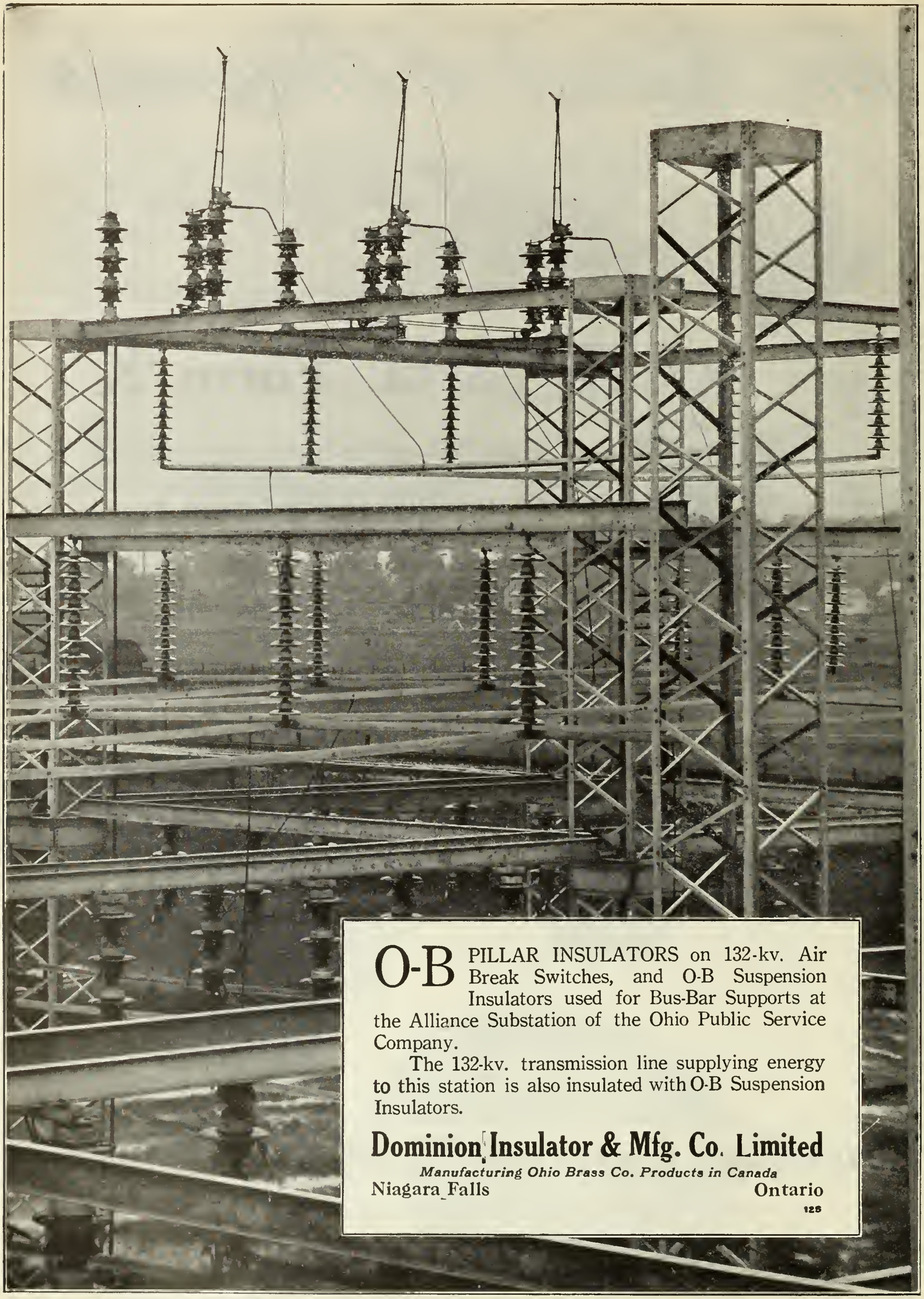
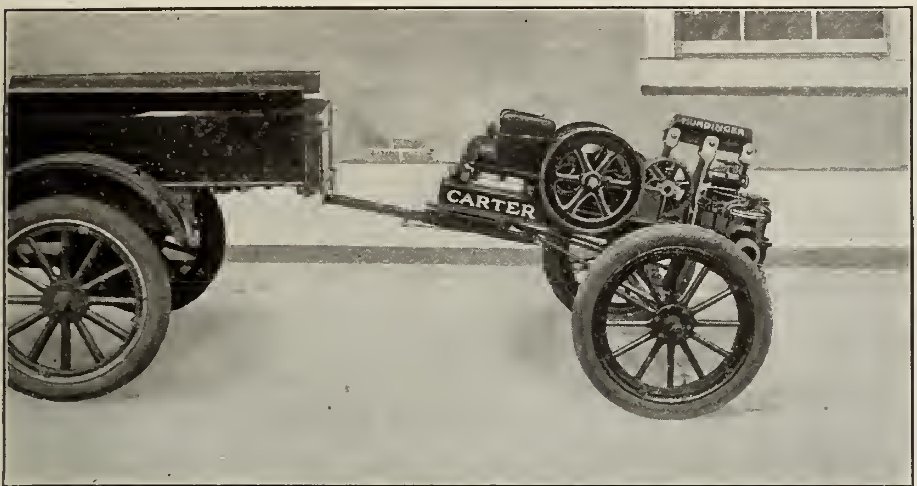

O-B PILLAR INSULATORS on 132-kv. Air Break Switches, and O-B Suspension Insulators used for Bus-Bar Supports at the Alliance Substation of the Ohio Public Service Company.
The 132-kv. transmission line supplying energy to this station is also insulated with O-B Suspension Insulators.
Dominion Insulator & Mfg. Co. Limited
Manufacturing Ohio Brass Co. Products in Canada
Niagara Falls Ontario
125

The Humdinger



This shows one type of mounting for quick moves.

A new

Diaphragm Pump

for

50 ft. Head

Lifts 20 ft. Forces 30 ft.

Send for particulars

Single and Double

Pumps

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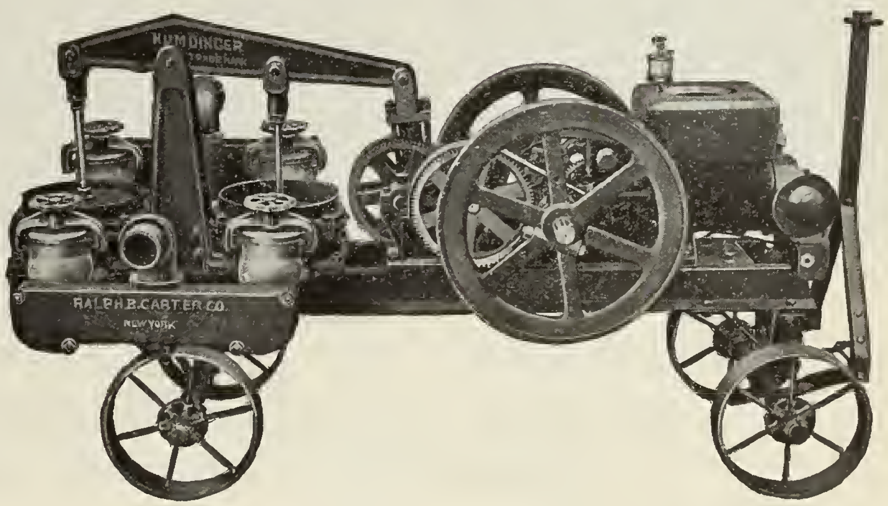
Skids or on Trucks

with

Fuller & Johnson

Gasoline Engine

Stock Carried



A Humdinger Double Outfit.

Bucyrus Shovels and Draglines, Western Cars,
Barber Greene Bucket Loaders and Belt Conveyors.

MUSSENS LIMITED

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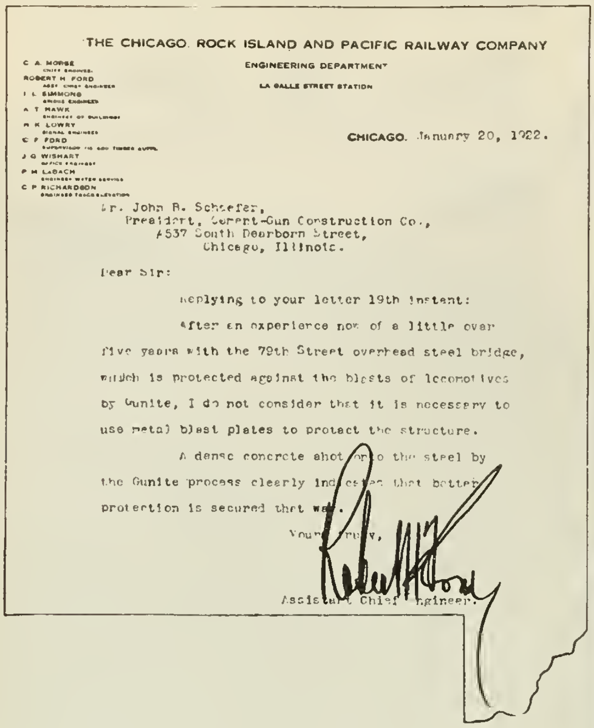

THE CHICAGO, ROCK ISLAND AND PACIFIC RAILWAY COMPANY

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C. P. RICHARDSON

CHICAGO. January 20, 1922.

Mr. John B. Schaefer,
President, Cement-Gun Construction Co.,
4537 South Dearborn Street,
Chicago, Illinois.

Dear Sir:

Replying to your letter 19th instant:

After an experience now of a little over five years with the 79th Street overhead steel bridge, which is protected against the blasts of locomotives by Gunite, I do not consider that it is necessary to use metal blast plates to protect the structure.

A dense concrete shot onto the steel by the Gunite process clearly indicates that better protection is secured that way.

Yours truly,

Robert H. Ford

Assistant Chief Engineer.

— THE —

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THE JOURNAL OF
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OF CANADA

APRIL 1924 Volume VII, No. 4

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The Cost of Hydro-Electric Power

The effect of Power Factor, Load Factor and Diversity Factor on the Cost of Power

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Paper read before the Montreal Branch, The Engineering Institute of Canada, December 13th, 1923.

In this paper the cost of large blocks of power only will be considered. The cost of power depends on:—

(a) The cost of the power development including transmission lines, on which interest and sinking fund payments must be made and on which a reasonable profit should be earned.

(b) Costs incidental to the operation and maintenance of the properties.

(c) The characteristics of the loads supplied, such as power factor, load factor and diversity factor.

The cost of power delivered at the customer's meter consists of two parts:—

(a) A fixed cost which is independent of the amount of power used, that is, a cost which is the same whether the system is fully loaded or carries very little load.

This part of the cost includes interest and sinking funds payments on the capital invested in the plant, head office salaries, taxes, insurance, operating and maintenance expenses, and a large part of the reserves for renewals and depreciation and contingencies.

(b) A cost which depends on the amount of power used, which includes the cost of the line losses and the generator and transformer copper losses. The core losses which are constant losses independent of the load should properly be included in part (a). In addition to the losses, the remaining part of the reserves for renewals and depreciation and contingencies must be included here.

Water rentals should be included in part (b), unless they are based on the rated capacity of the plant, when they would go into part (a).

Let us assume that the cost of a hydro-electric development including the step-up transformers is represented by $100.00 per horse power or per kilovolt ampere of plant capacity at eighty per cent power factor. Sixty-five to seventy per cent of this is a fixed cost independent of the capacity of the plant and thirty-five to thirty per cent is dependent on the capacity. Fifteen or twenty per cent is the cost of the electrical equipment which depends directly on the capacity.

A transmission line with two double circuits including the step-down transformer station may be taken as costing $50.00 per horse power or per kilovolt ampere.

Interest and sinking fund charges to take care of the capital invested in the system will require an annual payment of approximately nine per cent or $13.50 per horse power.

The other items in the fixed cost would probably amount to about $5.00 per horse power made up somewhat as follows:—

Operating and maintenance costs—		
Generating station	$1.00	per h.p., per year
Transmission line	0.50	" "
Step-down station	0.50	" "
Water rentals	0.50	" "
Taxes and insurance	0.25	" "
Reserve for renewals and depreciation	1.00	" "
Reserve for contingencies	0.25	" "
Head office salaries	1.00	" "
	$5.00	per h.p., per year

This makes the fixed cost per horse power per year, $18.50. If a larger allowance is made for water rentals and contingencies, this fixed cost might be $19.00 per horse power per year.

The efficiency of generation and transmission of the power will be of the order of eighty per cent overall:—

Generator	96 per cent
Step-up transformers	98 "
Transmission line	90 "
Step-down transformers	98 "

Overall efficiency is 82.5 per cent or approximately 80 per cent. This will increase the cost per horse power to, $\frac{19.00}{0.80}$ = $23.75 or $24.00 per horse power per year. This cost of $24.00 per horse power does not make any allowance for profits, (bond interest is not profit), or any allowance for the carrying charges of the development during the years while the load was building up to the full capacity of the station, but it is based on the assumption that the full output is sold and paid for.

Roughly eighty per cent of the cost of power in an hydro-electric plant is the fixed charge covering the items enumerated in part (a), and the remaining twenty per cent of the cost is the variable cost depending on the load delivered. Bond interest is by far the largest single item and it often represents considerably more than fifty per cent of the total cost of power.

In cases where elaborate precautions are taken to insure continuity of service under all conditions, the fixed cost will be largely increased. Such cases are the installation of steam reserve for an hydro-electric plant, duplicate transmission lines on separate rights of way, or expensive storage dams to take care of low water periods. Where the flow of water is regulated by storage dams built by the government, an increased water rental is charged proportional to the amount of water used.

To this cost of $24.00 per horse power or $32.00 per kilowatt, we may add $3.00 per horse power or $4.00 per kilowatt to provide for profits and any omissions. This price of $27.00 per horse power per year or $36.00 per kilowatt per year is based on an assumed generator power factor of eighty per cent which corresponds to a load power factor of about ninety per cent and it represents power taken at one hundred per cent load factor.

If the load power factor is lower than 90 per cent additional costs are incurred and must be paid. For example, if the load power factor is 80 per cent instead of 90, the losses are increased by about 3.3 per cent and the capacity of the electrical equipment in the generating station must be increased about 20 per cent resulting in an increased cost of $1.00 to $2.00 per horse power per year. When the power is taken at a load factor less than 100 per cent, certain reductions in cost result, but they are not in any way proportional to the reduction in the load factor.

Power Factor

Power factor is the ratio of the $\frac{\text{watts}}{\text{volt amperes}} = \frac{\text{kilowatts}}{\text{kilovolt amperes}} = \frac{\text{power current}}{\text{total current}} = \text{Cos } A$; i.e., the cosine of the angle by which the current lags behind the voltage. The reciprocal of this ratio is of interest as it gives a more definite idea of the increase in current to supply a given load due to low power factor, it is the ratio $\frac{1}{\text{Cos } A} = \frac{\text{total current}}{\text{power current}}$

$\text{Cos } A$ =	0.40	0.50	0.60	0.70	0.80	0.90	1.00
$\frac{1}{\text{Cos } A}$ =	2.50	2.00	1.67	1.43	1.25	1.11	1.00
$\frac{1}{\text{Cos } A}$ =	6.25	4.00	2.79	2.05	1.57	1.23	1.00

$\frac{1}{\text{Cos } A}$ represents the increase in current to supply a given load over that required at unity power factor. $\frac{1}{\text{Cos}^2 A}$ represents the increase of line losses in supplying a given load over the losses at unity power factor. A given system delivers a fixed kilowatt load at 100 per cent voltage and at 100 per cent power factor, — the line current is 100; the resistance drop in the system = I R = 10 per cent; and the reactance drop = I X = 30 per cent. The per cent regulation is given by the formula, D =

$$\text{I R Cos } A + \text{I X Sin } A + \frac{(\text{I X Cos } A - \text{I R Sin } A)^2}{200} =$$

14.5 per cent; i.e. voltage required at the generating station = 114.5 per cent of that required at the receiver. Power factor at the generating station is 95 per cent. Loss of power is 10 per cent. The kv. a. capacity of the generators is 114.5 per cent.

With the same kilowatt load at 90 per cent power factor and the same voltage, — the line current is 111 per cent; the resistance drop is 11.1 per cent; the reactance drop is 33.3 per cent; the regulation is 27.7 per cent; the generator power factor is 80 per cent; and the loss of power is 12.3 per cent. The kv. a. capacity of the generators is 140 per cent of the kw. delivered.

With the same kilowatt load at 80 per cent power factor, — the line current is 125 per cent; the regulation is 35 per cent; the generator power factor is 69 per cent; the loss of power is 15.6 per cent. The kv. a. capacity of the generators is 168 per cent of the kw. delivered.

The drop in load power factor from 90 per cent to 80 per cent results in an increase of 3.3 per cent in the losses and an increase of 20 per cent in the capacity of the generators besides requiring a much larger range of voltage and excitation.

Low power factor increases the losses and so increases the variable part of the cost of power but it also increases the fixed cost as it requires the installation of generators of increased capacity and with a larger power factor range.

Another objection is that the voltage at the generating station varies through such a wide range from no load to full load that consumers taking power from any point between the generating station and the end of the line will not receive power at constant voltage. Directly or indirectly low power factor increases the costs of the power company and so must be reflected in the charges to the consumers. Power, except at very short distances from the power station, should be sold at 90 per cent power factor or higher as it is much preferable for the large consumer to correct his power factor by installing synchronous condenser capacity than to deliver large lagging currents over the lines.

In the calculations above the effect of line capacity has not been included but it is to some extent offset by the magnetizing current of the transformers.

The accompanying chart, figure No. 1, shows these results graphically.

The effect of low power factor at light load is much less serious than at heavy load and it is of special importance to maintain high power factor at heavy load. Fortunately this is the general tendency in the ordinary electrical load.

Load Factor

When we are discussing load factor, it is necessary to consider the cost of energy as well as the cost of power. Load factor is the ratio of the average power to the peak power. The interval of maximum load and the period over which the average is taken should be definitely specified, such as "half hour, monthly" load factor.

Peak power is the average power during a time interval of specified duration occurring within a given period of time, that interval being selected during which the average power is greatest.

A power company sells to the consumer; — 1. The right to use a part of its installed capacity (maximum demand). 2. The right to use that capacity for a certain part of the time, (represented by load factor).

The peak power and maximum demand are usually considered to represent the same quantity. The maximum demand is, however, often understood to mean the maximum power contracted for by the consumer and set aside for him by the power company and therefore to be paid for by the consumer. If the actual peak power taken is less than this, the consumer is not making the best use of his contract privileges. If the actual peak taken is greater than the contract value, an excess charge is made. It is here considered that maximum demand and peaks power are the same.

To obtain its required revenue the power company may:—

(A) Charge a fixed amount per horse power per year based on the maximum demand assuming that the load factor will be 100 per cent. This will of necessity be a high charge and the consumer will attempt to keep his load factor high in order to reduce the cost of energy, i.e., the cost per kilowatt hour. In the case worked out above the charge per horse power per year is $27.00 which at 100 per cent load factor is equivalent to 0.41 cents per kilowatt hour and at 50 per cent load factor is equivalent to 0.82 cents per kilowatt hour; — or

(B) The company may make a definite charge per kilowatt hour and fix a minimum load factor or set a minimum monthly payment. To obtain the same revenue as in (A) the charge might be 0.82 cents per kilowatt hour with a guaranteed minimum load factor of 50 per cent or 1.36 cents per kilowatt hour with a guaranteed minimum load factor of 30 per cent; — or

(C) The company may use a mixed rate, making a reasonable charge per horse power per month or year or per kilowatt per month or year plus a graded kilowatt hour charge, as for example: — $1.50 per month per kilowatt of demand, plus 1 cent per kilowatt hour for the first 100 hours' use of maximum demand, plus ½ cent per kilowatt hour for all the rest.

For the privilege of receiving power the customer pays $1.50 per month per kilowatt of demand; for the first 100 hours' use he pays $1.00 per month; for the next 100 hours' use he pays $0.50 per month. If he uses the power only 200 hours in the month the return to the company per month is $3.00 per kilowatt of demand or $36.00 per kilowatt per year which is equivalent to $27.00 per horse power per year. The load factor is 27.7 per cent. The consumer has the privilege of taking more kilowatt hours at the low rate and so improving his load factor and decreasing his energy cost per kilowatt hour.

Power at the time of peak is more valuable than off-peak power, but the off-peak power has a value which can easily be realized by considering the amount of steam produced in the electric steam generators at the plants of the various paper companies in this district.

The sale of off-peak power in large quantities is not all clear gain, however, as water is used which might otherwise be stored above the dam for use at the period of peak load and the operation and maintenance charges in the plant are increased.

The load factor of some electro-chemical industries is over 90 per cent. The load factor of paper mills is of the order of 75 per cent, not including electric steam generators. The load factor of a combined motor and lighting load is of the order of 30 per cent. The load factor of small industrial establishments may be as low as 15 to 20 per cent. When paying for electric power on the mixed rate the higher the load factor the less is the cost of energy and a low load factor means an abnormally high cost per kilowatt hour.

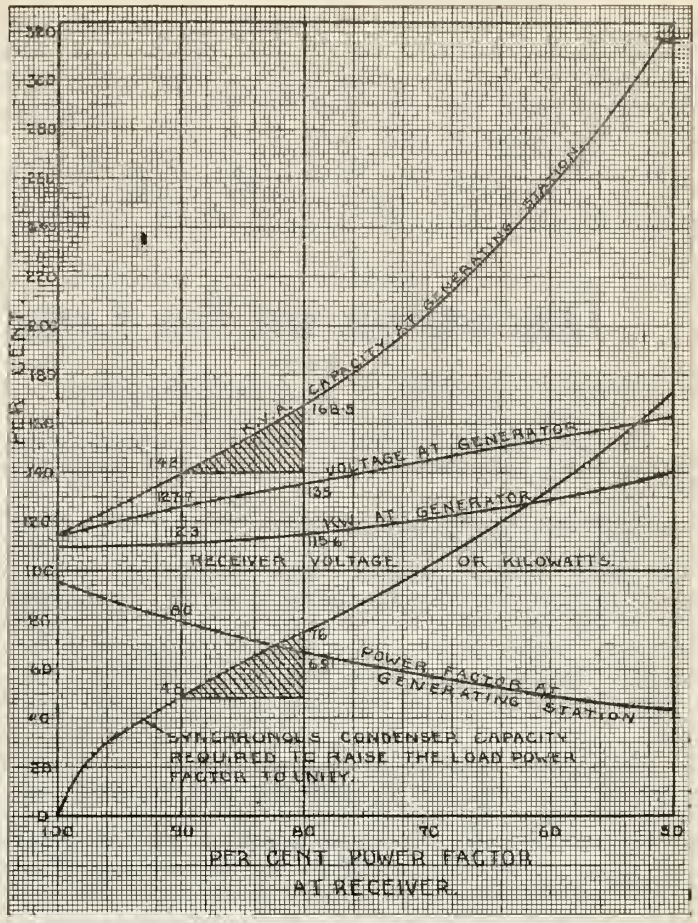

Figure No. 1.—Per Cent Power Factor at Receiver.

Since the fixed cost of power is much higher than the part of the cost which varies with load, the cost of power is very slightly affected by the load factor, but the reverse is true of the cost of energy.

Diversity Factor

Where several classes of load are supplied from the same power development, the average load factor of the total load usually is higher than the average of the load factors of the individual components of the load, due to the fact that the peaks of the various loads do not coincide. In other words the maximum load of the entire system is less than the sum of the maximum loads of the parts of the system. The ratio of the sum of the maximum power demands of the subdivisions of the system to the maximum demand of the whole system at the point of supply is called the "diversity factor" at that point. The greater the diversity factor, the higher obviously is the load factor of the whole system and the higher the economy of the operation of the system.

It seems to be the general impression among small power consumers that the power companies are able to sell their power twice over at least making the diversity factor 2.00. It is possible that in some very special cases a large distributing company with a well diversified load might be able to contract for power up to twice the available supply. This, of course, would only be possible if considerably less than half of the consumers took their peak load at any given time and a very extensive and expensive distributing system would be required. Such a distributing system would probably cost more than the entire power development including the transmission system and it involves very heavy maintenance and operating costs and the power losses in it are large, both the copper losses and the fixed core losses. The power factor particularly at light loads is very low.

A power generating company which sells wholesale to a few systems and large companies cannot contract to deliver power more than 20 to 30 per cent beyond its rated capacity, since the peak demands of the various large consumers occur at approximately the same period during the day, i.e., they are only slightly diversified.

There is no diversity factor applicable to kilowatt hour charges.

The fact that there is diversity enables the power company to serve more consumers than it otherwise could and makes it possible to reduce the charge for power.

Discussion on the Cost of Hydro-Electric Power

Discussion by Dr. L. A. Herdt, M.E.I.C.

Power companies render *service* to its various consumers in the form of light, heat, power and transportation.

Some people feel that service like salvation ought to be free. Unfortunately, power companies cannot give such *service* away. It sells it and the financial returns that it obtains measures its ability to serve. To thinking men it has become a business axiom that, "He profits most who serves best". The properly managed utility company that aims at service first and makes the service a high grade one is the one that will inevitably profit most.

Directly or indirectly power companies serve every home, hotel, store, factory, church, telegraph and telephone with heat, light or power, and in the case of tramways it provides the important service of transportation. The power company furnishes to its various clients energy, and this energy is utilized in the form of heat or light or power. There is no service equally useful to that electricity can render and the comfort, prosperity of the people and the growth of the territory it serves largely depends on it. The people that are thus served are very unfamiliar with the things that are served to them. They cannot see the electric current that gives them this service. They also cannot visualize the dams, power houses, tower lines, and the machinery whose work is necessary to give them this service.

The cost of power is made up as stated in Professor Christie's paper of two parts, one of fixed costs and one variable:—

(A) A fixed cost independent of the amount of power used, this is, the cost which is the same whether the system is loaded or not. This is a *service charge* and should be worked up as a fixed charge per k.w., of maximum demand or per k.w., of connected load

This fixed cost should cover, as stated by Professor Christie, interest and sinking fund payments, depreciation, maintenance and a part of operating expenses, mainly labour.

(B) A cost proportional to the amount of power generated made up of fuel, water, oil, labour, etc. This is a charge for electrical energy at so much per k.w.hr.

(C) To this should be added another amount (C),— a cost depending on the reliability of service, steam reserve in case of a hydraulic plant, duplicate transmission lines, storage dams, etc. Rates for power are therefore to be based on, — (A) is the capacity charge; (B) is the energy charge; (C) is the reliability charge.

In hydro-electric plants, (A) the capacity charge, is large; (B) the energy charge, is relatively small; and (C) can be made large or small depending on the conditions of service. (C) can be absorbed in (A) so that the rates for power is made up of (A) plus (B).

However, if (A), the fixed cost for power, represents in full this service charge and (B), the cost proportional to the amount of energy used it should not be necessary to fix a guaranteed minimum load factor as stated on page 179 (item B), of this paper.

The hydro-electric power company desires to fix its rates to obtain a definite revenue per unit of power, that is from the sale of *power*, — kilowatt. The consumer desires rates fixed to pay a certain amount for electrical energy in k.w. hrs., this to be at as low a figure as possible, his cost of power is to be figured as an amount that should vary with the output of this finished manufactured goods.

The customer in many cases does not understand a complex form of schedule of rates. He wants to know what his energy is going to cost him. The problem is then to find an equitable basis for the cost of this service.

Power Factor. To the non-technical man "power factor" has always been a somewhat mysterious subject.

I was pleased to note that Professor Christie states that the power factor is the ratio of the watts to the volt, amperes or ratio of kilowatts to kilovolt amperes. That is, the ratio of the power current to the total current equals the cosine of the angle by which the currents lags behind the volts. Power factor is a *ratio* not a quantity.

Machine generating capacity is a matter of volt amperes or kilovolt amperes. When a utility plant is loaded to capacity the most vital consideration is to improve the power factor at the time of the station-maximum, and therefore a customer with a relatively poor power factor should properly pay a higher rate for service. He requires more of the station capacity than another customer with equal demand and equal load factor but better power factor.

Some form of power factor clause therefore, which will vary the *demand* component of the customer's bill in inverse ratio to his power factor, constitutes a proper element in rates. The power company would be quite right if its billing charge for service charge was made on a kv.a., basis with a bonus or penalty for power factor above and below a specified amount on *power demand* not *energy*. The power factor clauses with which we are familiar are based upon average power factor; a quantity determined by way of two watthour meters over a long period of time. The consumers average power factor thus determined can be conveniently improved by static condensers operating at times of light load, but this power factor correction does not improve in any way the peak load condition of the power company.

Companies in applying power factor clauses should aim at the improvement of the power factor of the consumer at maximum load rather than seek increased revenues. Difficulties in the satisfactory measurement of anything except the average power factor have handicapped companies in applying power factor clauses based on peak conditions.

What is required is a kv.a., demand meter ranking with the k.w., demand meter in accuracy, cost and simplicity. Professor Christie states that the effect of low power factor at light load is much less serious than at heavy load and that it is of special importance to maintain high power factor at heavy load.

High power factor at full load is of great importance, but *low* power factor at *light* load is a blessing in disguise. Many systems of distribution would show great advantages in voltage regulation by a low power factor at light load as well as by high power factor at full load.

I have dwelt somewhat at length on this matter of power factor correction because it appears to me that insufficient attention has been paid to power factor in this country.

Discussion by Frederick B. Brown, M. Sc., M.E.I.C.

I have followed Professor Christie's paper with much interest. The ordinary layman has the idea that power generation and distribution is a very simple matter. The main things in which he is interested as affecting his business are, the price of power, and the quality of service. Technical questions involving power factor, load factor diversity factor, and so on, do not concern him, except in so far as they touch his pocket-book The price of power to the consumer is usually not the cost of power to the company, or the authorities which supply it. Theoretically, in some communities, the price to the consumer is supposed to be the cost to the producer, but the problem is so complex under these conditions that it is almost mpossible to determine accurately what the cost of power for any particular consumer may be when the consumer is served from a complicated network of transmission and distribution lines.

Professor Christie has brought out the fundamental elements entering into the cost of power to the producer, and shows the theoretical affect of various factors on the cost. The discussion which some of the other members present have contributed, has dealt more with the rates charged to consumers, and methods of billing and the different bases of power contracts, than with the actual factors entering into the cost of production and transmission and distribution, and it is not my intention to discuss the paper from that point of view.

Professor Christie has referred to a sub-divided power cost based on a theoretical developnent cost of $100 per horse-power at the plant, and $50 for the transmission system, making the delivered cost $150 per horse-power, based on the generator capacity at the generating station. With these assumptions he deduces certain costs of power with interest and sinking fund at 9 per cent of the capital cost, and with the other items of cost at the power plant amounting to about $5.00 per horse-power per year, finally reaching a figure of $24.00 per horse-power per annum as the cost of power delivered after providing for the losses from the generating station to the point of delivery. This cost is based on an assumed generator power factor of 80 per cent, corresponding to a load power factor of 90 per cent, and representing power taken at 100 per cent load factor.

As a matter of interest, the following table is submitted showing actual costs of nine different companies of widely varying characteristics in size, voltage, length of transmission lines, and so forth. In the table, the interest and sinking fund charges are considerably less than the 9 per cent figure assumed by Professor Christie, because the cost of money to these companies was in no case as high as that figure. The interest and sinking fund given in the table would average about 7 per cent. From the table it will be seen that the cost of power varies between very wide limits according to the local conditions, but on the whole the same elements of cost enter into the final result, and follow closely the factors of Professor Christie's paper. It is impossible to make an assumption as to how much power is to cost unless all the conditions are known, location and size of plant, length and capacity of transmission line, local conditions of construction, efficiency of design, character and amount of load, and so forth must all be known before even an approximation of power costs can be made. It is a remarkable thing, however, that the cost of power is not greatly affected in most plants of magnitude by variations in capital cost of considerable amount. In a plant having a capacity of say 100,000 horse-power, the addition of half a million dollars to the cost of construction would only add 30 cents or 40 cents per horse-power per annum to the cost of power at the plant. A plant with a high construction cost for generation and a short transmission line might have the same cost of power as a plant with low construction costs at the power house and a long transmission line.

The table has been compiled to show the effect of some of these variations, and is submitted as a matter of interest. One remarkable point to be noted is the relation between the annual cost per horse-power developed and the annual cost per horse-power billed, showing that in most cases the diversity factor offsets the losses in the system.

Memo re Cost of Power.

Company Number	H.P. developed plus purchased	H.P. billed	Cap. cost per h.p. Developed	Transm. miles of primary lines	Annual cost per h.p. developed	Annual cost per h.p. billed
1	1,280	1,207	$166	27	$21	$22
2	3,698	2,132	290	77	24	42
3	860	963	390	79	49	47
4	22,670	10,533	285	92	10	21
5	249,908	244,346	121	40	12	13
6	5,073	5,441	278	171	42	39
7	6,400	4,699	320	296	36	49
8	26,400	29,950	361	500	39	34
9	191,573	201,521	193	467	22	21

Percentage Costs.

Company Number	Purchased power plus overhead, contingencies and M'tce.	Overhead and gen. exp.	Renewals	Cont'g's.	Interest and Sinking Fund	Total
1	28	10	23	1	38	100
2	28	9	20	–	43	100
3	22	10	21	–	47	100
4	70	3	4	1	22	100
5	31	6	10	1	52	100
6	35	11	19	1	34	100
7	18	17	20	1	44	100
8	33	12	18	1	36	100
9	62	5	8	1	24	100

Remarks.

Company No.

1. Small plant, wooden pole lines, 22,000 volts.
2. Three small generating stations, wooden pole lines, 33,000 volts.
3. One plant, wooden pole lines, 44,000 volts.
4. Large plant partly developed, 110,000-volt lines, no diversity, in process of growth.

5. Large plant fully developed, 110,000 volts and 44,000-volt lines, short lines, small diversity.
6. Four plants tied by extensive network, 44,000-volt lines.
7. One plant with extensive network, 44,000-volt lines.
8. Many small plants, extensive network, 44,000-volt lines.
9. Two large plants, fully developed, 110,000-volt network, long lines, large diversity, some purchased power.

In the table, the capital cost figures include the plant and primary transmission system, but no retail distribution lines.

Discussion by P. S. Gregory, A.M.E.I.C.

Professor Christie has derived from basic facts, the cost of producing electric energy from a hydro electric development and I would like to briefly compare his figures with the cost of producing electric energy by means of steam.

I will take as a basis for the cost of producing electric energy by means of steam, the figures given for the Connors Creek plant of the Detroit Edison Company, which were published in the "Electrical World" for August 25th, 1923. This plant carries a maximum load of 158,000 k.w., so that the figures given pertain to a large size plant in which high efficiencies would be obtained. The figures for the twelve months ending June 30th, 1923, are as follows:—

Cost of fuel	0.461c. per k.w.hr.	(79 per cent)
Cost of wages	0.055c. "	(9.5 "
Other operating charges	0.018c. "	(3 "
Maintenance charges	0.049c. "	(8½ "
	0.583c.	(100 ")

The cost of fuel delivered at this plant is $5.85 per ton of 2,000 pounds which is as cheap if not cheaper than it can be purchased in this province. The half hour monthly load factor of this plant averaged 48.8 per cent during the year and at this load factor, the cost per horse power per year, that is the cost of producing 8,760 $\times$ .746 $\times$ .488 or 3,180 k.w.hrs., was:—

Cost of fuel	0.461 × 3180 =	$14.65
Cost of wages	0.055 × 3180 =	1.75
Other operating charges	0.018 × 3180 =	.58
Maintenance charges	0.049 × 3180 =	1.56
		$18.54

The cost per horse power per year at 80 per cent load factor, that is the cost of producing 8,760 $\times$ .746 $\times$ .8 or 5,200 k.w.hrs., based on the same total yearly maintenance charges would be:—

Cost of fuel	0.461 × 5200 =	$24.00
Cost of wages	0.055 × 5200 =	2.85
Other operating charges	0.018 × 5200 =	.14
Maintenance charges	as before =	1.56
		$29.35

To these figures must be added interest and sinking fund charges and a figure of $40.00 per h.p., of installed capacity may reasonably be assumed as the capital charges of the plant. In order to compare with Professor Christie's figures an allowance of 9 per cent to cover interest and sinking fund charges should be added which will bring the total cost of producing electric energy by steam in such a plant as $32.95 per h.p., per year, to which must be added in conformity with Professor Christie's figures, an amount of $2.00 per h.p., per year to cover taxes and insurance, reserves and head office salaries, bringing the total cost to $34.95 or say $35.00.

As this figure includes no allowance for profit it can be compared with Professor Christie's cost price of $24.00 per h.p., per year based on 80 per cent load factor from which it would appear that the cost of producing energy at 80 per cent load factor by steam is nearly 50 per cent higher than the cost of producing it hydro-electrically. This figure would have to be corrected according to the fluctuation in the cost of coal from the stated base price of $5.85 per ton delivered at the plant.

As Professor Christie's figures for the cost of electric energy are as high if not higher than the prevailing power rates, this is evidence that the producers of hydro-electric power in this province do not charge for their energy all that the traffic would bear but give to the consumers the benefit of the lower costs of production. As a matter of fact practically all of the large contracts for high load factor power in this province are at rates very considerably lower than the rates derived by Professor Christie and this power is sold at between one-half and two-thirds of the cost of energy produced by steam.

In a discussion of power rates, the fact must not be lost sight of that from the viewpoint of the consumer the important question is the cost of electric energy per unit of manufactured product or to put it differently the cost of the energy purchased as compared with the cost of labour. In practically all industries except the manufacture of ground wood pulp, calcium carbide or other electro chemical products or of steel in an electric furnace, the cost of the electric energy when expressed as a percentage of the cost of the manufactured unit is a very small figure indeed. It can be readily seen that in a factory employing say fifty men and using 50 h.p., the cost of the electric energy in comparison to the cost of labour will be of the order of 2½ per cent, and if as is frequently the case the horse power per man is less than one, the percentage of electric energy costs as compared with wages becomes almost negligible. I mention this way of looking at the cost of power in order to bring out the fact that the unavoidable increase in the cost of electric power during the past few years is not such a serious thing for power users as might be thought at first and that the manufacturers can in general well afford to purchase all their power requirements at the prevailing rates.

A far more important consideration from the purchasers point of view than the cost of power is the continuity and the adequacy of the supply. In manufacturing, raw materials, labour and power are the essentials and continuous production is impossible if any one of these three are only intermittently available. The loss to a manufacturer consequent upon a shutting off even for a very short period of the supply of power may far outweight the entire cost of the power over a week or even over a month especially in the case of a continuous process plant.

The adequacy of power supply to meet the needs of expansion is equally important. Under proper market conditions many manufacturers can increase their output without additional capital investment provided sufficient raw material, labour and power are available. At such a time the inability to purchase the added power requirements might mean a financial loss of serious dimensions.

In view of these facts the factors for a power user to consider in the purchase of power are in the order of their importance: — First — continuity of supply; second — adequacy of supply both present and future; and finally — cost.

Discussion by P. T. Davies

The author in his paper has very truly stated the elements involved in estimating the cost of power and has arrived at a figure that for cost is not substantially at variance with the cost basis obtaining in the district.

It is not generally understood that fixed charges make up the bulk of the cost of supplying power even when such power is generated by steam.

The writer some little time ago analyzed the costs of the largest aggregation of steam plants in the world, that of the Chicago Commonwealth Edison, and was not surprised to find that even when coal was the prime source of energy that the fixed charges were over 85 per cent of the total expense of running the company.

It is a fact that if every customer on the line of an electric company cut his load down to one k.w.hr. per month, that the actual expense of running an hydro-electric system would not be decreased by more than 10 per cent, this fact would predicate the practice of selling all electrical energy on a flat rate basis and this was the original method adopted by power companies for the sale of its product. This practice, however, lead to waste and was not popular; the apparatus available for measuring and limiting demand was not satisfactory so that flat rates for at any rate small power and lighting have not been retained.

A major item in the cost of power lies in storage either daily or seasonal. A plant with no storage can only develop for a 100 per cent load factor, whereas if there is a pond equal to one day's flow of the river, manifestly the plant can be installed to develop this amount divided by the load factor. A concrete example of this is the present development of the St. Francis river at Drummondville; the present development has practically no storage so that all that can be obtained is the flow of the river; the plant under construction 3 miles above will however have a 24-hour storage, and as the system's weekly load factor is around 55 per cent the original plant can now be doubled.

With storage, every kilowatt hour becomes of value and waste of power is to be discountenanced, therefore flat rates are certain to be eliminated although the economic equation is 90 per cent solvable in terms of flat rates.

The writer has no quarrel with Professor Christie's figures but does believe that the allowance or head office overhead is low. The item taxes and head office salaries only amounts to $1.25 per h.p., or about 4 per cent of the $27.00 arrived at. In the writer's opinion, these items should be nearer 20 per cent if efficient well paid management and normal taxes are to be paid. While $27.00 a h.p., is a fair figure of cost for 10 hour customers, a figure of $35.00 per h.p., would be nearer cost for 24-hour power at the 2,200 volt busbar.

One of the main items in the cost of power at the customer is distribution, and I would like to go a little outside this paper in discussing this to emphasize this item of expense. Consider for a minute the capital costs per customer for distribution on a lighting system. Including meters, the cost for one mile of line, 80 customers fed with reasonably regulated voltage will be some $3,200.00; 80 lighting customers will have a demand of not over 8 k.w., so that the cost per kilowatt for distribution will be $400.00 or $300.00 per h.p., which is double the total cost for generating and transmitting noted in Professor Christie's paper.

It is a fact that the generating cost is a small item to an electric company, that if it had its power given to it to-morrow, it could not reduce the rates for this cause more than ½ cent per kilowatt hour. The main cost of serving small customers and many large ones is the distribution expense plus the commercial expense involved in attending to them.

Professor Christie is to be congratulated upon again referring to that old man of the sea "Power Factor". I am unqualifiedly in favour of billing on a kv.a., basis entirely and tearing up all our contracts which are made on a k.w., basis and mean nothing but an approximation.

The Storage of Bituminous Coal.

Losses which may occur in Storage Coal and Proposed Remedies

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Paper read before the Sault Ste. Marie Branch, The Engineering Institute of Canada, January 25th, 1924.

This subject has been given so much study and research that it is probably impossible to give anything new upon it. Still, without doubt, large losses continue to occur in storage coal and the object of this paper will be, first, to review some of the losses that may and do occur; second, to consider some of the remedies proposed and wherein they have failed or not proven expedient; and third, to point out the advantages of one remedy which the author believes applicable to the majority of cases and which will eliminate most of the loss at an expense commensurate with the loss prevented.

Losses in Storage Coal

The largest collective loss in storage coal is probably the loss due to actual combustion or "firing" of coal in the storage pile, where the heating or oxidization is so rapid and the conditions for heat dissemination so poor that the coal actually catches on fire and strenuous methods are necessary to avoid total loss of the pile. In these the approximate loss may be easily ascertained.

The losses which occur when the oxidization is not sufficient to ignite the coal are less readily discernable and probably, in the majority of cases, escape detection. Especially is this so when the coal is used for steam producing purposes only.

Table No. 1 gives the results of an experiment in which samples of coal ground to pass through a 200 mesh screen were subjected to oxidization at a temperature of 100° C., for periods of from two to eleven days. These results show the loss that may occur under conditions favorable to oxidization, even at this low temperature.

Figure No. 4 is a photograph of crucible tests of the samples from tests tabulated in table No. 1, and gives a good indication of the effect of oxidization on the coking property of the coal. The sample after eleven days

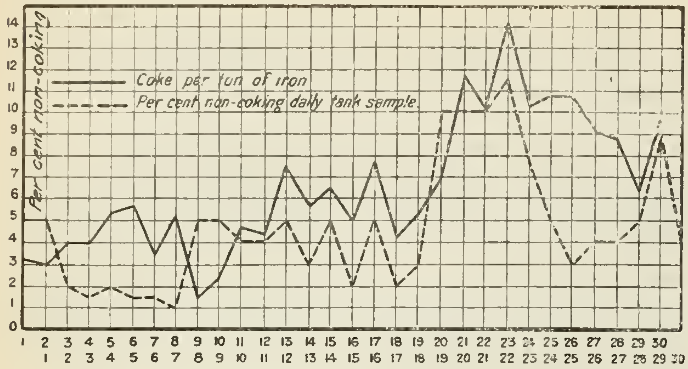

Figure No. 1.—Variation of Coke used per Ton of Iron Produced in Blast Furnaces.

heating showing that the coking property has been practically destroyed.

This test shows that under conditions of heating and oxidization which, to say the least, would not cause any apprehension as to trouble, a loss in heating value as high as 13.7 per cent may occur. Such a loss would probably pass by with practically no consideration when the coal is used for steaming purposes.

Table No. 2 tabulates a case in which a sample was taken from actual storage coal after approximately eight months in storage. This sample was separated into various sizes as shown and ultimate analyses taken on samples 1, (that portion over ¼ mesh screen), 2, (that portion between ¼ mesh and 1/8 mesh), 3, (that portion through 1/8 mesh), and 9, (that portion through 100 mesh). This actual case shows a loss of 19 per cent of the heating value in the case of that portion through 100 mesh in spite of the fact that no actual combustion occurred in the storage pile.

Seriousness of Losses in Coal used for Coke Manufacture

When the coal is used for the manufacture of coke and the by-products which may be obtained, the losses are of a much more serious nature. In most cases the coke is used for metallurgical purposes and must possess physical characteristics which will enable it to stand up under the burdens necessary in these operations. If these physical properties are not up to the standard, the burden must be lightened, which results in decrease of production and increase of coke and raw materials per ton of product.

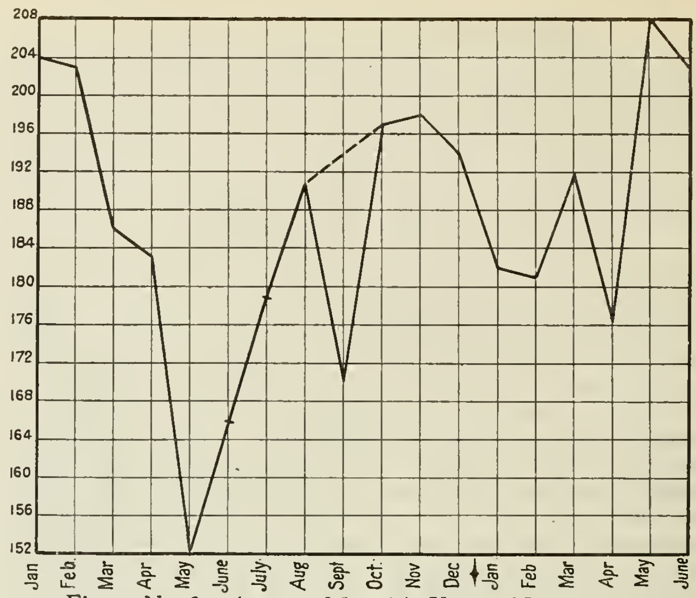

Figure No. 3.—Average Monthly Yield of Light Oil for two Seasons.

While the exact losses are difficult to segregate and determine our experience has shown that a loss of one dollar per ton of coal used may occur under circumstances where no great trouble has been experienced with heating in the storage pile.

Graph 1 shows how the coke used per ton of iron produced in a blast furnace may vary with the per cent of non-coking coal used in the coking mixture. When the other variables entering into blast furnace operation are considered, the similarity of these curves is remarkable.

The effect of the use of oxidized coal for coking purposes is more clearly shown by its effect upon the yield of by-products when coked in by-product ovens. The by-products obtained are gas, ammonia, tar and light oil. Graph 2 is a curve of the average monthly yield of ammonium sulphate for a number of years and shows clearly the loss of production due to oxidized coal used during the early spring months. This loss may run as high as 5 pounds sulphate per ton coal, (about 15 cents per ton coal at average market price). Graph 3 is a curve showing a similar variation in yield of light oil for two seasons and shows that the loss may be as high as 20 per cent. The decrease in yields of gas and tar is similar.

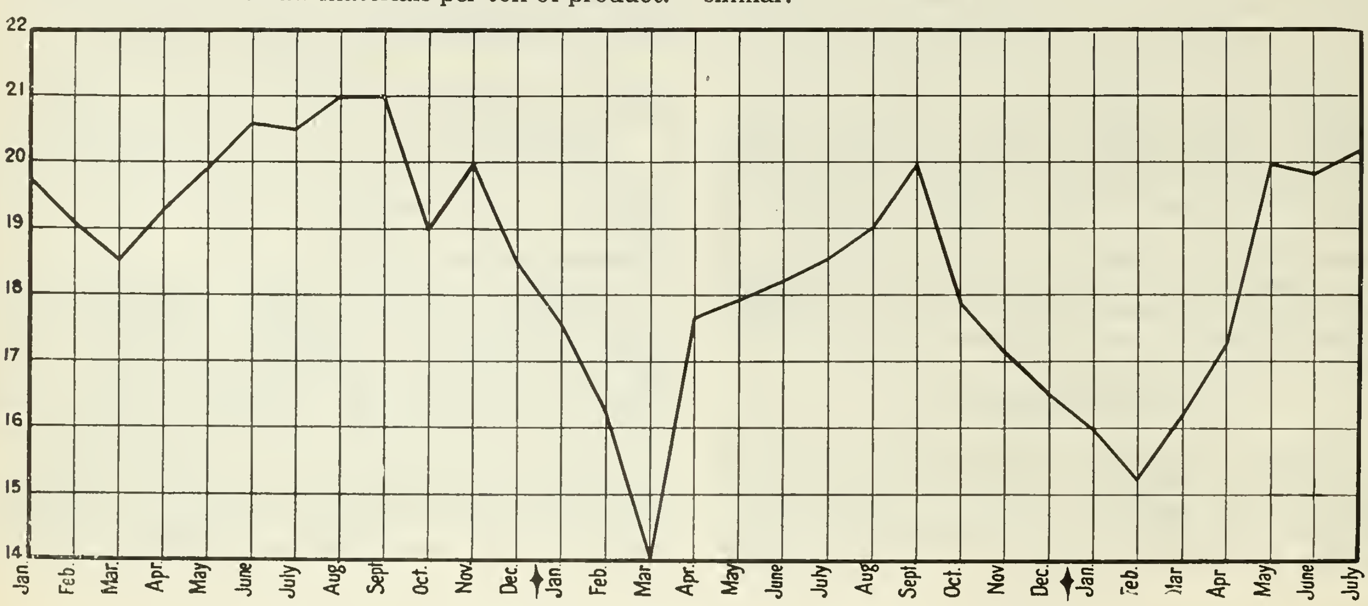

Figure No. 2.—Average Monthly Yield of Ammonium Sulphate from 1914 to 1922

TABLE No. 1

Sample	Time of heating days	Increase Weight per cent	Coking quality	Ultimate Analysis C per cent	H_2 per cent	N_2 per cent	O_2 per cent	S per cent	Ash per cent	*Calculated B. T. U.	Per cent B. T. U. Loss
1	0	0	good	78.18	5.03	1.48	7.08	1.31	6.92	14,037	0
2	2	1.94	fair	76.08	4.99	1.40	9.51	1.37	6.64	13,519	3.69
3	4	3.14	medium	74.99	4.88	1.40	10.72	1.31	6.70	13,196	5.99
4	6	3.90	poor	73.83	4.66	1.37	12.23	1.35	6.56	12,774	9.00
5	11	4.30	pract. dest.	71.48	4.50	1.32	15.02	1.32	6.42	12,114	13.70
†6	11 at 125°C.	7.82	none	68.31	4.16	1.23	18.79	1.31	6.20	10,962	21.90

*14,600 C + 62,000(H — 1/8O) + 4,050 S †Special test run for 11 days at 125°C.

Taking everything into consideration a loss as high as two dollars per ton coal may easily occur even under conditions of oxidization which are not severe enough to cause extensive combustion.

Proposed Remedies

The problem of preventing combustion or oxidization may be solved either by preventing the access of air to the coal or by establishing conditions in the storage pile such that the air has little or no effect.

Many simple remedies have been proposed which prove efficient on small stocks but when applied to large stocks they involve expense and trouble too great to be economical. Ventilation of the pile is one of these. Ventilation, to be effective, must be very thorough; under-ventilation is worse than none at all.

Much trouble can be avoided by careful attention, during stocking, so as to avoid segregation of the lumps and fines as the lumps provide easy access for the air and the fines ideal conditions for oxidization and the accumulation of heat. Certain coke companies in addition to this careful attention have coated the outside of the pile with mud, thus further preventing the access of air. I understand that the results have been very satisfactory. All of these remedies require almost expert attention to make them effective.

Of all the systems recommended, that of stocking under water comes the nearest to being ideal. However there are very few cases where the expense involved and the weather conditions will permit the use of this method.

The system which is applicable and effective in the large majority of cases, regardless of weather conditions and size of storage and in which the expense involved per ton will vary only slightly with the size of the operations, is that of screening the coal at the point of storage and stocking the lump and screenings separately. I know of cases where lump coal has been in stock for seven or eight years and its coking property, etc., not appreciably affected at the end of this time. The screenings should be used first, as produced if possible, but in case it is necessary to stock them the deterioration is small as the air has little chance to gain access to the pile.

The screening plant may consist of a small portable outfit for small operations but in any case the screening is a simple and inexpensive operation.

In many cases where lump coal is required or preferable for certain uses and where snow and water interfere with winter use, this system effects a saving in addition to the prevention of combustion and oxidization.

ORIGINAL 2 DAYS 4 DAYS 6 DAYS 11 DAYS

Figure No. 4.—Crucible Tests of the Samples Tabulated in Table No. 1.

TABLE No. 2, HEATED COAL FROM STOCK PILE

Sieve Test			Per cent
1. On	1/4″	mesh	49.6
2. On	1/8″	"	19.1
3. Thru	1/8″	"	31.3
			100.0
4. On	20	mesh	13.75
5. On	40	"	7.75
6. On	60	"	4.00
7. On	80	"	0.25
8. On	100	"	1.25
9. Thru	100	"	4.75

	Ultimate Analysis C per cent	H_2 per cent	N_2 per cent	O_2 per cent	S per cent	Ash per cent	Calculated B. t. u.	Per cent Loss
1	74.25	5.00	1.50	8.08	1.37	9.80	13,370	0
2	74.00	5.00	1.44	9.21	1.15	9.20	13,238	1.0
3	71.72	4.27	1.37	9.33	0.91	12.40	12,430	7.1
9	66.00	3.37	1.17	13.01	1.20	15.25	10,764	19.0

The Fuel Problem

A review of the Fuel Situation in Canada, the Problems, and Progress towards a Solution

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Paper read before the Annual General and General Professional Meeting, The Engineering Institute of Canada, Ottawa, January 23rd, 1924.

Introduction

The question of the fuel situation of Canada is one of such interest to the country as a whole and of the utmost importance to the people of Ontario and Quebec that no apology is necessary for its introduction at this time. It is one which should not be allowed to pass into the background until a remedy is secured for our present condition.

I do not think any more clear or concise exposition of our fuel situation has been given than in the interim report of the Dominion Fuel Board, issued last spring and although I am satisfied that most, if not all, of those present are quite familiar with that situation, I think it would be well to present it again briefly, as it affects the whole Dominion, then to outline the problems, especially that which we consider to be the most urgent one facing this country, and finally to indicate what progress the Fuel Board and others have made towards a solution, and the plans being made for the future.

Outline of our Fuel Situation

Canada's annual consumption of all kinds of coal, as you know, varies from twenty-nine to thirty-five million tons, and although we have enormous resources, estimated to be about one-sixth of all the coal in the world, these are so distributed that we have been unable to draw our full supply from them, but are forced to import over half of this amount from foreign fields to the south of our border. The uncertainty of dependence on a single source of supply for our most populous and industrialized centres has been demonstrated several times in the past and constitutes a real danger when that source is not under our own political control.

While the great national problem facing us is a supply of fuel for what has been called the "Acute Fuel Area", embracing Ontario and part of Quebec, the seriousness of the situation for the present has to do with a supply of domestic fuel for this particular area and to the fact that this supply is being drawn from a small area in Pennsylvania where the reserves of coal are not large and exhaustion is in sight. The fact that we are drawing our domestic supply of fuel from a foreign source and that that supply may not be available for us very long either because of exhaustion of the supply or through legislative action, makes us conscious of our unsatisfactory position. To overcome this position constitutes our most urgent problem.

Disturbances in the production and transport of coal have recently accentuated our precarious condition and have brought us to a realization that insofar as coal is concerned we are a deficit country. In 1923 our deficit was about 20,000,000 tons.

The World's Coal Trade

It will provide an interesting and instructive background to our own fuel situation if we consider for a minute the coal situation of the world. Whether it affords us any comfort or not and whether or not any lesson can be drawn, it is interesting to note that in having to import coal, Canada is in the same position as most of the countries of the world. There is, however, this difference, that we have the coal, and plenty of it. In the case of most of these other countries their deficiency cannot be overcome except by imports, because it is due to the unequal distribution of the coal fields of the world and to the fact that international boundaries have not been defined with respect to these coal fields. These boundaries, if not largely accidental in their location, have been defined in accordance with physiographic features such as mountains, valleys, or bodies of water. Only recently have people become conscious of mineral resources and their tremendous national importance and it is only in modern times that attempts have been made by nations to alter boundaries so as to include important mineral resources, such as coal, iron or oil. This consciousness has in recent years been one, at least, of the causes of war.

If we look at the coal situation of the world we find that three countries dominate the coal trade, namely, United States, Great Britain and Germany, because the great coal fields of the world are situated within their boundaries. They produce normally over eighty per cent of the total world production and, in addition to being the chief consuming countries, they are the countries having the largest exportable surplus.

The chief deficit countries, on the other hand, are France, Italy, Holland, Switzerland, Austria, Spain and the Scandinavian countries on the east of the Atlantic, and Canada, Brazil, Argentine and other South American states on the other side. Of the exporting countries Germany normally dominated the land trade of Central Europe, while British coal controlled the maritime trade of the Atlantic, providing fuel for the countries bordering the North sea, Baltic, Mediterranean and the Atlantic coasts of Spain and France. A small trade is done with the south Atlantic countries. United States sends the major portion of her exportable surplus to Canada and the remainder goes to Central and South America and only a small portion crosses the Atlantic, mainly to Italy.

Such are the broad features of coal production and movement in the world. If we were to go into the question of the zones controlled by the different producing fields we would find that the controlling factors for each field, are:—

(1) Geographical location,
(2) Cost of production, and
(3) Quality of coal.

Governed by these factors each field under normal conditions of trade has its own recognized and fairly well defined market and this market is determined not by proximity to the coal field, but primarily by the cost of transportation, and only to a minor extent by political boundaries. For example, under present freight rates, it costs no more to carry coal three thousand miles across the Atlantic than it does to transport it two hundred miles by rail over here. This is what gives Great Britain, whose coal fields are only a few miles from the sea, so much wider range for her coals than the United States whose coal fields are two hundred to four hundred miles from the sea.

Fluctuation in costs of production, changes in transportation rates or industrial disturbances, will cause some shifting of the zones controlled by each field, as was the case when American coal went to Great Britain during the strike of 1921 and again when British coal came to the United States in 1922, but unless substantial tariffs are applied against certain coals, political boundaries do not affect the shifting of the market zones.

A study of the coal trade of the world indicates clearly that except as it is affected by tariff barriers coal, from each field moves freely into definite markets which are determined primarily by the cost of transportation, to some extent by cost of mining and the quality of the coal, but only slightly by political boundaries. An appreciation of this fact makes it easy to understand why we are importing coal from a foreign country when we have an abundance of our own. It is one of the consequences of the uneven distribution of the natural resources of the earth and of laying out political boundaries in defiance of natural conditions.

The Problems

Canada is faced with a number of problems insofar as coal is concerned. Some of these, however, are of local importance, while others must be met and solved by the industry itself.

The coal industry of Vancouver Island for example, is faced with a problem brought about by the competition of cheap fuel oil from California, Mexico and Peru.

Alberta's problem is to extend her markets to absorb the production she is capable of making and so permit of more uniform production throughout the year. Her capacity to produce is said to be about fifteen to twenty millions while her markets will only absorb about seven millions. It would appear as if Alberta will have this problem with her always because of her enormous resources and the ease with which new mines can be opened. She will be constantly striving to secure new markets for the production she is capable of making unless steps are taken to prevent the opening up of new mines that are not necessary to supply existing demand. This is a problem arising out of a superabundance of coal resources. The provincial government has already met with distinct success in extending the markets for Alberta coal.

In Saskatchewan there is the problem of the utilization of the great lignite beds.

In New Brunswick the industry is faced with a problem of how best to mine their thin seams and make the greatest possible recovery.

In Nova Scotia there are problems of markets, of submarine mining and of increasing the production to supply the demands of our eastern provinces.

These are some of the problems with which we are faced. The great problem and the one of national importance, however, has to do with our imports of coal into the coal less area of Ontario and western Quebec. The most urgent phase of this problem is how and where to secure a substitute or substitutes for about five million tons of anthracite imported from the United States. This is the problem to which the Fuel Board is giving special attention at present and in this the board is glad to express its appreciation of the valuable aid the Fuel Committee of *The Engineering Institute* has already given.

There is no occasion to believe that the substitution in Canada of other fuels in place of five million tons of American anthracite would be considered by the Government of the United States as an unfriendly act. There is on the other hand reason to suspect that any action we might take in this direction would be considered officially as a neighbourly action and meet with approval because of the condition of the anthracite industry, the dwindling reserves and expanding market in the United States.

Canada has been treated very generously both by the government of the United States and the coal operators in the matter of a supply of anthracite and the attitude is expressed officially in a publication by the United States Geological Survey called "World Atlas of Commercial Geology, 1921", when, in referring to exports of coal in 1913, the statement is made—"About ninety-eight per cent of the anthracite and seventy-five per cent of the bituminous coal went to Canada. The trade with Canada should be considered a part of the regular domestic business of the United States which American shippers are under quite as great obligation to maintain as the "lake movement" or the "New England movement". This relationship was recognized during the war in the close co-operation between the United States and Canadian fuel administrations."

The ninety-eight per cent of anthracite referred to represents only five per cent of the total production and this, no doubt, could be absorbed in the home markets. Such at least is the inference to be drawn from the threatened legislative action to place an embargo on the export of anthracite. Except politically, Canada's problem with respect to anthracite is no different from that of the New England states or the north central states, all of which are seeking substitutes for anthracite. If, therefore, we can procure substitutes, either native or foreign for this five million tons of imported American anthracite, we will relieve ourselves of considerable anxiety regarding a domestic fuel supply and at the same time meet the desires of our neighbours to the south. This, as I see it, is our most urgent fuel problem.

Progress towards a Solution

Now let us see what progress has been made to date towards solving the problem.

The Dominion Fuel Board was created by Order-in-Council, November 25th, 1922, on the recommendation of the Honourable Charles Stewart and consists of permanent officers of those government departments whose activities bear on our fuel situation. Its duties are to make investigations and keep in touch with the fuel position of Canada and to report on the methods by which shortages may be overcome and relief obtained from dependence on foreign and uncertain sources of supply.

On undertaking its duties the board found that considerable progress had already been made towards a solution of both our domestic and industrial fuel difficulties.

The situation in Manitoba was being attacked from two points of view, each with the object of displacing foreign coal, both domestic and industrial, that was being imported annually into that province from the United States. The government of Alberta, forced by the necessity of obtaining wider markets for the coal her mines are able to produce, undertook a campaign some four years ago to substitute her own coals in Manitoba for both kinds of imported coal. On the other hand, the Lignite Utilization Board about the same time commenced investigations with the object of converting the low grade lignites of southern Saskatchewan into a suitable substitute for the 400,000 tons or so of imported anthracite. Unfortunately for the Lignite Board, the government of Alberta had an easier road to travel towards a solution of this problem and reached the objective first.

What progress has been made on the Manitoba problem may be seen by the decrease in the quantity of anthracite going into that market. Progress in the displacement of industrial coal has not been as great. The yearly quantities of anthracite going to the Head of the Lakes and entering Manitoba from other ports are as follows:

Year 1919	478,582 tons
" 1920	308,202 "
" 1921	291,614 "
" 1922	74,531 "
" 1923	100,063 "

The results obtained are entirely to the credit of the Alberta government and have nothing to do with the Fuel Board. The completion of that work may well be left in the hands of the provincial government and of the Alberta coal operators.

In the east, excellent work in producing a domestic fuel out of peat was done by the Joint Peat Committee of the Dominion and Ontario governments. Machinery was developed, methods of operation devised and costs worked out and a demand for peat fuel created. The plant at Alfred has now been turned over to a private company which guarantees to operate it and produce peat fuel next summer.

Because of our enormous resources peat offers a partial substitute for anthracite and it may be used instead of anthracite in furnaces during the spring and fall and in kitchen stoves all the year round. It is also an excellent substitute for soft coal in grates. If our peat fuel industry were fully developed it could replace possibly about twenty-five per cent of our domestic fuel requirements.

Substitution of our own fuels for imported coal in the Manitoba market and the development of a peat industry in Ontario were the most important steps taken before the formation of the board to solve our domestic fuel problem. Owing to the strike in the anthracite and bituminous fields of the United States in 1922 and the consequent danger of a fuel famine during the winter, steps were taken shortly before the formation of the Board by Canadian dealers to import British coal as a substitute fuel. The coal imports from Great Britain for that year indicate the quantity received from that source.

Reference is made later to the progress made in replacing imported industrial fuel by the development of our water powers.

Substitutes for Anthracite

After a survey of the whole problem of imported fuels and a consideration of the progress made to date, the board, for reasons already given, decided to apply itself to the most urgent phase of the problem, namely, the replacing of the remainder of the imported anthracite by a fuel suitable for domestic purposes.

Alberta Coal

Several substitutes immediately presented themselves, the most obvious being that of the domestic fuels of Alberta. Here were a variety of fuels some of which had already proved entirely satisfactory for domestic purposes, and could be produced in sufficiently large quantities. The question, however, was one of the cost of transportation and of delivery in the consumer's cellar in Ontario cities.

After a discussion of this question with the chief freight traffic officers of the National Railways, the Department of Railways and Canals and of the Railway Commission, the board agreed that since the matter involved a question of government policy in connection with the National Railways it would be advisable to leave it in the hands of the committees of the Senate and House of Commons on fuels. Everyone is familiar with what followed, namely, an offer by the National Railways of a greatly reduced freight rate for a limited season of the year and the advantage taken of this offer by Alberta coal producers.

By-Product Coke and Nova Scotia Coal

Another substitute favourably considered by the board was the so-called domestic coke made in by-product recovery ovens. This commended itself to the board because it would permit the use of New Brunswick and Nova Scotia coals which, being bituminous coals, were in their raw state, subject to the same prejudice by anthracite users as the soft coals of the United States. In addition there were the great bituminous coal reserves of the United States which could be imported for coking purposes into areas incapable of being served by our own fuels.

The board was so impressed with the idea of substituting coke for anthracite that one of the first public announcements made by the minister, after the creation of the board, dealt with the necessity of gas companies applying the scheme of establishing by-product recovery ovens in our larger cities where the consumption of gas was already sufficient to warrant the building of the smallest commercial sized unit. Following up this idea, the board engaged a highly qualified engineer, Mr. J. L. Landt, to make a survey of the conditions surrounding seven of our largest cities, namely, Quebec, Montreal, Ottawa, Toronto, Hamilton, London and Port Colborne, with the object of determining whether or not it would be commercially feasible for private interests to establish by-product recovery ovens at these points. The field work for this investigation has now been completed and the results are being compiled into a report.

There is no doubt among those who know how to use it that by-product coke is a better domestic fuel than the anthracite now being imported from the United States. It is cleaner and can be sold at a lower figure. The tendency, therefore, in the larger cities of the United States today is to replace the use of anthracite by coke. Its use is also being extended from year to year in the maritime provinces and an announcement was made some time ago by the president of the British Empire Steel Corporation that it was the intention of that company to build a plant in Montreal and so extend the use of coke made from Nova Scotia coal into the provinces of Quebec and Ontario. This decision on the part of the British Empire Steel Corporation is highly important and if carried out will be the greatest advance made in the east towards extending the use of Canadian coal and the displacement of anthracite.

The results of the investigation made by the board's engineer on this subject would indicate that the conditions are favourable and the time is ripe for the adoption of this plan at a number of points. While the quantity of coke that can be manufactured is governed by certain factors mainly the gas consumption, it would appear that if plants were built at points where it is now considered commercially feasible to do so it would be possible to produce coke enough to displace from twenty-five to thirty-five per cent of our total anthracite importations.

These plants would mean a capital investment of several million dollars, and when in operation would find employment for about one thousand men and disburse some two and one-half millions of dollars annually for supplies, wages, etc. The first of these plants with a capacity of about 300 tons of coke per day has just been erected in Hamilton and will be in operation next month.

In order to encourage the use of domestic coal in the manufacture of by-product coke the board with the co-operation of the Mines Branch has conducted an exhaustive investigation into the coking qualities of the coals both of New Brunswick and Nova Scotia. Samples were taken for analysis from all the coal seams and the fusibility of the ash determined. In addition larger basket samples were taken and shipped for testing to different coke ovens. Large scale tests are also being conducted in the new ovens at Hamilton of four carloads of selected coal, one from the Minto field of New Brunswick and three from different fields in Nova Scotia. This investigation will serve to advertise the suitability of eastern coals for coking purposes and the quality of coke that may be made from them.

British Anthracite

The strike in the anthracite and bituminous fields of Pennsylvania in 1922 and the threatened shortage of coal in Canada gave the British coal producers an opportunity to get into the Canadian market which they were not slow to seize. By the close of 1922 there was imported into Canada about 640,000 tons of bituminous coal and 180,000 tons of anthracite making a total of about 820,000 tons of coal. For 1923 the imports are estimated to be over 530,000 tons, of which 261,659 tons was anthracite. The reduction in imports from Great Britain for 1923 was due to steady production in American mines during the year and the increased demand for British coal on the continent due to the stoppage of mining in the Ruhr.

Since 1922 British anthracite producers have become fairly familiar with the Canadian situation and fully appreciate the advantage they had in the matter of freight rates over their American competitors for the anthracite market in St. Lawrence points. Cargoes at that time could be contracted for at $1.75 per long ton from Swansea to Montreal as against a rail rate of $4.40 from the anthracite fields of Pennsylvania to Montreal. The price of coal at the mine in South Wales was, however, higher than the price at the mine in Pennsylvanie though this is fully offset by the better quality of the Welsh coal.

It would appear as if this movement of British coal to Canada were likely to be a continuous one and I was informed before leaving England by a member of the firm of Cleeves Western Valleys, the biggest producers of anthracite in Britain, that that company had made arrangements for a branch in Montreal where their coal would be screened and sized before being sold to the consumer. Other British anthracite companies are even establishing agencies in New England coast cities, which, by the way, is an indication of the acuteness of the anthracite situation even in parts of the United States.

There is another aspect of this movement of British coal to Canada which is important and one which has a bearing upon inter-Empire trade. At present Canada has an excess value of exports to Great Britain over imports of over two to one, amounting last year to over $200,000,000. Owing to the nature of the material carried in each direction there is apparently a much greater tonnage of freight than these figures would indicate going from Canada than there is coming in. The movement is evidently an unbalanced one and the freight rates in either direction are consequently higher than they might be if the traffic were more evenly balanced. Coal is the only commodity that Great Britain has to export to us in any bulk that would serve to rectify this condition in any degree. Any increase in the tonnage from east to west, therefore, should have some effect in lowering rates on our commodities going to Great Britain.

Wood

The most promising sources from which we hope to obtain substitutes for the diminishing supplies of American anthracite are Alberta coal, by-product coke, Welsh anthracite and peat. In addition an investigation is being undertaken to determine the extent to which more use could be made of our hardwoods for fuel purposes. At present wood comprises one quarter of the fuel consumed in Canada and amounts to about one cord per head of population. There is no doubt that under proper management wood could be used to advantage to a greater degree than at present.

Other Investigations

In the field of industrial fuel, plans have or will be made by the Fuel Board to explore certain avenues that give promise of leading to the use of substitutes for imported coal or the more efficient use of the fuels available. It is proposed for example to investigate and report upon the use of pulverized fuel in locomotives and power plants. An investigation has been under way for some time into the system of central heating and its application in certain sections of our cities. Several central heating plants are already in successful operation both in Canada and United States and there would appear to be a field for its wider application. Both pulverized fuel systems and central heating plants permit of the use of cheap low grade fuel and great economies are claimed for both systems. If there is virtue in either or both, a report from the board will assist their application. A central heating system is being installed in Winnipeg and terms have been worked out at which heat is to be delivered to consumers. Our investigations indicate that other cities are considering the adoption of this system particularly in the west where advantage may be taken of low priced fuel. Other investigations contemplated by the board include furnace design and the use of insulating material in house construction.

Recovery of St. Lawrence Markets

Although the imports of bituminous coal into Canada were greater in 1923 than any previous year it is gratifying to note the success which has attended the efforts of Nova Scotia coal producers to recover the markets of the St. Lawrence lost during the war.

The shipments into St. Lawrence points during 1923 amounted to about 1,700,000 tons and if it had not been for the strike in July these would have exceeded the shipments of any previous year. This has been accomplished in the face of competition from low price bituminous coal from the United States.

The Influence of Water Power

No statement of the fuel problem of Canada can afford to omit reference to the development of our water powers and the great relief that has thereby already been afforded to the coal situation.

From 1886 to 1913 the total coal consumption increased in a fairly regular manner in proportion to the population and in 1913 the total first exceeded 30,000,000 tons. *In 1921 however the total consumption was less than in 1913.* In 1922 it was 12 per cent lower than in 1921, but 1922 was a year of restricted consumption.

It can be clearly shown by analysis of official statistics that this stationary or even slightly decreasing total consumption of coal over 9 years is due to the increasing use of water power in industry. Over approximately this period, *while the population increased 20 per cent the use of water power in industry increased 254 per cent.*

The analysis of statistics referred to included the uses of coal for different purposes and the amount of water power and fuel power used in industries and it practically confirmed the now generally accepted figure for the coal equivalent of water power, i.e. 9 tons of coal per installed horse power per annum. The total saving of coal due to our present development is now over 29,000,000 tons per annum, worth at $10. per ton $290,000,000. a year, and most of this represents money that would have been sent abroad if this water power had not been developed.

These figures apply to the whole Dominion but the particular point of interest is to apply the results to the acute fuel area, Ontario and Quebec.

The combined coal consumption of these provinces for 1921 was 18,690,000 tons but the coal equivalent of developed water power in the same area is over 23,000,000 tons, so that *but for this developed water power Ontario and Quebec would require considerably more than twice their present supply of coal.*

It is therefore evident that one of the greatest factors in improving our coal situation is and will be an active policy of water power development.

Conclusion

It is evident that the problem of the fuel supply of Canada is not simple or easy of solution and I have not attempted to do more than briefly outline it. I have then indicated the steps that have already been taken and the most important plans being carried out to arrive at a solution. The Fuel Board has other avenues to explore and other plans in view but it was not considered necessary to present them here. I have indicated what progress has been made towards a solution and I think the results are very gratifying. There is, however, still much to be done before we can say that our position is entirely satisfactory. It is especially urgent that consumers of anthracite recognize the necessity of securing and using substitutes for our anthracite importations. For this there are several reasons, namely:

(1) The certainty of ultimate exhaustion of American anthracite supplies.
(2) Possibility of an embargo against export.
(3) Rising prices.
(4) The fact that Canada cannot control supply, price or quality of this coal.

A change from one fuel to another cannot be made satisfactorily in a few days, months or even years, but since a change may be forced upon us suddenly it behooves us to make our plans in advance so that we will be fully prepared for the time when Pennsylvania anthracite can no longer be obtained.

Perhaps the most important and gratifying feature of the whole situation has been the development among Canadians of a consciousness of our position as regards fuel and a determination to rectify it. This is of prime importance and must result in an improvement of our condition and ultimately in a solution of our difficulties.

Lorne Bridge, Brantford, Ont., as it appeared on January 12th, 1924.

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THE

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All Members are urged to Assist in Completing War Service Records

The attention of the membership is directed to the fact that in accordance with the proposal made by the Honour Roll and War Trophies Committee, as announced in the March issue of *The Journal*, a war memorial is to be erected in memory of those members of *The Institute* who were killed in action during the Great War, and a bronze record containing the names of all who served overseas.

With a view to securing as complete a record as possible, the members have been requested from time to time, through the pages of *The Journal*, to send in details of their service overseas. In order that there may not be any omissions from the permanent records, all members of *The Institute* of all grades who were members during their service overseas with any of the allied armies, are urged to assure themselves that this fact has been noted at headquarters, either by referring to the 1923 issue of the Year Book, pages 42 to 237, where the sign for "service with allied armies" should appear opposite their name, or by advising the secretary of their service.

Confederation of Intellectual Workers

In response to a request received by *The Institute* to be represented at the International Congress of the Confederation of Intellectual Workers, held in Paris in December, the Council requested two members of *The Institute*, Mr. W. F. Tye, M.E.I.C., and Baron Gustave de Coriolis, A.M.E.I.C., to kindly represent *The Institute* and report the result of their observations. At a previous meeting of the Confederation *The Institute* was represented by Mr. W. F. Drysdale, M.E.I.C., then residing in Paris, who reported that the organization had many desirable features, and suggested that *The Institute* should become interested in the movement.

As the report received from Mr. Tye and Baron de Coriolis covers the result of their conclusions it will be read with interest by members of *The Institute* throughout Canada.

Paris, January 3rd, 1923.

The President and Council,
The Engineering Institute of Canada.

Gentlemen,

As requested by the secretary, we attended the sessions of the International Congress of the Confederation of Intellectual Workers held at the Sorbonne, in the city of Paris, December 27th, 28th, and 29th, 1923.

The following countries, members of the International Confederation, were represented by two delegates each: France, Great Britain, Belgium, Denmark, Norway, Bulgaria and Greece. In addition to ourselves, there was one observer from Poland, and two from the United States, one representing a Confederation of University Professors and the other some industrial engineering organization. Neither of these gentlemen, however, remained for more than an hour or two. A full report of the meeting is being prepared by the secretariat which they expect to deliver to us in about two week's time. When received it will be forwarded to you.

We do not believe there will be any advantage to *The Engineering Institute* in sending mere "observers" such as we were to any future congress unless it is the intention to form a confederation of intellectual workers in Canada and join the International Confederation. We were there simply as observers without power to take part in the discussions: we can only send you a report of the proceedings which a letter to the secretary would have gotten for you.

As you may however desire to join this movement, we will try and briefly give you an outline of its present standing and its aims and objects.

Rise and Progress of the Movement

This movement had its origin in the desperate needs of the French intellectual workers in the trying years following the war. Before the war the French, undoubtedly, put more brains into their work than did the people of any other country. Quality with them was more important than mass production, and consequently the intellectual worker, regardless of his financial standing, had a position in France that he did not have in any other country. The war for a time changed all this. The production of dainty artistic work, for which France was noted and which furnished so much work for its intellectuals, had to give place to the production of war material and, after the war was over, the material needs of the people, regardless of the quality, was a necessity of pressing consideration.

Under such conditions, the intellectual worker found himself deposed from his high estate. The cost of living rose rapidly owing to the depreciation in the value of the franc. He had no labour unions to force up the price of his work to meet the increased cost of living and his position became desperate. Some of the intellectual associations tried to join the labour unions but they would have nothing to do with them; there was nothing left for them to do, if they were to have a living remuneration, but to unionize themselves. This they proceeded to do and the "Confederation des Travailleurs Intellectuels" usually spoken of as the "C.T.I." was formed. Its success was immediate and striking. We enclose a pamphlet "Associations et Groupements Professionnels adhérents à la C. T. I.," which will show you that over 100 intellectual associations have joined the movement. They range from engineers, doctors and lawyers to professeurs de danse; in short they

Walter J. Francis, C.E., M.E.I.C., President of The Engineering Institute of Canada, died at his home, 444 Prince Albert Avenue, Westmount, Quebec, on Thursday, March sixth, in his fifty-third year.

have formed "one big union" of the intellectual life of France. As a result of this, we are told that the improvement in the life of the intellectual worker has been very great.

Such in short is the history of the rise of the French C. T. I.

We enclose a pamphlet "Intellectual combines in France and England" by Cloudsley Brereton, a reprint of an article in the Contemporary Review for August 1923, which will give you in much more detail the history of the movement in both France and England.

Aims and Objects

Its aims, as set forth in the original manifesto, are to: "Represent, co-ordinate and defend the interest of all of those, men or women, who derive their principal means of existence not from their material labour or the income of investments or property, but from the work of their brains and the product of their thoughts". Its aims and objects are enlarged upon in the various pamphlets which we enclose.

In England the movement has been much less thorough and the intellectual associations engaged in it of a less high order. The doctors, lawyers and engineers of the higher grades have not joined the movement, for instance the Institution of Civil Engineers is not a member. As one of the English delegates told me, the movement was composed of those more nearly allied with and similar to the trade unions.

In the other countries, the movement is, we believe, much more nearly in its infancy than France and Great Britain. The report of the congress held April 5th, 6th, and 7th, 1923, which we attach, gives lists of the associations in the various countries interested in the movement. The present congress was a much more formal affair. It was only attended by two official delegates from each country having a national C. T. I., and the few observers already mentioned. Practically its only work was to draw up the statutes of the organization; copy of which we attach.

Should Canada wish to join this movement, it would be necessary to form a Canadian C. T. I. This need not be as thorough and complete as the French C. T. I. The original adherence of three of the large intellectual associations, say for instance: *The Engineering Institute*, the Press Association and the Civil Servants organization, would be sufficient to gain your admittance.

We believe that this report, together with the various pamphlets attached, will give you a fair comprehension of the extent of the movement and its aims and objects and will enable you to decide whether such a federation be possible in Canada or not, and if it be possible, whether it is necessary or advisable. The Council, being in closer touch with the situation in Canada, will be much better able than we are to say whether such a federation is possible, necessary or advisable.

We believe, however, that a few words on the international aspect may not be out of place. International life and international politics in America are very simple. North of the Rio Grande there are two countries only, the people of each having the same aims, aspirations and ideals; there is one boundary line only on which there is not a soldier, a gun or a warship. In Europe there are many countries the frontiers of which bristle with rival fortifications and soldiers. Jealousies are rampant and mutual distrust abounds. Under such conditions, the international relations of the intellectuals are beset with currents and cross-currents induced by the national jealousies. In America, the international intellectual complications are few and simple; in Europe many and complicated. Under such conditions would our few and simple problems get much consideration from the International Congress? The Council should, we believe, give serious consideration to this aspect of the matter before deciding to join. The question in short is: Should we adopt the isolation policy adopted by the United States in political matters or should we join whole heartedly in the movement as we have done in the League of Nations.

Faithfully yours,

W. F. Tye, M.E.I.C.
Baron Gustave de Coriolis, A.M.E.I.C.

The Institute receives Invitations to Special Functions in London

The First World Power Conference which has been arranged to convene at London, England, June 30th to July 12th, has aroused a wide interest among engineers in this country. The conference takes place during the British Empire Exhibition, and advantage is being taken of the occasion, when engineers from all parts of the world will be congregating in London, to hold a number of special functions to which the visiting engineers will be invited.

On the evening of July 15th, a Joint Engineering Conversazione will be held in the premises of The Institution of Civil Engineers, Great George Street, Westminster, S.W.I., which will be at the invitation of the Presidents and the present and former Members of the Councils of The Institution of Civil Engineers, The Institution of Mechanical Engineers, and The Institution of Electrical Engineers, and in connection with which *The Institute* has been invited to forward the names of those members, and their ladies, who are expected to be in England next summer.

The Institution of Electrical Engineers have very kindly extended an invitation for six representatives of *The Institute* and their ladies to take part in the programme of functions which are being organized for the period July 9th to 15th.

While a definite programme has not yet been completed by The Institution of Mechanical Engineers, a similar invitation has been extended by that Institution to Canadian mechanical engineers to attend the functions which are being arranged.

Through a Representative Committee, entrusted by the Royal Society with the arrangements for the celebration of the centenary of the birth of Lord Kelvin, which occurred on June 26th, 1824, *The Institute* has been kindly invited to name a member of a Committee of Honour which is to consist of Representatives of Scientific and Technical Bodies interested in the science to whose advancement Lord Kelvin so greatly contributed.

Appreciation from the Press

Fortunately for the engineering profession there is at last being impressed upon the consciousness of men in high places the real value of the work being done by the engineer. It is gratifying to note editorial reference to the work of *The Institute* in a number of publications recently. These will doubtless be read with pride and will give the members of the profession a deeper feeling of the high position that this body occupies in relation to the welfare of the country.

Engineering and Reconstruction

Engineering has contributed much towards the present condition of unemployment in the world. What is more, it will continue to create even more unemployment. When it is called unemployment, this result of engineering progress would appear to be anti-social and contrary to the welfare of the human race. But when it is called labour-saving, or leisure, it is obviously the condition that every one is striving for.

From the engineering point of view, it might thus be said that the problem in industrial nations is not so much unemployment as poverty. Along with industrial progress, there is grinding poverty for millions in the growing reserve of unemployed. This poverty is not due to lack of output, but actually occurs at times when production has never been greater or more efficient.

Engineering has solved the problem of producing an abundant material supply for mankind. With excessive toil or long hours of labour, it is possible for the industrial nations to supply themselves, and the rest of the world, with all the goods that are termed necessities of life. This ability to produce is being improved from year to year, even though improvement is discouraged to some extent because of lack of ability among the people as consumers to purchase the goods when they are produced. The urgent need in the reconstruction period ahead is for an intensive study of the engineering of consumption, as the engineering of production has been studied in the last century.

At the annual meeting of *The Engineering Institute of Canada* in Ottawa tomorrow and Thursday, papers of great value will be given by men who are well qualified to discuss plans for the further improvement of production in Canada. Mr. D. W. MacLachlin, hydraulic engineer of the department of railways and canals, will lead the discussion on the project to develop hydro-electric power on the St. Lawrence river, where at present well over one million horse-power is allowed to run to waste. The harnessing of this solar energy would at once release an army of men from the laborious work of coal mining and the firing of steam boilers, particularly in some of the main industrial districts of the United States. In place of the wasteful method of burning coal, after having hauled it for hundreds of miles at high cost over steam railways, the St. Lawrence power development scheme would substitute the far more economical service of electrical engineering.

Of course, the cumulative effect of this engineering progress is to dispense with manual labour. But so is practically all labour-saving progress; although, to a limited extent, labour-saving machinery has in some instances meant an increased demand for labour in other forms of industry. But there is obviously a limit to this expansion of labour demand in a system that is directed so largely to the object of cutting down labour costs. That limit has apparently been about reached, at least untill purchasing power for the consumption of goods has been brought more nearly up to the capacity of industry to produce and deliver the goods.

Perhaps the time is not far distant when Canadian engineers will turn more to the study of this aspect of reconstruction. Major C. H. Douglas is not the only consulting engineer of high standing in Great Britain who is directing thought to this problem, although he is entitled to the credit of leadership.

As a speaker said in Belfast recently, in a lecture on "The Unsuspected Cause of Poverty and War", the problem is not so much one of unemployment as of lack of purchasing power. "Applied Science for generations", he said, "has been hard at work shifting the burden of work from the backs of men to machines. The outstanding characteristic of our age is that labour is a diminishing factor in production, because solar energy is taking the place of human energy. Science, in producing labour-saving machinery, is striving to reduce the quantity of human work. It is out to create unemployment, the true name of which is leisure."

Because the engineer is making it possible so largely to dispense with manual labour, it does not follow that he is responsible primarily for the poverty which accompanies unemployment. But the public may fairly look to the engineering profession which has done so much to solve the problem of production, to give some attention also to the engineering of consumption. There is no body of professional workers better qualified, from training and experience, to explore new paths to bring demand up to supply, even as they have already developed the world's capacity to supply far ahead of the present effective demand.

Ottawa Citizen, January 22nd, 1924.

Commercial Airway to Canada

The British director of civil aviation, Sir W. S. Brancker, expressed the opinion recently in Canada that a commercial airship service could be established as a paying venture between Great Britain and the Dominion. He seemed to think that it would come, however, only after the Burney scheme for establishing a regular airship service between Great Britain and India has made further progress. When the proposed commercial airway to India is operating on a paying basis, as is expected to be the case within the next five years, the travelling public should be ready also to make the trip in comfort across the Atlantic in one of the great air liners that aircraft designers have in mind.

Canada should be able to make a very strong bid for the transatlantic air service when it comes. Airship terminals at Halifax, or possibly further inland, in one of the sheltered bays of New Brunswick, would be very conveniently situated for railway connections to New York, Boston, and other American cities. At the present time, however, Canada has no mooring mast or landing establishment for airships. It is apparently as necessary to construct specially designed terminals for an airway as for a railway.

Meteorology will be an important factor in determining where the airway terminals are to be located. Some of the mechanical difficulties of mooring gigantic airships have been overcome in recent years. It is much simpler to moor the air liner with a light steel wire rope to a miniature Eiffel tower, than to drag her down for housing in an immense shed with the aid of a company of a hundred or more trained groundsmen. But the mooring tower has to be located at a point where it will be visible during the day, without too many interruptions due to foggy weather.

Perhaps the mooring mast will have to be improved upon before airway terminals can be regarded as quite as satisfactory for passengers as are the modern railway stations and landing piers at ocean ports. Sir W. S. Brancker's address to *The Engineering Institute of Canada* should inspire Canadian civil engineers to give some thought to the possibility of designing better terminals for airships, so that when the opportunity comes for establishing the transatlantic service, Canada will be ready. *Christian Science Monitor February, 12th., 1924.*

The Acute Fuel Area

Here in Ontario we are part of what *Dr. Charles Camsell, deputy minister of mines, calls "the acute fuel area." Although Canada is believed to possess about a sixth of all the coal in the world, the coal fields are so distributed that we have been unable to draw our full supply from them. We are a deficit country, and our deficit in 1923 was almost twenty million tons of coal, considerably more than half the annual consumption, which ranges from twenty-nine to thirty-five million tons.

The deficit area in Ontario and western Quebec pays for the bulk of this huge importation. The five million tons of anthracite brought into the country is burned largely in the homes and business premises of the people of this province. At retail prices it represents this year an expenditure of almost eighty million dollars, of which not more than fifteen million consists of the cost of haulage, delivery and dealers' profits at home, the balance going to the producers and handlers across the border.

Ontario's soft coal bill becomes less of a burden year by year because of the increasing use of water in power production, but it is probably true that, until our main lines of steam railway are converted to electric trackage, we must continue to import into this province from six to nine million tons of bituminous coal yearly, or its coke equivalent, at a cost of from thirty to forty-five million dollars. Even under coal famine conditions last winter, imports of coal and coke into Canada totalled almost fifteen million tons, which cost $77,636,000.

These figures justify the conclusion of Dr. Camsell that the desire now shown to rectify our position by lessening coal imports is of prime importance and must result in improvement. There is, however, a threefold danger in delay: first, because of the certainty of the ultimate exhaustion of Pennsylvania's hard coal deposits; second, from rising prices; and, third, from a possible embargo against export. It may require the last-mentioned to rouse us to action in this province.

Globe, Toronto. 25th, 1924.

**Dr. Camsell's paper is published in full in this issue of The Journal.*

Canadian Engineering Progress

Engineering has done much to place Canada among the great super-producing nations, especially in overcoming transportation obstacles. But the tendency in the Dominion is to press forward with still more new projects for the development of natural resources. Discussion at the sessions of the annual meeting of *The Engineering Institute of Canada*, in Ottawa, recently, seemed to be largely concerned with plans for increasing the Dominion's capacity to produce. Comprehensive discussion of the St. Lawrence deep-waterway project, and the power development connected with it, placed some valuable information on record in the annals of *The Institute*. The engineers also discussed the problem of an improved fuel supply from Canada's own natural resources. At the present time, some of the most populous provinces of Canada are almost entirely dependent upon coal from the United States for domestic heating purposes. But research work is being pressed forward vigorously to produce suitable substitutes for Pennsylvania anthracite.

The conversion of Canadian coals into household coke is seen to be one of the most economical methods. As a plan for utilizing home resources it should appeal to the Canadian public. At the same time, with the exception of some interests in the United States that are commercially concerned with exporting anthracite to Canada, it is believed that American public opinion would regard with approval the Dominion's initiative to substitute Canadian for imported fuel. The supply of anthracite in recent years has not been greatly in excess of the demand.

In addition to the Canadian engineering research for fuel materials, such as coke, peat, lignites, gas, and oil, there is every reason to believe that the development of the Dominion's "white coal" resources will be greatly expedited within the next few years. It is so much more economical to use electricity instead of steam for industrial purposes that the arguments in favour of harnessing Canadian rivers and waterfalls find ready acceptance.

Such organizations as *The Engineering Institute of Canada* do excellent work in helping to stimulate public interest in the possibilities of increased production and improved service. It would be well for the Dominion, and for other super-producing countries, if a consumers' institute, or the people organized as consumers in some form, were devoting as much constructive thought to the urgent problem of increasing distribution—in other words, of bringing effective demand more nearly up to the established capacity of modern industry to produce and deliver the goods. — *The Christian Science Monitor, February 7th, 1924.*

An Engineering Senate

It is of immense value to Canada to have such a thorough discussion by competent men, as *The Engineering Institute of Canada* conducted yesterday on the St. Lawrence development proposals. Mr. D. W. MacLachlan has devoted years of intensive study to the problem. He gave such a wealth of detail in opening the discussion that the annals of *The Engineering Institute* may this year become one of the most widely used sources of reference for all who are looking for first hand information to help them to form an opinion on the merits of the project.

It would have been better for Canada if some of the existing national works in this country had been as thoroughly discussed by men outside of the political arena before the first votes were passed in the House. The Senate of Canada might become a useful institution if it could be reformed in some manner to give the country the benefit of the experience of such organizations as The Engineering Institute.—

Ottawa Citizen, January 25th, 1924.

Colonel John By.

Few suggestions of a like nature will be received with more sympathy than that for the erection of a suitable monument to Colonel By in Ottawa, which was mentioned by Mr. H. P. Hill in his interesting address before *The Engineering Institute of Canada* last Thursday. Several extremely persuasive considerations make the idea a readily acceptable one.

Col. By was the founder of the capital of Canada, and for more than thirty years it was called after him. Yet there exists no adequate memorial to this man who was in every sense of the phrase, a splendid character. There is a ward of the city which still retains his name, and there is in Major's Hill park, a pile of stones which came from his house, but outside of these there is no memorial which fittingly symbolizes the honour, and esteem in which Colonel By's name and deeds are held in the minds of the citizens of the city which he founded.

Mr. Hill, in his talk to the engineers, gave an indication of the fine type of man John By was. He had courage and enterprise, and was a man of upright character and good breeding. He fought under Wellington in Britain's wars abroad, and came to Canada to build what was at the time a public waterway of great importance and magnitude. It is in use today after uninterrupted operation since 1832. The fact that Col. By was made the scapegoat of the row which developed when the costs mounted to four or five times the original estimate, and that he was recalled and retired from the army list, thus being robbed of his just reward for so fine an achievement, should only increase the desire of those who came after him to perpetuate his memory in some enduring form.

Two years from now, in 1926, will fall the centenary of the arrival at the Chaudiere of Col. By of the Royal Engineers, from England. There will undoubtedly be some public celebration of the event. Few ceremonies would be more impressive or appropriate than the unveiling of a monument to the founder of the city of Ottawa.

Ottawa Citizen, January, 28th, 1924.

The Canadian Engineer.

The national organization of the engineers of Canada has been meeting in Ottawa during the last two days and the character of the men who are here for the event reflects the high standing which the profession holds in the life of this country. The public generally will not fail to recognize the importance of the profession which *The Engineering Institute of Canada* represents, nor to acknowledge the great debt which they as a nation owe to the engineer.

Not only would national progress be impossible in Canada without the engineer, but civilization itself could not go on. In every phase of community existence the service of the engineer is necessary. In the home, the workshop, when moving from place to place, his services are indispensable. He has brought comforts and conveniences incalculable for all to enjoy, and his work and thought are winning new triumphs each day.

The engineer is the true founder of the greatness to which this country can lay claim. His railroads have pathed the wilderness, his bridges have leapt the rivers and ravines, his great dams have stored nature's energy and his canals and ships have carried the merchandise of a nation. Perhaps in Canada more than in any other country is his name writ in letters of gold on the scroll of its history.

Ottawa Citizen, January 24th, 1924.

The Engineer in the Hydro Commission

The Hydro-Electric Inquiry Commission commonly known as the Gregory Commission has at last reported after two years of investigation upon the activities of the Hydro-Electric Power Commission of Ontario for the last fifteen years. Inasmuch as this investigation was basicly engineering, covering an audit not only of financial affairs, but of engineering, construction, rates, and personnel in a report consisting of nearly one hundred volumes summed up in a final report of two volumes, its conclusions are naturally of great interest to the engineering profession. None of these reports are yet printed, but it will be unfortunate in the interest of engineering if the government does not see fit to publish the entire series which deals with $250,000,000.00 worth of engineering investments, and the light and power operations of about 300 municipalities in 13 separate districts.

Our late lamented President, Mr. Walter J. Francis, was the engineer for the Inquiry Commission and in charge of these investigations, and his carefulness, thoroughness and value to the commission are testified to formally in the reports. This was the last and greatest work that Mr. Francis did, and was without doubt his crowning achievement as no report of such magnitude and detail has ever been issued before. Inasmuch as owing to its technical nature throughout, the Hydro activities are of great interest to the engineering professional generally, the conclusions arrived at with regard to the engineering work and the engineering staff are of interest to the profession. From this report we quote as follows:—

"We cannot conclude our report without making reference to the valuable and efficient services rendered to us in the course of our investigations by Mr. Walter J. Francis, our consulting engineer, who has, with great ability and untiring energy and with a degree of thoroughness seldom equalled, examined the engineering records of the commission, arranged and classified many of them, and prepared charts in which he tells in graphic form the history of construction, operation and results. He has also prepared for us from the great mass of material in the files of the commission, reports on all engineering matters that have been the subject of our inquiry. Mr. Francis has, throughout the whole of his work, received most valuable and cordial co-operation from the engineering staff of the Hydro Commission. Without their help and co-operation it would have been impossible for him to have accomplished what he did in the time that he did it.

The engineering department of the Hydro Commission is made up of men of high professional qualifications as engineers, and as such they are serving the commission zealously and efficiently. The various plants of the commission are exceptionally well operated by them. When inspecting these plants we have been much impressed with the outstanding character and ability of the engineers in charge.

The design of the Queenston-Chippawa development was based upon the most intricate calculations known in the theory of hydraulics, but even so, there was some doubt as to whether or not the results sought for would be obtained through it. It now appears clear that the engineers of the commission, as designers of this great work, surpassed even their own expectations. The canal was designed to pass 15,000 cubic feet of water per second, but we are advised by our consulting engineer, (W. J. Francis), that it is capable of passing 18,000 cubic feet of water per second or more. The engineers stated that they hoped to get 30 h.p., per second-foot, but the test which we have had made indicates that the amount will be exceeded. It was originally estimated that it would develop 500,000 h.p., but it seems clear that it will, on completion, develop 550,000 electrical horse power, — a most substantial increase. The plant now has an efficiency of over 90 per cent, an unusually high figure and one which indicates a fineness of design seldom, if ever before, attained in a work of this character. It is, in short, a magnificent piece of engineering.

As an engineering work, it reflects great credit upon the chief engineer, F. A. Gaby, who was directly responsible for it to the commission, and upon H. G. Acres and his staff, who were responsible for the detailed planning of the work. Still greater does this credit appear when it is remembered that, in addition to the engineering work, Mr. Acres and certain of his principal assistants had to shoulder the burden of directing construction, a responsibility which they should not have had. We have been much impressed with the evidence of the spirit of co-operation which prevailed in the engineering staff, and the loyalty with which they served the commission. However difficult conditions were, they never faltered in carrying out the instructions given to them. From beginning to end there is not about them a breath of suspicion of any personal wrongdoing."

In summing up his final impressions of the engineers, one of the members of the Inquiry Commission, not himself an engineer, and who previously had the impression which is generally held that the engineer is a sort of superior plumber, concluded "This whole Hydro is run by the engineers and God". In short, the report of this very critical commission appointed by a very critical government has eulogized the work of the engineers of the Hydro so as to indicate to the public the outstanding value of their services in connection with a great work.

President Francis Dies Suddenly

The Engineering Institute called upon for the second time within one year to mourn the loss of a President.

"Death loves a shining mark" has apt application to the sudden passing of President Walter J. Francis, who died as he sat in his home on Prince Albert Avenue, Westmount, on the evening of Thursday, March sixth. By a remarkable coincidence that day marked the anniversary of the death of the immediate Past-President, Arthur St-Laurent.

While *The Engineering Institute* has been singularly blessed by loyal and devoted members giving freely of their time and ability to advance its welfare, it can be truly said that no one in all the profession in Canada has given such untiring devotion and unremitting service as that which was the contribution of the late Walter J. Francis to his fellow engineers.

Spurred on by an impelling determination to achieve and accomplish, to produce that which reached the highest point of excellence, to finish the work on hand, not for the reward itself, but for the sheer joy that comes to the master craftsman in the completion of a task well and truly done, and to do so with the intensity of a soul inspired, were dominant, outstanding characteristics of Walter Francis' nature. That keen, alert mind, vibrating in ceaseless activity, found no occasion for relaxation, and as the filament of an electric lamp, under a voltage greater than that for which it is designed, burns more intensely and is of short duration, so his body, responding with constant energy greater than its physical capacity, collapsed under the strain to which it was subjected.

Although two weeks and a half previously he had been confined to the house from throat trouble, and later for a week due to slight indisposition, for three days previous to his death he had been at his office, where he displayed his usual energy towards his work. On Wednesday afternoon, March fifth, he made final arrangements for framing and completing the branch charters which bear his signature, and which he had planned to present in person to each of the branches of *The Institute*. During the evening of March sixth, the news of his death was flashed across the continent to every branch centre, and the messages received in reply, both personal and official, indicated that not only did the whole *Institute* mourn its President, but that in many instances there was the heartfelt loss of a personal friend.

The late Mr. Francis was born in Toronto on January 28th, 1872, the son of Joseph and Elizabeth Francis, and was educated in Ontario public schools, and the Toronto Collegiate Institute. He was an honour graduate, with the degree of C.E., of the University of Toronto, 1893.

Quoting from *The Engineering Journal* of April nineteen twenty-three:—

"After graduation he became assistant to the chief engineer in charge of design and construction, Toronto Union Station. In 1896 he was appointed chief draughtsman on bridge construction with the Central Bridge Engineering Company, where he remained for one year. Subsequently he was engaged with the Department of Railways and Canals, and in that period he designed and was in charge of construction of two hydraulic lift locks on the Trent Canal, one at Peterborough and the other at Kirkfield, for a paper on which he was awarded the Gzowski Medal in 1906. During this year he was in charge of the 32,000 h.p. hydro-electric plant, Bonnington Falls. In 1907, Mr. Francis was assistant manager and chief engineer of the Dominion Engineering and Construction Company, Montreal, as well as engineer to the Royal Commission on the Quebec Bridge disaster. In 1908 he was appointed exclusive writer for "The Engineer", London. In 1909 he reported on various hydro-electric power propositions including those of Campbellford, Ontario, and North Saskatchewan River, Edmonton. In 1910 he reported on public utilities of the city of Edmonton, the Herald Building disaster, Montreal, Boxer Building collapse, Montreal, construction of the Don Syphon for main sewers, city of Toronto, hydro-electric and steam plants, city of Quebec, and represented the Canadian Society of Civil Engineers on the committee appointed to revise the by-laws of the city of Montreal."

In 1910 Mr. Francis formed a partnership with Mr. Frederick B. Brown, M.Sc., M.E.I.C., which continued up to the time of his death. This firm has had an active career, having designed and reported on numerous hydro-electric and steam power plants including the construction of the Moose Jaw water supply, the hydro-electric plant at Carillon, water supply and underground electric distribution, Edmonton, and roads, sewage and other municipal undertakings in various Canadian cities, the Lower St. Lawrence Power Company, and a very large hydro-electric development on the Gatineau River. The firm was a member of the Water Board of Montreal, having been appointed on its creation and continuing until the work was taken over by the city staff.

Two years ago when the Royal Commission was appointed by the provincial government of Ontario to make a complete report on the activities of the Hydro-Electric Power Commission of Ontario, Mr. Francis and Mr. Brown were appointed consulting engineers to the commission, the work involved in which took up the major portion of their time for the past two years.

Nearly every activity of *The Institute* has seen Mr. Francis taking a prominent part, and important membership committees, such as the Committee on Society Affairs and the Committee on Policy, as well as numberless Council committees, have received the benefit of his active participation. After the adoption of the report of the Committee on Society Affairs, Mr. Francis was mainly instrumental in the establishing of the Montreal Branch of which he was the first chairman. He held the remarkable record of being continuously an officer of *The Institute*, either as councillor or vice-president, since the beginning of 1910, having been councillor from that year until 1918, and vice-president until the death of Mr. St-Laurent.

Mr. Francis was vice-president of the Corporation of Professional Engineers of Quebec in 1920; has been president of the Engineering Alumni Association, University of Toronto; held membership in the American Society of Civil Engineers, the Institution of Civil Engineers of Great Britain, American Institute of Consulting Engineers (Charter Member), the Engineering Society of Toronto (Life Member), American Public Health Association, Montreal Board of Trade, the Rotary Club of Montreal of which he was president in 1917, the University Club of Montreal, National Club of Toronto, the Royal Societies Club, London, England, and numerous other organizations. In Rotary International he held appointment, for seven years, and was a past president of the Rotary Club of Montreal and a member of several international committees. In the Boy Scouts and Wolf Club movements he was an active officer, occupying the office of president of the Montreal Boy Scouts at the time of his death. He found time in addition for hospital work in two different institutions, as well as being the secretary of the Shriners' Hospitals for Crippled Children. He was a 32nd degree Free Mason, a member of the Royal Order of Scotland, and a past Grand First Principal of the Grand Chapter of Royal Arch Masons of Quebec.

On November 26th, 1896, he married Miss Laure Elizabeth Grainger of Toronto. He is survived by Mrs. Francis and two sons, Edward and Francis.

The funeral, held at three o'clock on the afternoon of Saturday, March eight, was conducted under Masonic auspices by the M.W. Brother Rev. Allan P. Shatford, Grand Master of the Grand Lodge of Quebec, assisted by Rev. Brother Malcolm Campbell, District Grand Chaplain and by Rev. Brother Johnston, Past District Grand Chaplain. Service was held at the late residence, 444 Prince Albert Avenue, and later at the crematorium of the Mount Royal Cemetery.

A detachment of the Boy Scouts, in uniform, with colour party, carrying draped colours and reversed staves, with bugles, formed a guard of honour, lining Prince Albert Avenue on either side, and later brought up the rear of the cortege. A detachment of police, in charge of Chief Wren and Chief Belanger, who attended the funeral, aided in guiding the large gathering, which was one of the largest ever assembled at a funeral in Montreal. Boy Scouts were represented by all of the higher officials, followed by almost all the active Scout officers of the Montreal district. The Rotary Club of Montreal was represented by a delegation of nearly its entire membership. An unusually large delegation of Masonic officers was present, including leading officers of the Grand Lodge of Quebec, and representatives from various masonic bodies. The ritual was in charge of Royal Albert Lodge, which paraded in regalia to the house, where the musical part of the service was taken by the Royal Albert choir.

The Engineering Institute of Canada was represented by members of Council in a body including — Past-Presidents R. A. Ross, G. H. Duggan, Phelps Johnson, and J. M. R. Fairbairn, Vice-Presidents F. P. Shearwood and J. B. Challies, Councillors A. R. Decary, K. M. Cameron, R. L. Dobbin, Frederick B. Brown, J. A. Duchastel, George R. MacLeod, Geo. D. Macdougall, R. O. Wynne-Roberts, C. M. McKergow, and Major-General Sir Alex. Bertram, Treasurer. Among other members of *The Institute* present were — Brig.-Gen. C. H. Mitchell, C.M.G., representing the Toronto Branch; J. L. Rannie, representing the Ottawa Branch; R. L. Dobbin and R. C. Flitton, representing the Peterboro Branch; A. R. Décary and A. B. Normandin, representing the Quebec Branch; Geo. D. Macdougall, representing the Cape Breton Branch; O. O. Lefebvre, J. L. Busfield and E. A. Ryan, representing the Montreal Branch, the members of which branch also attended in a body; Captain J. G. Ross and Professor J. A. Bancroft, representing the Canadian Institute of Mining and Metallurgy; Professor R. W. Angus, representing the Faculty of Applied Science of the University of Toronto: J. M. R. Fairbairn and Roy Campbell, representing the Montreal branch of the Alumni

Association of the University of Toronto, and Dean Frank D. Adams representing McGill University. There were also represented the Kiwanis Club, the city of Westmount, the city of Verdun, the city of Montreal, and numerous other bodies.

The floral tokens were evidence of the close personal association the late President had with many organizations, as well as with a large number of personal friends who thus paid a last tribute to one who occupied a high place in the esteem of his fellow men.

Resolutions of condolence and sympathy were passed by many organizations. At the Rotary Club of Montreal on the eleventh instant, the members in passing a resolution honoured his memory by standing in silence. A similar ceremony was observed at the Montreal Boy Scout Council where a resolution was also passed. At the Montreal Branch meeting on the thirteenth instant, standing in solemn silence for sixty seconds, with bowed heads, the members mourned the dead President of *The Institute* as their first official business since his death. A resolution proposed by Past-President R. A. Ross, who referred to the profound sense of loss sustained by *The Institute*, was seconded by Major J. A. Duchastel, past-chairman of the branch. A resolution was recorded in the minutes of Council at a special meeting held on March fourteenth, as follows:

WHEREAS *The Institute* has suffered the loss of its President by the sudden death of Walter J. Francis as he sat in his home on the evening of Thursday, March sixth, nineteen twenty-four, and

WHEREAS the late President, in addition to filling in a masterly manner the high office he occupied, made many sacrifices in the interests of the profession he loved and for the welfare of *The Institute* to which he was devoted,

Be it resolved —

THAT this meeting of Council, assembled in special session, record with feelings of personal sorrow the irreparable loss sustained by *The Engineering Institute* and by the entire engineering profession in the death of Mr. Francis, who was an inspiration to his fellow engineers, a man of high ideals, of unswerving integrity, a leader in every phase of *The Institute's* growth and development, a zealous champion of all that tended to elevate the standard and increase the status of the engineering profession, and a constant exponent and example of good citizenship, loyalty to his profession and usefulness to his fellow men, and

Be it further resolved —

THAT the Council of this *Institute* extend to Mrs. Francis and family its sincere sympathy in the great loss they have sustained.

Although his active life has been suddenly severed, the influence of Walter Francis will be felt for good for many a day by the engineering profession throughout Canada.

OBITUARY

Frederick Crossley, M.E.I.C.

Word has been received of the death of Frederick Crossley, M.E.I.C., on February 26th, 1924, at his late home in Keighley, Yorkshire, England. The late Mr. Crossley was sixty-eight years old at the time of his death, having been born at Keighley on January 8th, 1856. He received his early education at the Grammar School and Georges' Place Academy, Keighley, and was later pupil with and subsequently assistant to W. & J. B. Bailey, architects and surveyors of Keighley from 1872 to 1879.

On coming to Canada Mr. Crossley entered the service of the Canadian Pacific Railway Company in 1882, and was located first in Montreal and later in Toronto, until July 1903 when he was transferred to Winnipeg as engineer in charge of the company's shops in that city. In April 1907 he was appointed assistant to the assistant chief engineer of the Canadian Pacific Railway's western lines, with headquarters in Winnipeg, where he resided until 1913, when failing health forced him to retire to England.

Mr. Crossley was predeceased by his wife in 1912 and is survived by three sons, Ernest of Montreal, and Percy and George of Winnipeg. He was elected Associate Member of *The Institute* on March 11th, 1892, and was transferred to Member on January 14th, 1909.

PERSONALS

E. L. Johnston, S.E.I.C., of Montreal, has accepted a position with the American Steel Foundries of Grant City, Ill.

J. B. Naylor, S.E.I.C., formerly of Kingston, Ont., is at present on test work with the General Electric Company.

W. A. Gale, S.E.I.C., of Victoria, B.C., is on the research staff of the American Trona Corporation, Trona, California.

Geo. S. Walker, Jr.E.I.C., of Toronto, has accepted a position with the London and Pacific Petroleum Company Limited, Negritos, Talara, Peru, South America.

V. W. Isaac, S.E.I.C., formerly with the Montreal office of the Dodge Manufacturing Company, has accepted a position with the Howard Smith Paper Mills at Cornwall, Ontario.

M. B. Wyman, S.E.I.C., is at present with the East Pittsburgh works of the Westinghouse Electric and Manufacturing Company.

E. Fortin, Jr.E.I.C., has been transferred by the Barrett Company, Limited, from Montreal to Marpole, British Columbia.

G. Vibert Douglas, A.M.E.I.C., has been appointed to the staff of Harvard University in the department of Geology. Mr. Douglas is a graduate of McGill University of 1920.

H. F. Bennett, A.M.E.I.C., chairman of the St. John Branch has been promoted by the Public Works Department from assistant engineer at St. John, N.B., to senior assistant engineer at Halifax, N.S.

R. N. Blackburn, M.E.I.C., has been promoted from chief inspector of steam boilers for the province to Saskatchewan, to chief mechanical superintendent, Department of Public Works province of Saskatchewan.

J. M. Cuddy, S.E.I.C., until recently with the Dryden Paper Company Limited of Dryden, Ontario, has accepted a position with the Canadian Explosives Limited at McMasterville, Quebec.

H. M. Finlayson, S.E.I.C., is at present located at Cornwall, Ont., as junior engineer on the St. Lawrence development, Department of Railways and Canals. Mr. Finlayson is a graduate of McGill University.

H. G. de Carteret, S.E.I.C., formerly with the Truscon Steel Company of Youngstown, Ohio, has accepted a position in department of draughting and designing of the Dwight P. Robinson Company, Inc., New York City.

W. G. Alexander Adams, A.M.E.I.C., of the Oakwood Construction Company, Inc., of Detroit, Michigan, is at present located in Rochester, New York, in charge of the installation of sewers for the village of Brighton.

Alex. Gray, M.E.I.C., engineer in charge of the St. John Harbour for the Department of Public Works, sailed on March 14th, for the Old Country on business for the department.

W. D. Adams, A.M.E.I.C., is assistant engineer with Walter J. Francis and Company, Montreal. Mr. Adams was for a year and a half associated with the Toronto office of the company being employed on the work of the Hydro-Electric enquiry commission.

M. D. Stewart, S.E.I.C., who was for a time purchasing agent with Bremner and Norris and Company Limited, of Montreal, has accepted a position with Price Brothers at Chicoutimi West. Mr. Stewart is a graduate from the University of Toronto in 1922.

R. J. Rainnie, S.E.I.C., who graduated from McGill University in 1923 and who was for a time in Sussex, New Brunswick, has been for the past few months with Stone & Webster, Inc., of Boston, Mass., in the management division.

O. H. Coté, A.M.E.I.C., who for some three years Industrial Commissioner to the Quebec Board of Trade, and who has been in private practice in the city of Quebec as a consulting civil engineer for the past year, has moved his offices to Woonsocket, Rhode Island, were he is carrying on his consulting work.

D. J. Emrey, A.M.E.I.C., has accepted a position with the Fort William Paper Company, Fort William, Ont. Mr. Emrey is a graduate of Queen's University of 1922, and was for a time field superintendent, bridge department, of the Canadian Des Moines Steel Company, Limited, of Chatham, Ont.

H. C. Lott, A.M.E.I.C., who has been with the British forces in Iraq, Mesopotamia is on his way to Canada coming through China and Japan and expects to arrive here during May or June. Mr. Lott's permanent address will be Lloyds Bank Limited, Cox's Branch, 16 Charing Cross, London, S.W.1.

Corbett F. Whitton, A.M.E.I.C., of Hamilton, is vice-president of the newly incorporated Gurney Scale Company, Limited, which has taken over the business of the old Gurney Scale Company, owned by J. P. Steedman who is president of the new company. Mr. Whitton is a graduate of McGill University from which he received his degree of B.Sc., in mechanical engineering in 1908.

F. G. Goodspeed, M.E.I.C., of St. John, N.B., has been transferred to Winnipeg as district engineer with the Department of Public Works of Canada. Mr. Goodspeed is a graduate of Acadia University and the University of New Brunswick, having received his degree of B.A. from the former and that of B.Sc. from the latter. His connection with the Federal Department of Public Works extends over a number of years, having been district engineer at Edmonton, Alta., and St. John, N.B., prior to his present appointment.

M. C. Hendry, M.E.I.C., who has been on the staff of the Nova Scotia Power Commission until recently, is now with the Hydro-Electric Power Commission of Ontario. Mr. Hendry is a graduate from the University of Toronto with the class of 1909, and was for eight years with the Dominion Water Power Branch. He was engineer in charge of investigating and reporting on power and storage possibilities of rivers in Alberta and later chief engineer of the Manitoba Hydrometric Survey. In 1919 he was appointed to the staff of the hydraulic department of the Hydro-Electric Power Commission of Ontario as engineer in charge of investigation on the St. Lawrence river.

George D. MacKinnon, M.E.I.C., of Sherbrooke, Que., has acquired the lumber business of the Wm. Rutherford and Sons, Company, Ltd., of Montreal, and will be president of the reorganized company which will operate under the name of the Rutherford Lumber Company, Ltd. The original company was founded by the late Wm. Rutherford about fifty years ago, and the present plant is located on Atwater Avenue, Montreal. Mr. MacKinnon's wide business interests include the Mackinnon Steel Company, Ltd., of Montreal and Sherbrooke, of which he is vice-president and managing director, the Manganese Steel Castings, of Sherbrooke, of which he is proprietor, and the Pressure Proof Rings, Ltd., of Sherbrooke, of which he is vice-president.

T. W. Harvie, M.E.I.C., has been appointed general manager of the Port of Montreal and will have jurisdictional charge over all the service and physical activities of the harbour. Mr. Harvie is a native of Lanarkshire, Scotland, and was born at Coat Bridge, on August 5th, 1877. After some eleven years experience in construction work in the Old Country, namely in connection with harbours, Mr. Harvey came to Canada and was appointed resident engineer on construction of a new Victoria Pier, shore wharves, upper section of harbour high level terminal railway and various smaller works in the Port of Montreal. In 1913 he was appointed assistant chief engineer for the harbour commissioners and in 1922 chief engineer, which position he has held until his recent appointment.

Newly Incorporated Firms of Engineers

Norman R. Gibson, M.E.I.C., and Henry P. Rust, M.E.I.C., are associated with the firm of Harper and Taylor Incorporated of Philadelphia and Niagara Falls. This firm has only recently been incorporated and the principals, H. Birchard Taylor and John L. Harper are engineers of international reputation. In addition to Messrs. Gibson and Rust, who are widely known in engineering circles in this country, there are associated with the firm Oliver D. Dales, J. Allen Johnson and Louis S. Bernstein. The new firm will undertake the design, construction, operation and management of hydro-electric power projects and the general practice of engineering.

Mr. Gibson is a graduate of 1904 from the University of Toronto and has been connected with the Niagara Falls Power Company, Niagara Falls, N.Y., for the past few years as their hydraulic engineer. He has been appointed manager of the Niagara Falls office of the company.

Mr. Rust who is manager of the Philadelphia office is also a graduate of the University of Toronto and has had a very extensive experience in hydro-electric work in its various phases.

Hew Martin Scott, M.E.I.C., leaves for visit to Scotland

Hew Martin Scott, M.E.I.C., who resigned from the Peter Lyall and Sons Construction Company at the end of February of this year, has sailed for Scotland to visit his parents. On his return he expects to enter the general contracting business, with headquarters at Toronto.

Mr. Scott was a director of the Peter Lyall Company, by whom he has been employed since he came out from Scotland, fourteen years ago. He has, latterly, been manager of their Welland ship canal contract at Thorold.

In addition to this work, he has been connected with, or in charge of this company's operations on many important works throughout Canada, including the construction of the Royal Alexandra hotel of Winnipeg, the Palliser hotel of Calgary, the Union station of Toronto, the new customs house of Ottawa, the Transportation building of Montreal, and the Esquimalt drydock. During part of the period of the late war he had charge of the operation of the Peter Lyall Company's three munition plants at Montreal.

Mr. Scott was born at Girvan, Aireshire, Scotland, receiving his initial technical education at the Glasgow Technical School, and as apprentice to Eagleshan and Company of Aire.

ARTHUR SURVEYER, B.A., B.A.Sc., C.E., M.E.I.C.

PRESIDENT

The Engineering Institute of Canada.

Although called upon unexpectedly to assume the responsibility of the office of president of *The Institute*, Mr. Arthur Surveyer, who, in virtue of the fact that he was the senior vice-president of *The Institute*, became president at a special meeting of Council held on March fourteenth, nineteen twenty-four, is a worthy successor to the eminent man who preceded him, and possesses to a high degree all the qualifications of mind and heart to enable him to maintain a superior interpretation of the high traditions of the office.

President Surveyer was born in Montreal, the son of L. J. A. Surveyer and of Hectorine Fabre, on the seventeenth day of December, 1878, where he has made his home almost continuously since. He was graduated from Laval University, Montreal, with the degree of B.A. in 1898, and in 1902 from the Ecole Polytechnique, Montreal, he received the degree of B.A.Sc. and C.E. The following year was spent taking a post-graduate course at the Ecole Spéciale d'Industrie et des Mines du Hainaut, Mons, Belgium.

President Surveyer began his professional career with the Public Works Department of Canada in 1904, where he continued until 1911, acting as assistant engineer on the Georgian Bay Ship Canal survey, field work, design of locks and dams, etcetera. Later he reported on the applications of hydro-electric companies to divert water from the St. Lawrence river, and was supervising engineer during the construction of the Port Arthur drydock and shipbuilding plant. He also reported on the project to dam the St. Lawrence.

Since July 1911, Mr. Surveyer has been in private practice, in Montreal. The following month he was appointed by the Federal Government a member of the St. Lawrence River Commission to judge all difficulties arising between the hydro-electric companies and the ship-owning companies. In 1912 he reported to the Federal Government on the effect of the Chicago Drainage Canal diversion on the harbours of the St. Lawrence and the Great Lakes. He was later associated in making a joint report on the opportunity of the Government guaranteeing the bonds of the Montreal Tunnel Company ($15,000,000) and the Montreal Central Terminal Company ($7,500,000).

During his career as consulting engineer Mr. Surveyer has had many important assignments. He has been employed in a consulting capacity by all the important cities in the province of Quebec, as well as the Department of Public Works, Canada, the Department of Lands and Forests, Quebec, and the Quebec Streams' Commission. Among the more important assignments are; report on the regulation of the Batiscan river; report to the Shipping Federation of Canada on the effect of the construction of partial dams on the St. Lawrence river below Montreal; report to the Quebec Streams' Commission on contractors' claims and on quality and economy of construction of the Gouin dam at the head of the St. Maurice river (cost $1,710,000); he was selected by the engineers of Montreal as member of a committee, representing the rate paying engineers of Montreal, to report on a proposed expenditure of $12,000,000 for an hydro-electric municipal plant; design and supervision of construction of a 4,000 h.p. hydro-electric plant for the Two Miles Falls Water Power Company; report to the British Columbia Electric Railway Company on the opportunity of acquiring the hydro-electric system belonging to the Western Power Company of Canada for a cash payment of about $2,000,000 and a guarantee of a $5,500,000 bond issue; preliminary design and estimate of a 240,000 h.p. development at Carillon, on the Ottawa river; report to the Banque Nationale of Quebec on industrial loan of $250,000; joint appraisal with the W. B. Richards & Co. of the plant of the National Farming Machinery Company; design and supervision of construction of a six storey department store for Dupuis Frères ($650,000); design and supervision of construction of a six storey building for the Baillargeon Express Company ($400,000); design and estimate for a 9,000 h.p. development for the Provincial Public Utilities Company; valuation of the E. B. Eddy Company's plant at Hull, including 15,000 h.p. development, an eighty ton mechanical pulp mill, fifty ton sulphite pulp mill, fifty-five ton newsprint mill, twenty ton wrapping paper mill, indurated fibre ware mill, and a match factory with a daily capacity of one hundred and twenty million matches; and a report to Rene T. Leclerc Limited, investment bankers, on the purchase of a $2,500,000 bond issue for a proposed 28,000 h.p. hydro-electric development.

ARTHUR SURVEYER, B.A., B.A.Sc., C.E., M.E.I.C.

President

The Engineering Institute of Canada.

Important commissions have been assigned to him by the following industrial and public utility corporations — Shipping Federation of Canada; New Zealand Shipping Company; Dominion Pulp Paper Company; Canadian National Railways; Montreal Public Service Corporation; La Cie C. H. Catelli Ltée; British Columbia Electric Railways; Provincial Public Utilities; Dupuis Frères, Ltée; Cook Construction Company; Canadian Consolidated Rubber Company; Lotbiniere Lumber Company; Lake Megantic Pulp Company; The James MacLaren Company; Armstrong Whitworth Company of Canada; Canadian Light and Power Company; St. Francis Hydraulic Power Company; Two Miles Falls Water Power Company; La Banque Nationale, Quebec; J. B. Baillargeon Express Company, and the Canadian Pacific Railway Company.

President Surveyer takes an active interest in educational matters, being a member of the Board of Directors of the Ecole Polytechnique de Montréal, and has rendered splendid voluntary service for a number of years on the Research Council of Canada. He is a member of the Corporation of Professional Engineers of Quebec, the British Institution of Civil Engineers, and the Société des Ingénieurs Civils de France.

President Surveyer married Miss Blanche Cholette on the tenth day of January, 1910; his family consists of five children.

He is a member of the University Club of Montreal.

For many years Mr. Surveyer has been one of the most active members of *The Engineering Institute of Canada*, having been a member of all of the important committees, including not only the standing committees of the Council, but special committees dealing with the welfare of *The Institute*. He was elected to the Council in 1915, on which he served continuously until the end of 1921. He was then elected vice-president, and immediately prior to his elevation to the presidency was serving his third year as vice-president, so that this is the tenth year he has been continuously in office.

Mr. Surveyer has specialized in semi-financial and technical investigations and in these fields his work has been highly successful.

Although still a comparatively young man, Mr. Surveyer possesses, with a splendid engineering training and experience, a judicial mind of unusual foresight and judgment. These qualities, combined with the highest principles of integrity and professional honour, have placed him in the forefront of consulting engineers in the Dominion, and it is anticipated that even greater success is ensured for him in the future.

Tensile Reinforcement in Concrete Dams

by
J. B. Macphail, B.A., B.Sc., A.M.E.I.C.,
The Shawinigan Engineering Company Limited.

In the design of a concrete dam, subject to ice pressure, which depends on gravity for its stability, it is found that the upper portions can not be made stable by gravity alone without using excessive top width. As a result, tensile reinforcement will be required extending from the top downwards to a certain point such that the overlying portion of the dam will be stable as a gravity section.

A method commonly used to determine the amount of such reinforcement is to make the assumption that at any given elevation a certain vertical force, acting at the upstream face, will be required to make the line of the resultant pressure pass within the middle third of this base, and that this force, divided by a suitable unit stress will give the area of reinforcement required.

Let us examine the argument. The conclusion is that the resultant pressure passes within the middle third of the base plane chosen. This requires that there shall be pressure over the whole base, decreasing from the toe to zero or more at the heel. But with any common steel stress, the concrete adjacent thereto will crack, even if only in hairline cracks, and there can not then be pressure over the whole base, but there will be a pressure diagram of the kind shown in figure No. 1. The position of the line of zero stress will depend on the steel stress and therefore on the amount of steel used, so the amount and the stress can not be arbitrarily chosen.

The rule of the middle third combined with tension at the upstream face is an unhappy confusion of ideas, and a discussion of the fact should be unnecessary; but when it is given in at least one text book as an example of modern practice, criticism of it seems justified.

Let us remember that in a stable gravity section of a dam the three fundamental equations of equilibrium are satisfied:—

i Sum of vertical forces = 0
ii Sum of horizontal forces = 0
iii Sum of moments of all forces = 0

and that it is assumed that the compressive stresss on the base follow a linear law of variation.

To improve on the faulty method quoted, it is necessary to assume in addition only that the tensile stresses are also subject to the linear law of variation and that the concrete can not take tension.

For any given case, therefore, it is necessary only to set up these equations and to solve them for the steel and concrete stresses, the amount of steel and the position of the line of zero stress.

A numerical example will best serve to illustrate the question raised. Consider the stability of the dam shown in figure No. I on a plane 26 feet below the top, taking a portion one foot thick perpendicular to the paper, with ice and water pressures acting as shown.

Using the method first mentioned, it will be found that a force of 33,500 pounds acting 0.5 foot from the upstream face will be required to make the section stable as a gravity section or say steel reinforcement at two square inches per linear foot of dam.

This may be verified. The base pressure diagram is a triangle of an area representing $W + T = C$. Taking moments about the toe, the overturning moment due to the external forces is: —

for ice	40,000 × 14	560,000 foot-pounds.
for water	7,030 × 5	35,000 "
Total		595,000 foot-pounds.

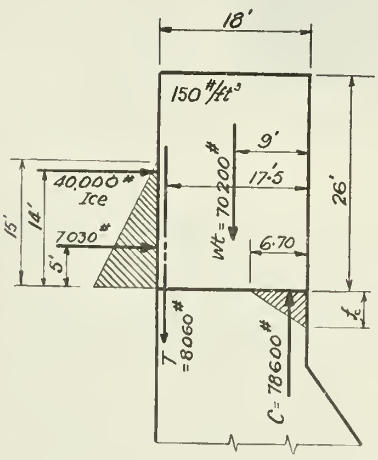


Figure No. 1.

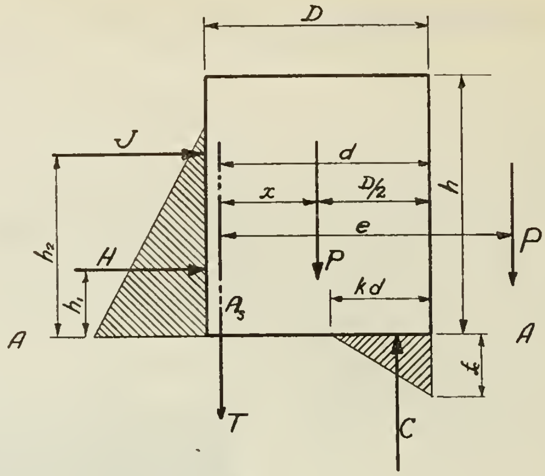


Figure No. 2.

The restoring moment due to the internal forces is: —

for W:	70,200 × 9	632,000 foot-pounds.
for T:	33,500 × 17.5	586,000 "
		1,218,000 foot-pounds.
less C:	$103{,}700 \times \frac{18}{3}$	622,000 "
Net		596,000 foot-pounds.

which agrees with the overturning moment within the accuracy of the slide-rule.

Also $C = T + W$ by inspection. So the value of $T = 33{,}500$ pounds is correct, and $f_c = 80$ pounds per square inch.

Applying the second method, the stresses in the dam when so reinforced are found to be $f_s = 4{,}030$ pounds per square inch and $f_c = 163$ pounds per square inch with $kd = 6.70$ feet.

This may be checked in the same way:

for W:		632,000 foot-pounds.
for T:	8,060 × 17.5	141,000 "
		773,000 foot-pounds.
less C:	$78{,}600 \times \frac{6.70}{3}$	175,000 "
		598,000 foot-pounds.

agreeing with the overturning moment.

Suppose now that one-fourth of the steel is used, or one-half a square inch per linear foot of dam. The stresses by the second method will be found to be $f_s = 9{,}350$ pounds per square inch, $f_c = 221$ pounds per square inch, and $kd = 4.69$ feet.

This also may be verified:—

for W:		632,000 foot-pounds.
for T:	4,675 × 17.5	81,900 "
		714,000 foot-pounds.
less C:	$74{,}700 \times \frac{4.69}{3}$	117,000 "
		597,000 foot-pounds,

which agrees with the overturning moment within the limits of accuracy of the slide-rule.

It is evident that further reduction in the steel area could be made, but at the expense of the concrete stress, so comparing the two examples as they stand, and accepting $f_c = 221$ pounds per square inch as satisfactory, a dam designed by the first method would contain four times as much steel as necessary, and would show a computed concrete stress of one-third or one-half the probable value.

The safety of the structure or of its components against failure by shear or sliding on joints must also be investigated.

The section taken in figure No. I was chosen for purposes of illustration and shows a greater waste of steel than was anticipated: in two dams that were investigated one of which is proposed and one built, there was between two and two and a half times as much steel as was necessary. The waste seems to increase rapidly with an increase in the ratio of total steel tension to weight, as found by the first method.

The application of the general equations of equilibrium is given in any standard text book on reinforced concrete, but the relations between the variables are so complicated that methods of solution differ.

The method given by Faber and Bowie, in "Reinforced Concrete Design", volume I, chapter III, which is there used for the design of eccentrically loaded columns, is convenient in form, and can be applied to the cases considered in this paper. The curves which they give do not include the values of the variables which occur in these cases. Accordingly additional ones have been computed and are plotted in figure No. III. In order to understand their application, it is necessary to give, in condensed form, the theory on which they are based, and to show how it applies to dams, as follows:—

Consider the stability on the base AA of the section of the dam shown in figure No. II, taking a portion of thickness b perpendicular to the plane of the paper.

Replace the external forces acting on the section by a single force acting with eccentricity e such that $e = \frac{Hh_1 + Jh_2 + Px}{P}$ taking moments about the intersection of the steel with the base, where H = water pressure; J = ice pressure; P = weight of the section above AA. Equate vertical forces and

$$P = C - T = bkd\frac{f_c}{2} - A_s f_s \qquad (1)$$

Equate the moments of the external and internal forces about the plane of the steel and

$$Pe = bkd\frac{f_c}{2}.d\left\{1 - \frac{k}{3}\right\} \qquad (2)$$

divide (2) by (1): divide both sides of the resulting equation by d: put $A_s = \frac{pbd}{100}$: multiply numerator and denominator of the right hand side by $\frac{100}{f_s bd}$ and finally put $\frac{f_s}{f_c} = t$

This gives $$\frac{e}{d} = \frac{\frac{50\,k}{t}\left\{1 - \frac{k}{3}\right\}}{\frac{50\,k}{t} - p} \qquad (3)$$

But $$\frac{kd}{d} = k = \frac{nf_c}{f_s + nf_c} = \frac{nf_c}{f_c t + nf_c} = \frac{n}{t+n} \qquad (4)$$

and $$1 - \frac{k}{3} = 1 - \frac{n}{3\,(t+n)} = \frac{t + \frac{2}{3}n}{t+n}$$

where $n = \frac{E_s}{E_c}$

make these substitutions in (3) and multiply numerator and denominator by $(t + n)$,

This gives:—

$$\frac{e}{d} = \frac{\frac{t + \frac{2}{3}n}{t+n} \cdot \frac{50n}{t}}{\frac{50n}{t} - p\,(t+n)} \qquad (5)$$

Note that p percentage of steel, and not the steel ratio as usual.

The ratio $\frac{e}{d}$ is known, so (5) may be solved by trial for t. Then k may be found from (4) whence kd and jd are known.

A series of curves may be plotted giving values of $\frac{e}{d}$ as ordinates and values of t as abcissae, with a different curve for each value of p, as in figure No. III. This will help in the choice of a trial value for t in the solution of (5).

Then taking moments about C

$$A_s f_s jd = P\,(e - jd) \text{ or } f_s = \frac{P}{A_s} \cdot \frac{e - jd}{jd} \qquad (6)$$

and moments about T

$$f = \frac{2Pe}{bkdjd} \qquad (7)$$

The results may be checked by substitution in (1) and (2).

The character of formula (5) shows that the results will be little affected by an error in the value of n and it may be shown that a decrease in the value of E_c will decrease slightly the value found for f_c and will increase slightly the value found for f_s.

The application of this method to a dam whose downstream face is not vertical at the plane AA, will give the value of f_c normal to the plane AA. The result may be in error, but the absolute value of the error should not be greater than that which occurs in the calculations for an unreinforced dam, and the permissable unit stress in the concrete is usually so expressed for this purpose.

It is hoped that the proposed method has been shown to be sound, and that it will be of use in dealing with problems of dams and the reinforcement of mass concrete.

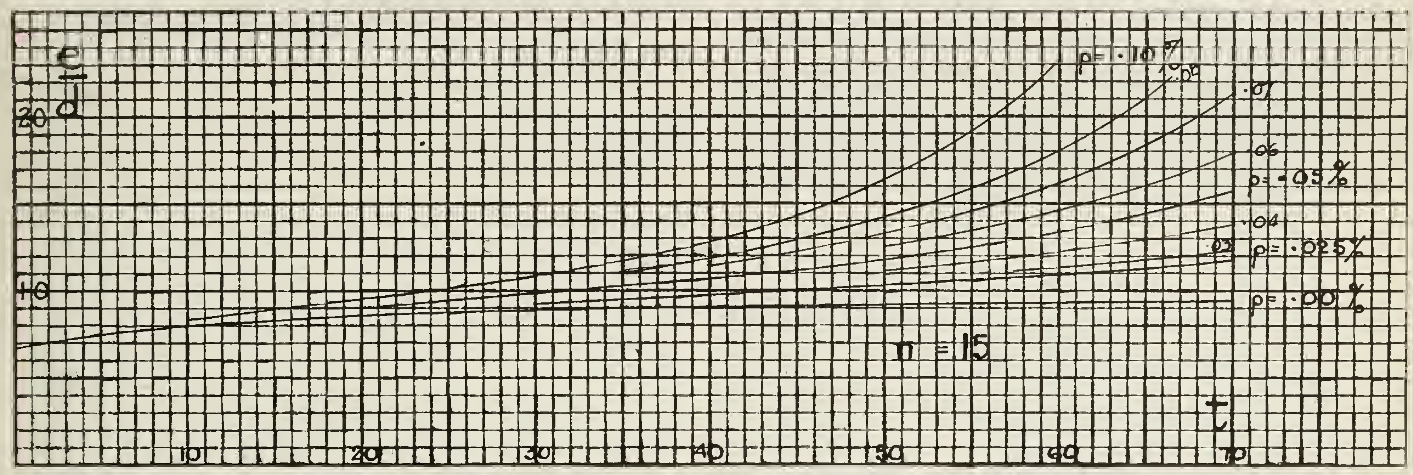


Figure No. 3.

British Standard Specifications and Reports

The British Engineering Standards Association has issued a list of the standard specifications and reports issued by the Association. The list is complete to February of this year and may be secured from R. J. Durley, M.E.I.C., the secretary of the Canadian Engineering Standards Association.

Charles A. Coffin Foundation Fellowships

Five thousand dollars is available for award annually by the Charles A. Coffin Foundation, established by the General Electric Company, for fellowships in electricity, physics and physical chemistry, to graduates of the universities, colleges and technical schools of the United States who have shown, by the character of their work, that they could, with advantage, undertake or continue research work in educational institutions either in this country or abroad.

Applications must be filed with the Committee by April 15, 1924, and should be addressed to W. W. Trench, Secretary, Charles A. Coffin Foundation, Schenectady, New York, from whom the necessary blanks may be obtained on request. Candidates who have been graduated for more than one year may mail their applications direct to the secretary of the Foundation, at the same address.

ELECTIONS AND TRANSFERS

At the meeting of Council held on March 14th, 1924, the following students were admitted:—

BOYD, Ivan William, 406 Johnston Street, Kingston, Ont.
ELLEGETT, Henry Victor, P.O. Box 464, Bowmanville, Ont.
FINKLE, C. Seymour, 68 Lincoln Road, Walkerville, Ont.
KENT, Kenneth MacIvor, 4024 Dorchester Street West, Montreal.
KERNAGHAN, Edward Benson, 630 Sherbrooke Street, Winnipeg, Man.
MacDONALD, Frank Sanborn, 17 Spring Garden Road, Halifax, N.S.
McINTOSH, Hugh Allan, Knox College, Toronto, Ont.
McLAREN, Leo Gerard, 481 Notre Dame Street, St. Lambert, Que.
MEANEY, Daniel Ignatius, 23 Carleton Street, Halifax, N.S.
RORKE, Charles Burrell, 515 Peebles Street, Wilkinsburg, Pa.
SUTHERLAND, George MacKenzie, 115½ Morris Street, Halifax, N.S.

Report of Fuel Committee of the London Branch of The Engineering Institute of Canada, October, 1923.

This committee was appointed to consider the use of Alberta Lignite Coal in Ontario. In doing so, it was found that the crisis due to the shortage of fuel which we had passed the previous winter, presented many questions affecting the country at large, and that attention should be given them. Much data and information has been collected, and certain conclusions and recommendations reached, are given in this report.

A Committee of unusual importance and value to Canada, known as the Dominion Fuel Board, was appointed by the government by Order-in-Council, (P. C 2381) November 25th, 1922. It is charged with the duty of investigating and reporting upon all fuel problems in Canada. Its personnel is composed of men of high attainments, who have specialized in fuels and problems connected therewith. The committee is possessed of ample funds and can employ experts, conduct experiments and do research work not otherwise possible. They have now been sitting a year. An interim report was issued last spring and recently a report on coke and by-products.

The eastern and western provinces have an abundance of fuel but that portion of Ontario from lake Superior to Ottawa river is without coal deposits and dependent upon outside supplies, chiefly from the United States. Your committee feel that this great industrial section of Canada should have other sources of coal supply so that the interruption of the supply from any one source will not interrupt the manufacturing industry, throwing men out of work, causing distress in the homes, and many other inconveniences.

In the year 1900, our population was 5,000,000; it is now about 9,500,000. The curve on the population chart will rise rapidly, and without doubt young members of this branch will see a population in Canada of 50,000,000. We now use about 4.0 tons of coal per capita. This curve is also increasing rapidly, and by the time the 50,000,000 population is reached, we will require 6 tons per capita, making an enormous total requirement of 300 million tons per year. The accompanying diagram shows our population and consumption of coal also a forecast of to the end of this century. The requirements of our friends to the south will have also increased. Their coal will have to be hoisted from greater depths, pumping and other items of expense in mining will have increased. Thinner seams, now unprofitable, will have to be worked.

Our requirements will then be more than the present production of the premier coal state in the union, viz, — Pennsylvania, or in other words, more than half the total production to-day, of the United States. If our forge and furnace fires are to be the index of our prosperity, and Canadian homes warmed through our long cold winters, then it is incumbent upon the people of Ontario to endeavour to supply coal for their own needs or at least to supplement the American supply by coal from other places. Our total exports of coal to various parts of the world in 1920, amounted to two and one-half million tons. This will increase yearly and at the time we are using the 300 million tons mentioned above, we will be supplying large sections of the United States.

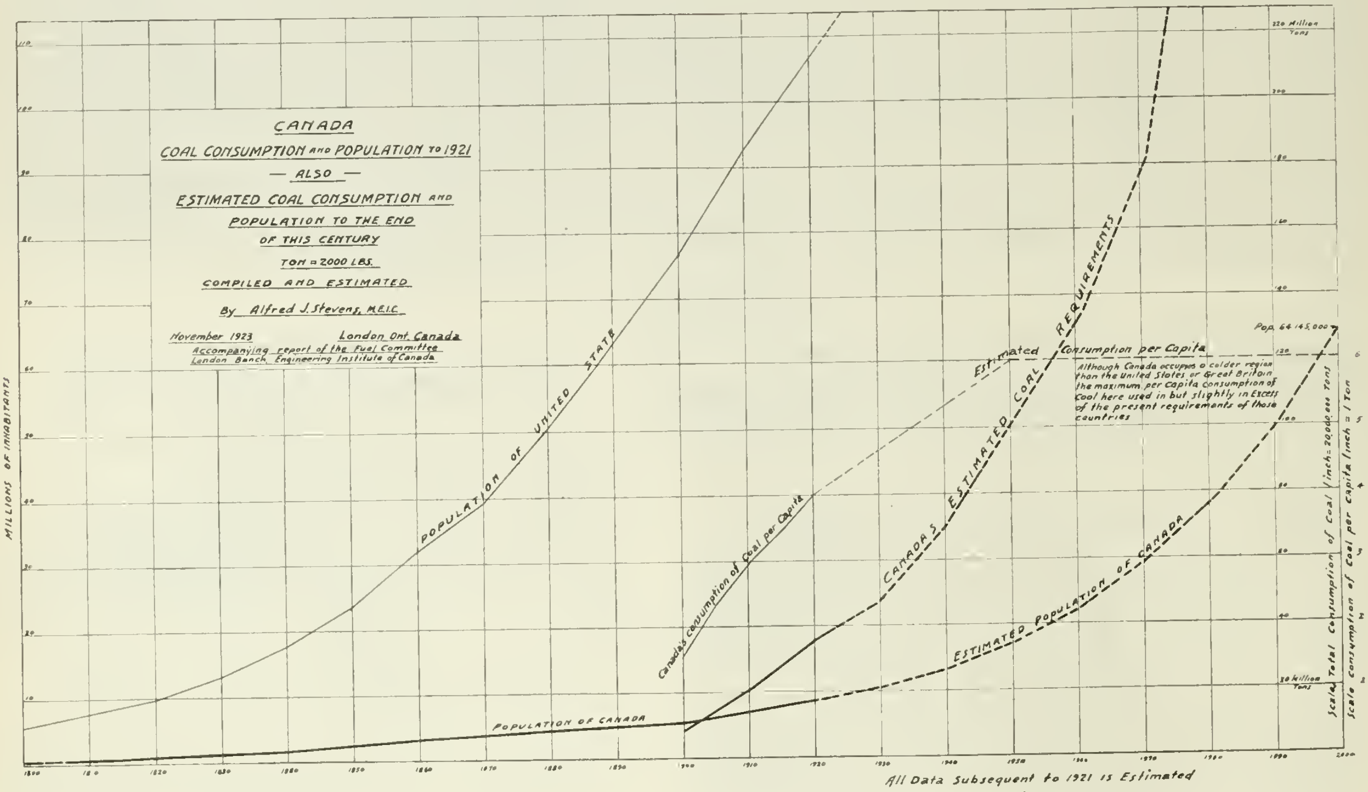
Until about four years ago, the people of Manitoba and many in the other prairie provinces, through custom and prejudice, would burn nothing but anthracite coal in their residences. Owing to curtailment of shipments, they used Alberta lignite and now find it satisfactory. The samples of Alberta coal received in this province last spring, burnt freely and with little ash and smoke. If this coal is satisfactory for the prairie provinces, there is no doubt but what it would be suitable for domestic heating in Ontario. As is well known the coal supply in Alberta is practically inexhaustible.

It might here be stated that the Anthracite mined in United States is all from Pennsylvania and amounted in 1920, to 79½ million tons. Canada purchased nearly 5 million tons, thus leaving 74½ million tons for the United States. Your committee has not figures to show the distribution of this, but without doubt, most of it was used in the eastern half of the country. At St. Paul and vicinity, by-product coke has recently displaced anthracite. If large and populous sections of the United States can now get along without anthracite, it goes without serious questioning that industrial Ontario can do likewise and will look for other supplies of fuel and gradually become accustomed to their use.

It is about six times the distance from Ontario to Alberta that it is to Pennsylvania. The coal rate from Pennsylvania to London is $4.91 gross per ton. Assuming that a coal rate of $7.00 per ton from Alberta to Ontario be established, then the effect of the 53 cents per ton customs duty is equal to 180 miles haulage of a ton of coal. Anthracite coal enters free of duty. It might here be remarked in connection with a suggestion made some time ago, that the western coal should be coked before being shipped to market, that the Pennsylvania bituminous coal could be treated in the same way, also it is probable that the cost per ton-mile from the state of Pennsylvania will remain, for many reasons, cheaper than from Alberta, hence it is probable that a reduction in the rate on coal or coke from Alberta would be followed by a corresponding reduction in freight from United States points, or cost of coal delivered in Canada.

The prices of coal at the end of September were as follows:—

Pennsylvania — Bituminous			
Pittsburg district, mine run	$2.00 — 2.25	net ton	
slack	1.00 — 1.10	"	
Central Pennsylvania, South fork	2.90 — 3.15	"	
West Virginia			
Smokeless mine run	2.75 — 3.00	"	
Slack	2.00 — 2.75	"	



Pennsylvania, Anthracite		
Company, egg, stove and nut	8.75 — 9.25	gross ton
Pea	6.25 — 6.65	"
Independent, egg, stove and nut	9.75 — 13.50	"
Pea	6 75 — 9.00	"
Beehive coke (Connsellville)	4.00 — 4.75	net ton
Alberta, mine run	3.75	"

It is to be noted that there is a great spread in prices for anthracite, egg, stove and nut, that is possibly not due solely to the percentage of ash in various coals.

Coke Oven By-products.

The coke oven plants at Sydney, N.S., Sault Ste Marie, Ont., Hamilton, Ont., and Anyoz, B.C., are by-product plants, and the recoveries of coke oven by-products in 1920, included 14,000,000 gallons of tar; 20,000 tons sulphate of ammonia, and important quantities of benzol, toluol, solvent naphtha and naphthalene. Other by-product coke ovens will be placed in operation this year and the coke placed on the market.

The Fuel Board of Canada in their Interim Report, 1923, state that great improvements have been made in the technique of the manufacture of domestic coke oven very recently, and the product made is much superior to the ordinary gas-house coke. It is a dense material of approximately the same heating value as anthracite and should be produced at a price to compete with it.

In 1920, the coke output was 1.3 million tons, of which Ontario produced slightly more than half from imported coal which paid 53 cents per ton, whereas imported coke enters duty free. One ton of coal will make about 62/100 ton of coke.

Your committee received much valuable information and suggestions concerning the fuel problems of Canada from Mr. William Pearce, statistician of the Department of Colonization and Development, Canadian Pacific Railway Company, Calgary, Alberta, of which the following is an epitome:—

1. To extend the radius of consumption of Canadian coals take our highest grades, (bituminous), and convert them into domestic coke and briquettes, both of which are as good an article as anthracite. The coking will furnish all the binder required and at a very low cost.
2. If de-ashing them to the extent of 75 or 80 per cent should prove commercially practicable and such appears probable, that in itself would greatly extend the radius of consumption.
3. Domestic coke and briquettes can be stored without danger from heating or spontaneous combustion or material deterioration, therefore mining operations and transportation can be ensured for the entire year, thereby greatly reducing the costs both of mining and transportation.
4. Much of the lignites or soft coals or the so-called domestic coals of Alberta are very high grades, "fool-proof" in use and for a certain field could probably not be supplemented either by domestic coke or briquettes, but owing to their lower calorific values and non-adaptability to storage can be economically mined and stored only during a portion of the year the limit to which they can be profitably shipped in comparison with the bituminous, causes the latter to be the class to which efforts to extend our marked should be confined.
5. Whether the extension of the market is to be confined to either Nova Scotia or Alberta and British Columbia coals, they should all go through by-product ovens. To burn raw coal is a crime. All the by-products should and can be profitably utilized.
6. For ordinary heating purposes electrical heating cannot compete nor is it likely owing to the short radiation properties of electrical heat that it even will prove a serious competitor even when electrical energy can be supplied at the minimum cost.
7. It is always a matter of some difficulty to drive the public to substitute one form of fuel for another, but it is submitted, having in view what has been accomplished in this line, it will not prove difficult or expensive to substitute domestic coke and briquettes for anthracite or any other grade of fuel now used.
8. Extend the Nova Scotia coals as far west as may be possible; the Alberta and British Columbia coals as far east, the gap to be supplied by United States coals. In every case, except for large steam plants and locomotives to have fuel in the form of coke and briquettes. Even for these uses it may and likely will prove profitable to convert the coal required into coke and briquettes.
9. Where there would be a large consumption of coke, gas and any other by-products it would be advantageous for the location of by-product ovens. Outside of them probably it will prove advantageous to locate the by-product ovens at or near the points of mining.
10. The probable success of the combinations of the processes utilized in high temperature and low temperature carbonization will so greatly lower the production of gas but much more than compensate for it in other by-products, particularly in creosote oils, benzel and ammonia that there will be no surplus or gas available.
11. In larger centres central heating plants could with great advantage be installed, thereby economizing on quantity and cost and adding greatly to the comfort of the consumer.

Many samples of Alberta lignite coal received in Ontario last spring were analyzed and burnt in grates and furnaces. It was found that they varied greatly in quality. The samples received were probably from the best mines. Coal from the same mine may vary according to its location in the mine, the picking or removal of slate and other causes.

On account of the water route from Nova Scotia to Quebec and Montreal, bituminous coal can be delivered in competition with American coal. Your committee feel that one of the great benefits that would accrue to Ontario upon the completion of a deep water way from the lakes to the ocean, would be the delivery of Nova Scotia and British coal to ports on the Great Lakes. The charter rate from Nova Scotia to Great Lake ports without doubt, will be less than the rail rate from the United States. The coal could then be passed through by-product ovens and together with the gas and other products, used locally or the coal or coke, etc., could be re-shipped to other points. In this connection, we desire strongly to point out the necessity of keeping all electrical current, "White Coal" developed with Canadian water for use in building towns and cities on the Canadian side of the river or boundary line. This can be used in smaller units and distributed much easier than steam power developed from coal. To keep it free from future entanglements, the Canadian portion of the enterprise should be financed by Empire capital.

It must be born in mind that the grades of Alberta coal proposed to be shipped to Ontario, are to compete with anthracite for domestic purposes.

The Alberta coal has almost entirely displaced the use of American coal throughout the prairie provinces. A small quantity of American coal is used there; one notable example being 9,000 tons of smokeless Pocahontas, mine run, which was contracted for at $9.98 per ton delivered in users bin Winnipeg. This price included the customs duty 53 cents per ton. This coal was, at the same time, selling at $9.40 per ton in Detroit, Michigan. The Winnipeg price is cheaper than Alberta coal had been sold for in Winnipeg, thus the Alberta coal resulted in lowering the price of the American coal.

It may here be said that Alberta coal of the various grades, sells readily throughout the prairie provinces and is satisfactory for their use. Without doubt this coal would be found satisfactory, for nearly all purposes in Ontario. In Nova Scotia furnaces that formerly burnt anthracite, have been discarded and larger furnaces to burn Nova Scotia bituminous, installed. This coal would also be used for nearly all Ontario purposes. Other prices paid for coal this year, delivered in users bins in large orders were:

Toronto,	Pocahontas	$10.45 ton
	anthracite, egg and stove	$15.50
Ottawa,	anthracite	$16.15 ton
	bituminous from N.B.	$10.70
Montreal,	anthracite, egg and stove	$15.50 ton

In conclusion your committee wish to again draw your attention to the plate attached hereto which shows the yearly increase in the quantity of coal necessary for this country. We must have a plentiful supply of coal for industrial development. We therefore strongly recommend that the people of Ontario do everything possible to retain and develop commercial relations with all parties who have fuel for sale, in other words, hold all existing commercial connections and develop others to suit the exigencies as they may arise. Canadians should possibly increase their investments in foreign coal mines. Looking forward 68 years when we will have 50,000,000 population and will require 300,000,000 tons of coal per annum, Canada will then probably be exporting more coal than we will import. We hope the proposed deep water way from the Great Lakes to the sea, during the period of open navigation, and while carrying the commerce of two peoples, may be able to a great extent, supply the Great Lake region with Nova Scotia and Welsh coal.

We urge the continuance of the Dominion Fuel Board and would strongly recommend that it be sufficiently financed for investigations and research work and supported with public approval. The problems to be investigated are many and much of the data required must be collected with patience, covering long periods of time. Your committee wish to thank many provincial government, city and town officials, mine owners, university staffs, railway officials and others for valuable data which has been of assistance and guidance in the preparation of this report.

Much technical information collected by the committee, has not been presented, but it was a guidance in drawing the conclusions and recommendations herein contained. The committee wish to thank the London Branch of *The Engineering Institute* for many considerations and favours during the preparation of this report.

ALFRED J. STEVENS, M.E.I.C., *Chairman,*
A. H. MORGAN, M.E.I.C.,
ROBERT ANGUS, M.E.I.C.,
R. I. OLMSTED, A.M.E.I.C.

A Review of Work Completed Underway and Projected in the Niagara District

Niagara, St. Catharines and Toronto Railway Programme

The Niagara, St. Catharines and Toronto Railway, now part of the Canadian National system, has made a start on a large programme of renovation and improvement. The programme includes re-routing of their cars in the city of St. Catharines, the laying of rails on new streets, to tap hitherto unserved portions of the city, and the building of a large new station there. The latter, which was started last fall, is now nearing completion.

In the city of Niagara Falls, Ont., their main line will be extended through the city to the cantilever bridge below the falls, to the great improvement of the electric service from Buffalo to Port Dalhousie on lake Ontario. The work in this city is estimated to cost $500,000., and will be undertaken soon, provided their franchise, which is now before the municipality, is approved at an election to be held this month. The total amount to be spent by the railway in this district, is in excess of two million dollars.

New Bridge over Niagara Gorge

The Michigan Central Railway is progressing rapidly with the construction of a new bridge to span the Niagara River gorge at Niagara Falls. The bridge will replace the one now in use by the railway, and will be a short distance downstream from it. The concrete piers, and other ground works have already been completed, and it is expected the bridge will be open for traffic in the fall of this year.

Scenic Tunnel Extended

The scenic tunnel under the Horseshoe falls, extending from the Canadian shore, and built for the edification of those who will pay for such artificial thrills, has quite recently been extended, and now reaches almost to the apex of the Horseshoe.

Paving Programme of Niagara Falls, Ont.

Niagara Falls, Ont., has an extensive paving programme for the coming season. It is expected that 60,000 superficial yards of asphalt will be laid. The city owns its own asphalt plant, and is prospering under the guidance of its city manager and city engineer, T. S. Scott, M.E.I.C.

Works at St. Catharines

With the exception of work on the Niagara, St. Catharines and Toronto Railway, and on the Welland ship canal, no engineering activities of outstanding importance are in prospect in St. Catharines and its environs for 1924. The several miles of roadway built in this section during the last couple of years meet present requirements.

Chippawa Power Development

Work on the Chippawa power development is still in progress. In a recent issue of *The Journal*, we outlined the address given before this branch by F. H. Farmer, A.M.E.I.C., describing the work of installing a 55,000-kv.a., generator at the Queenston power house, for the Hydro-Electric Power Commission of Ontario. Two more units, of 58,000 h.p., each are expected to be installed and in operation by the end of this year. The battery of generators for the development of power from the Chippawa canal will then be complete.

Some survey work is being done by the hydro commission in the district adjacent to Niagara Falls, and around the present Chippawa canal, in the expectation that some day, in the not far distant future, a second canal may be required, to meet the ever-increasing demand for electric energy.

Extension to Government Elevator at Port Colborne

Towards the end of last summer, work was begun on the erection of a $450,000., addition to the government elevator at Port Colborne. This elevator lies at the southern or lake Erie end of the present Welland canal. The new structure will have a capacity of one million bushels. The foundations for the building were completed last season, and it is expected that it will be ready for use by August 1st, next. E. G. M. Cape and Company of Montreal are contractors for the building, which is to be of reinforced concrete construction. The Standard Steel Construction Company, as sub-contractors, will handle the steel work for the bins, etc. Mr. Sutherland, representing the former company is resident engineer in charge, under the supervision of J. C. Moyer, A.M.E.I.C., assistant superintendent of the Welland canal.

Welland Ship Canal

Work on this waterway has progressed rapidly during the last two or three seasons. Four or five years, and a sum of money in excess of $40,000,000., are yet required before it will be complete. At Port Weller, the northern or lake Ontario end, the reinforced concrete crib work in the harbour requires only three more cribs and the placing of the superstructure, and this part of the work will be finished. This will be done this coming season. Dredges are at work cleaning the harbour bottom. Much of this work will also be completed this year. The concrete work on sections 1 and 2 is well advanced. The unwatering gates are now being erected in lock 1. At lock 3 the foundation for the west wall was poured last year between walls of steel sheet piling. This proceeding was necessary because of the unstable nature of the ground. Excavation for the lock chamber will be pushed energetically this summer.

The work on section 3, during the past winter, included the crushing of limestone, dirt excavation in lock 4 and the cleaning of the floor and rock walls of lock 5, in readiness for concrete pouring this summer. The coping of the lock 5 walls will practically coincide with the natural grade at the top of the Niagara escarpment. The rock here consists of thin alternate strata of shale and low-grade sandstone, useless for concrete aggregate.. This rock weathers rapidly, and the face of the cut, now several years old, requires careful cleaning before concrete can be poured against it. Concrete was poured in the floor and the wall foundations at the south end of this lock last fall.

Lock 6 is complete except for the north and south extremities. During the winter, a rather spectacular engineering feat was accomplished without mishap. The travelling tower, from the east chamber of lock 6, having fulfilled its mission there, was lowered to the floor of lock 5, a vertical distance of 46½ feet. The tower is about 155 feet high, and weighs about 300 tons.

A trestle was built from the breast-wall of lock 5 to a shallow excavation in the floor of the lock. This trestle formed an angle of about 30 degrees with the horizontal. On the upper end of this was erected a wedge shaped platform, whose upper plane was horizontal, and on a level with the floor of lock 6. The timber runners of this platform lay on the runners of the trestle. When this was firmly secured, the tower was run out unto it. Two donkey engines, placed at the lower end of the trestle, supplied both brakes and motive power, being attached to the platform by cables passing over pulleys. Thus the tower and platform moved down together, and the tower is now at an elevation which will permit it to be run off unto the floor, as soon as the adjacent slab is poured.

The forms from lock 6 have been lowered in the same manner. When concreting is finished in the west chamber of the lock, the second tower will also be brought down.

Lock 7 is about 60 per cent complete. The concrete work there will probably be finished this year.

A large quantity of earth was excavated at section 4 last year. Rock excavation will be rushed this season.

The work on section 5 consists largely of dredging, the canal in this section co-inciding with the present Welland canal. Most of this work is complete.

The contract for section 8, which covers a section of canal prism, the guard lock, and the harbour works at Port Colborne, on lake Erie, has recently been awarded to the A. W. Robertson Company, and it is expected that work will be started there this year.

The plans and specifications for section 7 are now being prepared, and tenders will soon be called for. This section extends from Main street, Welland, to the north end of section 8, in the vicinity of Ramey's Bend.

R. Hogg, Jr.E.I.C.,
Niagara Peninsula Branch.

Fuel Conservation Convention, held by Dominion Atlantic Railway.

The Dominion Atlantic Railway, which runs through the famous Annapolis Valley, connecting Halifax with Yarmouth, N.S., held a three-day fuel conservation convention in Kentville, N.S., from February 28th, to March 1st, and prominent in the company's fuel conservation endeavours is the name of D. L. Derrom, M.E.I.C. The meetings were open to the public and the discussions were extended to cover the domestic uses of fuel. The convention hall contained exhibits of domestic fuel burning appliances, and placards and diagrams illustrating the purposes of various models.

The benefit which the railway is deriving from the correct application of the results of its research work is a lesson to all transportation and industrial concerns which derive their energy from fuel, and the splendid methods by which its information is being passed along to the public is worthy of emulation by governmental and other bodies entrusted with similar work.

De Laval Steam Turbine Company, of Trenton, N. J., has issued an illustrated leaflet describing the water works pumping station of the city of Allentown, Pa. The water supply for the 85,000 inhabitants is taken from two springs, one located near the pumping station and the other at a distance of five miles, and water is supplied to 19,000 connections at a single family rate of only $3.75 net per year. The pressure varies from 40 to 100 lbs., which is sufficient for fire purposes. The principal pumping equipment consists of two centrifugal pumps designed to be driven either by steam turbine or by an electric motor using purchased electric power.

Employment Bureau and Members' Exchange

The following is a list of students who will be available for positions at the close of the present academic year.

*McGill University

Name	Year	Course	Experience	Work preferred
Adams, A. O.	II	......	1 yr. rodman, C.P.R.; 2 yrs. draftsman and calculator, pulp and paper co. and Air Board; 4½ months draftsman, Laurentide Air Service	General engineering or aeronautics.
Airey, H. T.	II	......	2 months labourer, mining and smelting co.	Mining, Kootenay district.
Benjamin, A.	IV	Elec.	3 years general electric work, house wiring and electrician; 20 months Montreal Tramways car shop, electrical dept.	Electrical, Montreal.
Brodie, LeS.	II	......	5 weeks telephone operator; 3 months purser; 2 months, Canada Car & Foundry	Civil, surveying.
Cossitt, L. S.	IV	Mech.	1 year machine shop; 1 year drafting	Mechanical.
Merritt, G. M.	III	Civil	2 summers real estate salesman	Construction.
Ridgewell, E. P.	II	......	2 years chemical lab. assistant — steel paint and varnish; 5 months microscopic lab. assistant; 6 months asst. chemist, Northern Aluminum Co.	Metallurgical; inorganic industrial chemistry, Montreal.
Rutherford, J. F.	II	......	1½ months Routex Corporation	Electrical, Montreal.
Savage, M. H.	II	......	1 summer draftsman, telephone work, Northern Electric	Electrical, radio, survey assistant.
Stewart, D.	III	Elec.	8½ years book-keeping and cost accounting, secretarial; 2½ months draftsman, Northern Electric	Electrical.
Theobalds, T. R.	I	......	......	Survey.
Weisburgh, C.	IV	Elec.	3 years business, Babbitt & Co.; one year and three summers department foreman Wilke Laundry Co.	Electrical.

*More detailed information may be obtained on application to the Faculty of Applied Science, McGill University.

Situations Wanted

Technical Graduate

Graduate McGill University 1923, in metallurgical engineering with B.A. from Laval University, requires position where there is a good possibility of advancement. Experienced as draughtsman, chainman, chemist, inspector and electrician. Married. Speaks French and English. Apply box No. 139-W.

Consulting Engineer

Consulting engineer, fifteen years association with the industries manufacturing sawmill, pulp and papermaking, hydraulic turbines, power plant and special machinery, desires permanent connection with manufacturer or firm of consulting engineers. Apply box No. 140-W.

Civil Engineer

Student member; age twenty-two; two years civil engineering; two years field work as instrumentman desires permanent position with engineering or contracting firm, where there is opportunity for advancement. Will go anywhere and do anything, though would prefer to be located near Montreal. Excellent references. Slightly lame. Salary not main consideration. Apply box No. 141-W.

Situations Vacant

Electrical Engineer

Competent electrical engineer to act as resident engineer in charge of the installation of electrical and mechanical equipment for a 24,000 h.p. water power station in Northern Ontario. Apply box No. 84-V

Construction Engineer

Recent graduate with one or two years experience in construction work required for industrial firm in Montreal. Apply box No. 90-V.

Electrical Engineer

Technical graduate preferably with two or three years experience, unmarried. Must be able to take complete charge of a small power plant and the electrical machinery of a paper mill. Location Western Ontario. Apply box No. 100-V.

Mechanical Engineer

Third year or graduate for conducting performance tests on return tubular boilers and Wheelock and Corliss engines. Must be thoroughly acquainted with this work. State qualifications, reference and initial salary required. Apply box No. 101-V.

See also page 217.

ANNOUNCEMENT OF MEETINGS

Further information may be secured from the secretaries of the various branches, whose addresses will be found under "Officers of Branches", on page 176 of *The Journal.*

SASKATCHEWAN BRANCH:—
Secretary-Treasurer, D. A. R. McCannel, A.M.E.I.C.

Apr. 11th. Address on "Highway Construction in Saskatchewan", by H. R. MacKenzie, A.M.E.I.C., chief engineer, Saskatchewan Department of Highways, Regina, Sask.

ST. JOHN BRANCH:—
Secretary-Treasurer, W. J. Johnston, A.M.E.I.C.

Apr. 17th. Address on "Concrete in Sea Water", by A. G. Tapley, A.M.E.I.C., Public Works of Canada, St. John, N.B.

WINNIPEG BRANCH:—
Secretary-Treasurer, P. Burke-Gaffney, A.M.E.I.C.

Apr. 3rd. Address on "Electric Steam Boilers", by Mr. De Kermor.
Apr. 17th. Reports of Committees.
May 1st. Annual Meeting.

PETERBOROUGH BRANCH:—
Secretary, R. C. Flitton, A.M.E.I.C.

Apr. 10th. Address on "Making of Moving Pictures", by B. E. Norrish, A.M.E.I.C.
Apr. 24th. Address on "Engineering Education", by Fraser S. Keith, M.E.I.C.

Strathcona Memorial Fellowship in Transportation

A Strathcona Memorial Fellowship in Transportation, of One Thousand Dollars, is offered annually for advanced work in Transportation, with special reference to the construction, equipment and operation of railroads, the problems connected with the efficient transportation of passengers and freight and the financial and legislative questions involved. The holder of the Fellowship must be a man who has obtained his first degree from an institution of high standing. In making the award, preference is given in accordance with the will of Lord Strathcona to such persons or to sons of such persons as have been, for at least two years, connected in some manner with the railways of the Northwest.

Applications for this Fellowship should be addressed to the Dean of the Graduate School of Yale University, New Haven, Conn., before May 1, on blanks which may be obtained from the Dean, and should be accompanied by:

1. A statement of the applicant's education and practical experience.
2. A statement of the particular field of interest to the applicant and his reasons and purposes for desiring the Fellowship.
3. Letters of recommendation.
4. Reprints of articles or publications by the applicant.

BRANCH NEWS

Lethbridge Branch

Geo. S. Brown, A.M.E.I.C., Secretary-Treasurer.

The Deterioration and Preservative Treatment of Timber.

An exhaustive address on the above subject was given by A. S. Dawson, M.E.I.C., before the meeting of the Lethbridge Branch on February 23rd.

In the course of his remarks Mr. Dawson said it was probably true that more lumber was annually destroyed in the forests of this country by decay than by fire. Moreover to preserve the forest it was just as important to arrest the ravages of wood-decaying fungi, as it was to endeavor to prevent forest fires.

Mr. Dawson dealt at length with the question of preserving cut lumber and referred especially to railway ties. There were he said, on the Canadian railways probably 120,000,000 of these in service. The annual replacements, without considering those used for extensions, would average about 12,000,000. Preservative treatment had been developed to a degree of effectiveness in various countries which made it possible to double or even treble the life of many species of wood.

By preservative treatment fast-growing, non-durable species of lumber could be converted into superior durable timber suitable for structural purposes, timber that was otherwise regarded as little more than worthless. It enabled trees removed in thinning the forest to be put to higher uses, and made it possible for inferior logs to be used to better advantage than if left to rot in the woods or be sawn into inferior grades.

In addition to the direct effects on the forests, wood preservation was a direct financial economy to all large users of timber. Every foot of timber made to give longer services by preservative treatment meant a lessened drain on the forests. It was therefore a vitally important phase of conservation.

Mr. Dawson said that he believed the day would come when many large treating plants would be established in western Canada; that it would be common practice to treat most of the timber used, and that this would result in large quantities of certain woods being used for ties and other constructional purposes, and which are useless for these purposes unless treated.

The paper was one of the most thorough and exhaustive ever presented to the branch on any subject. Full of facts and backed up with an array of statistics it will when printed become a classic on the subject.

Mr. Dow, chairman of the meeting, in introducing Mr. Dawson said that when the history of the West is written the lecturer's name would receive a prominent place and Lethbridge was to be congratulated on being able to get him to speak to us. Mr. Dawson is not only a member of the Engineering Institute of Canada, but is also a member of the American Society of Civil Engineers and representative of the Alberta Professional Engineers on the Senate at Edmonton University.

Mr. Geo. Fleming obliged with solos which were much appreciated. The Engineers are getting a name for music and it was announced that there is to be a competition in the near future between the quartette that has held forth on one or two occasions and another quartette. Visitors were J. S. Lloyd, Geo. Babgate, Dan Quigley, W. B. Crossing, D. J. McCrae and a new affiliate Chas Giffen. Mrs. Dunning and Vic. Ludgate again kindly assisted with the musical part of the programme.

Kingston Branch

A. Jackson, A.M.E.I.C., Secretary-Treasurer.

At the regular meeting of February 18th, 1924, G. P. Graham, formerly of the city engineering department, Albany, N. Y., now representing the Asphalt Association of New York, gave an illustrated lecture on the uses of asphalt in highway construction. The speaker first gave the different sources from which asphalt is obtained and explained the methods of refining. By the use of slides, different types of roads were shown on which asphalt could be used to advantage and also the part asphalt could play in resurfacing old roads in a bad state of repair. In applying the asphalt the old method of pouring from cars by hand, has been replaced by mechanical sprinklers, which give greater uniformity in the thickness of the coat, particularly the type which travels along one half of the road and by the use of an extended arm sprays the other half.

Moving pictures were shown of the operation of mixing plants on road work, as well as the other operations in building the road. In the discussion which followed, Mr. Graham stated that natural asphalt and the asphalt from petroleum were equally good.

The Fuel Problem of Ontario

James White, M.E.I.C., of Ottawa, chief engineer of the former Conservation Commission, addressed the Kingston Branch at their regular meeting on February 26th, on "The Fuel Problem in Ontario". Mr. White gave figures on the quantities of both anthracite and bituminous coal imported into Canada, stating that Ontario used 64 per cent of all anthracite coal coming in.

With a map showing deposits of coal in Canada, the question of using Canadian coal in Ontario was gone into. Bituminous coal from Nova Scotia has never been brought farther than Brockville. To carry Alberta coal to Ontario the C. P. R. and C. N. R. give costs of $9.95 and $9.00 respectively, per ton. This coal costs $4.50 per ton at the minehead and to compete with imported coal it must sell at $11.00. Thus economically, Alberta coal cannot be used.

It has been thought that by carbonizing the lignites of Alberta, a satisfactory fuel could be obtained, but the investigations up to the present have not turned out satisfactorily. The carbonization did not present any difficulty, but the briquetting did, since it was found that these lignites could not be briquetted dry and inexpensive binders were not satisfactory. Coal tar was found to be the only satisfactory binder, but its cost is prohibitive. Pulverized coal is a low priced fuel of high efficiency and is satisfactory for industrial concerns. Very large central coking plants is one solution to Ontario's fuel problem. This so called domestic coke is comparatively high in volatile matter and could replace anthracite. Also, the gas from such a plant could be sold for ten cents per thousand cubic feet, according to one authority.

Considerable investigation has been done with a view to using peat as a domestic fuel, but thus far the cost of driving off the water is too high. A peat bed forty feet thick is only equivalent to a layer of coal one foot thick, and to drive off the water for a ton of peat, the heat of two ton of peat would be required. Again commercial peat occupies four times the space of an amount of coal, with the same heating value, which means additional labour in handling and cars for carrying.

The objection to the use of petroleum in the same as that for anthracite coal, namely that it has to be imported, while the cost of electrical energy for heating is prohibitive.

Under present conditions, Welsh anthracite for domestic purposes is the most economical and satisfactory. It only contains about 3 per cent ash and does not require the furnace attention of other grades of anthracite. In conclusion, the speaker pointed out that freighters would come into Montreal with a 50 per cent cargo if they were guaranteed a full cargo to carry away. From this it would seem that there would not be any difficulty getting ships to carry coal to this country, if they were guaranteed an outgoing cargo of wheat.

LaGabelle Development

On March 6th, the Kingston Branch held a joint meeting with the Engineering Society of Queen's University and Julian C. Smith, M.E.I.C., of the Shawinigan Water and Power Company, gave an illustrated lecture on the construction of the water power at LaGabelle, Quebec, on the St. Maurice river.

Slides were shown of the LaGabelle area and the course of river traced. The site of the dam was indicated, and it was pointed out that by using this site, the first half of the dam could be built on dry land and openings left for by-passing the river, while the other half was constructed. Moving pictures were then shown, first of the site in 1923, before any work had been done, and then month by month, showing the work as it progressed until completed this year. The speaker commenting on the different points as the film went through.

At the conclusion of the address, Mr. Smith went into a number of the problems encountered in the design of water power and gave methods of arriving at their solution.

On the morning after the lecture, Mr. Smith addressed the final year engineering students of Queen's University on the financial organization and design of a station of a hydro-electric power plant, at which many of the members of the Kingston Branch were present.

London Branch

E. A. Gray, Jr.E.I.C., Secretary-Treasurer.

R. I. Olmsted, A.M.E.I.C., Branch News Editor.

The regular monthly meeting of the London Branch was held in the Board Room, Board of Education, Public Utilities Building, on February 20th.

After the minutes of the previous meeting had been read and adopted, the chairman, E. V. Buchanan, M.E.I.C., introduced the speaker of the evening, Germain P. Graham, Albany, N.Y., eastern manager, Asphalt Association (formerly of the engineering department of the city of Albany, N.Y.).

Mr. Graham gave an address on the subject "Asphalt", and supplied slides and moving pictures to illustrate. Asphaltic sources of supply were first treated with the process of refining, etc., fully covered. Then followed the development of the use of asphalt from the first application down to present day methods.

In addition to the development of the use of asphalt, Mr. Graham covered fully the equipment used and explained the best method of preparing and finishing, with particular reference to rolling.

The address was more of a general rather than technical nature, and at the conclusion brought forth a considerable amount of discussion.

In view of weather conditions, the attendance was very good, some twenty being present.

City Planning Discussed

At a joint meeting of the London Branch and the Round Table Club, on March 21st, Col. Ibbotson Leonard D.S.O. M.E.I.C., member of the London Town Planning Commission and W.P. Near B.A.Sc. M.E.I.C., city engineer lead the discussion on City Planning, with particular reference to tentative recommendations made in a report of a preliminary survey of London, made by Thomas Adams in 1922.

Hamilton Branch

W. F. McLaren, M.E.I.C., Secretary-Treasurer.

On Wednesday, February 27th, the Hamilton Branch met with the Canadian Section of the American Waterworks Association at a banquet in the Royal Connaught hotel. Fred A. Dallyn, A.M.E.I.C., chairman of the Canadian Section, presided. J. W. Tyrrell, M.E.I.C., chairman of the Hamilton Branch, and R. Dobbin, M.E.I.C., of Peterboro, past chairman of the Canadian Section, were among those at the head table. George W. Fuller, M.E.I.C., of New York, chairman of the American Waterworks Association, was guest of honour.

Water Purification

After the banquet and a welcome from Mayor Jutten, Mr. Fuller addressed the meeting on the subject of "Water Purification", in part as follows:

It is ninety-five years ago that water purification by means of sand filtration was first established at London, England. In those days the purpose was to get clean water acceptable to sight and smell. That viewpoint prevailed for some fifty years and filtration was adopted by many important European cities. A brief outline of developments in this field is of interest, notwithstanding that the early beginnings had no relation to the germ theory of disease or to an adequate appreciation of all the benefits of pure and wholesome water.

The first guide post along the road of progress in America, came from the thorough investigations of European filtration practice, by the late J. P. Kirkwood, for many years chief engineer of the Brooklyn waterworks, who was commissioned to make this investigation by St. Louis. His published report was a classic on the subject, and was translated into several languages.

About forty years ago, two important events occurred in relation to the quality of public water supplies. The principal one was the recognition by the leading sanitarians of the germ theory of disease. The second was the establishment of laboratory methods based on the new science of bacteriology. Water examinations quickly took on a new aspect as compared with earlier records comprising chemical tests only. In a short time numerous investigations were under way to record the bacterial removal by various purification processes.

About fifteen years ago it was found that a large proportion of the objectionable bacteria in water might be eliminated by chlorine. This process has been adopted very generally in America as one means of purifying water. In some instances its use is the sole method of treatment, while in other cases its use is in conjunction with filtration, either to serve as a factor of safety, hygienically or with the purpose of permitting economies as compared with filtration practice in earlier years. Chlorination is a very helpful procedure, but too much has been expected of it in many places. Its efficiency depends upon having the right quantity of chlorine present in all of the water to be treated. The presence of trade wastes in some supplies has limited the usefulness of chlorination.

While Hamilton has enjoyed the benefits of protection from its own sewage flow in a degree not found in some cities elsewhere, yet its use of an unfiltered lake supply is a custom which is at variance with the best practice found elsewhere. Absence of water purification represented a prevailing view at many of the cities on the great lakes a few years ago, but that view has been materially modified in recent years. Nearly all cities have adopted either filtration or chlorination, and it is of much significance that Chicago, during the past few months, had found chlorination inadequate in protecting its citizens from water-born diseases.

Oshawa, Whitby, Port Credit, Kingsville, Amherstberg, Niagara-on-the-Lake, Wallaceburg, and cities in the United States have enjoyed the benefits of filtration plants for some years. Detroit has recently put a filter plant in service. Buffalo is building one, and Milwaukee is accumulating funds to do the same through an increase, within a few years, of its water rates, of 50 per cent within the city limits and 100 per cent outside.

Victoria Branch

E. P. Girdwood, M.E.I.C., Secretary-Treasurer.

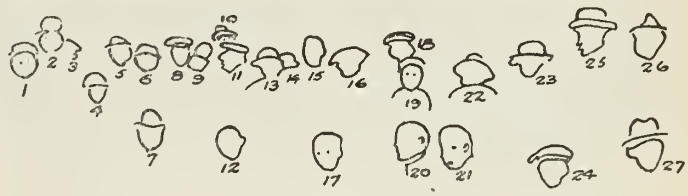
A very successful, and interesting paper was given by Patrick Philip, M.E.I.C., chief engineer, provincial public works on highways, on February 13th. His paper, dealing with the "Evolution of Highways" was very instructive, and included the information that there were 16,300 miles of roads in the province of British Columbia.

A description of all the standard surfacing was discussed, and above all, a standard road with good drainage was recommended, surfacing to come later, according to traffic demands.

The paper was rendered doubly interesting by blue prints of standard structures, and sections of roads, aided by a splendid set of photographs which were a credit to Mr. Philip.

Through the courtesy of Dr. J. S. Plaskett, a visit to the Dominion Observatory was arranged for the 8th of March. to which the ladies were invited.

Victoria Branch visits Dominion Observatory.



1. J. B. Lambert
2. C. O. Marston
3. F. W. Knewstubb
4. Mr. Bainbridge, Jr.
5. K. M. Chadwick
6. Miss Graves
7. G. Forde
8. R. A. Bainbridge
9. Mrs. Graves
10. H. F. Bourne.
11. R. Fowler
12. J. H. Blake
13. Mrs. Icke
14.
15. Victor Bigwood
16. Mrs. J. H. Blake
17. H. Nation
18. C. E. P. Faulkner
19. Miss Bigwood
20. A. Long
21. H. M. Bigwood
22. Mrs. Bigwood
23. Mrs. C. F. P. Faulkner
24. Mr. Girdwood, Jr.
25. Col. A. W. R. Wilby
26. M. P. Blair
27. F. G. Aldous

Cape Breton Branch

D. W. J. Brown, Jr.E.I.C., Secretary-Treasurer.

The January meeting was held at Glace Bay on the evening of the eighth. Through the courtesy of the Dominion Coal Co. Ltd. the Officials Club was placed at the disposal of the branch for this meeting. A general invitation was extended to the officials of the Dominion Coal Company, to whom it was thought the subject of the paper would be particularly interesting, as it dealt with a phase of the coal mining industry.

The Application of Alternating Current Motors to Mining Service

Horace Longley, M.E.I.C., the newly elected chairman, called the meeting to order at eight o'clock, and after a short address thanking the members for the honour conferred on him, and outlining the policies of the branch for the year, introduced George Morrison, A.M.E.I.C., the speaker of the evening.

Mr. Morrison is the resident manager of the English Electric Company of Canada Ltd., Sydney Branch Office, and chose as his subject "The Application of Alternating Current Motors to Mining Service". Mr. Morrison opened his paper by outlining the advantages of alternating over direct current. He went on to show the importance of maintaining a steady load and power factor, and outlined the various conditions which would influence the selection of the type of motor. The features of construction of motors for mining service were also discussed fully, and then the three types, induction, synchronous and asynchronous-synchronous were analyzed and compared very carefully. Charts showing the characteristics of each type were an instructive feature, and were fully explained during the course of the lecture. He then took up the questions of pumping, ventilation, compressed air supply and winding, and showed how a motor should be chosen for each of the respective services.

At the close of the paper, lantern slides illustrative of the lecture were shown. Discussions were read by J. S. Whyte, M.E.I.C., E. L. Martheleur, M.E.I.C., and by A. L. Hay, A.M.E.I.C., (for W. Herd, M.E.I.C., who was unavoidably absent); to which Mr. Morrison replied.

Mine Ventilation

At the March meeting of the Cape Breton Branch, held on Tuesday, the 11th, chairman H. Longley, M.E.I.C., informed the branch of the sad news of the president's death, the members voicing their sympathy as a whole.

The speaker of the evening was A. L. Hay, A.M.E.I.C., who had chosen as his subject "Mine Ventilation", and the branch, knowing that such would prove of interest to the officials of the local coal mining companies, had extended to them an invitation to be present. The meeting was undoubtedly the best attended of the season, the members of the branch being out numbered by the various coal company officials.

In opening his paper, Mr. Hay dealt with the importance of maintaining efficient and adequate ventilation throughout a mine, stressing the point that poor ventilation always means a heavy financial loss due to its enervating effect on man and beast and that it might also result in permanent ill-health to the miners or be the cause of the loss of hundreds of lives.

Mine atmosphere is polluted principally from the breathing of men and horses, the burning of explosives, the decomposition of vegetable matter, and the occlusion of gas from the coal and surrounding strata, the principal of the latter being methane or marsh gas, which when mixed in suitable proportion with air is inflammable and highly explosive, the Bureau of Mines at Washington giving the low and high limits of the explosive range as occurring when the gas content of the air is 5.5 per cent and 13 per cent respectively, although 1 per cent of methane in the presence of coal dust may precipitate an explosion.

The history of ventilation from the primitive waterfall, steam jet, and furnace was traced down to the modern centrifugal ventilator, capable of delivering upwards of one million cubic feet of air per minute.

The various factors governing the quantity of air necessary to render the mine atmosphere harmless were gone into and the question of mine inspection very fully discussed, the principle and evolution of the safety lamp, by means of which the presence of gas is usually detected, being carefully explained.

Quoting from observations of the mines in the Sydney Coal Field, Mr. Hay gave some surprising figures as to the quantity of gas generated in, and air necessary to ventilate, these mines. One particular mine has an output of 470,000,000 cubic feet or 10,000 tons of methane gas annually. Other collieries are free from explosive gas. One of the ventilating fans of the Dominion Coal Company delivers eleven tons of air per minute. The relation of air input to coal output throughout the collieries of the Dominion Coal Company is from 2¼ tons per ton to 9 tons per ton, the average being 6 tons of air per ton of coal mined.

The proper distribution of air was shown to be a subject of prime importance and the excess power required through improper distribution was shown, by actual examples, to be enormous.

Within the past three years the Dominion Coal Company has inaugurated a campaign in all their mines to ensure better, safer, and more efficient ventilation. Among the principles laid down and standards aimed at to obtain these are the following:

1. That the main air current be split as near to the bottom of the downcast shaft as possible and every mine ventilated by at least two main intakes.
2. That secondary splits be laid off for different sections so as to maintain a normal velocity throughout the mine.
3. That the return from any section if charged with more than one-quarter of one percent methane, must not be used to ventilate a second section, but is to be directed into the main return.
4. That the mine be ventilated ascensionally, taking the fresh current to the lowest workings and ventilating the places from this point.
5. That all return air be directed into the waste workings so that these gobs will be kept from gas accumulations.
6. That all returns be kept in a fit condition to travel in with safety.
7. That the airways be enlarged to reduce the pressure on the air to the minimum.
8. That the air be conserved and the maximum quantity utilized for the purpose for which it is intended.
9. That the air be measured in all sections of the mine and analyses made of the mine air at regular intervals, so as to have available full information of the condition of every part of the mine from the standpoint of ventilation.

This necessitated, on the part of the Coal Company, cleaning and putting in proper condition 49 miles of airway, building over 2,000 permanent stoppings and numerous concrete overcasts, the total expenditure being such as to surprise any who were not actually in touch with the work.

Since the re-designing and re-modelling of the ventilating system, air in one colliery is delivered with a loss of 4 per cent through an airway 6,000 feet long, having 47 stoppings, 5 doors, and 2 overcasts, the water gauge being 0.9 inch at the entry.

At the end of the paper a number of lantern slides were shown explaining the various points touched on, and this was followed by a general discussion, the speakers congratulating Mr. Hay on the excellence of his paper and also on the remarkable results obtained from the re-designing of the ventilation system of the Coal Company, which was under his direct charge.

Border Cities Branch

F. Jas. Bridges, A.M.E.I.C., Secretary-Treasurer.

The regular monthly meeting of the Border Cities Branch was held in the Prince Edward hotel on Friday evening February 8th.

There was a large turnout of members and also many visitors who were interested in asphalt paving. Among these were several city employees, Imperial Oil Company men as well as several local contractors.

Road Building

The chairman, J. E. Porter, A.M.E.I.C., introduced Germain P. Graham, of the Albany branch of the Asphalt Association of America, who addressed the branch on the subject of "Road Building". In a few preliminary remarks, he spoke of the education of engineers, stating that he believed an arts course was very essential as a preliminary training to the engineering course. This would equip the engineer for a broader field for his talents.

The engineer has a very large field in road building. He is interested, not only in the preliminary surveys and the laying out of the roads, but also in the sales end of road materials. The city streets of yesterday are being lengthened out into long connecting links of highways from city to city, across the provinces and states. They are fast taking the place, in regard to the engineer, formerly held by the railroads of the country. These highways necessitated the laying of water mains, conduits and require a commission to look after them. All of these services can be supplied by the engineer.

The principal sources of supply for asphaltic petroleum are California, Mexico, Venezuela and in the asphalt lakes of Trinidad. Nature has endowed Canada and the United States with large deposits of sand and stone all of which can be used with asphalt to make the most durable roads. The engineer is required to lay out the lines and grades to meet the demands of present day traffic and also with an eye to the future traffic. The local conditions must also be considered in regard kind and supply of local materials which can be mixed with asphalt. Many old roads can also be resurfaced, using the old road as the foundation course. It is a very important point in using old roads not to disturbed the old foundation as this would be breaking the backbone of the road. The city of Windsor can boast of 80 or 90 miles of paved roads and with the present population between 40 and 45 thousand, this is about double the mileage usual practice allows.

The speaker then illustrated his remarks by the use of slides. These pictures showed the geological formations where asphalt was found. Asphalt is mostly taken from asphalt lakes lumps and transported to the refineries.

Pictures were also shown of the asphalt lakes in Trinidad, the methods used in taking it out and the general appearance of the lake. A graphic slide showed the method of distilling the crude asphalt, taking out the vegetable matters which float, and tapping the stills to take off the pure asphalt. This product is brought to the required consistancies by the use of petroleum fluxes. The cost of the material is determined largely by the fact that there is only 64 per cent bitumen in the crude lumps which have to be transported from the lakes to the distilling plant. Different methods of using asphalt were shown in cross-sections of pavements wherein asphalt was used as asphalt macadam, asphalt concrete, sheet asphalt, asphalt blocks, asphalt as a filler and as expansion joints. Roads in process of construction were shown picturing dumping raking and rolling of the foundation stone until it is mechanically locked. The proper amount of rolling is determined by experience and this ensures against downward, longitudinal and side movements, while asphalt is used to take care of the upward movement and also to make the whole mass impervious to water.

The methods of applying the asphalt were then shown. At a temperature of from 300 to 325 degrees Fahr., there is required about 1¾ gallons per yard of 2½-inch pavement. This was first applied by hand. It is often now applied by mechanical pressure from tank automobiles, some using distributors at the back, others using appliances at the side, thereby not disturbing the road bed as it is being treated. After this binding coat is applied the whole road is gone over, filling up the voids with a slightly smaller stone. Pictures were shown of country roads in New York State built by hand work at a cost of $12,000 to $14,000 per mile. Many asphalt pavements which have been used for many years are now failing only structurally due to the very rapid and unforseen growth of automobile transportation, which was never dreamed of when they were constructed. Slides were shown of many different mixing plants used in conjunction with extensive road building programs.

Sault Ste. Marie Branch

W. S. Wilson, A.M.E.I.C., Secretary-Treasurer.

At the monthly meeting of the Sault Ste. Marie Branch, held on January 25th, which was preceded by a dinner, the speaker of the evening was W. Seymour, M.E.I.C., superintendent of coke ovens, Algoma Steel Corporation, who gave a noteworthy paper on "The Storage of Bituminous Coal". The paper was illustrated by charts and photographs of coking tests and practice. In view of the importance of the subject the paper is published in full in this issue of *The Journal.*

A fuel committee of the branch, composed of Messrs. G. H. Kohl, W. Seymour and C. Stenbol, was appointed. It might be noted that a considerable amount of coke is used locally as fuel, with satisfactory results.

The enlisting of the interest of the non-resident members of the Sault Ste. Marie Branch is a difficult problem and the executive of the branch are trying to stimulate interest and wish to find means to be of service to such members. To this end they are sending a circular letter to each member.

Radio

A regular meeting of the Sault Ste. Marie Branch was held on Friday February 29th, at which the speaker of the evening was Jas. Donnelly, chief electrician of the steel plant of Algoma Steel Corporation, who addressed the meeting on the Subject of "Radio".

He traced briefly the history of the development noting the part taken by Hertz, Marconi and Polson. The long distance achievements of 1916 and the subsequent advances were also described.

The make-up of the various devices was described and their functions clearly explained. Mr. Donnelly also drew diagrams to illustrate the relative positions of the component parts of the sets and noted the efficiencies and disadvantages of some of the more commonly used systems.

Inspection of Technical School

A special meeting was held at the Technical School on the evening of March 18th, for the purpose of inspecting the facilities of the school and learning the scheme of instruction.

C. H. Speer, chairman of the Advisory Industrial Committee had arranged for the instructors to give the members a short talk on their work and we were favored with descriptions of the various courses, showing the great care taken in mapping out the ground to be covered to suit the local needs and as far as possible to enable the pupils to get a basic training useful to them on entering positions in the industries.

Mr. Speer noted that the people whom the school was designed to benefit were somewhat slow to take advantage of the excellent and varied facilities for instruction which have been provided. Especially is this true of the night classes which in the technical schools in many other cities are filled with people of all ages anxious to complete or extend their education.

L. J. Williams, the principal, briefly addressed the meeting telling of the numbers of pupils enrolled, including an enrollment for the night classes of from 175 to 300 pupils at different times in the last six months and the desire of the staff to be of greater service to the community.

It was fortunate that Mr. Gavin, director of Technical Education, Department of Education, Toronto, was in the city. He gave very briefly some of the aspects of technical education and the position of the industries in relation to it, and noted that the apprenticeship system was a thing of the past in most trades in Canada and that the technical schools were endeavouring to in some measure fill the gap. He spoke of part time system in practice in several large manufacturing plants in conjunction with the technical schools. The high school type of education was designed as a part of the training of those entering the professions and the technical school for those entering other occupations. The field covered by the local technical school could be broadened to a great degree if the necessity were shown.

The Technical School building was then inspected. This building and equipment represent an investment of almost $250,000. of which three-quarters was provided by the provincial government a large subsidy which should be of very great value to the people of the district.

Saskatchewan Branch

J. W. D. Farrell, A.M.E.I.C., Secretary-Treasurer.

At the annual meeting of the branch held on March seventh, the following officers were elected for the ensuing year:—

Chairman	C. J. Mackenzie, M.E.I.C.
Vice-Chairman	R. N. Blackburn, A.M.E.I.C.
Secretary-Treasurer	J. W. D. Farrell, A.M.E.I.C.
Executive	H. R. MacKenzie, A.M.E.I.C.
	S. R. Parker, A.M.E.I.C.
	W. R. Warren, A.M.E.I.C.
	H. N. Macpherson, A.M.E.I.C.
	J. D. Peters, A.M.E.I.C.
	G. M. Williams, A.M.E.I.C.
	D. A. R. McCannel, A.M.E.I.C.
	A. C. Garner, M.E.I.C.
Ex-Officio	R. N. Blackburn, M.E.I.C.
	A. R. Greig, M.E.I.C.
Nominating	H. S. Carpenter, M.E.I.C.
	L. A. Thornton, M.E.I.C.
	H. W. Greene, M.E.I.C.
	H. McI. Weir, M.E.I.C.
	S. Young, A.M.E.I.C.
Auditors	C. C. Cronk, A.M.E.I.C.
	H. G. Phillips, A.M.E.I.C.

Annual Report of the Executive Committee

To the members of the Saskatchewan Branch:

While the past year has been one of general depressed conditions and particularly has this condition existed in Saskatchewan, your executive believe that our branch has experienced a year of pronounced advancement. Through the loyal and active support of the members and also through several standing committees, the branch has made gains in many directions. Your executive have held eleven meetings, at which the routine business of the branch received attention and there have also been held seventeen special and regular meetings in addition to two social evenings. The attendance at all meetings has been satisfactory, showing a keen interest in the work of our branch and an increased attendance is shown over the preceding year.

The present branch membership consists of 130, which is made up as follows:—

Members	22	Students	13
Associate Members	80	Affiliates	2
Juniors	8	Branch Affiliates	5

As a result of considerable correspondence, mainly with headquarters, our branch records appear to be in good condition and much better than a year ago, when we included several members on our branch lists, who, for various reasons, were shown in error. Fifteen new applications have been received during this year and several of these are now awaiting final action by the parent society, following which we expect to receive further additions to our branch membership. With regard to membership your executive believe there is yet more worthy material available and we ask for your co-operation in making the Saskatchewan Branch one hundred per cent representative of the qualified engineers of this province.

Attached hereto is the financial statement for the past year, which has been audited by your auditors and which we are pleased to mention shows a much better financial condition than one year ago. As the various activities of the branch have been ably taken care of by sub-committees, whose reports will be received this evening, the work of these committees has been left for their reports.

Respectfully submitted,

D. A. R. McCannel, A.M.E.I.C.,
Secretary-Treasurer.

Financial Statement

March 8th, 1923 to March 1st, 1924.

Revenue		
Bank balance, March 18th, 1923	$ 84.36	
Saskatchewan Branch dues	274.50	
Rebates from Headquarters	236.57	
Meeting receipts	351.25	
Sundries, Branch news, etc	24.31	
		$970.99
Expenditure		
Rebates to Headquarters	$ 30.60	
Meeting expenditure, including receipts	473.25	
Stationery, printing and stamps	141.42	
Sundries	23.35	
Honorarium to secretary-treasurer	100.00	
Scholarship to University of Saskatchewan for 1922 and 1923	200.00	
Bank balance, March 1st, 1924	2.37	
		$970.99
Assets		
Bank balance, March 1st, 1924	$ 2.37	
Outstanding branch arrears	237.50	
Outstanding arrears, headquarters rebates	141.25	
Outstanding current, Headquarters rebates	393.75	
Furniture and library	50.00	
		$824.87
Liabilities		
Branch dues paid in advance	$ 5.00	
Accounts payable	67.84	
Surplus	752.03	
		$824.87

Certified correct,
E. A. Markham, A.M.E.I.C., C. C. Cronk, A.M.E.I.C., *Auditors.*

Report of Committee on Attendance, Recreation and Entertainment.

Your Committee on Attendance, Recreation and Entertainment, consisting of H. N. Macpherson, A.M.E.I.C., D. A. R. McCannel, A.M.E.C., and R. W. E. Loucks is a branch of the Papers and Library Committee under the chairmanship of S. R. Parker, A.M.E.I.C. H. N. Macpherson, A.M.E.I.C., who was chairman of this sub-committee the previous year continued to act in that capacity until October when pressure of work compelled him to resign and the chairmanship was taken over by R. W. E. Loucks, A.M.E.I.C. Much of the detail work, particularly as regards attendance was carried out by the Secretary D. A. R. McCannel, A.M.E.I.C.

The attendance at the meetings throughout the year has been fair and shows an improvement over the previous year. The thanks of the committee are extended to the team captains who have assisted so ably in this work and to the secretary, who has kept in touch with these captains. The team captains are W. L. Campkin, Jr.E.I.C., C. E. Malone, J.E.I.C., C. W. Doody, T. McGuinness, A.M.E.I.C., P. C. Perry, A.M.E.I.C., D. H. Lunan, and D. C. M. Davies, A.M.E.I.C. These captains have also assisted materially in arranging and carrying out special entertainment features.

The summer meeting at Estevan on August 16th, 17th, and 18th, 1923, and the visits to the mines and other industrial establishments in that vicinity, was a decided success and the outstanding event of the season. This has been referred to by the chairman and will not be enlarged upon in this report. The trip to Condie on September 22nd, 1923, for inspection of the dam and subsidiary works in connection with the C.N.R., water-supply proved both interesting and enjoyable. The ladies were present on both these occasions.

The ladies entertained the members at a Valentine party at the ohme of H. S. Carpenter, A.M.E.I.C., on February 22nd, last. This has also been referred to by the chairman and other than stating that this affair was a "huge success". I will make no further comments.

The usual ladies night at the date of our annual meeting took a somewhat different form this year, as evidenced by the joint cabaret put on in the Trading Company banquet hall on March 4th, by the engineers and Gyro Club. This event was a decided success, about 300 persons attending. Novel forms of entertainment were introduced with a varied programme of special features and dances.

At the regular meeting on February 28th, where a joint meeting by telephone was carried out in conjunction with the Engineering Society of the University of Saskatchewan, the interval between the dinner hour and meeting was occupied very pleasantly with a friendly round of bridge.

The committee also wish to thank Miss H. M. White, who has so willingly and ably assisted with the entertainment at the meetings. An effort has been made throughout the season to introduce a certain amount of entertainment into each meeting, thus helping to produce that psychological effect so necessary to proper assimilation of our dinner.

Respectfully submitted on behalf of the committee.

R. W. E. Loucks, A.M.E.I.C., *Chairman.*

Report of the Papers and Library Committee

On behalf of the committee, I beg to report that after the first three meetings of this committee when the provisional papers programme was decided on, no further meetings have been held of the main committee, the necessary work being carried out by the sectional committee on publication and publicity under the able convenorship of W. D. Houston, and the entertainment committee originally under the convenorship of H. M. Macpherson, A.M.E.I.C., and latterly of R. W. E. Loucks, A.M.E.I.C. This change was necessitated by Mr. Macpherson not being able to devote the necessary time to the work.

With the consent of the executive, H. Ross Mackenzie was co-opted to this committee.

Your committee wishes to express its appreciation to the various gentlemen outside the membership of the branch who have kindly furnished papers during the current year.

A demonstration of a two way public address system was successfully given between Saskatoon and Regina on February 28th, in which the Engineering Society of the University of Saskatchewan and this branch participated in a joint meeting. This particular meeting is mentioned on account of it being unique, in that it was the "longest haul" joint meeting in Canada, and that the equipment used was considerably less than one-twentieth of the value of any similar equipment which was previously considered necessary to conduct a demonstration of this kind.

It is pointed out that there is an inherent difficulty in distinguishing clearly for a short time any speech reproduced by any existing loud-speaking horn on the market, but it will no doubt have been noticed that after the first quarter of an hour or so, considerably less difficulty was experienced in distinguishing clearly.

In closing this report, I would like to thank all the members of this committee for their very hearty support during the past year.

Samuel R. Parker, A.M.E.I.C.,
Chairman, Papers and Library Committee

Montreal Branch

E. A. Ryan, A.M.E.I.C., Secretary-Treasurer.
W. H. Abbott, A.M.E.I.C., Branch News Editor.

In the death on March 6th, of Walter J. Francis, M.E.I.C., President of *The Institute*, the Montreal Branch in common with all the members of the Engineering Profession lost one of its most prominent members and one who had done more to build up the Montreal Branch and uphold the honour and prestige of the engineering profession in Montreal and Canada than, perhaps, any individual member. Mr. Francis was the founder and the first chairman of this branch. The account of Mr. Francis' life and various activities will be found in another place in this issue of the Journal, and it only remains to record here the heartfelt sorrow of the members of the branch for his untimely death and the gap which will be left in the membership of this branch in particular. The regular weekly meeting of the branch was to have been held on the night on which he died, and it was the sad duty of the reception committee to inform the members as they arrived for the meeting of the loss which we had sustained.

R. A. Ross, M.E.I.C., past-president of *The Institute*, presented the following resolution of condolence and sorrow for the death of President Walter J. Francis at the meeting of the branch held on March 13th.

"Whereas *The Engineering Institute of Canada* has sustained a severe loss in the sudden death of President Walter J. Francis at his home, on Thursday, March 6th, 1924, who, during the fifty-two years of his life had attained a high place in the engineering profession in Canada, who had been at all times an active and zealous worker for the interests of *The Institute*, taking a leading part in all its activities, who was the founder of the Montreal Branch and its first chairman:

"Be it resolved, that this meeting of the Montreal Branch of *The Institute;* held Thursday March the 13th, record with deep regret the passing of one who was at all times a noble example of loyalty to his chosen profession, who practised the gospel of service to his community and to his fellow men: and

"Be it further resolved, that we, the members of the Montreal Branch, extend to Mrs. Francis and the family our sincere sympathy in their great loss, which is shared with them by the entire engineering profession in the Dominion."

Mr. Ross spoke of his own sense of loss and personal sorrow in the loss of a dear friend and colleague, not only professionally and in the activities of *The Institute*, but also in more intimate life. He spoke with feeling of Mr. Francis' continuous efforts to keep the engineering profession true to its highest ideals of honour and service to the community, and his many years of generous service to both *The Institute* and the Montreal Branch.

"He was suddenly cut off at the very height of his activity and ability to do his best and most useful work," said Mr. Ross, "when increasing prosperity was rewarding many years of incessant and successful labours. As I stood in the chapel on Mount Royal last Saturday to say final farewell to my old friend, when the bugles sounded ' "Last Post" ' I could not but think of Bunyan's line in the Pilgrim's Progress, after he had passed the River of Death: 'And so he passed over, and all the trumpets sounded for him on the other shore !'"

J. A. Duchastel, M.E.I.C., Past Chairman of the Montreal Branch, seconded the resolution, and in a few well chosen words spoke of Mr. Francis' unfailing alacrity in helping his brother Engineers and in upholding the dignity of the profession.

J. L. Busfield, M.E.I.C., Vice-Chairman of the Branch presided, and after the members had registered their vote on the resolution by standing in silence for one minute, the chair was turned over to A. F. Hanly, A.M.E.I.C.

Report of Montreal Branch Fuel Committee

At the regular weekly meeting of the branch held on February 21st, the report of the Montreal Branch Fuel Committee was presented by F. A. Combe, M.E.I.C., chairman of the committee. This meeting was open to the public and there was a very good attendance.

John T. Farmer, M.E.I.C., pointed out the necessity for a fuel committee both for the study of the fuel situation and the education of the householder to an understanding of his needs and to help him in solving his fuel problem. Mr. Farmer discussed the values of different fuels, of which he had a large assortment of samples on view, with particular regard to domestic heating. The talk was illustrated with lantern slides and proved very interesting.

J. R. Donald, A.M.E.I.C., advocated some form of supervision of the sale of fuel both in regard to weights and possibly B. t. u. content. He pointed out that more money was spent on fuel in Montreal than on any other one commodity and that there were no safeguards for the ordinary purchaser.

G. C. Mackenzie, M.E.I.C., defined the "acute area" as regards fuel as that part of Canada lying between Quebec and Winnipeg. A steady increase in the importations of coal from the United States and the danger of the depletion of the mining area which produced most of the coal imported into this area was pointed out by the speaker, who also gave some experiences of his own in burning different fuels in domestic furnaces.

Representatives of various coke manufacturers and coal interests in Canada and Great Britain were present and described their products. The "householder" was also represented and one reported that he had found Scotch anthracite very good in fact, "it was mostly coal".

A Method of Raising Sunken Ships

An interesting paper was read by W. W. Johnston of the Reno Marine Salvage Corporation, at the meeting held on February 28th. The speaker described the method of raising sunken ships invented by Mr. Reno, who was the inventor of the "Escalator" or moving stairway. This method consists essentially of a tractor equipped with drills for drilling holes in the sides of the sunken vessel whereby a series of vertical pontoons may be attached, and being filled with air, lift the vessel to the surface. It is claimed that with this method ships lying at a depth of four hundred feet may be successfully salvaged, the greatest depth to which a diver is able to descend being one hundred feet. According to the speaker there are nearly three thousand vessels on the coasts of Great Britain and America which are in locations favourable for salvage by this method with cargoes of a value of over five billion dollars.

Meeting of Papers and Meetings Committee

Under the chairmanship of W. C. Adams, M.E.I.C., a meeting of the Papers and Meetings Committee was held on March 3rd, to discuss the policy and inaugurate the activities for the session 1924-25. The chairmen and vice-chairmen of the different sections of the committee were present and it was decided to hold these meetings on the first Monday in each month, or oftener if business required it.

Several matters were discussed and duties allotted to members of the committee. Among others it was suggested that copies of papers to be presented be printed before the reading of the paper and copies placed in the hands of persons selected to lead in the discussion as early as possible, other copies to be available for those requesting them. One paper per month by a prominent person, (engineer or otherwise), on a subject of general engineering or national interest, should be arranged. These papers would, in the main, be non-technical and would call for no prearranged discussion. All other papers presented should be of a technical nature only, and should be selected with regard to their value in presenting new methods and applications of engineering principles. A "get-together" meeting to be held twice a year, and the subject of dinners, smokers and entertainments were discussed, but it was considered that the arrangements for these should not come under the direction of the Papers and Meetings Committee, and should be handled by a separate committee working in close liaison with present committee as regards dates available, etc.

The question of the starting of meetings promptly at the time set came in for some discussion, and it was the consensus of opinion that drastic action was necessary to eliminate the inconvenience and annoyance caused by members coming in late. The time at which meetings should start showed some diversity of opinion and it was thought that it might be advisable to obtain the views of the membership at large as to the most convenient time.

In connection with this latter question it was suggested that those members living in Notre Dame de Grace and Outremont, who would stay in town for dinner on the nights of meetings, might get together for dinner at some hotel or restaurant. The difficulty of arranging this was appreciated and it was thought best to merely place the suggestion before the members. It is rumored that some members have already adopted this suggestion and this may form the nucleus of larger gatherings of this sort in the future.

The paper for the evening was read by H. J. G. McLean, A.M.E.I.C., and dealt with "The Pulp and Paper Industry".

The Speaker commenced his address with a description of the production of paper in Western China as far back as the year 950 A. D. and explained that the industry is still being carried on with little change in the methods of manufacture. In comparing the cost of paper as made in China with paper imported from Canada, he stated that they are able to sell their product at only a slightly lower figure than the price of Canadian paper delivered into the interior of China.

Passing to the production of paper at the present time in Canada, it was stated that the value of the pulp and paper produced in Canada in 1922 exceeded one hundred and fifty-five million dollars, and one of the chief factors in the phenomenal development during recent years was the progress made in the generation and transmission of hydro-electric energy.

Mr. McLean exhibited a number of lantern slides showing methods of manufacture in China and illustrating the types of machines used in the manufacture of paper in Canada at the present time. The speaker also described the stages of manufacture from the wood to finished paper with views of the various types of grinders and paper machines developed in recent years.

Views were shown of the results of an accident due to bursting of a dryer drum on a paper machine in Germany in 1908, and the speaker suggested the need of a rigid Government inspection of installations where revolving cylinders were used on paper machines.

Reference was made to the miniature paper machines which were being installed at the British Empire Exhibition.

Executive Meeting

At a meeting of the Executive held on March 10th, various matters were discussed including the policy of the Papers and Meetings Committee for 1924-25. A new section of the branch was inaugurated, namely the Municipal Section, and Geo. R. MacLeod, M.E.I.C., was appointed chairman of this section.

The approval of Council of *The Institute* for the holding of the next annual meeting of *The Institute* in Montreal was received. This meeting will take place in January 1925 under the auspices of the Montreal Branch.

Toronto Branch

J. H. Curzon, A.M.E.I.C., Secretary-Treasurer.
L. W. Wynne-Roberts, A.M.E.I.C., Branch News Editor.

D. W. McLachlan, M.E.I.C., engineer in charge of the St. Lawrence ship canal, Department of Railways and Canals, addressed the Toronto Branch on February 21st, discussing the important features of various projects for the improvement of the St. Lawrence river. His paper was illustrated by maps and lantern slides, and was of intense interest to the representative gathering of engineers, a number of whom took part in the ensuing debate. Major Alec. Lewis, M.P.P., secretary of the Deep Waterways Association, who was present, remarked that the International Joint Commission consisted of three representatives from Canada and three from the United States, and that the Americans suggest that the cost of the project be borne on the ratio that the two countries use the water for five years prior to construction. Major Lewis was strongly of the opinion that the power question must not overshadow the transportation problem. J. J. Traill, A.M.E.I.C., took exception to the statement of the speaker of the evening regarding ice slopes and said that no average ice slopes existed, but it was found that the ice slopes were fairly steep. During the past 40 years, ice jams have occurred six times at Croil island. On account of these, frazil, anchor, and cake ice caused backwater for 10 or 12 miles upstream, and at lock 23 at Morrisburg, this amounted at different times to 5 feet, less than 1 foot, 10 feet, and nearly 12 feet. The speaker stated that in his opinion, the 18 foot backwater mentioned by Mr. McLachlan has never been approached.

Research in Automobile Development

Charles F. Kettering, President of the General Motors Research Corporation, was the speaker on February 26th, at a joint meeting of the Toronto Branch, and the Toronto branch of the American Society of Mechanical Engineers. His subject was "Research in Automobile Development", and in a humorous address, pleaded for the simplification of science. Scientific and technical matters, said he, could be regarded as such once they were understandable. Mr. Kettering's address was replete with simple analogies, and at one point stated that were he a professor, he would ask no other equipment than a ball suspended on a rubber band, because in the actions of that were bound up the fundamentals of all science. Mr. Kettering gave his opinions that most difficulties were mental, and that once human minds applied to research could appreciate the fact that all things were fundamentally simple, the major bars to an indefinitely great step of progress would vanish. At one point he digressed to give a humoroar description of the Einstein theory which, he declared, was very simple. If he would propel himself through space at 186,000 miles per second, light speed, he would make a thousand year tour of the solar system and return to earth not one moment older than when he left.

Turning to the automobile, in the development of which he is more particularly interested, he said automotive engineers were confronted with literally thousands of problems. One which he instanced was the problem, recently solved, of testing paint-work in a brief time, so that its condition at the end of the test would be exactly similar to a weathering of two years in service. That had proved simple. Various types of paint-work were merely subjected to a few days' test, half the time under ultra-violet rays and the other half under a water shower. The effect was to turn the laboratory into a speeded-up measuring service.

In his opinion there was hardly any part of the automobile which was perfect. The units were all satisfactory as far as they had gone, but they were far from perfect when one considered all that could be done. Another automotive triumph, in a minor way, was the perfection of such a simple thing as a fan belt. Belt manufacturers gave the industry a belt which they declared to be the best possible. Research men discovered the faults and ultimately the belt men gave them a belt 7,000 per cent greater in efficiency.

In conclusion, Mr. Kettering stated that civilization is just getting away from the point where it is hungry or looking for a place to sleep, and that now there is no necessity to accept anything as satisfactory, if its faults can be discovered.

Canada's Arctic Expedition, 1923

One hundred and seventy-eight members and their friends were present on March 6th, to listen to J. D. Craig, M.E.I.C., officer in charge, Canada's Arctic Expedition, 1923. By means of lantern slides and moving pictures, depicting life and customs in the far north, the story of the 1923 expedition was revealed. The expedition of the Department of the Interior was largely for the purpose of keeping in touch with the northern stations, in addition to administering justice among the Eskimos. Much of Mr. Craig's talk dealt with the natives and their ways of living. Particularly interesting were the scenes in which Mr. Craig's men raised the British flag over the 75-year old graves of some of Franklin's men on Beachy Island where the famous explorer passed his first winter.

The quarters which he occupied in 1845-46 were shown as well as the cenotaph which was erected by Lady Franklin to her husband. The lecture was open to the public, who took advantage of this unusual opportunity of seeing pictures of the far north.

Insulation and Heating Possibilities in Buildings

On March 13th, James Govan, Architect and Inspector of Hospitals in an address on "Insulation and Heating Possibilities in Buildings", explained how to cut the fuel bills by more than half.

"It will be impossible in a few years to sell an uninsulated house," said Mr. Govan during the course of the address, which consisted mainly of descriptions of new insulating materials and discussion concerning their application to practical problems of heating. Remarkable savings were indicated in figures which were obtained by Mr. Govan in experiments with the new materials. The lecturer showed what a surprising amount of heat escaped through walls and roof of the ordinary house, as well as through crevices around doors and windows. By scientific use of insulating materials in an experimental bungalow; at a cost of $450. the Armour Institute of Technology had been able to save in construction expense and in the first year's coal bills over $600. Mr. Govan had been able to utilize the conclusions drawn from this remarkable practical experiment to great advantage. "You heating men," he asserted "will have to change all your formulas."

The lecturer was amused at a booklet which had reached him describing minutely "the most perfect house in America". The house contained, he said, every appliance, even to a security burglar-alarm lock on the door. Where this lock was really needed, however, explained Mr. Govan, was on the coal cellar, for there was not a word in the descriptive booklet mentioning insulation.

The meeting passed a motion expressing the most sincere regret at the sudden death of the late Walter J. Francis, M.E.I.C., whose passing brought to the entire engineering profession a very great loss, as well as deep feeling of personal bereavement to many of the members with whom he had for years been closely associated.

Following a vote of condolence, the meeting transacted an item of business in the adoption of a memorandum containing a schedule of professional fees for consulting Engineers which was brought in by the committee responsible for its compiling.

Annual Meeting

The Annual Meeting of the Branch was held on March 20th, at which the election of Officers took place, and reports of the secretary-treasurer and chairmen of the various committees were read and adopted.

Professor C. R. Young, M.E.I.C, gave a résumé of the activities of the branch during his tenure of office. The policy of the executive had been to popularize meetings as far as possible, and these were well attended. Five meetings were held under the joint auspices of the Toronto branches of the E.I.C., and the A.S.M.E., which were very successful. Other features were two luncheon-meetings and a smoker at Hart House, the programme being provided by the students. In order to encourage students' interest, prizes were given for papers prepared by students, the results of which have already been announced in the Journal. In the matter of routine, the by-laws of the branch had been revised, a catalogue prepared of technical books in the Toronto libraries, both University and Public, and an inventory of property owned by the branch was taken.

On the motion of A. Crumpton, M.E.I.C., seconded by H. K. Wicksteed, M.E.I.C., the branch members tendered the retiring chairman their appreciation of his efforts during the year, and expressed their opinion that the winter session had been very satisfactory in every way.

The report of the scrutineers of whom the chairman was George Phelps, A.M.E.I.C., was as follows:—

Chairman, J. M. Oxley, M.E.I.C., (by acclamation). Vice-Chairman, N. D. Wilson, A.M.E.I.C. Secretary-Treasurer, J. H. Curzon, A.M.E.I.C.

New members of executive: Prof. R. W. Angus, M.E.I.C., H. K. Wicksteed, M.E.I.C., E. T. J. Brandon, A.M.E.I.C.

H. A. Goldman, A.M.E.I.C., as chairman of the auditors, reported the audit was not quite completed.

The secretary-treasurer, J. A. Knight, A.M.E.I.C., reported that the branch had held twenty meetings, and that the average attendance at luncheon meetings was 150; at regular meetings 79. The executive had held fifteen meetings at which the average attendance was 8. The membership of the branch now totalled 701 comprising:—

Resident Members	141
" Associate Members	259
" Juniors	57
Non-resident Members	3
" Associate Members	21
" Juniors	6
Students, Resident and Non-resident	202
Affiliates, Branch, Institute	12
	701

The receipts for the year totalled $1,493.21; expenditures $1,327.61, leaving a balance in hand of $165.60. Included in the expenditures were amounts approximately $200. for printing and publication of the Year Book and By-Laws; $110. for cataloging technical books in the libraries; $38. purchase of office furniture, $40. for revision of by-laws, all of which amounts are expenditures out of the ordinary.

L. W. Wynne-Roberts, A.M.E.I.C., chairman, Publicity Committee reported that the activities of the branch had received considerable publicity both in the technical and daily press, as follows:— *The Engineering Journal*, about 49 columns, Contract Record, about 27 columns, Canadian Engineer, about 22 columns. The Toronto daily press had published accounts of meetings totalling 175 inches or about 10 columns.

The reports of the activities of the other committees were presented by their respective chairmen or members of committee, and were duly adopted by the meeting.

R. O. Wynne-Roberts, M.E.I.C., under the order of new business, strongly urged the formation of a municipal section, comprising all engineers interested in municipal problems. He suggested that papers could be read at different centres and visits made to the municipal works. He was confident that such a programme would be of much benefit to those who attended.

J. M. Oxley, M.E.I.C., the newly elected chairman, thanked the members for the honour conferred upon him in electing him by acclamation. Having been elected, he would endeavour to fulfil the duties to the best of his ability and sought the active co-operation of the members.

N. D. Wilson, A.M.E.I.C., J. H. Curzon, A.M.E.I.C., and H. K Wicksteed, M.E.I.C., in accepting office, also thanked the members for their support.

Halifax Branch

K. L. Dawson, A.M.E.I.C., Secretary-Treasurer.

The regular monthly meeting of the Halifax Branch held in the "Green Lantern" after an enjoyable supper was addressed by Gordon S. Stairs, B.Sc., A.M.E.I.C., town-manager of Wolfville, N.S.

The subject of Mr. Stairs lecture was "Town Management". That modern towns and cities are business corporations involving the handling of millions of dollars yearly in a tremendously complex and intricate way; and that the manager plan of municipal government is the closest approach to the establishing of an administration on a modern business basis that has yet been evolved, were the two points on which he placed great stress.

Twelve years ago, the speaker stated there were only two cities in the United States operating under the manager system, while at the end of 1923, some 320 towns and cities in the United States and Canada had adopted the system. It is interesting to note that it was first adopted in the old states of Virginia and South Carolina and in old provinces of Quebec and the maritimes. Mr. Stairs stated that the populations of the towns and cities which have adopted the system range from 500 up to 800,000; that the ages of the managers vary from 25 to 70 years and their salaries from $600 to $20,000.

Fine results have accrued to the citizens of villages, towns and cities up to and over 200,000 population which have employed city managers. Of the large cities the latest to adopt the manager system is Cleveland, Ohio, with a population of about 800,000. The speaker then gave a number of specific instances of the success which follows the adoption of the plan.

In Dayton, Ohio, not long after the manager was appointed, a deficit of $125,000 was wiped out. After which the water-works system was placed on a paying basis; the eight-hour-day for civic employees was introduced; a municipal bathing beach was constructed; the city paving plant was put into operation; the city death rate was reduced by district physicians and visiting nurses. All these and other improvements have been brought into effect as well as the establishment of a sound business administration.

Coming to Canada there is in the province of New Brunswick the notable success of the system in the town of Woodstock which adopted this plan in 1919 with R. Fraser Armstrong, A.M.E.I.C., as the first manager. In the province of Quebec there are five city managers and it is said of the city of Westmount that it is the best managed in Canada.

Mr. Stairs stated that in Great Britain and Germany the position of town manager is closely paralleled by those expert administrators the town clerk and the burgomaster respectively. In those countries municipal work is entered into as a profession more than on this side of the Atlantic.

In Great Britain the official corresponds most closely to the German burgomaster and in some respects to the American mayor is the town clerk. His office is distinguished and requires ability of a high order. The clerk is elected by the council, receives a generous salary, holds office during good behaviour and makes a profession of his calling. To him the council turns for advice on all kinds of municipal questions. The town clerk, with the salaried heads of departments, constitutes the expert element in the administration of British cities.

As worked out in America, there are two plans under which the manager system may be introduced, the council-manager and the commission-manager plans. Under both of these the manager is the administrative head of practically all departments. He is subject to the control of the council or commission as a unit. He is responsible for the business administration of the corporation including purchasing of supplies, advising on the awarding of contracts, the collection of rates, and the carrying out of public improvements. He must combine business and technical knowledge. He is usually responsible for the enforcement of laws and ordinances. Under the commission-manager plan, the office of mayor is dispensed with, the commission usually being business men elected for a term of years at a salary.

As worked out in the small town of Wolfville, the town manager combined several offices. He is the superintendent of streets, water works, sewers, and electric distribution system and building inspector. He performs the duties of the several chairmen of standing committees of council. The duties are varied and more or less strenuous, and the small town system in a way violates one of the cardinal laws of management, namely that of divorce of planning from performance. However, the majority of citizens are co-operating splendidly in the new system, the late town council was solidly behind it and seemed to be pleased with any results attained.

In recommending the city-managership as a field of endeavour for young engineers, Mr. Stairs stated that universities and colleges are organizing courses to give the necessary academic training. No such career can be offered in any other form of city government. City managers are appointed on the basis of executive ability and knowledge of city administration. Their tenure of office depends on services rendered. While the engineer is preeminently fitted for entering this profession, he must never forget that technical knowledge is not enough. A knowledge of, and ability in, business administration are also demanded. When cities want a city-manager, they seek a man with reputation for giving efficient service at all times in expenditure of money and attention to details, who is able to convince that, at all times, he can get the most and the best out of that which is available.

Summing up the objections to the system, he stated that they are all in a large measure due to ignorance of its working.

This meeting was open to the public immediately after the supper and a number of visitors came in including Mayor Mosher of Dartmouth; Robert Stanford, chairman of the Dartmouth Board of Trade; J. W. Douglas, manager of the Royal Bank of Canada, Dartmouth; George A. Ormon, secretary of the Dartmouth Board of Trade.

Mayor Mosher said that the mayor himself could do a great number of things more than he accomplishes if he could only receive the same backing which is given to the city manager. In his opinion, a manager can have no more control over the fixed charges of a town than a mayor and the fixed charges may be a large proportion of the total expenditures. In Dartmouth, they require $2. out of every $2.95 collected in the form of taxes. He expressed neither opposition nor favour for a town manager. He felt it was not essential for the success of either a mayor or a manager that he show a surplus for any year. Citizens were not looking for dividends but for a lower tax rate.

Mr. Stanford, Mr. Douglass and Mr. Ormon spoke briefly. They brought greetings from the Dartmouth Board of Trade and expressed themselves as favourable to the city-manager form of government.

D. W. Robb, M.E.I.C., formerly mayor of Amherst, N.S., considered that the crucial point is to get the right man. No business or factory could get along without a good manager. He agreed with Mayor Mosher that the control over fixed charges was somewhat beyond the manager or the mayor except in so far as either could see that they could not increase unduly. The weakness of the mayor and council system, so largely in vogue, is its limitations on the tenure of office of the members of the city government. Water supplies, sewers and streets are apt to be neglected. Personally he would refuse to run a town without an engineer in charge of these essentials. The town manager has the advantage that he is selected to watch the details of city utilities and services and governed by a contract it is upon his success that he has to build his reputation. His own experience is that a mayor is apt to give more time to the town or city than he can afford.

W. A. Winfield, M.E.I.C., suggested that we are all citizens as well as engineers and that we are all familiar, more or less, with private firms and corporations. Any comparison between the managements of corporations and municipalities generally puts the municipality in a bad light. In many cases the circumstances surrounding their election to municipal offices and their tenure of them tie the hands of competent men. Sometimes poll tax payers vote for expenditures to provide work whether for the good of the city or not. Numbers count and not interest. City-managership is the best, but get a good man and give him a free hand. There should be no preference for local tax payers. Get the best man available, no matter where he is. Councils and mayors do not have a free hand. It is the common thing to have people interfere. He did not think that fixed charges are uncontrollable. An expert town manager on investigation can find ways to spread or reduce the burden. Such a man needs four or five years to build up a run down proposition. Popular judgment is very apt to be influenced by the conditions of the pockets of the tax payers. Popular cries therefore may be altogether wrong and if done are wished undone. Unmerited abuse prevents many good men putting themselves forward for civic positions.

Colonel F. W. W. Doane, A.M.E.I.C., city engineer of Halifax, said that three things are essential in the appointment of a city manager. First get the right man, second give him a chance to obtain efficiency, third his appointment must be desired by the rate payers. Unless the rate payers desire what the manager is appointed to do, he cannot do it. The difficulty in the ordinary administration of cities is to obtain a dollar for every dollar spent. The men who become mayors and aldermen are not in themselves to blame, it is the evils of the system which allows political interference in civic affairs.

During the supper the singing was led by members of students orchestra of N.S. Technical College.

Ottawa Branch

F. C. C. Lynch, Affiliate E.I.C., Secretary-Treasurer.

The little theatre in the Victoria Memorial Museum was crowded to the doors on the evening of February 19th, when J. D. Craig, B.Sc., M.E.I.C., of the Northwest Territories Branch of the Department of the Interior, delivered a most educational lecture on "Canada's Arctic Expedition of 1923," under the joint auspices of the Professional Institute of the Civil Service of Canada and the Ottawa Branch of *The Engineering Institute of Canada.* The lecture was splendidly illustrated with motion pictures of the Arctic, and the picturesque home of the Eskimo.

Mr. Craig, who was in charge of a party, gave an account of what had been accomplished. Mr. Craig pointed out that with his party was a detachment of the R.C.M.P., which had gone north to establish police posts and also to maintain the sovereignity of the King. Much scientific knowledge of the Arctic islands had been gained and the speaker ventured the opinion that it was quite possible that there was great mineral and oil wealth in the Arctic. He was confident that some day Canada would be proud to say that she owned the Arctic Islands.

Describing his party's trip, Mr. Craig said that the easterly portion of the northern archipelago of the Arctic islands had been cruised. A post established by another party in 1922 had been re-supplied and a new post had been built at Cumberland gulf.

McMillan, the American explorer, and his party, were met at Etah in Greenland by Mr. Craig's party. Cordial relations were established between the two parties and McMillan's party heard much world news over Mr. Craig's radio. McMillan had a radio but not as powerful as the Canadian party's. The value of the wireless was also pointed out by Mr. Craig, who said that the winter was by far the best season of the year to listen-in.

Wonderful pictures of Arctic animal and native life were shown, and pictures of the midnight sun were also viewed with great interest by many professional and technical men present.

Roadless Vehicles

Roadless vehicles was the subject of an interesting address, illustrated with moving pictures, at the meeting of the Ottawa Branch which was held in the Victoria Museum on February 29th. The speaker was Lewis K. Davis, general manager, Roadless Patents Holding Company, Washington, D. C.

In his address Mr. Davis described the rapid development which has been made in motor vehicles which carry their own tracks, typified by caterpillars, tractors and tanks. Very many interesting performance comparisons were made with the ordinary type of truck, showing the great superiority of the roadless vehicles for all kinds of construction work. Moving pictures, fast and slow, showed some of the tests carried out by the company. Films loaned by the United States Ordnance Department were also shown, illustrating different types of tractors, both civil and military.

St. John Branch

W. J. Johnston, A.M.E.I.C., Secretary-Treasurer.

A Few Electric Transmission Economies and their Relation to Rate Fixing

"A Few Electric Transmission Economies and their Relation to Rate Fixation" was the subject of a paper delivered on the evening of March 12th, to the members of the St. John Branch of *The Engineering Institute of Canada* by Budleigh Faraday, Commercial Manager, New Brunswick Power Co.

The growth of the electrical industry has been so comparatively recent and research work made necessary many changes in design and equipment so that electrical engineers have been forced to give continued study to these changes. So interesting may this study become that an engineer may devote his time to the purely scientific phase of the undertaking to the neglect of equally important economic problems. It is essentially the place of the engineer to indicate to the public, and to the rate-fixing bodies representing the public, the peculiarities under which his particular industry operates in order that an equitable rate for service performed may be assured. Without this attention to the commercial aspect of his industry the engineer fails as a business man.

The rate allowed in the electrical industry by rate-fixing bodies must be adequate to cover all fixed charges and provide a reasonable return the money invested if the business is to survive. In fixing this rate cognizance should be taken of the peculiar operating problems — the hazards disadvantages and inherent losses involved in the production and distribution of electrical energy.

The total registration of all the consumers' meters on a distribution system is less than the total energy for same period of time registered on meter at power house. This shrinkage of current between production and consumer may result from several causes, and is the resultant of the combined resistance, physical and magnetic, of the circuit over which the energy is delivered. These losses include:—

(a) Line losses or I^2R losses. W (watts) $= I^2$ or (line current in amperes)^2 times R (resistance of the current in ohms). These losses are variable but a close estimate may be obtained from 24-hour load curves. The more energy delivered over a given circuit at a given time, the greater will these losses be.

(b) Leakage losses, — due to defective insulators, contact of the line with trees, wet surfaces, etc. These vary with the design and condition of the circuit.

(c) Transformer losses, consisting of copper losses and core losses. The copper loss varies with the load on the transformer and increases with a greater load. The iron losses remain practically constant while transformer is connected to circuit.

(d) Meter losses although small per meter go on continuously while current is on the line. These increase proportionately with number of meters and in the aggregate on some systems may amount to more than (a) the line losses.

(e) Theft of current which is current used without being recorded on meters and may be intentional or due to direct physical contact. This loss cannot be attributed to defective meters as in laboratory tests of a number of standard makes it was found a negligible proportion of meters registered high. On some systems this unaccounted for loss of current is a serious item.

On the surface it would appear that some of these losses could be reduced with proper equipment but in some instances at a so much greater cost that the installation of improved apparatus is not warranted. The line losses may be reduced by increasing the size of the copper conductor thus reducing the resistance to the flow of current but a limit is reached beyond which there is no economy in adding more copper and increasing the original cost of the circuit. Greater efficiency might be obtained by use of conduits rather than overhead systems but the gain would not justify the expense. As to improved equipment, within generating plants results approaching 98% efficiency have been obtained, but the all-over efficiency of a distribution system is much lower.

As an illustration neglect the power lost in generation, distribution and stepping-down to a 2200 volt bus-bar delivered at bus-bar in a 200 kilowatt block at a cost of 5 cents per kilowatt hour.

Line losses	10%	$1.00
Leakage losses	½%	.10
Transformer core-losses		.13
" copper losses		.15
Meter losses		.005
Theft of current (neglected for small block of power)		......
		$1.385

Thus 200 kilowatt at 5c. or $10.00 value at starting point becomes decreased in value over a one-hour period by $1.385 so that $8.615 may be collected. Over-all losses on many systems range from 20% to 28% thus reducing an apparent 5c per kwh. rate to an actual earning rate of 3.6c. to 4c. per kwh.

The low power factor further reduces the earning power of an enterprise. If the power station produced 100 watts and only 70 watts be used then the power factor would be 70%; but if the consumer have sufficient machinery to use 100 watts the power company must have sufficient capacity on hand to supply this peak-load when demanded. This has led to the agitation for the payment of all power loads on A. K.V.A. basis.

The slowness of turnover of capital in an electric utility company — once in four years on an average—makes it difficult for such a concern to operate, particularly when restricted to an arbitrarily-fixed schedule of prices, made in some cases apparently without due allowance for all factors entering into cost of service rendered. This practice is in contrast with the ordinary commercial establishment having a turn-over three or four times per annum and subject to no restraint as to prices charged. Unless utility companies with the necessary large investment of capital in plant and equipment be permitted to charge a fair rate to cover service rendered and provide sinking funds for renewals, depreciation, interest charges, etc. Money will cease to be attracted to the electrical industry except at a higher rate.

Owing to the resignation of H. F. Bennett, A.M.E.I.C., as chairman of the branch who has removed to Halifax, N. S., the Branch Executive elected G. N. Hatfield, A.M.E.I.C., chairman, F. G. Goodspeed, M.E.I.C., vice-chairman, and A. R. Crookshank, M.E.I.C., member of executive to remain in office until regular election of officers of branch.

Calgary Branch

G. P. F. Boese, A.M.E.I.C., Secretary-Treasurer.
W. St. J. Miller, A.M.E.I.C., Branch News Editor.

Annual Meeting

The annual meeting of this branch was held on March 8th, at which the reports of the various committees were presented and a few words from the acting chairman, P. J. Jennings, M.E.I.C., relative to the past year's activities showed that a most successful year had been conducted both from a business and social standpoint. Reports were given by B. L. Thorne, M.E.I.C., policy committee; A. S. Chapman, A.M.E.I.C., credentials committee; R.S. Trowsdale, A.M.E.I.C., attendance committee; D.W. Hays, M.E.I.C., library committee; F. K. Beach, A.M.E.I.C., programme committee; P. J. Jennings, M.E.I.C., prize committee; and W. St. J. Miller, A.M.E.I.C., branch news committee.

F. K. Beach, A.M.E.I.C., gave a résumé of meetings held, papers read, and social gatherings, all of which pointed to a very healthy activity since the last annual meeting. He referred to the service the local press had rendered by their presence at meetings, together with the full reports of papers that they had published.

The financial statement presented by the treasurer, G. P. F. Boese, A.M.E.I.C., was a gratification to all members, especially as a substantial balance was carried forward in the form of victory bonds and cash in hand. A. Fraser, A.M.E.I.C., read the auditors' report, which put the O. K. on the very excellent report of the treasurer.

The branch editor's report was favourably received and commented on, particularly as the facts stated showed a substantial lead in amount of rebate received for news submitted over most of the largest branches in the Dominion. This rebate amounted to 21 per cent of the total revenue accruing to the branch, and compared with annual dues it comprised 36 per cent of same.

D. W. Hays, M.E.I.C., in submitting the report of the library committee, pointed out that one of the recommendations he had to present was that a complete index of all the more important engineering articles in the engineering periodicals be kept by a responsible member of the branch in such form that they could be readily referred to. This suggestion produced considerable discussion, it being pointed out that such articles are already available through the Journal's engineering index, also that the public library of this city keep an exhaustive index month by month of such articles and information.

The chairman then announced the results of the ballots as presented by the scrutineers. The following members were declared duly elected to fill vacancies:—R. S. Trowsdale, A.M.E.I.C., district engineer, Canadian General Electric Company, was appointed chairman for the coming year. For secretary-treasurer, G. P. F. Boese, A.M.E.I.C., assistant to chief engineer D.N.R., C.P.R., Executive, Lt.-Col. W. S. Fetherstonhaugh, C. B. E., M.E.I.C., division engineer, C. N. R., B. Russell, A.M.E.I.C., drainage engineer, R. Ser., Calgary, J. H. Ross, A.M.E.I.C., Institute of Technology and Art. Calgary.

Mr. Jennings, before retiring from the chair, expressed a hearty appreciation of the efforts of the retiring officers and committees in the useful work they had so ably performed during the year. He then introduced the new chairman who thanked the members for the honour bestowed upon him. In his remarks Mr. Trowsdale struck a decided note of optimism regarding the future of *The Institute* and engineering profession in general. He considered that commercial engineers have more occasion to look into the future than engineers in other branches pointing out that there had been an increase of 50 per cent in automobile exports in the Dominion during 1923. He predicted great expansion within the next ten years with development in engineering works, all of which would in consequence reflect on the engineering profession, this expansion being already noticeable in British Columbia and eastern points. The speaker stated that in the United States exhaustive studies had been made of business prospects for the next decade, when a consumption of 125 billion k. w. hrs., was predicted with an expenditure of something like six billion dollars. He quoted statistics to show that in Canada the sale of electricity had increased rapidly in the last few years, 1923 being 26 per cent greater than 1922. Concluding he emphasized the fact that economy and reliability were the two secrets of success in engineering as in every other line of business Mr. Jennings moved a very hearty vote of thanks to the retiring and untiring secretary, J. A. Spreckley, A.M.E.I.C., stating that it would be difficult to find one who had the interest of *The Institute* and members more at heart than he had. Also that during his two years tenure of office he had proved himself extremely worthy of the position he held on the executive. Mr. Trowsdale in seconding laid stress on the importance to *The Institute* of a capable and energetic secretary as so much depended on his organizing ability. In a few remarks Mr. Spreckley went over the ground of the branch activities during the year and modestly disclaimed credit, stating that he had derived pleasure in performing his duties as secretary.

J. H. Ross, A.M.E.I.C., offered an opinion that more thought should be directed to the training of engineers as public speakers in both elocution and expression, He considered this ability was lacking in a great number of engineers and was somewhat of a discredit to the profession. He advanced the theory that knowing one's subject thoroughly demanded respect, and suggested that time might well be spent during meetings for members to give five minute talks on books or general subjects, both subject and speaker being picked out at random.

On February 18th, a paper of outstanding merit was read before the branch by A. S. Dawson, M.E.I.C., entitled "The deterioration and preservative treatment of timber". The word "outstanding" is used advisedly, because of the conviction that such an exhaustive effort has seldom, if ever, been displayed before members of the local branch in the form of a paper, or rather it might well be called a treatise. It is anticipated that the paper will be published in full and will form a valuable addition to the volumes of the Journal.

Deep regret at the death of President Walter J. Francis was expressed for the branch by B. L. Thorne, M.E.I.C., who voiced the sympathetic condolences of all members present at the meeting.

An announcement by the chairman that Fraser S. Keith, M.E.I.C., had been commpelled to postpone his western visit was received with general regret.

Vancouver Branch

P. H. Buchan, A.M.E.I.C., Secretary-Treasurer.

Vancouver's Water Supply

During the past twelve months, the attention of the citizens of the area known as "Greater Vancouver" has been directed to the rather serious problem of water supply. The experiences of last summer, arising from the unusually dry weather, were largely responsible for causing it to be generally realized that the water problem cannot remain passive, without resulting in an acute situation, injurious to the welfare of the whole area, which at present is dependent on the water supply from the mountains on the worth side of Burrard Inlet.

The matter has been the subject of considerable discussion in the public press, and no little attention has been paid to it by the executive bodies of the various cities and municipalities concerned. Apparently the only point upon which there seems to be complete unanimity of opinion is the fact that something must be done quickly to avert the impending shortage of water, due to the rapid growth in population. The direct result of the discussion has fortunately developed the general opinion that, apart from temporary expedients of an engineering nature, certain fundamental questions must be definitely and permanently settled, if adequate provision for the future is to be brought about.

The question has therefore resolved itself into three main issues: 1 Conservation of the "North Shore" water supply. 2. Finance. 3. Administration.

When satisfactory solutions of these questions have been attained, there is little doubt that engineering skill will do the rest.

In order to assist in guiding public opinion into safe channels, the Vancouver Branch Executive Committee decided to ask Ernest Cleveland, M.E.I.C., comptroller of water-lights, Victoria, B. C., to address an open general meeting of the Vancouver Branch on "The Greater Vancouver Water Problem". Invitations were extended to the mayors, reeves and councils of the cities and municipalities affected, to attend the meeting and take part in the discussion of Mr. Cleveland's paper. The public, through the press, was also invited to attend.

The meeting was held in the Board of Trade Auditorium on Tuesday, February, 19th, 1924. The hall being practically filled to capacity. It is safe to say, that from the standpoint of attendance of the members of the Vancouver Branch, the event was a record.

James Muirhead, M.E.I.C., chairman of the Vancouver Branch, officiated in the chair, having with him on the platform His Worship Mayor Owen and Mr. Cleveland, the speaker of the evening.

Mr. Muirhead welcomed the visitors on behalf of *The Institute*, and after briefly outlining the purpose of the meeting, requested Mayor Owen to introduce the speaker.

In opening, Mr. Cleveland declared the need "vital and urgent" that some sort of Greater Vancouver water scheme should be instituted to protect and conserve the future water supply of Vancouver, South Vancouver, Burnaby, Point Grey, and also the city of North Vancouver and the districts of North and West Vancouver.

He recited the history of water works development, starting at April 6, 1886, the day when Vancouver was incorporated as a city. Mr. Cleveland then discussed the water situation of the various municipalities and dwelt at some length on the prospective future requirement of the area. At present the consumption from Capilano and Seymour Creek developments was variously estimated at from twenty-six to twenty-nine million gallons per day. The variance of estimates he attributed to the lack of adequate measuring instruments on the streams at the intakes.

Taking the rate of growth obtaining in 1921 as a basis of calculation, by 1925 he predicted a minimum average of thirty-two and one-half million gallons per day would be required by the districts and city on the south short of Burrard Inlet.

He estimated the capacity of the mains on the Seymour at twenty-two million and on the Capilano at thirteen and one-half million gallons per day, or a total potential supply capacity of thirty-five and one-half million gallons per day. With a margin of only ten per cent, above average daily requirements, the supply was inadequate when it was considered that the daily requirements in summer might run from twenty to thirty million gallons over the average for the year.

He then dealt with the wider problem of conservation and protection of the watersheds.

The recurrence of low water on the Seymour, when the stream dropped from a normal of 36 cubic feet per second, to as low as five cubic feet per second, made it essential that water storage problems must be met on the creek. By adequate storage methods, sufficient water could be conserved on this stream alone, he said, to supply a city of one million inhabitants all the year round.

Upon conclusion of Mr. Cleveland's address, Mr. Muirhead stated that the matter was open for discussion and invited a member of those present to speak, among whom was Mayor Owen. His worship referred at first to Mr. Cleveland's references to watershed protection. and then outlined the opinion expressed earlier in the day by the City Council regarding control of the waterworks which was, that the city can look after its interests and those of its neighbors in regard to water supply and that the citizens will be willing to furnish all the capital necessary for protection and development to meet requirements but, that the City Council this year is not prepared to exchange a paying utility for a commission of doubtful value. At least before any change can be made the citizens will have the chance to consider the matter very carefully indeed."

The mayor pointed out that at present the city has cheap and plentiful water, and despite the free service of water to hospitals, schools, parks and other institutions, such services being estimated to be worth $60,000 a year, the utility shows an annual profit of about $50,000.

This announcement, made by Mayor Owen appeared at the outset to transcend in interest the facts set forth by the government water engineer in his address. Several speakers from adjacent municipalities expressed regret at the City Council's decisions.

Inordinate

Donald Cameron, M.E.I.C., former business partner of Mr. Cleveland's, drew attention to the inordinate waste of water in the city. Mr. Cleveland had said that Vancouver water consumption approximated 175 gallons per capita per day. Some authorities held that 36 gallons a day was ample. In such conditions, it seemed to him that adequate methods of eliminating waste in the distribution system, without any further development would more than supply double the present population.

Prof. E. G. Matheson, M.E.I.C., suggested that a metering system for the whole district would go a long way toward augmenting the supply by preventing waste, although he admitted that the representatives who put forward such a scheme likely would be hard hit at the next election.

Reeve Tom Brooks of South Vancouver Municipality and Reeve Geo. A. Walkem, M.E.I.C., of the Municipality of Point Grey also participated in the discussion, expressing the hope for a satisfactory resolution quickly.

Although the discussion did not culminate in any resolution, beyond a very cordial one expressing the hearty thanks of all present to the speaker of the evening, it was evident, from the friendly candour of the various contributers to the discussion, that a good feeling had been created among the representatives of the executive bodies of Vancouver and the surrounding municipalities; and that the object of the branch executive to lay the foundations of serious and practical consideration of the fundamental issues involved in the greater Vancouver water problem, had been attained.

Members of *The Institute* will doubtless follow the progress of the solution of this problem with greater interest, because they have contributed real service in this effort to establish our water-supply on a sound basis.

Moncton Branch

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

A very delightful supper meeting of the Moncton Branch, was held on Tuesday evening March 18th, at the "Barker House". After supper had been served vocal selections were rendered by Messrs. Dodge and Stiven, — the music being much enjoyed by all present. Major McKie accompanied both singers.

The Natural Resources of New Brunswick

The speaker of the evening was Doctor Bigelow of Mount Allison University, Sackville. His address was on the natural resources of New Brunswick, and necessarily covered a very wide field, the general subject being sub-divided under the following four principal heads;—agriculture, lumber, fish and minerals. The Doctor, in a foreword to his address, stated, that of course there was a natural resource of the province that was not being included in his paper, that of the workers, and in this connection, he remarked that he had recently been reading "Sam Slick", and this writer had stated that the Nova Scotians had a wonderful country, but that they wouldn't work it.

In dealing with the subject of lumber, the speaker said that a general survey of the province determining the percentage of different kinds of trees showed that although over one-third of our forest growth was hard woods, yet only a little over one per cent or possibly two per cent of this was cut for commercial use, while spruce and fir composed the great percentage of the cuts — spruce 50 per cent, fir 25 per cent, then in smaller percentages, pine, cedar, hemlock and poplar; and in view of this, he stated emphatically that commercial uses must be found for our hard woods, and that they must be used in the paper manufacture just the same as the soft woods are used for this to-day, and he was quite certain that hard woods could be used just as well as soft woods for this industry. In connection with the pulp and paper manufacture, Doctor Bigelow said that if the water power development of the Grand falls was realized and 125,000 h. p., obtained from this development, the whole of this power could be utilized for paper manufacture alone. The speaker was very enthusiastic in regard to the utilization of our water power in connection with the development of industries that would take the pulp from the forests and turn out the finished product, and not do as we are doing at the present time, such as shipping the raw material across the border into the United States, there to be turned into the finer grades of paper, and incidentally giving to the United States the labour element which such plants demand, which additional population could be used to great advantage at home in using up the surplus produce of our farms, which is either going to waste or being shipped long distances for export. Dr. Bigelow enthused his hearers with the possibilities of this development, and his plans for the utilization of the by-products, etc., etc., derived from this industry, making them feel that an industry of this kind could not go wrong financially. He stated that the ideal condition and position for a pulp and paper mill is in conjunction with a saw mill, so that waste lumber and saw dust can be utilized for heating. In this instance he cited the Bathurst Lumber Company who have such a plant, and are exceptionally progressive and strong financially.

In discussing the mineral resources of the province Doctor Biglow covered a broad field of study and work. He, as a student of this subject, explained very fully how all the mineral deposits, especially the particular kind of coal in this province, appeared to work in with our forest wealth. Again, our electrical possibilities worked in with both our forest and mineral resources, so that the by-products from one could be utilized in the finishing of a further material, or the production of other chemicals,—such as menthol, alcohol, acetone, tar, etc., all of which could be utilized in the development of some other natural resource, or for domestic use and the uses of transportation.

In conclusion, Doctor Bigelow said he was strongly of the opinion that the government should appoint a commission of experts to investigate these possibilities in our natural resources and their further development.

An Outline of Truss Bridge Design

On Tuesday evening, February 26th, the Moncton Branch held a meeting at Mount Allison University, Sackville, for the benefit of the students of *The Institute*.

A. E. Oulton, Jr.E.I.C., assistant engineer in the Bridge Department of the Canadian National Railways, Moncton, read an interesting and instructive paper entitled "An Outline of Truss Design". Mr. Oulton divided his subject into five different heads, namely: Historical development of bridge construction; Materials of construction; Foundations; Bridge substructures; Bridge superstructures.

The speaker had prepared several plates, illustrating the different types of trusses, such as the lattice, fink, Bollman, Whipple, Warren, Howe and Pratt, of which the Pratt truss has been the most used in the last 50 years, except in timber bridges where the Howe truss has been always favoured. He also discussed the plate girder now in use for clear spans up to 120 feet, the suspension, the cantilever, the swing, end lift, vertical lift, steel arch and concrete arch, explaining where each type is generally used, and exhibiting plates of bridges of each type now in existence.

In conclusion, Mr. Oulton impressed upon the students the importance of considering the permanency of various structural materials, remarking that if concrete disintegrates it is the fault of the builder, if steel rusts it is the fault of the maintenance force, proper painting would have prevented it, and finally, if traffic on our bridges increases in 5 or 10 years beyond their capacity, it is the fault of the engineer, he should have forseen this condition.

Lethbridge Branch

G. S. Brown, A.M.E.I.C., Secretary-Treasurer.

The last meeting of the local Branch of The Engineering Institute of Canada was held at the Y.M.C.A. on March 15th.

The chairman made suitable reference to the passing of President Francis and said that Canada had in the death of Mr. Francis suffered the loss of a real man and an eminent engineer. Mr. Dow expressed regret that Mr. Keith was not able to carry out his itinerary but hoped that he would visit our branch at an early date.

The War Memorial to be erected by The Institute was mentioned and Mr. Dow appealed for support.

The election of officers resulted in John Dow, M.E.I.C., being elected chairman, P. M. Sauder, H. P. Keith, A.M.E.I.C., and R. Miles, M.E.I.C., executive committee, G. S. Brown, A.M.E.I.C., secretary-treasurer, and Messrs. Broderick and Dunning, auditors.

The Fuel Committee, Messrs. M. Freeman, A.M.E.I.C., R. Livingstone, M.E.I.C., and Watson, presented an interesting interim report which shows that the subject, so important to Alberta, is receiving close attention.

Aerial Photography

Geo. Davies gave a paper on "Aerial Photography" as an aid to map making. Mr. Davies had been in the Flying Corps during the war and showed a number of interesting photographs of the battle front that he had taken from the air. He considered that the Canadian Air Force, which he said he understood is to be increased in numbers, should map the whole of Canada by camera as it would be excellent practice and would result in a far more valuable and accurate mapping of the country than is now available. He said that for municipal maps, tourists' maps, traffic routing maps and in many other ways aerial surveys would in the very near future replace ground surveys.

Messrs. Sauder, Meech, Miles and Meldrum reported on the work of their various committees and the season's meetings ended with a determination to make next year's sessions better yet.

(*See also page 205.*)

Winnipeg Branch

P. Burke-Gaffney, A.M.E.I.C., Secretary-Treasurer.

James Quail, A.M.E.I.C., Branch News Editor.

The Winnipeg Branch held a regular meeting Thursday evening March 6th, in the University Building. A. McGillivray, A.M.E.I.C., occupied the chair.

Visitors in the persons of N. W. Calvert of Detroit, Mich., and Fraser S. Keith, M.E.I.C., the general secretary of The Engineering Institute of Canada, were welcomed by the chairman.

Before the speaker of the evening was introduced Mr. Keith spoke to the meeting conveying greetings from the President and Council of The Institute and, as well, outlining some points of policy laid down by The Institute Committee on Policy. One of those points as emphasized was that The Institute as a whole had adopted the attitude that in the future it would take more interest in the social and economic affairs of its members than it had done in the past. A second point emphasized was that local branches active in university centres should take still more interest in the engineering student bodies.

The Corrosion of Metals

The chairman introduced Professor J. W. Shipley, D.SC., of the University of Manitoba, as the speaker of the evening. Professor Shipley's subject was announced as "The Corrosion of Metals".

Professor Shipley approached the discussion of his subject by drawing attention to interesting examples of corrosion. One of those was the fact that tin changes its structure at low temperatures, disintegrating into a powder in extreme cold. He related the historical incident, in this connection, of a village in Russia the roofs of the houses of which disappeared one cold night. The roofs were tin.

Corrosion of metals, particularly as corrosion action affects iron and steel, was shown to be a condition of outstanding importance. This fact is recognized by the branch of the engineering profession known as chemical engineering in its persistent effort to discover methods of preventing corrosion. These methods may be generally classified under two heads, namely, by alloying iron with some other substance or substances to produce a steel self resistent to corrosion and the other by coating a steel with a water or acid proof coating.

Corrosion of boilers, it was mentioned, is prevented by treatment of the boiler waters. Several methods of boiler water treatment were referred to.

Specimens of corroded iron were displayed and slides shown to illustrate the process of rusting and rust prevention.

The sad news of the death of President Walter J. Francis, was announced at the conclusion of the meeting. Sympathy of the Winnipeg Branch was extended to Mrs. Francis and family.

Employment Bureau

Assistant Engineer (Welland Ship Canal Construction)

An assistant engineer (Welland Ship Canal Construction) is required for the duration of the construction of the Welland Ship Canal at a salary of $6,300 per annum, prevailing rates.

Duties.– To assist the engineer (Welland Ship Canal Construction in supervision of the engineering staff, and in the location, design, and construction work of the Welland Ship Canal; to make special investments and reports and keep the engineer informed on matters relative to the work; to act for the engineer (Welland Ship Canal Construction) in his absence and to perform other related work as required.

Qualifications Required.—Graduation in engineering from a school of applied science of recognized standing; at least ten years of experience in canal engineering, survey, design, construction and maintenance work, five years of which shall have been in responsible charge of such work; thorough knowledge of canal design and construction; firmness, tact, good judgment and administrative ability.

Application forms properly filled in must be filed in the office of the Civil Service Commission **not later than April 17, 1924**. Application forms may be obtained from the postmasters at Prince Rupert, Vancouver, Victoria, Edmonton, Calgary, Regina, Winnipeg, Quebec, Charlottetown, Halifax, Fredericton and St. John, or from the secretary of the Civil Service Commission.

By Order of the Commission,

W. FORAN,

Secretary.

(See also page 205)

Recent Additions to the Library

Transactions, Proceedings, Etc.

Presented by the Societies.

The Mysore Engineers' Association, Bulletin, No. 1, Vol. 1. July, August and September, 1923.

Transactions of The Society of Engineers, (Incorporated), London, England, for 1923

Charter, By-Laws and List of Members and Associates of the Iron and Steel Institute, 1923.

Proceedings of the Lake Superior Mining Institute, Twenty-third Annual Meeting held at Duluth and Hibbing, August 28, 29, 30, 1923. Volume XXIII.

Catalogue of Rensselaer Polytechnic Institute, Troy, N.Y. March, 1923, Volume 22, No. 1; Photographic reproductions of work of graduates, September 1921, Volume 20, No. 3; Description of the mechanical, electrical, physical, chemical and materials testing laboratories and of the shop, September 1923, Volume 22, No. 3; Bulletin on Radio equipment; Bulletin on chemical engineering.

Presented by The Institution of Civil Engineers.

The Deflections of Suspension Bridges, by John Wyatt Spiller; The Experimental Development of an Automatic Integrating 'Intensity' Rain-Gauge without Clockwork, by John Willoughby Meares; A new Method for the Improvement of Existing Railway-Curves, by William Hamilton Shortt; The Estimation of Storm-Water Discharge from Inhabited Areas, by George Stephen Coleman; The Mechanical Screening of Circulating Water and of Sewage, by Herbert Addison; The Discharging-Capacity of Side Weirs, by George Stephen Coleman and Dempster Smith; Evaporation By the Vapour-Compression Method, by Thomas Evans Houghton; Inchinnan Opening Bridge, by William Bertram Hall; Catenary Measurements, by Rollo Appleyard.

Reports.

Presented by British Cast Iron Research Association.

Bureau Bulletin of the British Cast Iron Research Association, Volume 1, No. 3, July 1923.

Presented by the Montreal Board of Trade.

Eighty-First Annual Report of the Council of the Montreal Board of Trade, being for the year 1923.

Presented by The Honorary Advisory Council for Scientific and Industrial Research, Ottawa.

Report No. 14 on the Utilization of the Low Grade Iron Ores of Canada.

Presented by Howard W. Ambruster, Esq., New York.

Arsenic Calcium Arsenate and The Boll Weevil, articles and addresses by Howard W. Ambruster.

Presented by The Quebec Streams Commission.

Eleventh Report of The Quebec Streams Commission, 1922.

Presented by Department of the Interior, Northwest Territories and Yukon District, Ottawa.

Local Conditions in the Mackenzie District, 1922; Canada's Wild Buffalo.

Presented by Department of Commerce, Bureau of Standards, Washington, D.C.

Legal Weights (in pounds) per bushel of various Commodities. Circular No. 10.

Thermal-Conductivity Method for the Analysis of Gases, Technologic paper No. 249.

A New Electrical Telemeter, Technologic paper No. 247.

Exposure Tests on Colorless Waterproofing Materials, Technologic paper No. 248.

Wet-Process Enamels for Cast Iron, Technologic paper No. 246.

Wall Plaster; Its Ingredients, preparation and properties. Circular No. 151.

Presented by U.S. Department of the Interior, Bureau of Mines.

Self-Contained Mine Rescue Oxygen Breathing Apparatus, by D. J. Parker and E. H. Denny.

Technical Books.

Presented by E. & F. N. Spon, Limited.

The Elements of Automatic Telephony, by Arthur Crotch.

Address by A. G. Garner, M.E.I.C.

Retiring Chairman of the Saskatchewan Branch.
Presented at the Annual Meeting of the Branch, March 7th, 1924.

Until a recent meeting of your executive I was under the impression that a written address would not be required, but I was courteously advised that this should be done and hence the effort.

Although the usual reports of your executive and the several committees will be placed before you, possibly a synopsis of the conditions and activities of the branch for its year ending at this time, together with some suggestions the result of experience as your chairman may be of some value.

Membership

Membership comprising all grades remains about the same as for the year ending March, 1923, despite the fact that our zone or district under the by-laws of *The Institute* as amended last June, now covers the whole province. Considering conditions, however, we may congratulate ourselves in this respect rather than otherwise, for a number of members have left Canada, some have been taken over by other branches and some we dropped for non-payment of dues and others were erroneously included in our list since although accepted for membership they had not complied with the requirements. Our present statement is, I think, more sound and reliable than some of the previous ones and in this connection I may say that a good deal of work has been performed by the secretary in carefully reviewing each case and bringing same into agreement with headquarter records or vice versa as the case might be.

Financial Condition

At the commencement of the year there was a fairly heavy financial deficit and this necessitated a levy on the membership which in the main has been well met. A previous levy has been made in 1921. There is still a small deficit and I would suggest consideration of paying annual dues within the reach of all, rather than the periodic levy and I do not think it is your wish that the executive should spend much time and some worry over finances when that time could be devoted to better advantage in the general interests of the branch. A great deal of credit is due the Secretary for work in this connection and at times he has been appreciably out of pocket.

The Year's Programme

The programme of papers arranged by the Papers and Library Committee has, I think, been appreciated. Some of the addresses have been outstanding and of unusual interest, the average attendance at all meetings has been good, general interest, harmony and good fellowship seems to prevail and in all these respects I would say that the branch is steadily advancing. The wives and lady relatives and friends of the members resident in Regina are taking an increasing interest in the activities of the branch and exemplified their interest in a material way by entertaining us on February 22nd, at the home of Mrs. H. S. Carpenter. Not only was this function very enjoyable, but I am sure will be an encouragement towards greater efforts on our part. It was also unique in being, to the best of my knowledge, the first function of its kind held in connection with any branch of *The Institute*.

The most outstanding event in the past year appeared to be the summer meeting held at Estevan on August 17th and 18th. All who attended were royally treated by the people of Estevan and particularly by members of the committee, their relatives and friends resident in Estevan. A very good general knowledge was obtained of the coal mines, brick and other industrial plants, the Estevan Nurseries and local territory, and although every moment was fully occupied the whole event seemed like a very delightful picnic and the time all too short. A cordial invitation was extended to the branch to have its members make one or more further visits when convenient. A well planned summer meeting seems very desirable each year and in localities where appreciable benefit may be derived professionally as well as socially.

Legislation

Regarding legislation it would seem well to modify our views if necessary to ensure the passing of legislation covering the profession in this province. This might be merely a skeleton at the outset to be built up from time to time as conditions warranted or become more favourable, in the meantime we would receive a measure of public recognition and standing not otherwise obtainable. I would recommend serious consideration of this problem during the coming year with a view to further action.

A Committee on Natural Resources

It would appear advisable to appoint a special committee to carry out investigations in connection with our lignite and the clays of the province, or possibly a committee on natural resources might be formed to be divided into sub-committees. A good deal of material is now available and at least some investigation should be made by the Branch as to our lignite, thus following up our visit to Estevan and Mr. Hamilton's efforts.

If the branch can take up one or more problems rightly coming within its scope or sphere, which are uppermost in the mind of the public and in the order of their probability and value, we would be, to use a military term, "consolidating our position" and be looked to by the government and the public for expressions of opinion and advice on matters which can only be properly or to a large extent correctly determined by members of the profession. I have on several occasions recommended to those in authority, a research or advisory council, composed of engineers, surveyors, members of the faculty of the University of Saskatchewan and prominent professional and business men and with a view to furthering the development of our province and especially so when general development takes place and to which time we all look forward. At the present time, while a number of government officials, professors of the university and others are so employed there appears to be no coordination of their respective activities and efforts through some central body as outlined.

Students Activities

I would refer the members and incoming executive to the February number of *The Journal*, page 63, on the subject "Student Activities Committee. If there is anything further that can be done than has been done in the past depends (by reason of the distance separating the Branch Headquarters and the University of Saskatchewan) mainly upon knowing in what respects we can best accomplish desired results, and this information can only be supplied by the executive of the Engineering Society at the University of Saskatchewan and members of the branch resident in Saskatoon. A good start was made at the joint meeting of the branch and Engineering Society on February 28th by means of special telephone equipment and I then assured the Engineering Society that this would be one of the first steps towards closer co-operation and that we would welcome suggestions from their society. We must also carefully look to the interests of non-resident members and a committee struck for these purposes seems desirable.

No one can appreciate as well as the chairman, the great amount of work and how much of the success of the branch depends upon the secretary. I would recommend that he be relieved of the work of corresponding secretary to *The Journal* and of publicity in general, in so far as this is possible. These duties could be well performed by the Papers and Library Committee.

Comments on Institute Activities and The Journal

I would like to make a few comments as to headquarter activities and *The Journal*. Amendment to the by-laws passed last June is an advancement along right lines excepting that situated as we are the radius for residing members is too short, viz: — 25 miles. I am of the opinion that this should be further investigated with a view towards its being increased with respect to this branch and others similarly situated. The appointment of special committees to investigate prominent questions of public interest, I might mention particularly the "Committee on Fuel" is strengthening and improving our position.

Some of the papers published in *The Journal* have been of unusual interest, not only to ourselves but to the public generally. There is still a predominence of papers covering problems in Eastern Canada which is only to be expected by reason of the greater engineering activities in that section of Canada. We feel, however, that now and then papers are read to us worthy of publication and as *The Journal* is after all our only effective medium as to this point and expression of our views generally, we hope for an appreciation of these questions by those concerned.

Generally speaking there appears to have been a marked advancement by headquarters and improvements in *The Journal* which are bringing about results desired by the general membership, viz: — the advancement and improvement of the profession and an earnest desire to best serve the public interests.

Present Day Conditions

Turning to present day conditions, which are trying to a more or less extent to everyone in all walks of life and due in the main I would say to, the heavy debt incurred by the Great War, conditions in Europe, the payment of expensive works inaugurated before the war, the inflation of land value far beyond their real or actual value and possibly the reckless or extravagant expenditure of money both during the boom days in the years immediately prior to the war and in some respects during the war. These points seem to be often overlooked for we hear on every hand a cry for retranchment, economy and the solution of problems brought about by the conditions named, while on the other hand organizations and the public urge the carrying out of very large schemes involving many millions of dollars, some of which, if not all require a great deal more investigation before being launched and then only in the order of their value to the people as a whole and when conditions and finances warrant. Time, patience and a true realization of the situation by the individual and an honest effort on the part of every one towards assisting those in authority to solve the difficult problems of to-day appear to be the best line of conduct and action, meanwhile we have an opportunity for research work, planning for the future along right lines, and the betterment of conditions for all walks in life. Conditions to-day are not as bad as I have seen them in my thirty-six years of residence on these prairies, and moreover the outlook then was not so bright as compared with to-day, and so I say to those present and all members of the branch, have patience, prepare yourselves for the days of great development, and have confidence in yourselves and the splendid future before this province of ours.

In conclusion I have very fully appreciated the honour conferred upon me and regret that it has not been possible to do more in the material interests of the branch during my term of office, and desire also at this time to express my gratitude and thanks to the officers, members of committees and the membership at large for the splendid support which they have unreservedly given me during the year.

Preliminary Notice

of Applications for Admission and for Transfer

March 20th, 1924.

The By-laws now provide that the Council of the Institute shall approve, classify and elect candidates to membership and transfer from one grade of membership to a higher.

It is also provided that there shall be issued to all corporate members a list of the new applicants for admission and for transfer, containing a concise statement of the record of each applicant and the names of his references.

In order that the Council may determine justly the eligibility of each candidate, every member is asked to read carefully the list submitted herewith and to report promptly to the Secretary any facts which may affect the classification and election of any of the candidates. In cases where the professional career of an applicant is known to any member, such member is specially invited to make a definite recommendation as to the proper classification of the candidate.*

If to your knowledge facts exist which are derogatory to the personal reputation of any applicant, should be promptly communicated.

Communications relating to applicants are considered by the Council as strictly confidential.

The Council will consider the applications herein described in April, 1924.

Fraser S. Keith, Secretary.

*The professional requirements are as follows:—

Member shall be at least thirty-five years of age, and shall have been engaged in some branch of engineering for at least twelve years, which period may include apprenticeship or pupilage in a qualified engineer's office, or a term of instruction in a school of engineering recognized by the council. The term of twelve years may, at the discretion of the council, be reduced to ten years in the case of a candidate for election who has graduated from a school of engineering recognized by the council. In every case the candidate shall have held a position in which he had responsible charge for at least five years as an engineer qualified to design, direct or report on engineering projects. The occupancy of a chair as a professor in a faculty of applied science or engineering, after the candidate has attained the age of thirty years, shall be considered as responsible charge.

An Associate Member shall be at least twenty-seven years of age, and shall have been engaged in some branch of engineering for at least six years, which period may include apprenticeship or pupilage in a qualified engineer's office or a term of instruction in a school of engineering recognized by the council. In every case a candidate for election shall have held a position of professional responsibility, in charge of work as principal or assistant, for at least two years. The occupancy of a chair as an assistant professor or associate professor in a faculty of applied science of engineering, after the candidate has attained the age of twenty-seven years, shall be considered as professional responsibility.

Every candidate who has not graduated from a school of engineering recognized by the council, shall be required to pass an examination before a board of examiners appointed by the council. The candidate shall be examined on the theory and practice of engineering with special reference to the branch of engineering in which he has been engaged. This examination may be waived at the discretion of the council if the candidate has held a position of professional responsibility for five or more years.

A Junior shall be at least twenty-one years of age, and shall have been engaged in some branch of engineering for at least four years. This period may be reduced to one year, at the discretion of the council, if the candidate for election has graduated from a school of engineering recognized by the council. He shall not remain in the class of Junior after he has attained the age of thirty-three years.

Every candidate who has not graduated from a school of engineering recognized by the council, or has not passed the examinations of the first year in such a course, shall be required to pass an examination in the following subjects: geography, history (that of Canada in particular), arithmetic, geometry, euclid (books I, IV and VI), trigonometry, algebra up to and including quadratic equations.

A Student shall be at least seventeen years of age, and shall present a certificate of having passed successfully an examination equivalent to the final examination of a high school or the matriculation of an arts or science course. He shall either be pursuing a course of instruction in a school of engineering recognized by the council, in which case he shall not remain in the class of student for more than two years after graduation; or he shall be receiving a practical training in the profession, in which case he shall pass an examination equal to that prescribed for admission to the grade of Junior in the foregoing section and he shall not remain in the class of Student after he has attained the age of twenty-seven years.

An Affiliate shall be one who is not an engineer by profession but whose pursuits, scientific attainments or practical experience, qualify him to co-operate with engineers in the advancement of professional knowledge.

The fact that candidates give the names of certain members as references does not necessarily mean that their applications are endorsed by such members.

FOR ADMISSION

AGAR—GEORGE, of 66 St. Jules Street, Maisonneuve, Montreal, Que. Born at Barrow-in-Furness, England, August 8th, 1893; Educ., 1909-17, tech. school, Barrow-in-Furness; 1st class cert., City & Guilds of London Inst., final exam. mech. engrg., 1917; 1908-13, ap'tice to engrg., Vickers Limited Barrow-in-Furness, 2½ years shop work and 2½ years in mech. drawing office; 1913-17, marine engine dftsman., Vickers Limited, Barrow; 1917-23, asst. chief marine engrg. dftsman and designer for Canadian Vickers, Montreal; At present, chief mechanical dftsman and estimator, Canadian Vickers, Limited, Montreal.

References: E. S. Mattice, A. W. K. Massey, H. R. McClelland, A. H. Ross, C. O. Thomas.

BARNES—HOWARD TURNER, of Montreal, Que. Born at Woburn, Mass., July 21st, 1873; Educ., B.A.Sc. McGill Univ. 1893; M.A.Sc. 1895; D.Sc. 1900; F.R.S., London, 1911; F.R.S. Canada, 1898; F.A.P.S., F.A.A.A.; Former director of physics, and Macdonald professor of physics, McGill University. Head of physics dept. for 9 years. 1894, demonstrator in chemistry; 1896-99, demon. in physics; 1900-03, lecturer; 1904-06, asst. professor; 1907-08, associate professor; 1908, professor; 1909, director. At present engaged in private research.

References: J. T. Farmer, F. S. Keith, K. B. Thornton, A. Surveyer, F. W. Cowie.

BELL—CHARLES WILLIAM, of 30 Cameron Street, Moncton, N.B. Born at Barrington Passage, N.S., Aug. 20th, 1900; Six years and three months signal engrg. with C.N.R.; 6 mos. in charge of signals from Moncton to Oxford Jct.; 7 mos. in charge of signals and elec. apparatus, Edmundston Divn., 10 mos. in charge of signals from College Bridge to Maccan. At present signal inspr. and dftsman., C.N.R., Moncton, N.B.

References: G. L. Dickson, M. J. Murphy, J. R. Freeman, C. S. G. Rogers, J. G. Dryden.

BENNETT—ALDRAN REUBEN, of 179 Bonaccord Street, Moncton, N.B. Born at Caledonia, N.B., April 21st, 1891; 1912, dftsman., United Printing Machinery Co., Boston, Mass.; 1913-14, dftsman., B. F. Sturtevant Co., Boston; 1914-20, dftsman., C.N.R., Moncton, N.B.; 1920-22, sales engr., Canadian Sirocco Co., Windsor, Ont.; 1923, dftsman., Dominion Coal Co., Glace Bay, N.S.; 1923 to date, dftsman., C.N.R., Moncton, N.B.

References: G. L. Dickson, A. F. Stewart, J. R. Freeman, M. J. Murphy, F. H. Williams.

COXALL—CHARLES, of 2918 Hill Avenue, Regina, Sask. Born at London, England, June 25th, 1886; Educ., articled pupil in office of Wimperis & Arber, Arch'ts., London, England; 1904-10, continuation classes in design, constrn., etc., South Western Polytech., Kings College, London Univ. and Royal Academy School of Architecture; 1907-10, asst. in office of Victor Wilkins, Arch't. and Surveyor, London; 1910-12, dftsman. in office of John D. Atchison, Arch't., Winnipeg; 1913-14, with Cummins & Agnew, Civil Engrs., and Land Surveyors, Vernon, B.C.; 1914-17, office work on road constrn. and standardizing maps of the Okanagan district, with Prov. Supt. of Roads, Vernon, B.C.; 1917-19, dftsman in townsite branch, Dept. Natural Resources, C.P.R., Calgary; Jan. 1920 to date, designing dftsman in office of Provincial Architect, Parliament, Bldgs., Regina, Sask.

References: M. W. Sharon, R. N. Blackburn, A. P. Linton, D. T. Townsend, J. C. Dufresne, D. M. Mathieson, R. H. Murray.

DUDLEY—WILLIAM HARTMAN, of 56 Monck Street, Norwood, Man. Born at Toronto, Ont., July 19th, 1877; Educ., 3 years Collegiate Institute; 2½ years elect'l. engrg. course, Can. Gen. Elec. Co., Peterborough; 1898-99, power house operator at Lachine Rapids plant of Lachine Rapids Hydraulic & Land Co.; 1900-01, in charge of electrification of Soulanges Canal; 1902, in charge of elec. mach. installation work in Montreal district for C.G.E. Co.; 1903-04, with C.G.E. Co., supply dept., Toronto; 1905-20, district engr., for C.G.E. Co. with headquarters at Winnipeg, in charge of installation of electrical apparatus for Winnipeg Electric Rly., Assinaboine Ave. plant, 1905; Mill Street substation, 1906; Transcona substation, 1913; Electrification of Winnipeg Selkirk Rly., 1907; Calgary Power Co. plant at Horse Shoe Falls, generators, 1911; extension to Kakabeka Falls plant of Kaministiquia Power Co., 1911; and various other installations at Fort William and Port Arthur, Manitoba, Sask. and Alta.; 1920 to date, apparatus sales engr., Canadian General Electric Co., Winnipeg, Man.

References: G. R. Wright, E. V. Caton, C. A. Clendening.

HYNDMAN—WALTER EARDLEY, of Charlottetown, P.E.I. Born at Charlottetown, P.E.I., July 9th, 1875; Educ., partial course, first year science, McGill Univ.; Private tuition; 1892-95, shops and testing dept., Robb Engineering Co., Amherst, N.S.; 1897-99, dftsman in office of J. B. Hegan, res. engr., Dept. Public Works, P.E.I.; 1900, office and field work for C. H. Ellacott, D.L.S., Grand Forks, B.C.; 1901, accepted position as asst. engr. to J. B. Hegan, res. engr., Dept. of Public Works, Charlottetown; Jan. 1913, placed in charge of the district of P.E. Island, as acting district engr., and from June 1914 to date, district engr., Dept. Public Works, Canada, Charlottetown, P.E.I.

References: J. B. Hegan, C. E. W. Dodwell, K. M. Cameron, A. R. Dufresne, H. H. Shaw.

JOHNS—CHARLES D., of Windsor, Ont. Born at Marmora, Ont., July 13th, 1898; Educ., Undergrad. (3 years civil), Queen's Univ.; 1916, dftsman., British Chemical Co., Trenton; 1917, dftsman., Quaker Oats Co., Peterborough; 1917-21, dftsman., instr'man., asst. supt., McFarlane-Pratt-Hanley Ltd., Toronto and Midland; 1922 (summer), dftsman., Fegles Construction Co., Fort William, Ont.; 1923-24, estimator, asst. supt., John V. Gray Construction Co., of Toronto, Ont.

References: R. E. W. Hagarty, G. Blanchard, F. S. Milligan, R. J. Fuller, L. B. Tillson.

KEWIN—GEORGE EDWIN, of Niagara Falls South, Ont. Born at Toronto, Ont., Jan. 23rd, 1891; Educ., B.A.Sc., Univ. of Toronto, 1914; 1912 (summer), in factory, Can. Gen. Elec. Co., Peterborough; 1913 (summer), elect'l. constrn. Toronto terminal station, Toronto Power Co.; 1916-18, suptg. elect'l. constrn. at various stations; 1918-21, asst. engr. in elect'l. engrg. dept., on design of stations, with the H.E.P.C. of Ontario, and from 1921 to date, res. elect'l. engr. on the Queenston-Chippawa Development for the H.E.P.C. of Ontario.

References: H. G. Acres, A. C. D. Blanchard, E. T. J. Brandon, F. H. Farmer, T. H. Hogg, J. R. Montague, E. I. W. Jardine.

KILBOURN—FREDERICK BINNS, of 457 Mount Stephen Avenue, Westmount, Que. Born at Owen Sound, Ont., Dec. 14th, 1883; Educ., 1905-06, 1 year McGill Univ.; 1901-03, 2 years hydraulic constrn., 1 year electric power house operating, Montreal, Light Heat & Power Co.; 1906-19, in charge of constrn. and operation of Canada Cement plant No. 1, at Montreal; 1919 to date, gen. supt., of the Canada Cement Company's plant.

References: A. C. Tagge, A. E. Dubuc, J. A. Duchastel, W. Kennedy, Jr., R. M. Wilson.

LOGAN—ROBERT ARCHIBALD, of 136 West 52nd Street, New York City, U.S.A. Born at Middle Musquodoboit, N.S., August 17th, 1892; Educ., Diploma, N.S. Tech. Coll. 1911; D.L.S. 1914; Two years study of languages and prac. astronomy in Germany (prisoner of war); Certs. as Commercial Air Pilot and Air Engineer, Canadian Air Board; 1909, land surveys in N.S.; 1910-11, second asst. on D.L.S. in Man., Sask.; 1912, 1st asst. on winter surveys, in Alta., 2nd asst. and leveller on base line surveys, Alta.; 1913, 1st asst. on base line surveys, Man.; 1914-15, 1st asst. settlement and inspection surveys, northern Alta.; 1915-16, aeroplane pilot and engr., R.F.C.; 1917-19, Flight Commdr., R.F.C.; 1920-23, officer in charge of ground instructional section, Canadian Air Force, Camp Borden, having charge of practical work and instruction in wireless, aerial photography, navigation and aircraft engineering. Rank of Squadron Leader (Major) since Sept. 1921. Special investigator on flying conditions in the Arctic regions with Canadian Arctic expedition of 1922; At present manager of the Mapping Division, of the Fairchild Aerial Camera Corporation, New York City, directing a staff of twelve engineers in making aerial photographic maps.

References: E. Wilson, O. S. Finnie, J. D. Craig, A. M. Narraway, G. H. Blanchet, A. G. McLerie.

MACKENZIE—ALEXANDER RODERICK, of Vernon, B.C. Born at Inverness, Scotland, May 17th, 1874; Educ., Royal Academy, Inverness, Scotland; Admitted student, Inst. C.E., London, 1893; 1889-1893, articled ap'tiee, James Fraser, M.Inst.C.E., Inverness, Scotland; 1893-96, asst. res. engr. with the Highland Rly. Co. of Scotland on constrn. of Inverness-Aviemore Direct Rly.; 1896-1907, on engrg. staff Natal Govt. Rlys., South Africa; In charge of constrn. of sections of new lines and of location of over 400 miles of new rly. routes in mountainous country; Left the service with rank of first asst. engr.; Elected A.M. Inst. C.E., London, 1901; 1907-10, constrn. engr. with Mexican Light & Power Co., Mexico; 1910-12, engr. in charge of constrn. of 60,000 h.p. hydro-electric plant of the Western Power Company of Canada at Steve Falls, B.C.; 1912-16, private consulting practice, Vancouver, B.C.; 1916-19, overseas, Major and Company Commdr., 3rd Battn., C.R.T.; 1919-22, a Harbour Commissioner of the Port of Vancouver; April 1923 to date, manager of the Vernon Irrigation District, Vernon, B.C.

References: T. H. White, D. O. Lewis, C. Brakenridge, G. A. Walkem, R. G. Swan, W. G. Swan.

McDONALD—CLAUDE KNOX, of 61 Ann Street, Toronto, Ont. Born at Jamestown, Scotland, March 31st, 1885; Educ., 5 years evening tech. course, Technical College, Glasgow; Naval architecture course, Glasgow Univ.; 1902-08, ap'ticeship in design and constrn. of war and merchant ships, Messrs. Wm. Beardmore & Co. Ltd., Dalmuir, Scotland; 1908-09, ship dftsman., Messrs. A. and J. Inglis Ltd., Glasgow; 1909-11, design and constrn. of H.M. ships, Messrs. Scott's Shipbldg. & Engrg. Co. Ltd., Greenock, Scotland; 1911-14, and 3 mos. 1919, leading dftsman on design of large cargo and passenger ships, with same company; 1914-19, Royal Artillery, Lieut., T.F.; 1919-20, in charge of extensive ship repairs, Davie Shipbldg. Co., Levis, Que.; 1920-21 (5 mos.), dftsman., gen. flour mill constru., Maple Leaf Milling Co., Toronto; 1922-23, engr. and dftsman with Messrs. Walter J. Francis & Co., engaged on Hydro-Electric inquiry; 1923 to date (4 mos.), dftsman., Messrs. Canadian Line Materials Ltd., Toronto, on gen. mech. design.

References: W. P. Wilgar, D. S. Ellis, W. Storrie, R. O. Wynne-Roberts, W. D. Adams.

McLACHLIN—DAN, of Arnprior, Ont. Born at Arnprior, Ont., Feb. 27th, 1881; Educ., 2 years science, McGill Univ.; manager of an extensive lumber plant using engines, dynamos, steamboats, etc.

References: L. H. Cole, K. M. Cameron, O. S. Finnie, G. G. Gale.

RAMSAY—ROBERT, of Montreal, Que. Born at Glasgow, Scotland, Oct. 3rd, 1888; Educ., 1905-10, Newbie Tech. Classes, Annan, Scotland; 1910-13, West of Scotland Tech. College, Glasgow; 1904-10, ap'ticeship to engrg., Cochran & Co., Annan, Scotland; 1910-11, dftsman. on design of marine machinery for cargo vessels, Messrs. D. and W. Henderson, Glasgow; 1911-13, design of machinery for torpedo boat destroyers, Messrs. Yarrow & Co., Glasgow; 1913-16, design of machinery for light cruisers, Messrs. Vickers Limited, Barrow-in-Furness, England; 1916-23, chief dftsman. and asst. to gen. mgr., Messrs. Canadian Vickers, Montreal, in connection with the constrn. of machinery for ships and general engrg. work, and 1923 to date, asst. chief engr. with same firm.

References: E. S. Mattice, J. J. York, I. J. Tait, A. W. K. Massey, A. Hutchison.

STEEVES—DARRELL DARRINGTON, of 4074 Tupper Street, Westmount, Que. Born at St. John, N.B., Feb. 22nd, 1899; Educ., One year Univ. of N.B. Special course for returned men; Diploma, concrete engrg. course, I.C.S.; 1915, survey party, C.N.R., Fredericton, N.B.; 1916-19, overseas, 8th Can. Siege Batty.; 1920, with Lockwood, Greene & Co. of Boston and Montreal; 1922, field work, Harbour Commnrs. of Montreal; 1923 to date, dftsman. with The John S. Metcalfe Co., Montreal, Que.

References: E. G. Horne, G. R. Dalkin, G. J. Dodd, L. C. Hill, C. D. Norton.

TAYLOR—GILBERT FERGUSON, of Ottawa, Ont. Born at Dundee, Scotland, July 1st, 1878; Educ., Tech. School, Dundee; West of Scotland Tech. College, Glasgow; Qualified in bldg. constrn. arch'ture, plane and solid geom., maths. and mechs., Science and Arts Dept., South Kensington, London; 1892-97, articled pupil with Mr. Jas. H. Lamglands, C.E. and Arch't., Dundee; 1897-99, asst. with the late Mr. Jas. Sibbald, C.E. (M.I.C.E.); 1900-02, dftsman., engrg. dept., Glasgow Corporation Street Rlys. (Car Depots. Power Stations); 1903-04, asst. in roadway dept., City Engr's. office, Toronto; 1905-06, surveyor and valuator, Canadian Appraisal Co., Montreal; 1906-08, dftsman. and designer, engrg. dept., Grand Trunk Pacific Rly. Co., Montreal; Part time in charge of bldg. dept.; Designs and specifications, round house, mach. shops, station bldgs.; 1909-12, asst. engr., dept. of bridges and docks, city engr's. office, Toronto; Instr'man. Asst. in design and res. engr. on constrn. (bridges); 1912-14, struct'l. engr., city engr's. office, Victoria, B.C.; Designs and specifications for bridges, bldgs., etc.; In charge of constrn.; 1915-16, struct'l. engr., O'Brien Munitions (Powder Plant), Renfrew, Ont.; 1916-18, engr. on constrn. and asst. to struct'l. engr. with Mr. John A. Pearson (Darling & Pearson), at new Parliament Bldgs., Ottawa; 1919 (6 mos.), struct'l. engr. with Mr. J. A. Ewart, Ottawa; 1919-20, struct'l. engr., Dominion Govt., Public Works Dept. (Chief Architect's Br.); Sept. 1920 to date, struct'l. engr. in charge of design and supervision of bridges, works dept., City Hall, Ottawa. (In charge of constrn. Rideau St. Bridge from 1st Sept. 1920.)

References: C. H. Rust, G. G. Powell, T. Taylor, A. E. Foreman, A. H. Harkness, J. A. Ewart, A. F. Macallum, F. C. Askwith.

FOR TRANSFER FROM CLASS OF ASSOCIATE MEMBER TO MEMBER

GRAY—FRANCIS WILLIAM, of Sydney, N.S. Born at Hoyland Nether, Yorks, England, April 15th, 1877; Educ., 3 year part time coal mining course, Firth College, Sheffield (now Univ. of Sheffield); Pupil of G. Blako Walker, mining engr., Wharncliffe Silkstone Collieries; 1891-98, junior office employment; 1898-1901, pupilage in mining; 1901-1904, chief colliery surveyor; 1904-18, asst. to various gen. mgrs., Dominion Coal Company; 1918-19, asst. to president, Nova Scotia Steel & Coal Company; 1919-21, editor, Canadian Mining Journal and Iron and Steel; 1921-23, asst. to vice-president, and 1923 to date, asst. to the president, British Empire Steel Corporation, Sydney, N.S.

References: G. D. Macdougall, D. H. McDougall, J. T. Farmer, T. J. Brown, C. V. Corless, M. J. Butler, F. L. Wanklyn, J. McEvoy.

SHANLY—COOTE NISBITT, of Kenogami, Que. Born at Montreal, Que., Jan. 29th, 1889; Educ., 2 years, science faculty, McGill Univ.; 1905-08, various subordinate positions with C.P.R., Dominion Bridge Company, Prince Edward Island Ry., etc.; 1909, in charge of plane table party, C.P.R. (Irr. Dept.); 1910, in charge rly. location party, Kananaskis Coal Co.; 1911-12, city engrs.' office, Vancouver, waterworks and roads; 1913-14, design of concrete rly. structures, Can. Nor. Ont. Rly.; 1914-18, overseas, Capt., Royal Engrs., England, France, Salonika; 1919, principal vocational classes, Montreal Retraining Station, D.S.C.R.; 1920 to date, engrg. staff, Price Bros. & Co. Ltd.; 1920, asst. res. engr., Kenogami Paper Mills; res. engr. on constrn. of 16,000 h.p. hydro-electric development at Chute aux Galets; 1921-22, in charge of prelim. studies for mill and town sites; 1923, in charge of constrn. 12,000 h.p. hydro-electric development at Chicoutimi; 1924, in charge of special investigations of hydraulic works.

References: J. M. McCarthy, J. S. Dennis, W. G. Mitchell, F. S. Keith, F. B. Brown, W. S. Lea, A. A. MacDiarmid.

FOR TRANSFER FROM CLASS OF JUNIOR TO HIGHER GRADE

BISHOP—ARTHUR LEONARD, of 50 Ontario Street, St. Catharines, Ont. Born at Brantford, Ont., October 21st, 1895; Educ., Grad. R.M.C. Kingston, 1914; 1908-14 (summers), Coniagas Mines, Cobalt, Coniagas Reduction Co., Thorold, Ont., N.T.C. Rly.; 1915-18, overseas, Capt. Royal Engrs.; Since 1918, President, British American Shipbldg. Co., Welland, Ont., Director, Coniagas Mines, Vice-President, Coniagas Reduction Co., President, Electric Steel & Metals Ltd., Welland, President, Boving Hydraulic Co., Lindsay, President, Mabi Iron Works, New Liskeard, Ont.

References: R. W. Leonard, F. D. Reid, R. L. Peek, R. P. Rogers, H. F. J. Estrup, F. S. Keith, D. A. Mutch, F. B. Brown.

CALKINS—HAROLD A., of Montreal, Que. Born at Camden, N.J., U.S.A., Jan. 27th, 1892; Educ., B.Sc. McGill Univ. 1912; 1910 (summer), G.T.P. Ry., Fort William, Ont.; 1911 (summer), asst. to supt. constrn., J. S. Metcalfe Co., Windmill Point — grain elevators; 1912-16, engr. in charge of surveys and exploration parties for the Ungava Miners & Traders Ltd., Montreal; Organization and conduct of exploration parties east main coast of Ungava and northern Ontario; Dec. 1916, appointed asst. mgr., The Arlington Co. of Canada, Ltd., Toronto; Complete reorganization and systematizing of a celluloid article factory; June 1917 appointed works mgr. 1921 plant transferred to Montreal under direction of applicant, who resigned position in Jan. 1924; At present not employed.

References: R. A. C. Henry, H. M. MacKay, C. M. McKergow, I. R. Tait, J. H. Norris, L. deB. McCrady, D. M. Chadwick.

CREIGHTON—CHARLES SYDNEY, of Newcastle Street, Dartmouth, N.S. Born at Dartmouth, N.S., August 15th, 1890; Educ., B.Sc. in C.E., N.S. Tech. Coll. 1913; Full papers for rank of Lieut. in Royal Can. Engrs.; 1913-14, 6 mos. in shop, 1 year in dfting office, Toronto Structural Steel Co., Toronto; 1915-18, engr. officer in fortress of Halifax; 2 years with Dominion Iron & Steel Co., Sydney, on design, field work and dftsman.; Feb. 1921 to Nov. 1923, civil engr. to the Cape Breton Engineering Works, Ltd., and its successor the Verner Engineering & Manufacturing Works, Ltd.; At present manager of the Creighton Woodworking Co. with plant at Woodside, Dartmouth, N.S.

References: K. H. Marsh, A. P. Theuerkauf, R. J. Fisher, R. W. McColough, J. S. Misener, J. L. Allan.

GRAY—EARL ALEXANDER, of 1 Tecumseh Avenue, London, Ont. Born at Petrolia, Ont., Jan. 24th, 1892; 1907, 1st year Collegiate; Home study; 1907-09, asst. and student with C. A. Jones, C.E., Petrolia; 1910-12, dftsman, with various firms in London and U.S.A.; 1912-15, and 1919-22, asst. engr., Public Utilities Commission, London; 1915-19, overseas; Sept. 1922 to date, engr. in charge, design and special constrn. dept., Public Utilities Commission, London, Ont.

References: E. V. Buchanan, H.A.Brazier, F. W. Farncombe, W. P. Near, R. I. Olmsted, J. R. Rostron, W. M. Veitch, F. M. Brickenden.

McLEAN—HOWARD JOSEPH, of 1628–14th Avenue West, Calgary, Alta. Born at Toronto, April 2nd, 1895; Educ., 1912-13, 1st year engrg., Univ. of Toronto; 1914-18, complete course theory and practice of surveying, I.C.S. ;1917-18, complete course aerodynamics and flying, R.A.F. School; 1916-17, special course in steel analysis, arranged by Imperial Ministry of Munitions, Toronto Tech. School; 1913 (2 mos.), instr'man., Speight & Van Nostrand, Toronto; 1913 (3 mos.), instr'man. and topog'r., with W. Fitzgerald, O.L.S.; 1913-15, instr'man., rly. and bridge section, Dept. of Works, City of Toronto; (1915, acting res. engr.); 1915-17, chief examiner in charge of inspection and tests at contractors' plants, Imperial Ministry Munitions; 1919-20, dist. engr. in charge of field party, hydrometric surveys, irrig. divn., Dept. Interior, Calgary; 1920-21, engr. in charge of current meter rating station, Dom. Water Power Br., Calgary; 1921 to date, field engr. in charge of party and office engr. with Dominion Water Power Branch, Calgary.

References: A. L. Ford, V. M. Meek, P. J. Jennings, P. M. Sauder, O. H. Hoover, C. M. Arnold, J. A. Spreckley.

FOR TRANSFER FROM CLASS OF STUDENT TO HIGHER GRADE

GILBERT—EDGAR VALENTINE, of Drummondville, Que. Born at Liverpool, England, Sept. 3rd, 1896; Educ., B.Sc. (C.E.), McGill Univ. 1923; 1915-19, overseas, Can. Engrs.; 1920-21 (summers), rodman and transitman with Phillips & Benner, of Port Arthur, on O.L. surveys; 1922 (summer), erection of ventilation system, Mount Royal Hotel, Montreal; June 1923 to Feb. 1924, inspr. for Robt. W. Hunt & Co.; At present, dftsman. at Hemming's Falls, for Southern Canada Power Company, Montreal.

References: C. Warnock, T. C. Connell, R. DeL. French, H. M. MacKay, E. Brown, J. H. Trimingham, A. L. Harkness.

IRVIN—WILFRID F., of 421 Beresford Avenue, Toronto, Ont. Born at Brampton, Ont., Nov. 14th, 1896; Educ., B.A.Sc. (Honours), Univ. of Toronto, 1920; 1918 (summer), 3 mos. C.N.R. Arbitration Commission; 3½ mos. dfting., checking, Canadian Aeroplanes Limited; 1920 (4½ mos.), asst. to inspecting engr. on grading, G.T.R. Arbitration Commission; 1920 to date, with Toronto Transportation Commission as follows: Dec. 1920-June 1921, dfting. and estimating in connection with survey of Electric Rly. Transportation in Toronto and district; 3 mos. asst. to estimating engr.; 2½ years to date, asst. engr. on traffic study.

References: N. D. Wilson, T. S. Armstrong, A. E. K. Bunnell, F. B. Geodike, P. Gillespie.

PREVOST—EDOUARD, of 158 Laval Avenue, Montreal, Que. Born at Montreal, July 24th, 1899; Educ., B.S. Ecole Polytech., Univ. of Montreal, 1921; 1918 (summer), rodman and note recorder, geol. party, Sydney, N.S. and Calabogie, Ont.; 1919 (summer), topog'r., Quebec Streams Commission; 1920 (summer), inspr. on foundation work for Belgo-Canadian Paper Co., Shawinigan Falls; 1921-22, with Montreal Water Board on aqueduct enlargement; 1922 (May-July), mapper on a timber cruise for the Wayagamack Pulp & Paper Co. at Flamand, Que.; At present, field engr. for the Atlas Construction Co., and dftsman. for Messrs. Beaubien, Busfield & Co., Montreal.

References: deG. Beaubien, J. L. Busfield, O. O. Lefebvre, A. S. Dawes, C. J. Desbaillets, G. Claxton.

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A

ACCELEROMETERS

Automobile Acceleration, Measurement. New Quantitative Method of Measuring the Riding Comfort of Automobiles, F. H. Norton. Soc. Automotive Engrs.—Jl., vol. 14, no. 2, Feb. 1924, pp. 136-138, 3 figs. Discusses accelerations acting on passenger, and design of accelerometer; accuracy of readings; factors to be considered in further study.

ACCIDENTS

Industrial. Industrial Accidents and Hygiene. Monthly Labor Rev., vol. 18, no. 1, Jan. 1924, pp. 142-156. Conference on industrial accident rates called by U. S. Dept. of Labor; record of industrial accidents in United States for 1922; coke-oven accidents during 1922; accidents on steam railroads; decline in tuberculosis death rate; health conditions among chemical workers with respect to earnings.

AERONAUTICS

Developments. Some Recent Developments in Aircraft Instruments, H. E. Wimperis. Roy. Aeronautical Soc.—Jl., vol. 28, no. 157, Jan. 1924, pp. 3-29 and (discussion) 29-34, 15 figs. Discusses instruments for D. R. navigation and astronomical navigation, method of reducing sextant observations, determination of height, magnetic compass, etc.

AIR COMPRESSORS

High-Speed. High-Speed Air Compressors, J. M. Walshe. Iron & Coal Trades Rev., vol. 108, no. 2916, Jan. 18, 1924, pp. 98-99. Automatic control of air output; air-cylinder lubrication; explosions in air receivers and pipes; air pipework; air receivers; turbo-compressors. Paper read before Birmingham Assn. Mech. Engrs.

AIRCRAFT

British Industry. Problems of Aircraft Production in Great Britain. Aviation, vol. 16, no. 6, Feb. 11. 1924, pp. 151-153. How Great Britain fosters her aircraft industry.

Metal Construction. The Metal Construction of Aircraft. Aeroplane, vol. 26, no. 4, Jan. 23, 1924, pp. 76 and 78 (includes discussion). Abstract of two papers on Materials in Aircraft Construction read by J. D. North and L. Aitchison before Roy. Aeronautical Soc., together forming a whole, illustrating advantages to be derived from improved materials of construction and also some of the difficulties and dangers which are to be encountered in pioneer work in this direction. See also Flight, vol. 16, no. 4, Jan. 24, 1924, pp. 48-52, 6 figs., giving a more detailed account of L. Aitchison's paper, dealing with physical qualities of metals and alloys, particularly from point of view of reliability of such materials as conditioned by margin between ideal or specification strength and real strength which is achieved in practice.

AIRPLANE ENGINES

Air-Cooled, Cylinder Gages for. Two Gages for Aero-Engine Cylinders, W. H. Thompson. Am. Mach., vol. 60, no. 8, Feb. 21, 1924, pp. 297-298, 3 figs. Describes combination gages for inspecting various dimensions on air-cooled cylinders.

Light. A New Engine for Light Planes, G. D. Angle. Aviation, vol. 16, no. 6, Feb. 11, 1924, pp. 146-147. Engine built by Steel Products Eng. Co., Springfield, O., is air-cooled 2-cylinder opposed type operating on 4-cycle principle; develops 12 to 20 hp. and weighs only 50 lb.

AIRPLANES

Balancing of Moments. Practical Method for Balancing Airplane Moments, H. Hamburger. Nat. Advisory Committee for Aeronautics—Tech. Notes, no. 179, Feb. 1924, 34 pp., 8 figs. Shows how methods described in previous paper (Technische Berichte, vol. 2, no. 3, p. 463) can be practically utilized in computations; it is shown what conclusions can be drawn from diagram of moments in regard to defects in airplanes under investigation and what steps may be taken to remedy them.

Curvilinear Flight of. Curvilinear Flight of Airplanes, E. Salkowski. Nat. Advisory Committee for Aeronautics, Technical Notes, No. 176, Jan. 1924, 21 pp., 6 figs. on supp. pages. Results of investigation by Hoff, Hoff and writer. Describes method of calculation without any assumption in regard to variation of engine power with altitude and only with assumption that this relation is, in fact, empirically known from measurements taken in altitude tests. Translated from Technische Berichte, vol. 3, no. 7, pp. 267-274.

Wings. Proposal for Standardization of the Method of Computing Wing Sections, A. Gv. Paumhauer. Int. Aeronautics, vol. 1, no. 5, Dec. 1923-Jan. 1924, pp. 274-276 and 292, 2 figs. Report of Ryks-Studiedienst Voor de Luchtvaart, Amsterdam, Holland.

Note on the Relative Effect of the Dihedral and the Sweep Back of Airplane Wings, M. M. Munk. Nat. Advisory Committee for Aeronautics—Tech. Notes, no. 177, Jan. 1924, 4 pp. It appears from investigation that effect of sweep back is always smaller than that of dihedral.

AIRSHIPS

Fuel Consumption. The Compensation in Weight of Fuel Consumption of Airships, G. A. Crocco. Int. Aeronautics, vol. 1, no. 5, Dec. 1923-Jan. 1924, pp. 277-278. Condensation of combustion water.

Hydrogen vs. Helium for. Urges Hydrogen for Polar Flight. Aviation, vol. 16, no. 4, Jan. 28, 1924, pp. 95-96. Ralph Upson, in interview granted Detroit News, warns against inflation with non-inflammable helium and points out advantages of hydrogen over helium for polar flight of Shenandoah.

ALLOYS

Aluminum. *See Aluminum Alloys.*

Non-Ferrous, Contraction. Contraction and Shrinkage of Non-Ferrous Alloys, Rob. J. Anderson. Tech. Eng. News, vol. 4, no. 7, Jan. 1924, pp. 258, 294, 296 and 298. Notes on liquid, solidification and solid shrinkage; linear contraction; factors affecting contraction of alloy on casting.

ALUMINUM ALLOYS

Airplane Structural Work. Data on Aluminum Alloys for Airplane Structural Work, Fr. H. Colvin. Am. Mach., vol. 60, no. 7, Feb. 14, 1924, pp. 235-238, 9 figs. Standardizing channels, struts and other parts for construction of all-metal planes, even in small quantities; sizes and strength of rivets; distribution of weight.

Casting-Temperature Effects. The Influence of Casting Temperature of Aluminum Alloys, F. H. Hurren. Foundry Trade Jl., vol. 29, no. 388, Jan. 24, 1924, pp. 75-79. Results of experiments. Paper read at joint meeting of Instn. British Foundrymen and Inst. Metals.

Sand-Cast. Notes on a Sand-Cast Aluminum-Copper-Nickel-Magnesium Alloy, A. J. Lyon and S. Daniels. Soc. Automotive Engrs.—Jl., vol. 14, no. 2, Feb. 1924, pp. 173-181, 12 figs. Describes foundry practice and tabulates physical properties of sand-cast aluminum-base alloy containing 4 per cent of copper, 2 per cent of nickel and 1.5 per cent of magnesium; outlines methods of heat-treating this alloy to obtain maximum hardness and tensile properties; physical testing results were obtained in connection with manufacture of pistons and air cooled cylinder heads for aircraft engines.

APPRENTICES, TRAINING OF

System. A Modernized Apprentice System. Machy. (N. Y.), vol. 30, no. 6, Feb. 1924, pp. 415-418, 6 figs. How apprentices are trained by Warner & Swasey Co., in shop and classroom work.

ARCHES

Skew. Analysis of the Stresses in the Ring of a Concrete Skew Arch, J. Chas. Rathbun. Am. Soc. Civ. Engrs.—Proc., vol. 50, no. 2, Feb. 1924, pp. 133-174, 10 figs. Mathematical analysis of stresses in arch with fixed ends, with examples of application of formulas derived.

ATOMS

Kinetic. The Kinetic Atom, Oliver Lodge. Nature, vol. 113, no. 2827, Jan. 5, 1924, pp. 15-17, 3 figs. Evidence for nuclear atom; varieties of possible orbits; effect of ellipticity on spectrum.

Structure. Some Contemporary Advances in Physics, K. K. Darrow. Bell System Tech. Jl., vol. 3, no. 1, Jan. 1924, pp. 158-178, 13 figs. Deals principally with atomic structure.

AUTOMOBILE ENGINES

Air Cleaners. Motor Vehicle Makers Give Increased Attention to Air Cleaners, W. L. Carver. Automotive Industries, vol. 50, no. 4, Jan. 24, 1924, pp. 180-183, 7 figs. Five passenger cars at New York show carried these units as standard equipment; claimed to eliminate various troubles by preventing dust from entering engine with carburetor air; four different types for car, truck, and bus use.

Crankcase Drainage Facilities. Crankcase Drainage Facility and Oil-Sump Capacity, T. A. Waerner, Soc. Automotive Engrs.—Jl., vol. 14, no. 2, Feb. 1924, pp. 260-262. Discusses means of reducing percentages of fuel dilution as follows: (1) greater accessibility for draining engine-lubricating oil; (2) greater accessibility for cleaning vital parts before re-assembling, after draining used lubricating oil; and (3) more adequate consideration of crankage oil-sump design.

Lubrication. Some Experiments in the Lubrication of Commercial-Vehicle Engines, H. D. Nickinson. Automobile Engr., vol. 14, no. 185, Jan. 1924, pp. 24-29, 12 figs. Record of commercial tests, carried out in order to ascertain if there is any difference in results obtained when using different brands of lubricating oils for internal-combustion engines, and to see if, for commercial work, it is good policy to buy expensive oil, or otherwise.

Manifold Design. Fundamental Improvements in Manifold Design, A. M. Dean, J. W. Swan and C. A. Kirkham. Soc. Automotive Engrs.—Jl., vol. 14, no. 2, Feb. 1924, pp. 139-147, 13 figs. Points out shortcomings of present manifolds and describes principle of Swan manifold, based on equal distribution of wet fuel mixtures in exactly same ratio as that delivered to manifold by carburetor; advantages claimed for manifold of this type.

RADIATORS. Constructing Automobile Radiators, Chas. O. Herb. Machy. (N. Y.), vol. 30, no. 6, Feb. 1924, pp. 454-459, 13 figs. Building up tubular radiator cores of flat-fin type from brass stampings and tubes.

SPECIFICATIONS. American Stock Engine Specification. Motor Transport (N. Y.), vol. 29, no. 12, Jan. 15, 1924, p. 415. Specifications of the different makes for buses, trucks, tractors, passenger cars, and rail passenger cars.

V-TYPE FOUR-CYLINDER. V-Type Four Cylinder Engine Permits Compact Design, P. M. Heldt. Automotive Industries, vol. 50, no. 7, Feb. 14, 1924, pp. 337-339, 6 figs. Difficult problems involved in balance; cylinders may be placed opposite to one another or staggered; two cranksbaft arrangements are possible witb latter construction; size of angle determines irregularity in sequence of explosions.

AUTOMOBILE FUELS

WINTER TESTS. Winter Tests Show Greater Dilution with Heavy Fuels, J. A. C. Warner. Soc. Automotive Engrs.—Jl., vol. 14, no. 2, Feb. 1924, pp. 151-161, 10 figs. Report on results of winter tests by Bur. of Standards; discusses results of analyses of fresh crankcase oils and dilution results before making comparison between those obtained under summer and under winter conditions; notes on dilution vs. mileage; distillation of composite oil samples; comments upon crankcase-oil consumption.

AUTOMOBILE INDUSTRY

STANDARDIZATION. Standards Committee Meeting, Soc. Automotive Engrs.—Jl., vol. 14, no. 2, Feb. 1924, pp. 189-194. Report of Electrical Equipment Division on magnet-wire specifications; and of Tire and Rim Division on balloon tires.

AUTOMOBILES

AXLES. American Rear and Front Axle Specifications. Motor Transport (N. Y.), vol. 29, no. 12, Jan. 15, 1924, pp. 422-423. Specifications of different makes for passenger cars, buses and trucks.

BODIES. Why Not Build All-Purpose Bodies with Rear Doors? H. W. Perry. Automotive Industries, vol. 50, no. 3, Jan. 17, 1924, pp. 126-127. Suggests design for style of body that is obviously first a private passenger car body, but tbat is adapted for secondary purpose of carrying light loads of miscellaneous articles; side entrance for passengers would be retained and back seat cushions arranged to be folded quickly against rear of front seat.

BRAKES. Four-Wheel Brakes, H. Perrot. Soc. Automotive Engrs.—Jl., vol. 14, no. 2, Feb. 1924, pp. 101-106, 4 figs. Discusses servo-brake with special reference to Perrot system; advantages of which are set forth specifically; discusses brake-system design in general and comments on brake lining, front springs and various precautionary measures that must be incorporated; explains non-use of equalizers and cites seven specific important items that should govern all four-wheel-brake design; future development of automobile chassis, as affected by present trend of brake-system practice.

The Theory and Advantages of Balanced Brake Forces, Geo. L. Smith. Soc. Automotive Engrs.—Jl., vol. 14, no. 2, Feb. 1924, pp. 111-116, 4 figs. Describes two methods of brake application in use in United States, and expounds theory of balanced brake forces; practical applications of equalizing mechanism used in road tests of automobile; tests on wet pavements with study of skidding and skid-checking effects; results of tests on hills and effects of speed and pressure.

Two Types of Brakes for Front Axles Produced by Salisbury. Automotive Industries, vol. 50, no. 7, Feb. 14, 1924, pp. 344-345, 3 figs. Expanding device intended for cars weighing up to 2400 lb. and contracting for somewbat heavier models; unusual feature is use of Elliott-type steering knuckles.

DIFFERENTIALS. New Type Differential Prevents Traction Loss on Slippery Ground. Automotive Industries, vol. 50, no. 6, Feb. 7, 1923, p. 289, 2 figs. Permits driving wbeels to rotate at unequal speeds wbenever required; marketed under name of Bement drive.

ELECTRIC EQUIPMENT. Problems of Motor-Vehicle Electrical Equipment Maintenance, P. J. Durbam. Soc. Automotive Engrs.—Jl., vol. 14, no. 2, Feb. 1924, pp. 162-164. Facts regarding present obstacles to proper maintenance of automotive electrical equipment; among difficulties presented are: diagnosis, headlamps, accessibility, terminal connections, fuses, wiring color code, storage battery, starting motor and generator.

FUEL CONSUMPTION. Factors in Fuel Economy. Autocar, vol. 52, no. 1472, Jan. 4, 1924, pp. 17-23, 13 figs. Describes some factors tbat bave a distinct influence on good or bad fuel consumption; results of tests carried out on Brooklands track. (Eng.)

TORQUE, CARING FOR. Taking tbe Torque. Auto-Motor. Jl., vol. 29, no. 3, Jan. 17, 1923, pp. 55-57, 10 figs. Some examples of design in connection witb taking of torque reaction in motor power transmission.

WHEEL SLIP TESTING. Testing Wbeel Slip. Auto-car, vol. 52, no. 1474, Jan. 18, 1924, pp. 96-98, 3 figs. Results of trials with special instrument evolved to register action of differential.

WOOD FOR BODIES. Wood for Automobile Bodies, A. T. Upson and L. N. Ericksen. Soc. Automotive Engrs.—Jl., vol. 14, no. 2, Feb. 1924, pp. 165-170, 3 figs. Results of survey made by U. S. Forest Products laboratory of species, kinds, grades, sizes and amounts used by automotive industry; woods used for running boards and top bows; grades of lumber used; present status of body-part standardization; quality of stock required; utilization of lumber in body parts; suitability of woods for bodies.

AVIATION

COMMERCIAL. The Practical Difficulties of Commercial Flying, E. T. Courtney. Roy. Aeronautical Soc.—Jl., vol. 28, no. 157, Jan. 1924, pp. 35-41. Considers conditions under which modern commercial airplane flies; difficulties of flying on airplane through bad weatber; concludes that commercial flying, before it can be a success, must operate in any weatber in wbich other forms of transport can operate.

LONG-DISTANCE NAVIGATION. Recent Developments in the Navigation of the Air, H. B. Goodwin. U. S. Nav. Inst.—Proc., vol. 50, no. 251, Jan. 1924, pp. 68-76. Abstract of memoir of voyage by airplane accomplished by two Portuguese naval officers in spring of 1922; consideration of effect of "drift;" astronomical navigation; alternative metbod for zenith distance in Tropics.

B

BALANCING

LARGE ROTATING APPARATUS. Balancing Large Rotating Apparatus I. C. Fletcher. Elec. Jl., vol. 21, no. 1, Jan. 1924, pp. 5-10, 5 figs. Describes modern design of balancing machine and metbod of balancing.

BEAMS

CALCULATION. The Calculation of Beams Fixed at Both Ends with Special Regard to Longitudinal Strength (Zur Berechnung des beiderseits eingemauerten Trägers unter besonderer Berücksichtigung der Längskraft), F. Takabeya. Kyushu Imperial University College of Eng.—Memoirs, vol. 2, no. 7, 1922, pp. 277-326, 28 figs. and supp. tables. Development of general equations.

BEARINGS

BABBITTED. Pointers in tbe Casting of Babbitt Bearings, J. V. Romig. Can. Machy., vol. 31, no. 1, Jan. 3, 1924, p. 34, 4 figs. Metal must be well stirred and hot enough to ignite a dry pine sliver; white lead or smoke on shaft provides necessary clearance. See also Can. Foundryman, vol. 15, no. 1, Jan. 1923, p. 19, 4 figs.

BEARINGS, BALL

AUTOMOBILE, MANUFACTURE OF. Making Ball Bearings for Automobiles, H. R. Simonds. Iron Trade Rev., vol. 74, no. 5, Jan. 31, 1924, pp. 345-349, 9 figs. Describes manufacture of radial bearings at Chicago plant of U. S. Ball Bearing Mfg. Co.

BEARINGS, ROLLER

RAILWAY MOTOR CARS. New Tests with Roller Bearings on Railway Motor Cars (Neue Versuche mit Rolleniagern an Oeltriebwagen), W. Bethge. Motorwagen, vol. 27, no. 1, Jan. 10, 1924, pp. 6-7, 1 fig. Advantages and economy of roller bearings compared with journal bearings.

BLAST-FURNACE GAS

CLEANING. Dry Cleaning Blast Furnace Gas by Filtration Through Flue Dust, Geo. B. Cramp. Blast Furnace & Steel Plant, vol. 12, no. 2, Feb. 1924, pp. 101-103, 2 figs. Careful tests and investigation of conditions at each individual blast furnace necessary in determining area of dry cleaner.

DUST REMOVAL. Removing Dust from Blast Furnace Gases, N. H. Gellert. Iron Age, vol. 113, no. 6, Feb. 7, 1924, pp. 422-425, 1 fig. Electrolytic process installed by Colorado Fuel & Iron Co.; corona discharge produces ionized field which precipitates dust. (Abstract.) Paper read before Pueblo Soc. Engrs.

BLAST FURNACES

HOT-BLAST STOVES. Theory and Calculation of Hot-Blast Stoves (Zur Theorie und Berechnung der Winderbitzer). H. Grober. Stahl u. Eisen, vol. 44, no. 2, Jan. 10, 1924, pp. 33-39, 9 figs. Discusses physical laws according to which heat circulates in stove, and describes method by which a scientifically perfect theory and calculation can be developed; results of this work are also applicable to regenerators of open-hearth furnaces and similar industrial furnaces.

STOVES FOR, HEATING OF. Recent Experiences with Accelerated Heating of Blast-Furnace Stoves, A. Wefelscbeid. Fuels & Furnaces, vol. 2, no. 1, Jan. 1924, pp. 83-84, 2 figs. (Abstract.) Translated from Stahl u. Eisen, vol. 43, p. 1339, 1923.

BOILER FEEDWATER

AIR SEPARATOR. The Hickman Air Separator. West Machy World, vol. 15, no. 1, Jan. 1924, p. 42, 1 fig. Describes simple mecbanical device which extracts air bubbles from feedwater just after water has passed tbrough feedwater heater, practically eliminating interior corrosion.

FEED REGULATION. Boiler Feed-Water Regulation. Southern Engr., vol. 40, no. 5, Jan. 1924, pp. 44-51, 16 figs. Describes several designs of regulators.

HEATING. The Heating of Boiler Feedwater by Means of Steam Extracted from the Turbine (Réchauffage de l'eau d'alimentation de la chaudière au moyen de vapeur extraite de la turbine), A. Schlag. Revue Universelle des Mines, vol. 67, no. 1, Jan. 1, 1924, pp. 7-18, 6 figs. Calculation of actual saving of heat effected by this method.

TREATMENT. Boiler Corrosion and the Treatment of Boiler Feed Water, A. Winstanley. Colliery Guardian, vol. 127, nos. 3289 and 3290, Jan. 11 and 18, 1924, pp. 90-91 and 158. Pitting; lime soda process for pitting; general thinning; grooving, and other mechanical damage; treatment of boiler feedwater. From paper read before Past and Present Min. Students' Assn.

Feed Water for Efficient Boiler Operation, M. F. Newman. Combustion, vol. 10, no. 1, Jan. 1924, pp. 39-40. A principle of treating boiler feedwater to reduce to a minimum difficulties arising from impurities in water.

BOILER FIRING

EXCESS-AIR CALCULATION. Calculation of Excess Air, P. Verbeck. Combustion, vol. 10, no. 1, Jan. 1924, p. 61. Method of calculating excess air in boiler installations. Translated from Chemiker Zeitung, Aug. 9, 1923, pp. 681-682.

OIL. Burning Oil and Gas. Under Steam Boilers. Southern Engr., vol. 40, no. 5, Jan. 1924, pp. 12-28, 37 figs. Coal versus fuel oil; oil-burning systems; types of burners and their application to boiler furnaces; operating data.

BOILER FURNACES

AIR PREHEATING. Boiler-Test Results with Pre-heated Air, C. W. E. Clarke. Mech. Eng., vol. 46, no. 2, Feb. 1924, pp. 64-72, 10 figs. Data on elaborate tests recently carried out on units of Colfax station of Duquesne Light Co., showing that efficiency of unit is increased from 5 to 7 per cent by use of preheater. (Abstract.)

ANTHRACITE-DUST-BURNING. New Furnace Solves Problem of Burning Anthracite Dust. C. H. S. Tupholme. Coal Age, vol. 25, no. 5, Jan. 31, 1924, pp. 175-176, 4 figs. Difficulty in ignition and tendency to clog air passages overcome; piles at Welsh pits hitherto considered only waste now valuable.

GRATES. Stationary, Shaking, Dumping Grates and Hand Stokers. Southern Engr., vol. 40, no. 5, Jan. 1924, pp. 64-74, 24 figs. Points to be remembered when selecting a grate; adaptability of various designs, how they are handled and tbeir application to boiler furnaces.

LININGS. Boiler Furnace Economies, W. H. Gaylord, Jr. Ariz. Min. Jl., vol. 7, no. 16, Jan. 15, 1924, pp. 30-32, 5 figs. How old linings are used for repairs and reconstruction.

Plastic Material for Lining Boiler Furnace. Southern Engr., vol. 40, no. 5, Jan. 1924, pp. 9-11, 6 figs. Application of plastic materials for complete lining of new furnaces, facing of bridgewall and arches in Dutcboven furnaces, making or lining of fire-door arches and rear arch for return tubular boilers, and baffles for all forms of water-tube boilers, as well as repairing of these parts.

BOILER OPERATION

EFFICIENCY IN. Boiler-House Efficiency, Jas. T. Board, 2nd. Power, vol. 59, no. 5, Jan. 29, 1924, pp. 108-170. Points out tbat higb CO_2 is only one element of bigh overall efficiency; consideration must also be given to loss of fuel through grate, incomplete combustion and poor heat absorption due to soot, scale and leaky baffles.

Increases in Boiler Efficiency, V. Z. Caracristi. Combustion, vol. 10, no. 1, Jan. 1924, pp. 32-36, 3 figs. How they should be considered in relation to other factors to obtain lowest cost per unit of boiler output; relationship of various factors can be determined by means of three carefully prepared charts (as tbose illustrated).

BOILER PLATE

ALLOY STEELS FOR. Boiler Plate. (Die Kesselbaustoffe), P. Gœrens. Zeit. des Vereines deutscher Ingenieure, vol. 68, no. 3, Jan. 19, 1924, pp. 41-47, 11 figs. Deals with properties of unalloyed low-carbon steel and alloyed boiler plate at different temperatures, and influences of aging and recrystallization on these, which demonstrate advisability of using materials of bigher limit of elongation, such as alloy steels; points out that boiler drums of maximum size and wall tbickness can now be made of plain and alloy steels.

BOILERS

Gas Fired. Gas-Fired Boilers, J. D. Troup. Combustion, vol. 10, no. 2, Feb. 1924, pp. 110-113, 4 figs. Discussion of increasing importance of gaseous fuel as a possible or probable development of future, and of experience obtained and equipment available in use of gas for generating steam.

Heat-Balance Calculation. Discussion of the Heat Balance in Boiler Tests, A. Linguet. Paper Trade Jl., vol. 78, no. 5, Jan. 31, 1924, pp. 49-53. Discusses value of heat-balance calculations in making boiler tests. Translated from Chimie et Industrie, vol. 10, no. 5, Nov. 1923.

Hydrostatic Tests. Hydrostatic Pressure Tests on Boilers, W. H. Fittus. Power Plant Eng., vol. 28, no. 4, Feb. 15. 1924, pp. 219-220. Points out that many defect are not revealed by hydrostatic test; inspector must depend on visual examinations and hammer test.

Inspection. Proposed Rules for the Inspection of Material and Boilers. Mech. Eng., vol. 46, no. 2. Feb. 1924, pp. 100-103, 1 fig. Preliminary report of sub-committee of A.S.M.E. boiler code committee on rules for inspection of material and boilers.

Mercury-Vapor. The Emmet Mercury Vapour Plant. Engineer, vol. 137, no. 3551, Jan. 18, 1924, pp. 65-68, 4 figs. General arrangements and details of plant installed at Hartford Elec. Light Co.'s station at Hartford, Conn.

The Mercury-Vapor Boiler and Turbine. Mech. Eng., vol. 46, no. 2, Feb. 1924, pp. 91-93, 3 figs. Describes plant installed at Hartford and basic idea of plant; properties of mercury vapor which make it advantageous for use in binary-vapor system; difficulties with use of mercury; recent discussion on mercury-vapor system.

Waste-Heat. Practical Experiences with Waste-Heat Boilers Back of Open-Hearth Furnaces (Betriebserfahrungen mit Abhitzekesseln hinter Siemens Martin-Oefen), W. Schuster., Stahl u. Eisen, vol. 44, no. 3, Jan. 17, 1924, pp. 65-71, 4 figs. Describes four different types of boiler for waste-heat utilization in open-hearth furnaces, and gives operating results of three types; problem of superheater and preheater; prospects.

Waste-Heat Boilers, C. H. Bamber. Gas World, vol. 80, no. 2059, Jan. 5, 1924, pp. 19-20. Waste-heat versus solid fuel and convection versus radiation; waste-heat boiler design; water-tube boiler for waste heat; fire-tube boiler. Paper read before Manchester and District Jr. Gas Assn.

Water Circulation in. Chasing Bubbles in a Boiler. Power, vol. 59, no. 8, Feb. 19, 1924, pp. 288-289, 6 figs. Outline of where steam forms in Boiler and path of water circulation; describes glass model boiler used in study.

BOILERS, WATER-TUBE

British Developments. British Developments in Water Tube Boilers, F. Johnstone-Taylor. Power Plant Eng., vol. 28, no. 3, Feb. 1, 1924, pp. 173-174, 3 figs. New designs provide for independent circulation of water in tubes nearest fuel bed.

BRIDGES, CONCRETE

Arch. Building a Concrete Arch Around an Old Iron Bridge. E. H. Harder. Eng. News-Rec., vol. 92, no. 8, Feb. 21, 1924, pp. 320-323, 7 figs. Lower chord used for rib reinforcement and upper chord for concrete floor forms; trestel approach as continuous structure with considerable saving.

Toronto, Canada. Governor's Bridge in the Township of York, Ont., is Unique in Many Respects. Contract Rec. & Eng. Rev., vol. 37, no. 6, Feb. 6, 1924, pp. 121-127, 12 figs. Details of reinforced-concrete bridge 672 ft. overall length with main arch of 200 ft. span, across Belt Line Ravine, Toronto; by reason of flat arches, thin walled piers and abutments and electrically-welded reinforcing, it was built for only $100,000.

BRIDGES, SUSPENSION

Examination. An Account of an Examination of the Menai Suspension Bridge, H. T. Tudsberr and A. R. Gibbs. Engineering, vol. 117, no. 3027, Jan. 4, 1924, pp. 23-24. Examination of bridge built in 1820-26, which is still only road connection between Anglesey and mainland. (Abstract.) Paper read before Instn. Civ. Engrs.

BUILDING CONSTRUCTION

Pressed Steel in. Pressed Steel Construction for Fire Safety, A. I. Curtis. Eng. World, vol. 24, no. 1, Jan. 1924, pp. 10-12, 8 figs. Discusses reasons and claims for fireproof value of metal-lumber construction.

BUILDINGS

Failures. Reinforced-Concrete Hotel Under Construction Fails by Progressive Collapse, T. L. Condron. Eng. News-Rec., vol. 92, no. 6, Feb. 7, 1924, pp. 239-242, 6 figs. 8-story Benton Harbor structure completely wrecked by slow failure continuing 30 hours after removal of fifth-floor shores; cause not determined but materials and cold weather suspected.

C

CABLES, ELECTRIC

Telephone. The Work of Installation of the Underground Telephone Cable—Milan—Turin—Genoa, G. Magagnini. Elec. Communication, vol. 2, no. 3, Jan. 1924, pp. 192-200, 9 figs. Cable is placed in vitrified clay duct in its passage through cities and through inhabited centers in general, in special iron tubing over numerous bridges and through other constructions met with along route and in terra-cotta troughing in ordinary road routes.

CAR HEATING

Thermostat Equipment. Getting Best Results with Heater Control Equipment, L. P. Hynes. Elec. Ry. Jl., vol. 63, no. 3, Jan. 19, 1924, pp. 97-100, 4 figs. How to install, inspect, test and maintain mercury thermostat equipment in order to get best operating results and minimize maintenance expense; methods recommended as best by one manufacturer as result of experience on many properties.

CARS, FREIGHT

Inspection and Maintenance. Inspection and Maintenance of Freight Cars, E. Erickson. Ry. Mech. Engr., vol. 98, no. 2, Feb. 1924, pp. 98-100, 2 figs. Inspection of cars on arrival at receiving yard; cars coming from connections; inspection and repair in classification yards; inspection at miscellaneous loading points; inspection and repair on repair or shop tracks.

Types Built in 1923. Freight Cars. Ry. Rev., vol. 74, no. 1, Jan. 5, 1924, pp. 19-44, 65 figs. Representative examples of double-sheathed box, single-sheathed box, single-sheathed automobile and furniture, refrigerator, gondola, hopper, flat, steel tank, and caboose cars, and of miscellaneous freight-car equipment, built in 1923, giving principal dimensions and data, builder, and railroad built for.

CARS, PASSENGER

Long Island Ry. Features of New Long Island Cars. Elec. Ry. Jl., vol. 63, no. 5, Feb. 2, 1924, pp. 167-170, 7 figs. Framing designed to resist collapse in collision and facilitate repairs when damaged; two motors per car arranged for tap field control; length 64 ft. 5¾ in., width overall 9 ft. 10 7-16 in., seating capacity 78.

Types Built in 1923. Representative Examples of Passenger Train Cars Built in 1923. Ry. Rev., vol. 74, no. 1, Jan. 5, 1924, pp. 45-49, 17 figs. Illustrations of baggage, baggage-mail, passenger-baggage, passenger, and express refrigerator cars, with data giving principal dimensions, weight, builder, and railroad built for; illustrations of latest Pullman sleeping car equipment.

CARBON DIOXIDE

Electrometric Determination. Investigations in Photosynthesis, H. A. Spoehr and J. M. McGee. Indus. & Eng. Chem., vol. 16, no. 2, Feb. 1924, pp. 128-130, 1 fig. Electrometric method of determining large quantities of carbon dioxide in air stream.

CASE-HARDENING

Copper Coating in. Role of Copper in Case Carburizing, O. A. Knight and E. A. Thomas. Forging—Stamping—Heat Treating, vol. 10, no. 1, Jan. 1924, pp. 17-19, 1 fig. Experimental investigation indicates that action of copper in preventing carburization at operating temperatures is physical rather than catalytic.

CAST IRON

Contraction and Piping. Relation between Contraction and Piping in Cast Iron and the Composition of the Charge, O. Bauer and K. Sipp. Metal Industry (Lond.), vol. 24, no. 4, Jan. 24, 1924, pp. 85-86, 7 figs. Experiments to ascertain relation between contraction and piping in cast iron, and composition of charge, carried out at request of technical committee of German Foundry Assn. Translated from Stahl u. Eisen.

Electric-Furnace Manufacture. Electric Furnace Iron Cheap, L. J. Barton. Foundry, vol. 52, no. 2, Jan. 15, 1924, pp. 71-72. Saving effected by use of an all-scrap charge renders electric melting costs lower than for cupola in localities where coke prices are extremely high. Paper read at Am. Foundrymen's Assn. convention.

Nickel Additions. Cast Iron Alloyed with Nickel, P. D. Merica. Foundry, vol. 52, no. 4, Feb. 15, 1924, pp. 131-133. Studies of results obtained by additions of nickel in varying percentage; hardness increased and grain structure made more dense. See also Iron Trade Rev., vol. 74, no. 8, Feb. 21, 1924, pp. 555-556.

CASTING

Feeders and Densers in. Relative Values of Feeders or Densers in Grey Iron and Malleable Iron, E. Longden. Foundry Trade Jl., vol. 29, no. 386, Jan. 10, 1924, pp. 29-33 and discussion (Jan. 17, 1924) pp. 48-49, 46 figs. Results of experiments; comparison of merits of feeders and densers, and comparison between white and grey iron treated in same way and poured into same form of mold; evidence showing effect of gases in producing unsoundness principally in grey iron.

CASTINGS

Structural Weaknesses, Elimination of. The Elimination of Structural Weaknesses in Castings, O. Smalley. Foundry Trade Jl., vol. 29, no. 385, Jan. 3, 1924, pp. 5-11, 15 figs. Deals with structural weaknesses in relation to nature of crystallization of alloy on solidification and design of casting.

Transformer-Box Production. Making Transformer Castings, P. Dwyer. Foundry, vol. 52, no. 3, Feb. 1, 1924, pp. 81-85, 10 figs. Describes methods and equipment employed in Pittsfield (Mass.) foundry of Gen. Elec. Co. in making transformer boxes.

CEMENT

Storage Warehouses. Square and Triangular Cement Storage Warehouses. Eng. News-Rec., vol. 92, no. 5, Jan. 31, 1924, p. 185, 1 fig. Floor in one placed on cinder fill saves $45,000; in other moisture condensation limited by minimum openings.

CENTRAL STATIONS

Bridgeport, Conn. Steel Point Station at Bridgeport, W. F. Thompson. Power, vol. 59, no. 7, Feb. 12, 1924, pp. 238-244, 5 figs. Simplicity and accessibility are outstanding features of new plant of United Illuminating Co.

Diesel Engines for Standby Service. Diesel Engines for Standby Service in Steam and Hydro Plants, E. B. Pollister. Elec. Light & Power, vol. 2, no. 2, Feb. 1924, pp. 24-26 and 68, 9 figs. Ideal characteristics of a standby and auxiliary prime mover; data on recent installations.

Interconnection. A New England Interconnection, R. J. Andrus. Elec. World, vol. 83, no. 3, Jan. 19, 1924, pp. 127-130, 7 figs. Principal features of study undertaken in connection with decision of Twin State Gas & Elec. Co. to interconnect St. Johnsbury (Vt.) division with Berlin (N. H.) division by a transmission line 52 m. long to provide additional capacity; saved building a steam-plant addition.

Super-Power Plants and Systems. Southern Engr., vol. 40, no. 5, Jan. 1924, pp. 1-8, 19 figs. Whereby economies in distribution of electrical energy may be obtained through interconnection of electrical systems.

Load Dispatching. Load Dispatching—Directing the Operation of Large Central Station Systems, P. B. Juhnke. Elec. Light & Power, vol. 2, no. 2, Feb. 1924, pp. 13-17, 68-71 and 78, 3 figs. Relation of load dispatcher with generating stations; with transmission system; with substations and with distribution system; carrying capacity of cables; load dispatcher's diagram.

Problems. A Solution of Three Serious Central Station Problems, W. A. Layman. Rose Technic, vol. 33, no. 4, Jan. 1924, pp. 3-6 and 24-25, 3 figs. Discusses idle investment, excess system losses, and poor regulation.

CHAIN DRIVE

Roller Centers, Path of. The Path of Roller Centers in Chains, G. M. Bartlett. Machy. (Lond.), vol. 23, no. 592, Jan. 31, 1924, pp. 575-577, 5 figs. Results of paths followed by centers of chain pins when approaching and departing from sprockets both at high and low speeds.

CHIMNEYS

Reinforced-Concrete. Concrete Chimney to Serve Two Breechings, C. W. Geiger. Power Plant Eng., vol., 28, no. 4, Feb. 15, 1924, pp. 240-242, 1 fig. Brick division wall at breeching openings carried on reinforced-concrete beam placed just below these openings.

Steel. Steel Chimneys. F. Johnstone-Taylor. Power Engr., vol., 19, no. 215, Feb. 1924, pp. 45-48, 9 figs. Survey of characteristics and advantages of steel chimneys.

CHROMIUM

Applications in Chemical Industry. The Importance of Chromium to the Chemical Engineer, Chem. & Met. Eng., vol. 30, no. 4, Jan. 28, 1924, pp. 149-151. Notes on nickel-chromium alloys; chrome irons; metallic chromium.

CITY PLANNING

Principles. Regional and Metropolitan Planning Principles, G. R. Ford. Can. Engr., vol. 46, no. 2, Jan. 8, 1923, pp. 127-130. Methods of controlling and directing development of towns and cities; difference between regional and city planning; zoning ordinances; regulation of traffic; principles of regional planning; decentralizing industry; financing regional plan. From paper read at Nat. Conference on City Planning, Baltimore.

COAL

Carbonization. Using a Modified Mond Producer for Low-Temperature Carbonization, C. H. S. Tupholme. Chem. & Met. Eng., vol. 30, no. 7, Feb. 18, 1924, pp. 271-273, 2 figs. Process changed to produce richer gas and more tar, with increased overall thermal efficiency.

Classification. Classification of Coal That Will Enable Buyer to Know What Kind of Fuel He Is Getting, Geo. H. Ashley. Coal Age, vol. 25, no. 5, Jan. 31, 1924, pp. 167-171, 1 fig. Suggests that coals be divided into ten classes by percentages of fixed carbon with ash equated to 7 per cent; seven new classes added to recognized divisions; graded also for quality. Paper presented before Coal Min. Inst. Am. See also Coal Mine Mgt., vol. 3, no. 1, Jan. 1924, pp. 29-31 and 56-61.

Measurement by Volume. Coal Measurement by Volume versus Measurement by Weight, J. E. Lea. Eng. & Boiler House Rev., vol. 37, no. 6, Jan. 1924, pp. 194 and 196, 2 figs. Author points out merits of measurement by volume.

Preparation. The Preparation of Coals, J. Loriet. Queensland Govt. Min. Jl., vol. 24, no. 283, Dec. 1923, pp. 465-468. Requirements of consumers and responsibilities of producers; arrangement of storage hoppers, etc.; advances in mechanical equipment. Abridged from report in Chaleur et Industrie.

Thermal Conductivity and Specific Heat. The Thermal Conductivity and Specific Heat of Coal, F. S. Sinnatt and H. Macpherson. Fuel, vol. 3, no. 12, Jan. 1924, pp. 12-14. Method of determining thermal conductivity and specific heat.

Value for Steam Generation. The Value of Coal for Steam Generation, C. A. Joerger. Combustion, vol. 10, no. 1, Jan. 1924, pp. 59-60 and 65. Basis of determining value of a coal, and discussion of some of the items which cause confusion in terms, efficiency, economy, and capacity.

COAL DUST

Explosions. Powdered Coal Hazards, H. G. Jacobsen. Concrete, vol. 24, no. 1, Jan. 1924, pp. 5-7 (Cement Mill Section). Reviews investigations that were carried on during more than 100 years from almost first time mention was made of coal dust as an explosive in itself until time, only a few years ago, when this point was conclusively proved. Paper read at Twelfth Annual Safety Congress, Oct. 1923.

COAL HANDLING

Conveyors for. Coal Bunkers, Coal and Ash Conveyors. Southern Engr., vol. 40, no. 5, Jan. 1924, pp. 100-104, 106, 108 and 110, 16 figs. Design of coal bins, method of suspension and how lined; operation and types of coal and ash-conveying apparatus.

Power Plants. Coal and Ash Handling Systems for Power Plants, J. W. Geiger. Nat. Engr., vol. 28, no. 2, Feb. 1924, pp. 53-56. Description, advantages and disadvantages of different types of apparatus; factors to be considered in selection.

COAL MINES

Dewatering. The Water-Hoist for Shaft Un-Watering, J. J. Ruthledge. Coal Industry, vol. 7, no. 1, Jan. 1924, pp. 26-28, 2 figs. Construction and operation of water box, used in conjunction with hoisting cage; probably best method for un-watering shaft.

Lighting. Productive Lighting for Coal Mines, C. E. Egeler. Coal Industry, vol. 7, no. 1, Jan. 1924, pp. 4-7, 7 figs. Importance of better illumination underground; type of equipment needed for various sections of mine.

Valuations. Estimating Coal Mine and Coal Land Valuations, H. B. Miller. Coal Industry, vol. 7, no. 1, Jan. 1924, pp. 21-25. Factors to be considered when making valuation; outline for report on coal mine in connection with valuation.

Ventilation. Ventilation in Cape Breton Collieries, J. Moffatt. Can. Min. Jl., vol. 44, no. 48, Nov. 30, 1923, pp. 943-944. Ascensional system now being organized in collieries of Dominion Coal Co.

COAL MINING

Laying Out Workings. Machine Mining. Sci. & Art of Min., vol. 34, no. 12, Jan. 5, 1924, pp. 182-183, 3 figs. Layout out workings; semi-longwall method of working; wide headings; coal pillars; advantages of system.

Nova Scotia. Coal Mining in Nova Scotia in 1923, F. W. Gray. Can. Min. Jl., vol. 45, no. 1, Jan. 4, 1924, pp. 31-33. Production; output of various collieries; new collieries; outlook for 1924.

Thin Seams. Best Method of Opening and Working a Thin Seam 22 Inches Thick to Produce 4,500 Tons per week, R. C. Morgan. Iron & Coal Trades Rev., vol. 108, no. 2914, Jan. 4, 1924, pp. 18-20, 8 figs. Development of face, machine-cut faces, dealing with a wet seam, economical working of developed seam, turning stalls off headings, and arrangement of shifts and general ogrganization.

COAL STORAGE

Economic Phases. Economic Phases of Coal Storage, F. G. Tryon and W. F. McKenney. Mech. Eng., vol. 46, no. 2, Feb. 1924, pp. 73-76 and 108, 2 figs. Extent to which practice of storage has already been adopted; inducements to store offered by periodic fluctuations in price and supply of coal. (Abridged.)

COKE

Blast Furnace, Function in. Reactivity of Coke in Relation to Blast-Furnace Operation, G. St. J. Perrott and R. A. Sherman. Engrs. Soc. West. Pa.—Proc., vol. 39, no. 10, Jan. 1924, pp. 351-369 and (discussion 370-375, 5 figs. Prevailing views as to function of coke in blast furnace and properties possessed by desirable coke; discusses problem in light of recent data secured by writers, both in laboratory and at blast-furnace plants.

Reactivity. The Reactivity (Combustibility) of Coke (Die Reaktionsfähigkeit (Verbrennlichkeit) von Koks), Hans Bahr. Stahl u. Eisen, vol. 44, nos. 1 and 2, Jan. 3 and 10, 1924, pp. 1-9 and 39-42 and (discussion) 42-48, 12 figs. Account and results of author's tests; new method for determination of reactivity; influence of carbon modifications and an artificial powdery-iron addition; conclusions.

COKE MANUFACTURE

Formation of Coke Pieces. What Occurs in the Formation of Coke, A. Thau. Chem. & Met. Eng., vol. 30, no. 5, Feb. 4, 1924, pp. 222-227, 13 figs. How propagation of coking steam is affected by varying oven conditions and what this means in coke produced.

CONCRETE

Elasticity. Experimental Investigations on the Coefficient of Elasticity of Concrete. (Recherches expérimentales sur le coefficient d'élasticité du béton), G. Magnel. Revue Universelle des Mines, vol. 67, no. 1, Jan. 1924, pp. 38-40, 2 figs. Results show that with concrete aged between 3 months and 1 year resistance is slightly increased and during same time coefficient of elasticity remains practically constant; permanent deformation under same load is much less with 1 year than with 5 months of aging.

CONCRETE CONSTRUCTION

Cold-Weather. Building Concrete Structures in Winter. Can. Engr., vol. 46, no. 4, Jan. 22, 1924, pp. 169-172, 12 figs. Fundamentals of cold-weather concreting; describes methods employed including heating materials, protection while hardening, protective coverings for concrete, etc. From Bul. of Portland Cement Assn.

CONCRETE CONSTRUCTION, REINFORCED

Cost Estimating. Estimating the Cost of Reinforced Concrete, C. F. Dingham. Contract Rec. & Eng. Rev., vol. 38, no. 1, Jan. 2, 1924, pp. 1-4. Practical data that will enable contractor to figure on forming, placing, reinforcing and finishing concrete walls, slabs and columns.

Cinder Concrete Unit Test. Cinder Concrete Units Fire and Water Test. Concrete, vol. 24, no. 1, Jan. 1924, pp. 25-27, 4 figs. Abstract of report by A. H. Beyer of 3-hr. fire and water test made upon two partitions built of precast reinforced cinder concrete units erected by Non-Burnable Building Products Co., Inc., Yonkers, N. Y.

CONDENSERS, ELECTRIC

Static. Recent Advances in the Design, Manufacturing and Testing of Static Condensers in Power Sizes, R. E. Marbury. Am. Inst. Elec. Engrs. Jl., vol. 43, no. 2, Feb. 1924, pp. 114-118, 10 figs. Describes static condensers designed with insulation factors of safety such as have proved dependable in other apparatus for years.

CONDENSERS, STEAM

Tubes. Corrosion of Condenser Tubes, Johnstone Taylor. Mar. Eng. & Shipg. Age, vol. 29, no. 2, Feb. 1924, pp. 108-109. Recent investigations prove entrapped air to be cause of rapid corrosion.

CONVEYORS

Mail and Parcel Transport. Mechanical Messengers, R. Heumann. Eng. Progress, vol. 4, no. 12. Dec. 1924, pp. 254-259, 10 figs. Arrangement of pneumatic-tube plant; rope-conveyor plants, employed in business houses and smaller works where correspondence has to be distributed from one central point to different points and recollected; conveyor belts.

COOLING TOWERS

Operation. Analysis of Cooling Tower Operation, C. S. Robinson. Refrig. Eng., vol. 10, no. 6, Dec. 1923, pp. 201-204, 2 figs. Shows how an analysis of operation of cooling towers permits classification of tests, so that a comparison of the various types of towers is simple and accurate; discusses recent tests on cooling towers.

CO-OPERATIVE SOCIETIES

Co-operative Shingle Mills. Co-operation. Monthly Labor Rev., vol. 18, no. 1, Jan. 1924, pp. 170-178. Co-operative shingle mills in Western Washington.

CORROSION

Electrolytic De-Rusting Plant. The Removal of Rust by Electrolytic Processes, J. P. McLare. Engineering, vol. 117, no. 3027, Jan. 4, 1924, pp. 25-29, 5 figs. Results of experiments with alkaline bath; efficiency of bath; describes plant and its development; cost of installation.

Metallic. The Mechanism of Metallic Corrosion, G. D. Bengough and J. M. Stuart. World Power (formerly Beama), vol. 1, no. 1, Jan. 1924, pp. 25-34, 1 fig. Direct union with oxygen; hydrogen-displacement type of oxidation; formation of and changes in initial scale; corrosion of typical metals.

COST ACCOUNTING

Heat-Treating Department. The Complete Operation of a Practical Cost System, A. H. Gibson. Factory, vol. 32, no. 2, Feb. 1924, pp. 170-172, 234 and 236, 1 fig. Deals principally with problems of cost accounting in heat-treating department.

CRANKCASES

Jigs and Fixtures for. Jigs and Fixtures for Small Crankcases, A. J. Aires. Am. Mach., vol. 60, no. 5, Jan. 31, 1924, pp. 167-170, 9 figs. Locating crankcase from 4-bolt holes; centering case from center and end bearings; special sleeves for supporting crankcase walls while broaching and burnishing.

CRANES

Overhead Travelling, Motors for. Direct or Alternating Current for Overhead Travelling Cranes, Wm. L. Laing. Am. Mach., vol. 60, no. 4, Jan. 24, 1924, pp. 133-134. Advantages and disadvantages of each type; selecting crane motor with characteristics to fit work; speed, braking, overload capacity, service and other characteristics.

Underhung-Jib. 5-Ton Underhung-Jib Crane. Engineer, vol. 136, no. 3550, Jan. 11, 1924, pp. 48-49, 3 figs Describes overhead travelling crane with underhung jib, object of which is to reach into adjoining bays, or even beyond end of shop in which it is installed, and thus enable loads to be lifted and transferred from shop to shop without use of tramways or trucks.

CULVERTS

Iron Corrugated. How One Railroad Replaces Trestles with Corrugated Pipe, R. E. Caudle. Ry. Eng. & Maintenance, vol. 20, no. 1, Jan. 1924, pp. 19-20, 3 figs. Points out advantages of this type of culvert, and gives comparative costs of concrete, cast iron and corrugated culverts.

CUTTING TOOLS

Cutting Speeds. Cutting Speeds, Catlin. Eng. Production, vol. 7, no. 136, Jan. 1924, pp. 26-30, 15 figs. Consideration of speeds, type of machine and tool to be used.

D

DAMS

Alcona, Mich. Alcona Dam on Au Sable River, Wm. W. Tefft. Power, vol. 59, no. 6, Feb. 5, 1924, pp. 212-214, 4 figs. Two-unit 8000-kw. plant operating under head of 41 ft. max. ability at min. cost; features of interest are cubical design of plant with conduit spillway beneath power house, thin reinforced-concrete corewall, construction methods enforced by presence of quicksand, casting of steel-reinforced papier-maché conduit forms, etc.

Concrete. The Lake Mentz Dam on Sundays River. Engineer, vol. 137, no. 3553, Feb. 1, 1924, pp. 116-117, 3 figs. partly on p. 122. Scheme carried out by Sundays River Irrigation Board 90 miles north of Port Elizabeth, South Africa; dam consists of massive reinforced-concrete structure, at one end of which are suspended five free roller steel sluice gates, each 30 ft. wide by 25 ft. deep.

Hydraulic-Fill. Building the Highest Hydraulic Fill Dam, A. C. Eaton. Eng. News-Rec., vol. 92, no. 6, Feb. 7, 1924, pp. 235-238, 5 figs. Major unit of New England power system, Davis Bridge development on Deerfield River, Vt.; dam is 200 ft. high; construction operations on dam.

Multiple-Arch, Failure. Details of the Failure of an Italian Multiple-Arch Dam. Eng. News-Rec., vol. 92, no. 5, Jan. 31, 1924, pp. 182-184, 10 figs. Disastrous break of reinforced-concrete structure on masonry base of gravity section; plans not approved and workmanship doubtful; base laid in lime mortar; superstructure concrete poor.

DIESEL ENGINES

Valve Setting. Setting the Valves of a Diesel Engine, H. F. Birnie and R. C. Baumann, Power Plant Eng., vol. 28, no. 3, Feb. 1, 1924, pp. 180-182, 7 figs. Describes general process of valve setting.

DRILLING MACHINES

ROTATING TABLES. Drilling Motor Parts on the Rotating Table, W. F. Sandmann. Am. Mach., vol. 60, no. 6, Feb. 7, 1924, pp. 197-199, 6 figs. Examples of rotating fixtures used on large variety of automotive work; construction of fixtures and principles involved in design.

DROP FORGING

HAMMERS. New Type of Drop Hammer for Multiple-Die Stamping. Engineer, vol. 137, no. 3554, Feb. 8, 1924, pp. 154-155, 4 figs. Brett drop hammer fitted specially for multiple-die stamping work.

DUST

EXPLOSIONS. The Lower Limits of Concentration for Explosion of Dusts in Air, L. J. Trostel and H. W. Frevert. Chem. & Met. Eng., vol. 30, no. 4, Jan. 28, 1924, pp. 141-146, 5 figs. Recounts tests made at Bur. of Chemistry, Dept. of Agriculture, and interprets results in light of industrial needs.

E

ECONOMIZERS

HIGH-PRESSURE. Advances in Economiser Practice. Power Engr., vol. 19, no. 215, Feb. 1924, pp. 63-64, 3 figs. Describes Ringstay economizer for high-pressure work.

ELECTRIC DISTRIBUTION

LINES, CALCULATION. Calculating Distribution Lines, A. Burt. Elec. World, vol. 83, no. 5, Feb. 2, 1924, pp. 232-233. Rough-and-ready rule applied to ordinary distribution problems; illustrative examples for distribution circuits.

ELECTRIC FURNACES

ADVANTAGES. Electric Industrial Heating, H. M. Drake. Engineer, vol. 137, no. 3553, Feb. 1, 1924, pp. 114-116, 4 figs. Discusses practice and experiences in America; advantages of electric heating; author advocates more extensive use of electric heating in Great Britain.

GRANULAR-CARBON RESISTOR. Granular Carbon Resistor Furnaces, M. M. Austin. Indus. & Eng. Chem., vol. 16, no. 2, Feb. 1924, pp. 156-157, 2 figs. Describes two types in which some of disadvantages of such furnaces have been overcome and their construction simplified.

ELECTRIC GENERATORS, A. C.

65,000-KVA. The 65,000-kv-a. Vertical Waterwheel Generators for the Niagara Falls Power Company, M. C. Olson and E. B. Plenge. Gen. Elec. Rev., vol. 27, no. 2, Feb. 1924, pp. 90-97, 17 figs. Details of design of electric generator placed in operation Dec. 1923, measuring 31 ft. outside diameter and weighing 750 tons; its operation, combined with that of two similar machines now being built, will furnish an additional 100,000 hp. without diverting more water from Falls.

ELECTRIC LOCOMOTIVES

BALDWIN-WESTINGHOUSE. Baldwin-Westinghouse Electric Locomotives in South America and Japan, H. R. Barnes. Baldwin Locomotives, vol. 2, no. 3, Jan. 1924, pp. 3-18, 26 figs. Describes types employed in Chile, Argentina and Japan.

ELECTRIC METERS

BALL-TYPE KVA. Ball Type of Kva. Meter, B. H. Smith. Elec. World, vol. 83, no. 7, Feb. 16, 1924, pp. 333-334, 6 figs. New mechanical arrangement for getting root mean square of watt and wattless components to obtain kva. demand.

LONG-DISTANCE METHODS. Automatic Transmission of Power-Readings, B. H. Smith and B. T. Pierce. Am. Inst. Elec. Engrs.—Jl., vol. 43, no. 2, Feb. 1924, pp. 101-105, 17 figs. Automatic methods, which may be employed for remote metering, including frequency, inverse current, potentiometer, position, voltage, current and impulse.

ELECTRIC MOTORS

FYNN-WEICHSEL. Induction and Synchronous Features in New Motor. Coal Age, vol. 25, no. 4, Jan. 24, 1924, pp. 141-142, 2 figs. Describes Fynn-Weichsel motor, developed by Wagner Elec. Corp. of St. Louis, Mo., embodying best characteristics of both types; combines high efficiency, high torque, constant speed and high power factor.

ELECTRIC MOTORS, A. C.

SYNCHRONOUS. Bonusing Use of Synchronous Motors, H. B. Dwight. Elec. World, vol. 83, no. 6, Feb. 9, 1924, pp. 285-286. With or without power-factor rate clause it should be possible to secure increased use of corrective equipment by giving rebate on power bills based on kva. installed.

ELECTRIC RAILWAYS

PUBLIC RELATIONS. How to Secure Better Public Relations, E. C. Hathaway. Elec. Ry. Jl., vol. 63, no. 4, Jan. 26, 1924, pp. 139-140. Bad treatment of utility corporations results from personal grievances of customers; public relations committee should make company better understood; its manager should take active part in civic affairs; correct attitude of employees important; securities should have wide distribution locally.

ELECTRIC TRANSMISSION LINES

PROBLEMS. Some Theoretical Considerations of Power Transmission, C. L. Fortescue and C. F. Wagner. Am. Inst. Elec. Engrs.—Jl., vol. 43, no. 2, Feb. 1924, pp. 106-113, 8 figs. Following points are developed: Proof of circle diagram maintaining therein idea of angle between generator and receiver voltages; it is shown how characteristics of synchronous condenser limit maximum power that can be transmitted over line; effect of character of load on stability; comparison of 500-mi. line with condenser at mid-point.

SLEET FORMATION. Sleet Formation on Trolley and Transmission Lines, G. E. Luke. Elec. Traction, vol. 20, no. 1, Jan. 1924, pp. 18-19, 1 fig. Dangers due to ice or sleet coatings on overhead lines; means for preventing or removing ice; experimental data resulting from tests on trolley and transmission lines.

TOWERS. Comparative Data on Towers for High Tension Transmission, W. Dreyer. Eng. News-Rec., vol. 92, no. 5, Jan. 31, 1924, pp. 188-189, 3 figs. Single-circuit and double-circuit towers for 220-kv. and 110-kv. lines; towers for special problems.

ELECTRIC WELDING

BOILER CONSTRUCTION AND REPAIR. Electric Welding for Boiler Construction and Repairs. Eng. & Boiler House Rev., vol. 37, no. 7, Feb. 1924, pp. 238-240, 2 figs. Extent to which electric welding is applicable to boilers of all types; information regarding work already carried out.

ELECTRIC WELDING, ARC

PRECISION. Precision Welding, S. W. Mann. Coal Industry, vol. 7, no. 1, Jan. 1924, pp. 57-60, 3 figs. Describes process and method of repairing crankshaft known as neutralized precision weld.

ELECTRICAL WIRING

CONDUIT. Use of Bare Neutral is Suggested. Elec. News, vol. 33, no. 2, Jan. 15, 1924, pp. 37-38, 1 fig. Describes proposed system of conduit wiring, placed before Hydro Elec. Power Commission of Ontario; employs bare neutral in three wire circuits; advantages and comparative merits claimed for it.

ELECTRODEPOSITION

BASE METAL STRUCTURE, INFLUENCE OF. Some Relations Between the Microstructure of Metal Surfaces and Electrodeposition Made Thereon, A. K. Graham. Brass World, vol. 20, on. 1, Jan. 1924, pp. 3-7, 7 figs. Further evidence of influence of structure of base metal on electrodeposits.

ELEVATED RAILWAYS

CARS. Passenger Comfort the Feature of the New Chicago "L" Cars. Elec. Ry. Jl., vol. 63, no. 2, Jan. 12, 1924, pp. 55-59, 6 figs. Describes steel motor cars recently put in service by Chicago Elevated R.R.; low first cost and maintenance; plus seats, liberal ventilation, and insulation against noise and cold; wood roof necessary for overhead trolley.

ELEVATORS, ELECTRIC

PASSENGER, TIME-VELOCITY CHARACTERISTICS. Time-velocity Characteristics of the High-speed Passenger Elevator, Bassett Jones. Gen. Elec. Rev., vol. 27, no. 2, Feb. 1924, pp. 111-120, 5 figs. Discusses psychology of elevator passenger, physiological effect of acceleration and retardation on him, possible improvements in service through increased car velocity, quicker gate and door operation, better signal systems, and use of automatic stops; advances method of analyzing time-velocity relations assisting in designing, high-grade high-speed elevator installations.

EMPLOYEES

RATING SCALES. Personal Opinion Records and Rating Scales, Henry C. Link. Indus. Mgt. (N. Y.), vol. 67, no. 2, Feb. 1924, pp. 78-80, 1 fig. Suggestions for simple rating system; points out value of system of recording personal opinions as substitute for or supplement to more objective production records.

EMPLOYMENT MANAGEMENT

LABOR DISTRIBUTION. The Decimal Method of Labor Distribution, Jos. M. Schappert. Indus. Mgt. (N. Y.), vol. 67, no. 2, Feb. 1924, p. 98. Advantages of decimal system over common fraction method; outline of decimal system which may be established to betterment of labor costs in almost any organization.

ENAMELING

ELECTRIC FURNACES FOR. Enameling Cast-Iron Ware in Electric Furnaces, H. E. Kennedy. Chem. & Met. Eng., vol. 30, no. 5, Feb. 4, 1924, pp. 219-221, 5 figs. Advances in construction and disposition of metallic resistors have simplified use of electricity for this purpose.

SMELTERS. Types of Enamel Smelters, J. E. Hansen. Fuels & Furnaces, vol. 2, no. 2, Feb. 1924, pp. 141-144, 2 figs. Reverberatory and rotary smelters; experimental types.

ENGINEERING

LITERATURE. Engineering Literature, D. McNicol. Am. Inst. Elec. Engrs.—Jl., vol. 43, no. 2, Feb. 1924, pp. 131-135. Critical review of tendencies in technical literature, with statement of some of problems of publication.

ENGINEER

CONSULTING. The Costs of a Consulting Engineering Practice. Engineer, vol. 137, no. 3553, Feb. 1, 1924, pp. 113-114, 2 figs. Author points out importance of having accurate knowledge of costs of consulting-engineering practice and gives results of his own experience.

REFRIGERATING, RELATION TO EMPLOYER. Relation of the Engineer to His Employer, W. S. Vivian. Ice & Refrigeration, vol. 66, no. 1, Jan. 1924, pp. 12-16. Qualifications of engineer.

ENGINEHOUSES

WIRING AND LIGHTING. Enginehouse Wiring and Lighting on the Santa Fe. Ry. Elec. Engr., vol. 15, no. 1, Jan. 1924, pp. 13-16, 4 figs. Wires carried in lead-coated wrought-iron water pipe, and both wall and overhead-type reflectors used; threads and fittings lead-coated by wiremen.

EVAPORATORS

MULTIPLE-EFFECT. Designing an Efficient Evaporator, H. K. Moore. Chem. & Met. Eng., vol. 30, no. 7, Feb. 1924, pp. 274-278, 7 figs. Example of how fundamental principles underlying multiple-effect evaporation can be applied on commercial scale to industrial materials.

REFRIGERANTS. Evaporating Systems for Refrigerants, W. F. Davis. Power Plant Eng., vol. 28, no. 4, Feb. 15, 1924, pp. 250-251. Points out that evaporators should have in a measure all general qualities of good steam boiler (Abstract.) Paper read before Nat. Assn. Practical Engrs.

EXPLOSIVES

SELECTION AND USE. Commercial Explosives—Their Selection and Use, Douglas P. Allison. Eng. & Min. Jl.-Press, vol. 117, no. 5, Feb. 2, 1924, pp. 197-201, 5 figs. Conditions which have been responsible for manufacture of the different kinds of dynamite, and which govern its uses; discussion of the various kinds of explosives.

F

FANS

DESIGN AND APPLICATION. Some Common Faults in Fan Design and Application, F. G. Whipp. Domestic Eng. (Lond.), vol. 43, no. 12, Dec. 1923, and vol. 44, no. 1, Jan. 1924, pp. 253-259 and 17-19, 6 figs. Discusses speed of a fan, bearings, and methods of arranging fan drives.

MOTORS FOR. How to Choose Motors for Driving Industrial Fans, R. H. Rogers. Chem. & Met. Eng., vol. 30, no. 6, Feb. 11, 1924, pp. 231-233, 9 figs. Notes on utility of various types of motors and control devices that are available for fan service.

Motor Drives for Mine Fans, F. W. Cramer. Coal Industry, vol. 7, no. 1, Jan. 1924, pp. 8-11, 4 figs. Comparison of various types of motors which may be used to drive mine fans from standpoint of efficiency, speed control, initial cost and power factor.

SELECTION AND OPERATION. Selection and Operation of Centrifugal Fans, Chas. L. Hubbard. Power Plant Eng., vol. 28, no. 4, Feb. 15, 1924, pp. 242-244, 2 figs. Proportioning fan to its load is vital factor in securing economy; principles of fan operation; resistances and outlet velocities.

FERRO-ALLOYS

MICROGRAPHIC DETECTION OF CARBIDES. Micrographic Detection of Carbides in Ferrous Alloys, N. B. Pilling. Am. Inst. Min. & Met. Engrs.—Trans., No. 1289-S, Jan. 1924, 5 pp., 6 figs., also (abstract) Min. & Metallurgy, vol. 5, no. 205, Jan. 1924, p. 31. New reagent developed for micrographic analysis of silicon steels, consisting of a dilute solution of nitric acid and methyl alcohol in nitrobenzol; action differs from that of sodium picrate in that there is no persistent deep-seated staining and solution is used cold.

FIRE EXTINGUISHERS

Types and Proper Uses. Fire Extinguishers and Their Proper Uses, H. L. Pagett. Fire & Water Eng., vol. 75, no. 2, Jan. 9, 1924, pp. 59-60 and 86-88. Classification of various types as to fires they are best suited to extinguish; arranged in three general classes of fires.

First Aid Fire Appliances, Chas. R. D'Olive. Coal Mine Mgt., vol. 3, no. 1, Jan. 1924, pp. 32-36 and 63. Describes various types of fire extinguishers.

FIRE PROTECTION

Sprinklers. Some Things to Know About a Sprinkler System, C. C. Brown. Fire & Water Eng., vol. 75, nos. 3 and 5, Jan. 16 and 30, 1924, pp. 113-114, 118-119 and 134-135; and 209-210 and 232. Discusses all phases connected with proper installation and maintenance of automatic sprinklers.

Water Curtain. The Water Curtain as a Protection Against Conflagration, M. W. McIntyre. Fire & Water Eng., vol. 75, no. 1, Jan. 2, 1924, pp. 15-16 and 34, 5 figs. Describes system in use in large building in Cincinnati, O., and method employed in testing system's efficiency.

FIREBRICK

Tests. High Temperature Load and Fusion Tests of Fire Brick From the Pacific Northwest in Comparison with Other Well-Known Fire Brick, H. Wilson. Am. Ceramic Soc.—Jl., vol. 7, no 1, Jan. 1924, pp. 34-51, 10 figs. Results of tests made on 17 samples of fireclay brick from Pacific Northwest with 27 other commercial brands of fireclay, silica, magnesia, chromite, zirconia, diaspore, silicon carbide and crystalline alumina, as well as china clay and crystalline sillimanite products made at Univ. of Wash.

FLOTATION

Cyanide in. Cyanide in Flotation, W. E. Simpson. Min. Mag., vol. 30, no. 1, Jan. 1924, pp. 24-25. It has been discovered recently at Sullivan lead-zinc mine, British Columbia, that addition of sodium cyanide to an alkaline flotation circuit increases selective action of reagents which separate galena from blende. Details of Sullivan mine and ore.

Surface Reactions in. Surface Reactions in Flotation, A. W. Fahrenwald. Am. Inst. Min. & Met. Engrs.—Trans., No. 1283-M, Jan. 1924, 90 pp., 20 figs. Results of research on theory of flotation that extended over three years. Surface tension elucidated and made basis of oil absorption determinations; studies condition of small quantities of numerous flotation oils and pure organic substances dissolved or mixed with water; effects of several controlling agents on various mineral suspensions in water: experiments dealing with ion-adsorption, flocculation, and peptization of various pensions; etc.

FLOW OF AIR

Resistance to Falling Spheres. The Resistance of Air to Falling Spheres, Rob. G. Lunnon. Lond., Edinburgh, & Dublin Philosophical Mag. & Jl. Sci., vol. 47, no. 277, Jan. 1924, pp. 173-182, 1 fig. Investigates fall of small steel balls in coal-mine shafts and gives results for dry, still air.

FLUE-GAS ANALYSIS

Computation. Computations Involving Steam in Boiler Flue Gas, F. C. Evans. Combustion, vol. 10, no. 2, Feb. 1924, pp. 118-119. Discussion of method of finding loss due to moisture in coal and due to water from combustion of hydrogen; illustrated by alignment chart for use in solving equations for the purpose given in proposed Boiler Test Code of A.S.M.E.

Interpretation of. Interpretation of Flue Gas Analysis, F. D. Harger. Combustion, vol. 10, no. 2, Feb. 1924, pp. 115-117, 4 figs. Necessity of complete flue-gas analysis as a guide to efficient combustion, end to be obtained being highest possible percentage of CO_2 without formation of CO and other combustible gases. Cautions to be observed in interpreting flue-gas analysis; losses caused by escape unburned of combustible gases and relation of loss to other loss factors.

FOREMEN

Training. A Training Program for the Foreman, J. K. Novins. Railroad Herald vol. 28, nos. 2 and 3, Jan. and Feb. 1924, pp. 25-30 and 26-30. Outlining study course; study plan proposed by Federal Board for Vocational Education; choosing text material for foreman conferences.

FORESTRY

Reforestation. Reforestation and Timber Conservation, J. W. Blodgett. Mech. Eng., vol. 46, no. 2, Feb. 1924, pp. 59-63 and 72, 7 figs. Nation-wide reforestation policy a necessity; regrowth of timber for pulpwood and low-grade material; regrowth of timber suitable for lumber; points out that reforestation for lumber purposes is task for Federal Government; benefits to be derived from Federal reforestation of logged-off lands.

United States. The Evolution of Forest Industries in the United States, W. B. Creeley. West. Soc. Engrs.—Jl., vol. 29, no. 1, Jan. 1924, pp. 1-12. Notes on expanding scale of lumber operations and of timber use; relations of forest industries to timberland; utilization of raw material; transportation costs and lumber prices; situation of paper industry; transportation costs and reforestation; a national forestry policy.

FORGING

Collared Shaft. Calculations in Forging a Collared Shaft, C. J. Steen. Forging—Stamping—Heat Treating, vol. 10, no. 1, Jan. 1924, pp. 40-42, 10 figs. Method of calculating size of ingot and forging time; size of press and unit of forging pressure important factors.

FORGINGS

Steel. Recent Developments in Steel Forgings, J. L. Cox. Forging—Stamping—Heat Treating, vol. 10, no. 1, Jan. 1924, pp. 12-16, 13 figs. Review of developments in line of forging exceptionally large machine parts; forgings often employed to advantage in place of steel castings. Paper presented before Am. Iron & Steel Inst.

FOUNDRIES

Ingot Molds. Develop Ingot Mold Foundry, Pat Dwyer. Foundry, vol. 52, no. 4, Feb. 15, 1924, pp. 125-130, 9 figs. Practice at foundry of Vulcan Mold & Iron Co., Latrobe, Pa.; in addition to solid molds made in dry sand and poured vertically, split molds are made in halves in green sand and poured horizontally.

FUEL ECONOMY

Railways. Personnel in Fuel Economy, U. L. Richards. Railroad Herald, vol. 28, no. 2, Jan. 1924, pp. 31-32. Education and selection of employees. Extract from prize-winning paper in Int. Ry. Fuel Assn. contest. See also Ry. & Locomotive Eng., vol. 37, no. 1, Jan. 1924, pp. 7-12.

FUELS

Research. The Work of the Fuel Research Board, C. H. Lander. Colliery Guardian, vol. 127, no. 3291, Jan. 25, 1924, pp. 213-214. Physical and chemical survey of national coal resources; carbonization of coal; H. M. fuel research station; low-temperature and high-temperature carbonization; etc. Paper read before Midland Inst. Min. Engrs. See also Iron & Coal Trades Rev., vol. 108, no. 2916, Jan. 18, 1924, pp. 87-88.

See also Coal; Coke; Oil Fuel; Pulverized Coal.

FURNACES, FORGING

Heat Economy. Heat Economy of Coal Fired Rolling and Forging Furnaces. Fuels & Furnaces, vol. 2, no. 2, Feb. 1924, pp. 119-121. Heat distribution, economy and coal consumption of various types of furnaces with brick recuperators, cast-iron recuperators and waste-heat boilers.

FURNACES, HEATING

Rail-Heating. Rails Heated for Re-rolling in Stoker Fired Furnaces, Elmer C. Cook, Fuels & Furnaces, vol. 2, no. 1, Jan. 1924, pp. 27-29, 1 fig. Continuous furnaces at Sweet's Steel Co. used in recovery of oil rails.

Oil-and Gas-Heated. Recuperation for Oil and Gas Heated Furnaces, A. E. Walden. Gas Age-Rec., vol. 53, no. 4, Jan. 26, 1924, pp. 97-98 and 122, 3 figs. Design of industrial heating furnaces for increased economy in operation.

FURNACES, HEAT TREATING

Electric. Electric Furnaces, With Special Reference to the Heat Treatment of Steel, L. W. Wild. Eng. Production, vol. 7, no. 136, Jan. 1924, pp. 20-23, 11 figs. Discusses hardening, normalizing, annealing, tempering, and carburizing, and suitable furnaces.

G

GAUGES

Optical. Hilger Optical Gauges. Engineering, vol. 137, no. 3027, Jan. 4, 1924, p. 10, 3 figs. Designed during war for testing cylindrical tubes of eye-pieces of telescopes which are made in standard dimensions.

GAS ENGINES

Exhaust-Gas Utilization. Waste Exhaust-Gas and Its Utilization, V. L. Maleey. Oil Engine Power, vol. 2, no. 1, Jan. 1924, pp. 18-20, 2 figs. Details of tests carried out in connection with 160-b.hp. gas engine in shops of West. Mach. Co., Los Angeles.

GAS HOLDERS

Oxy-Acetylene Welding. Gas Holder Seams Welded by Oxy-Acetylene Torch, G. O. Carter. Gas Age-Rec., vol. 53, no. 3, Jan. 19, 1924, pp. 69-72, 8 figs. Describes work on a 50,000-cu. ft. holder.

GASES

Compressibility to High Pressures. The Compressibility of Five Gases to High Pressures, P. W. Bridgman. Am. Acad. Arts & Sciences—Proc., vol. 59, no. 8, Jan. 1924, pp. 173-211, 5 figs. Results of measurements of compressibility of hydrogen, helium, ammonia, nitrogen, and argon, to pressures varying from 12,000 to 15,000 kg./cm_2. References.

GASOLINE ENGINES

Radiotelegraph Equipment. A Petrol Engine for Wireless Telegraph Equipment. Engineering, vol. 117, no. 3029, Jan. 18, 1924, p. 76, 5 figs. Describes small engines constructed by J. W. Brooke & Co.

GEARS

Chucking. Better Ways of Chucking Gears for Grinding. Can. Machy., vol. 31, no. 1, Jan. 3, 1924, pp. 21-23, 14 figs. Every care must be taken in selection of material, preparation of blanks, setting and cutting on machine, heat treatment and bore-grinding operation.

Design. A New Chart for the Design of Spur Gears, H. E. Merritt. Machy. (Lond.), vol. 23, no. 588, Jan. 3, 1924, pp. 457-458, 4 figs. Chart includes all variables introduced in gear-design calculations, and being composed of straight lines throughout, gives results of great degree of accuracy; will cover all possible dimensions speeds, and stresses met with in practice.

Specifications. American Stock Gearset Specifications. Motor Transport (N. Y.), vol. 29, no. 12, Jan. 15, 1924, p. 421. Specifications of different makes for passenger cars, buses, trucks and tractors.

Worm Reduction. Worm Gear: Its Production and Efficiency and Its Application to Turpine Reduction Gearing, F. W. Lanchester. Engineering, vol. 117, no. 3031, Feb. 1, 1924, pp. 131-132. Author is not impressed with prospects of general use of worm gear as turbine reduction gearing. Report on efficiency tests made on work and worm wheel for Daimler Co. is appended.

GRAIN ELEVATORS

Pneumatic. Pneumatic Grain Elevators, W. Cramp and A. Priestley. Engineer, vol. 137, nos. 3550, 3551, 3552 and 3558, Jan. 11, 18, 25 and Feb. 1, 1924, pp. 34-36, 64-65, 89-90 and 112-113, 7 figs. Results of investigation at University of Manchester; suggests rational basis for future design. Jan. 11: Force exerted by air on grain and resulting velocities; grain velocity and air pressure. Jan. 18: Work on pneumatic conveyor and other work done by air; experimental plant used in tests of vertical pneumatic elevator. Jan. 25: Friction of grain on pipe; nozzles. Feb. 1: General method for design of plants; use of auxiliary air inlet in nozzles; application of formulas to other materials and media and to problem of horizontal conveyors.

GRINDING

Wheel-Forming Fixtures. Simplifying Form Grinding in Machine Shops, A. R. Noble. Can. Machy., vol. 31, no. 1, Jan. 3, 1924, pp. 33 and 46, 4 figs. Description of wheel-forming fixtures which have been successfully employed for various classes of work.

GRINDING MACHINES

Gear. A Full-Automatic Gear Grinder with Adjustable Involute Control. West. Machy. World, vol. 15, no. 1, Jan. 1924, pp. 31-33, 6 figs. Describes machine used in manufacture of ground involute gears, built by Fellows Gear Shaper Co., Springfield, Vt.

Internal. European Abrasive Equipment, B. Schapira. Abrasive Industry, vol. 5, no. 1, Jan. 1924, pp. 24-25, 5 figs. Describes horizontal and vertical-spindle internal grinders.

H

HEAT TREATING

Gear Blanks. Heat Treating Gear Blanks, R. L. Manier. Fuels & Furnaces, vol. 2, no. 2, Feb. 1924, pp. 161-163, 2 figs. Automatic proportioning system used in firing normalizing and carburizing furnaces at New Process Gear Corp.

Shop for. Modernizes Heat Treating Shop, E. F. Ross. Iron Trade Rev., vol. 74, no. 8, Feb. 21, 1924, pp. 541-545, 6 figs. Rochester gear manufacturer installs new high-temperature continuous automatic electric furnace for hardening high-speed gear-cutting tools.

HEATING, HOT-WATER

Institution Plant. An Institution Hot-Water Plant. Power Engr., vol. 19, no. 215, Feb. 1924, pp. 57-62, 14 figs. Arrangements for warming scattered buildings, wards of average-sized institution for poor, and for supply of hot water for domestic purposes.

HIGHWAYS

BANFF-WINDERMERE, CAN. The Banff-Windermere Highway, J. M. Wardle. Eng. Jl., vol. 7, no. 2, Feb. 1924, pp. 91-94, 7 figs. New highway, opened for traffic on June 30, 1923, extends from town of Banff, Alberta to Windermere district in Columbia River valley; total length is 93 mi.; construction problems; crowning and ditching.

EMBANKMENT ACROSS TIDAL MARSH. Highway Embankment Construction Across Tidal Marsh, (Wilmington, Del.), W. W. Mack. Eng. News-Rec., vol. 92, no. 6, Feb. 7, 1924, pp. 233-234, 2 figs. Vertical settlements of 40 ft. recorded; construction simply task of dumping enough material.

QUEBEC, CANADA. Status of Provincial Highways, Quebec, J. L. Boulanger. Can. Engr., vol. 46, no. 5, Jan. 29, 1924, pp. 193-195. Review of highway situation in Province of Quebec giving mileage of roads completed and under construction, also summary of work done by Provincial Department of Roads during 1923.

RESEARCH IN ILLINOIS. Highway Research in Illinois, C. Older. Am. Soc. Civ. Engrs.—Proc., vol. 50, no. 2, Feb. 1924, pp. 175-217, 26 figs. Describes series of research projects carefully planned to give insight and understanding of unsolved problems of rural pavement design; methods used in investigations, data obtained, and tentative conclusions drawn from these studies.

HOBBING MACHINES

GEAR. New Hobbing Machine Specially Designed to Rough and Finish Gears. Automotive Industries, vol. 50, no. 7, Feb. 14, 1924, pp. 347-348, 3 figs. Machine made by Gould & Eberhardt can be used for production of both spur and helical types in quantities; also adapted to diversified range of work.
New Gear Hobber. Iron Age, vol. 113, no. 5, Jan. 31, 1924, pp. 361-362, 3 figs. Machine for quantity production of spur and helical gears; drive arrangement a feature.

HYDRAULIC TURBINES

NORWAY POWER STATION. The Turbines at Raanaasfoss Power Station, Norway, H. Thoresen. Engineer, vol. 136, nos. 3551 and 3552, Jan. 18 and 25, 1924, pp. 60-63 and 86-88, 27 figs. partly on supp. plate. Determination of size of units and choice of type of turbine; description of turbines. Jan. 25: Efficiency tests and testing arrangements; test results.

HYDRO-ELECTRIC DEVELOPMENTS

CANADA. Hydro-Electric Progress in Canada, 1923. Can. Engr., vol. 46, no. 4, Jan. 22, 1924, pp. 177-178. Review of principal water power developments in Canada; works under construction or actively in prospect; about 255,000 hp. were added during year, bringing total installation to 3,228,000 hp.

DAVIS BRIDGE PROJECT, VERMONT. Davis Bridge Power Project to Develop 60,000 hp., A. C. Eaton. Eng. News-Rec., vol. 92, no. 4, Jan. 24, 1924, pp. 142-146, 8 figs. New England power-system unit to produce 390,000,000 kw-hr. annually on Deerfield River; in 70 mi. 1700 ft. of head are to be utilized; major unit is 200-ft. earth dam, highest on record.

EQUIPMENT SELECTION. Hydro-Electric Development with Special Reference to the Hydraulic Equipment, W. M. White, Boston Soc. Civ. Engrs.—Jl., vol. 11, no. 1, Jan. 1924, pp. 1-16 and (discussion) 16-20, 9 figs. Present general practice governing selection of machinery for various heads.

ITALY. Hydro-electric Plants of the Breda Company in the Lys Valley (Gli impianti della S. I. P. Breda in Valle Lys). Elettrotecnica, vol. 10, nos. 33 and 34, Nov. 25 and Dec. 5, 1923, pp. 790-800 and 813-823, 50 figs. Description of the four projects of the company, with special attention to Pont S. Martin plant, comprising two 14,000-hp. Pelton wheels operating under a head of 1700 ft.

SAN FRANCISCO, CAL. San Francisco's Hetch Hetchy Water Supply and Power Development, M. M. O'Shaughnessy. Gen. Elec. Rev., vol. 27, no. 2, Feb. 1924, pp. 78-84, 10 figs. Describes development as a whole and explains San Francisco water situation; features of hydro-electric development; describes dam to be known as O'Shaughnessy Dam which, when completed, will be highest in world.

HYDRO-ELECTRIC PLANTS

ASSEMBLING HYDRAULIC UNITS. Assembling Heavy Hydraulic Units in Plant at Bombay. Eng. News-Rec., vol. 92, no. 8, Feb. 21, 1924, pp. 328-329, 2 figs. Rotors and runners of six 10,000-kva. generating units shrunk on shafts with aid of only native labor.

BRITISH COLUMBIA. Hydro-Electric Plant, Pacific Mills, Ltd., G. S. Barry. Can. Engr., vol. 46, no. 4, Jan. 22, 1924, pp. 161-162, 3 figs. New unit installed in pulp and paper mill at Ocean Falls, B. C., increases output to 15,000 hp.; consists of a 6300-hp. Pelton wheel direct-connected to a Can. Gen. Elec. generator with exciter.

CALIFORNIA. Big Creek-San Joaquin Hydro-electric Project, Claude C. Brown. Power Plant Eng., vol. 28, no. 3, Feb. 1, 1924, pp. 167-172, 14 figs. Big Creek No. 3 plant, known as The Electric Giant, has three turbine units and develops total capacity of 105,000 hp. under head of 760 ft.
Largest Hydro-electric Plant in the West Placed in Service. Eng. World, vol. 24, no. 1, Jan. 1924, pp. 19-21, 6 figs. Details of Big Creek No. 3 power plant.

JIM FALLS, WIS. Completing the Jim Falls Hydro-Electric Development, A. J. Hammond. Eng. News-Rec., vol. 92, no. 7, Feb. 14, 1924, pp. 270-272, 6 figs. Time element a controlling feature; method of combating northern winter conditions; importance of careful preliminary studies.

I

ICE PLANTS

IMPROVEMENTS. Improvements in Ice Plants, R. C. Doremus. Refrig. World, vol. 59, no. 1, Jan. 1924, pp. 17-20. Some of the more recent changes in practice and equipment which have simplified operation and increased efficiency. Paper read at N. A. P. R. E. Convention. See also Ice & Refrigeration, vol. 66, no. 1, Jan. 1924, pp. 35-39.

INDICATORS

INTERNAL-COMBUSTION ENGINES. Low Speed Indicator Developed for High Speed Engines. Automotive Industries, vol. 50, no. 6, Feb. 7, 1923, pp. 298-299, 3 figs. Device invented by Budapest scientist traces diagram which is representative of large number of succeeding cycles in power plant; influence of sources of error is greatly reduced; device known as Juhasz indicator has been placed on market by Lehmann & Michels of Hamburg, Germany.

INDUSTRIAL MANAGEMENT

COST CONTROL BY BUDGET. Control Through Organization and Budgets, Thos. B. Fordham and Ed. H. Tingley. Mgt. & Administration, vol. 7, nos. 1 and 2, Jan. and Feb. 1924, pp. 57-62 and 205-208. Jan.: Compilation of budget. Feb.: Applying budget to industrial operations.

COST INFORMATION FOR DEPARTMENT HEADS. Supplying Financial and Cost Information, G. M. Pelton. Mgt. & Administration, vol. 7, no. 2, Feb. 1924, pp. 169-172. Discusses how and to what extent department heads should be supplied with financial and cost information.

MAINTENANCE WORK. Analysis of Work and Responsibilities of Maintenance Engineers, D. H. Braymer. Indus. Engr., vol. 82, no. 1, Jan. 1924, pp. 10-16, 8 figs. Discusses scope of maintenance work, with comments by readers on most effective methods of organizations, division of work and assignment of duties.

RAW-MATERIAL CONTROL. Extreme Variety Versus Standardization, J. H. Van Deventer. Indus. Mgt. (N. Y.), vol. 67, no. 2, Feb. 1924, pp. 81-88, 15 figs. Raw-material ordering routine at Schenectady plant of Gen. Elec. Co.

SUPERINTENDENTS, ELIMINATION OF. Work Without Superintendents, H. R. Simonds. Iron Trade Rev., vol. 74, no. 8, Feb. 21, 1924, pp. 548-550, 3 figs. 52 foremen of Massachusetts plant, employing 3000, are responsible only to general manager; experiment with simplified system proves successful.

TOOL-CRIB SYSTEM. A Tool-crib System, M. L. O'Flaherty. Machy. (N. Y.), vol. 30, no. 6, Feb. 1924, pp. 428-430, 5 figs. Proper tool-crib equipment; total classification; checking out tools for production work.

INDUSTRIAL RELATIONS

INTRA-PLANT RELATIONSHIPS. Intra-Plant Relationships and Industrial Leadership, R. H. Booth. Min. & Metallurgy, vol. 5, no. 206, Feb. 1924, pp. 67-71, 4 figs. Describes novel plan for objective presentation of business economics.

KANSAS CITY RYS. PLANS. Building Good Employee Relations in Kansas City. Elec. Ry. Jl., vol. 63, no. 2, Jan. 12, 1924, pp. 63-66, 3 figs. Principles and organization plant of employee brotherhood and representation plan which have contributed to present favorable situation in Kansas City; separate committee handles all wage matters; membership in brotherhood entirely voluntary.

PROGRESS IN. Progress in Industrial Relations, Chas. M. Mills. Iron Age, vol. 113, no. 4, Jan. 24, 1924, pp. 281-283. Important gains made by progressive corporations; employee representation, it is claimed, has accomplished much, but has not been perfected.

INDUSTRIAL TRUCKS

ELECTRIC. American Electric Truck Specifications. Motor Transport (N. Y.), vol. 29, no. 12, Jan. 15, 1924, pp. 418-419. Specifications of different makes.
Studies Savings Effected by Trucks. Iron Trade Rev., vol. 74, no. 7, Feb. 14, 1924, pp. 479-481, 4 figs. Possibilities of storage-battery truck service in foundry field investigated by company manufacturing storage-battery trucks.

INJECTORS

THERMAL EFFICIENT. The Thermal Efficiency of an Injector. Sibley Jl., of Eng., vol. 38, no. 1, Jan. 1924, pp. 13-15. Determination of this efficiency.

INSULATION, HEAT

DIATOMACEOUS-EARTH BRICK. The Manufacture of an Insulating Brick From Diatomaceous Earth, C. A. Smith. Am. Ceramic Soc.—Jl., vol. 7, no. 1, Jan. 1924, pp. 52-60, 9 figs. Pulverized diatomaceous earth was blended with each of the four clays, Tennessee ball, Redford shale, Rock Hill, Tionesta, in percentages of 0, 5, 10, 15, 20, 30, 50 clay; dry pressed briquettes were made using 50 to 60 per cent water, and were burned at cones 06, 02, and 2; heat conductivity tests made upon best bodies of series.

INTERNAL-COMBUSTION ENGINES

RADIATION CHARACTERISTICS. Radiation Characteristics of the Internal-Combustion Engine, Thos. Midgley, Jr. and H. H. McCarty. Soc. Automotive Engrs. —Jl., vol. 14, no. 2, Feb. 1924, pp. 182-185, 7 figs. Presents data showing how radiation varies with changes in character of combustion; it is concluded that radiation produced during internal combustion is function of chemical reaction involved to much greater extent than are merely temperatures of gases, although these play a marked part.
See also Airplane Engines, Automobile Engines; Diesel Engines; Gas Engines; Gasoline Engines; Oil Engines.

IRON AND STEEL

BIBLIOGRAPHY 1923. Review of Iron and Steel Literature for 1923, E. H. McClelland. Forging—Stamping—Heat Treating, vol. 10, no. 1, Jan. 1924, pp. 5-9. Classified list of more important books, serials and trade publications during year, with few of earlier date, not previously announced.

PACIFIC COAST, U. S. Iron and Steel on the Pacific Coast, C. E. Williams. Min. & Metallurgy, vol. 5. no. 205, Jan. 1924, pp. 23-25. Local demand and production; foreign pig iron being imported in preference to eastern United States products; raw-materials supply; smelting methods; sponge iron.

TERMINOLOGY. Iron and Steel Terminology, H. D. Hibbard. Min. & Metallurgy, vol. 5, no. 206, Feb. 1924, pp. 77-78. Clarifies use of terms often occurring in writings on iron and steel, and suggests several new short abbreviated names for some of the things related to subject which now are indicated by phrases.

TRADE OF GREAT BRITAIN. The Iron and Steel Trade in 1923. Iron & Coal Trades Rev., vol. 108, no. 2914, Jan. 4, 1924, pp. 8-17, 2 figs. District reviews, including pig-iron production, prices, iron ore, manufactured iron and steel, imports and exports, wages, by-product market, etc.

IRON CASTINGS

REINFORCED, FOR CYLINDERS. Reinforced Gray Iron Castings (La fonte armée). Fonderie Moderne, vol. 18, Jan. 1924, p. 16, 1 fig. Describes process employed for manufacture of automobile-engine cylinders by Belgian foundry; all parts of cylinder where porosity is frequent are provided with thin steel wall which welds closely to iron and ensures perfect tightness; by use of this method it becomes possible to cast cylinders in soft graphitic irons; same method has been employed for making high-pressure gas and liquid containers.

IRON FOUNDING

METALLURGY. History of Foundry Metallurgy. Metal Industry (Lond.), vol. 24, no. 4, Jan. 25, 1924, pp. 83-84. Traces development of basis of modern iron-foundry metallurgy, leading up to present-day opinions as to grading of pig irons.

PROBLEMS. Some Foundry Problems, A. H. Mundey. Foundry Trade Jl., vol. 29, no. 387, Jan. 17, 1924, pp. 58-61 and (discussion) 61-62. Deals with melting problems, non-ferrous alloys, heat treatment of gunmetal, diecasting, bell and brass founding, mold facings, high-tensile brasses, beta brass, etc. Paper read before Lond. branches of Inst. British Foundrymen and Inst. Metals.

THERMIT, APPLICATION OF. Application of Thermit in Foundry Practice. West. Machy. World, vol. 15, no. 1, Jan. 1924, pp. 29-30, 1 fig. For increasing temperature of iron and steel, and making semi-steel in ladle; use in riser; titanium thermit cans for purifying iron and steel; method of making steel castings by thermit process.

IRON METALLURGY

MANUFACTURE OF PURE IRON. Commercially Pure Iron. Gas Engr., vol. 40, no. 573, Jan. 1924, pp. 4-5, 2 figs. Purification of ingot iron; danger of fracture, and resistance to corrosion.

IRON ORE

SILICA CONTENT, EFFECT OF. How Silica Affects Cost of Iron, T. T. Read, T. L. Joseph and P. H. Royster. Iron Trade Rev., vol. 74, no. 4, Jan. 24, 1924, pp. 288-291, 2 figs. Great variation shown in values of iron ore; method suggested for scientific determination, according to results obtained in furnaces.

IRRIGATION

ALBERTA, CAN. Lethbridge Northern Irrigation District in Alberta, C. M. Arnold and H. G. Cockrane. Eng. News-Rec., vol. 92, no. 6, Feb. 7, 1924, pp. 243-248, 8 figs. Internal storage found cheaper than large canals; controlled hydraulic jump utilized in grade-reduction drops.

SEWAGE. Studies of Outlets and Crops on Sewage Irrigated Areas, Geo. A. Mitchell. Eng. News-Rec., vol. 92, no. 7, Feb. 14, 1924, pp. 284-287, 9 figs. Terra-cotta pipe lines used and several designs of concrete and concrete-protected cast-iron outlets tried; comparative yields of irrigated and non-irrigated land.

K

KILNS

CEMENT, REFRACTORIES FOR. Refractories for Rotary Portland Cement Kilns, R. M. Howe. Cement, Mill & Quarry, vol. 24, no. 2, Jan. 20, 1924, pp. 35-38, 1 fig. Factors controlling service secured from fire clay linings and possible advantages to be gained by using linings of another type.

L

LABOUR

BIBLIOGRAPHY. Publications Relating to Labour. Monthly Labor Rev., vol. 18, no. 1, Jan. 1924, pp. 206-215. List of official and unofficial publications in United States and foreign countries.

LABOUR TURNOVER

ABSENTISM. Absentism Factors for Industrial Plants, J. D. Hackett. Mgt. & Administration, vol. 7, no. 2, Feb. 1924, pp. 199-203. Relative importance of absence; nature, calculation and extent of absence; absence and wages; prevention of absence; remedies.

REDUCING. Reducing the Turnover of Labor, C. A. Walker. Iron Trade Rev., vol. 74, no. 5, Jan. 31, 1924, pp. 350-352, 4 figs. Suitable records afford basis for study of causes of labor turnover.

LATHES

GAP. The Buckman 8½-inch Center Lathe. Machy. (Lond.), vol. 23, no. 590, Jan. 17, 1924, pp. 511-512, 3 figs. Distinguishing feature of hollow-spindle, gap-bed lathe is novel construction of bed.

LIGHTING

EQUIPMENT DEPRECIATION. Depreciation of Lighting Equipment due to Dust and Dirt, E. A. Anderson and J. M. Ketch. Illuminating Eng.—Trans., vol. 19, no. 1, Jan. 1924, pp. 55-65 and (discussion) 65-86. Report of tests under service conditions to determine relative depreciation or loss in efficiency. Possibilities of a simple comparison standard for predicting depreciation rates in a particular installation.

METHODS. Modern Methods of Artificial Illumination, A. L. Powell. Am., Architect, vol. 125, no. 2438, Jan. 30, 1924, pp. 133-139, 8 figs. Desirable qualities of an illuminant, desirable qualities of illumination, and discussion of standard types of equipments which have diversified applications for different classes of service.

NOMENCLATURE AND STANDARDS. Recent Developments in Nomenclature and Standards. Illuminating Eng. Soc.—Trans., vol. 19, no. 1, Jan. 1924, pp. 7-16. Progress made during 1923 in revision of Illuminating Engineering Nomenclature and Photometric Standards previously prepared by I. E. S. committee and approved as American Standard by Am. Eng. Standards Committee. Presents questions for consideration on which it is desired to have discussion and advice, among which are definition of "light" and "lighting", matter of "brightness" and units to be used in measuring it, and use of term "luminaire".

PROBLEMS. Working with the Architect on Difficult Lighting Problems, A. D. Curtis and J. L. Stair. Illuminating Eng. Soc.—Trans., vol. 19, no. 1, Jan. 1924, pp. 43-54 and (discussion) 65-86, 15 figs. Emphasizes necessity for early consultation between architect and lighting man in planning of lighting features of a building as well as responsibility of lighting man in developing in himself an appreciation of architectural values so as to most intelligently work with his architectural colleague. Gives some specific examples of lighting problems to illustrate advantages to be derived by considering lighting as a component part of structure.

PROGRESS. Progress in the Art of Illumination, A. Bishoff. Illuminating Eng. Soc.—Trans., vol. 19, no. 1, Jan. 1924, pp. 17-27. Progress made from Jan. 1, 1900 to July 31, 1923, as evidenced by number of patents granted by U. S. Patent Office. Brief discussion of more active branches is given to indicate trend of thought followed by inventors.

LOCOMOTIVES

DEVELOPMENT. A Quarter Century of the Steam Locomotive, W. A. Austin. Ry. Rev., vol. 74, no. 2, Jan. 12, 1924, pp. 107-114, 24 figs. History of growth and development of the various types since introduction of first American Mogul and Atlantic types. Paper read before Pa. section of A.S.M.E.

DIESEL-ENGINED. The Next Step is the "Thermo-Locomotive", J. Barraja-Frauenfelder. Ry. Mech. Engr., vol. 98, no. 2, Feb. 1924, pp. 81-85, 1 fig. Application of Diesel engine to railway work; the Sulzer thermo-locomotive.

HIGH PRESSURES AND SUPERHEATED STEAM. Theoretical Savings Effected by Using High Pressures and Super-heated Steam. Ry. & Locomotive Eng., vol. 37, no. 1, Jan. 1924, pp. 12-13, 1 fig. Analysis of heat required to produce various steam pressures and temperatures of superheat. Chart giving comparison of B. t. u. values of characteristics of saturated and superheated steam at different pressures and temperatures.

INTERNAL-COMBUSTION. The "Still" System Internal Combustion Locomotive. Ry. & Locomotive Eng., vol. 37, no. 1, Jan. 1924, pp. 14-15. Notes on new development by Still Engine Co.; 2-6-2 type.

MIKADO. Mikado Type Locomotive, Canadian National Rys. Ry. Rev., vol. 74, no. 1, Jan. 5, 1924, pp. 12-16, 7 figs. Description of 45 engines designed largely to Can. Nat. standards especially for conditions in western Canada; cylinders 27 in. by 30 in. diam. driving wheels 63 in. diam.; boiler pressure 185 lb.; tractive power 54,600 lb. without booster and 65,000 lb. with.

TYPES BUILT IN 1923. Locomotives. Ry. Rev., vol. 74, no. 1, Jan. 5, 1924, pp. 52-63, 30 figs. Mikado, Pacific, mountain, 2-10-2, 2-10-0, Mallet, Consolidation, and switching types locomotives ordered by Class I railroads in 1923, and principal dimensions and illustrations of representative above-mentioned types.

VELOCITY PROFILES. The Preparation and Use of Velocity Profiles, V. I. Smart. Ry. Rev., vol. 74, no. 5, Feb. 2, 1924, pp. 209-215, 7 figs. Tractive effort, coal consumption, and running time may be obtained graphically from velocity profiles, prepared in accordance with principles laid down by Am. Ry. Eng. Assn.

LUBRICATING OILS

STEAM-TURBINE. Maintaining Quality of Steam Turbine Oils in Service, C. H. Bromley. Power, vol. 59, no. 4, Jan. 22, 1924, pp. 125-128, 6 figs. Principal factors in recent development of information and equipment as related to maintaining quality of lubricating oils in use in steam turbines.

LUBRICATION

JOURNAL. A Graphical Study of Journal Lubrication, H. A. S. Howarth. Mech. Eng., vol. 46, no. 2, Feb. 1924, pp. 77-79 and (discussion) 79-80, 10 figs. Visualizes characteristics of oil film and pressures within it for journal completely surrounded by its bearing; influences of clearance and viscosity upon journal friction are quantitatively shown by means of chart that can readily be used for designing bearings, (Abridged.)

TOOLS. Tool Engineering, A. A. Dowd and F. W. Curtis. Am. Mach. vol. 60, no. 4, Jan. 24, 1924, pp. 135-137, 3 figs. Use and importance of cutting lubricants; proper application of coolant to tool and work; lubricating milling cuts; value of lubricants in thread cutting.

M

MACHINE SHOPS

FORD MOTOR CO., CANADA. New Machine Shop for Ford Motor Co. Can. Engr., vol. 46, no. 7, Feb. 12, 1924, pp. 223-225, 3 figs. Covers 15 acres and is 1088 ft. by 570 ft. wide; a one-story sawtooth monitor type of building with a clear height under trusses of 14 ft. and with two longitudinal and one cross crane-ways.

MACHINE TOOLS

CONE PULLEY DRIVES. The Design of Cone Pulley Drives, S. Odegaard. Am. Mach., vol. 60, no. 7, Feb. 14, 1924, pp. 245-247, 1 fig. Useful tables for quick computation; design of back gearing; belt width and horsepower; design of drive for 24-in. lathe as example.

DEFECTS IN. Some Suggestions for Builders and Users of Machine Tools, Thos. Nadin. Soc. Automotive Engrs.—Jl., vol. 14, no. 2, Feb. 1924, pp. 134-135. Points out simple and obvious defects in many present-day production machine tools and offers constructive suggestions for their elimination.

PLATE AND BAR-WORKING. Plate and Bar-working Tools. Machy. (Lond.), vol. 23, no. 588, Jan. 3, 1924, pp. 450-454, 9 figs. Plate edge planers; frame plate slotting and milling machines.

SAFETY TAPPING MECHANISMS. Mechanisms for Preventing Tap Breakage, A. Pestel. Machy. (N. Y.), vol. 30, no. 6, Feb. 1924, pp. 424-426, 6 figs. Deals with more important problems involved in designing safety tapping mechanisms, and methods suggested for overcoming difficulties encountered with certain mechanisms developed for this work.

MACHINERY

GUARDS FOR. Construction of Machinery Guards. Nat Safety News, vol. 9, no. 1, Jan. 1924, pp. 43-53, 14 figs. Materials suitable for guard construction; machine tools needed for fabrication of guards; detailed guard features; specifications for guards; guard standards.

MAGNESIUM

FOUNDRY PRACTICE. Explains Use of Magnesium, H. J. Maybrey; Foundry, vol. 52, no. 3, Feb. 1, 1924, pp. 96-99, 3 figs. Peculiarities of metal which readily can be handled by foundryman are pointed out; features of molding and design, and means of avoiding defective castings. Paper presented at Int. Foundrymen's Congress.

MATERIALS

LIMIT OF ELASTICITY. The Static and Dynamic Elastic Limit in Material Testing and Construction (Die statische und dynamische Elastizitätsgrenze im Marerialprüfungs-und Konstruktionswesen), G. Welter. Zeit. des Vereines deutscher Ingenieure, vol. 68, no. 1, Jan. 5, 1924, pp. 9-11, 3 figs. Points out necessity for reform in material-testing practice and makes plea for detailed investigation of statically and dynamically true limit of elasticity of all structural materials, in order to keep pace with requirements of modern machinery construction.

MATERIALS HANDLING

AUTOMOBILE PLANTS. Flexibility in Handling Production Material, A. A. Brown. Soc. Automotive Engrs.—Jl., vol. 14, no. 2, Feb. 1924, pp. 148-150. Routing and handling materials through receiving department; stocking of materials; service-department requirements; shortage report and its significance; stock records.

Material Handling is Cut to Minimum in Jewett Assembly Plant, W. L. Carver. Automotive Industries, vol. 50, no. 6, Feb. 7, 1924, pp. 281-288, 10 figs. Facilities for straight-line material flow and elimination of burdensome handling incorporated in new assembling plant of Paige-Detroit Motor Car Co.

METALLURGY

DEVELOPMENTS. Developments in Metallurgy, S. B. Goodale. Blast Furnace & Steel Plant, vol. 12, no. 2, Feb. 1924, pp. 109-112. Review of investigational work being carried on by various agencies.

METALS

COLD WORKING. Effect of Severe Cold Working on Scratch and Brinell Hardness, H. S. Rawdon and W. H. Mutchler. Am. Inst. Min. & Met. Engrs.—Trans., No. 1291-N, Jan. 1924, 11 pp., 7 figs., also (abstract) Min. & Metallurgy, vol. 5, no. 205, Jan. 1924, p. 31. Results obtained when a series of metals, copper, iron, tin, etc., were cold rolled to a definite degree without any intermediate annealing and hardness determined by both scratch and Brinell methods.

FAILURE. Premature Failure of Metal Parts While in Use and Methods of Prevention (Le roturre accidentali dei materiali metallici in opera ed il modo di prevenirle, P. Forcella. Elettrotecnica, vol. 10, no. 28, Oct. 5, 1923, pp. 672-676, 37 figs. Deals with failures due to violent shock, forces greater than calculated, excessive use, heating to unusual temperatures, etc.

STRENGTH. Cross-Relations of Strengths of Metals in Tension, Compression, Torsion and Transverse Loading, G. B. Upton. Sibley Jl. of Eng., vol. 38, no. 1, Jan. 1924, pp. 2-6, 2 figs. Underlying relationships of strengths of materials under various kinds of loading; proper criteria of failure to apply to different kinds of metal in different places; reasons why specification of tension properties of a metal has been and will continue to be so satisfactory in insuring properties desired, whatever kind of loading is applied in actual structure.

USES. New Uses for Metals. Metal Industry (N. Y.), vol. 22, nos. 1 and 2, Jan. and Feb. 1924, pp. 1-4 and 55, 3 figs. Symposium containing following articles: Researching the Field of Brass and Copper Consumption, W. A. Willis; Development of Zinc, S. S. Tuthill; New Uses of Lead and Tin, G. O. Hiers; Aluminum; New Uses and Applications of Nickel and Its Products, E. A. Turner and R. L. Suhl; Miscellaneous Metals, A. Bregman.

MICA

MANUFACTURE OF BUILT-UP. The Manufacture of Built-Up Mica, J. R. McClain. Elec. Jl., vol. 21, no. 1, Jan. 1924, pp. 10-16, 5 figs. Method of mining; early application of sheet mica; classes of built-up mica; method of hand and machine building; semi-automatic building; selection of mica splittings and of bonds; general requirements of built-up mica.

MICROSCOPES

PORTABLE. Portable Microscope. Iron Age, vol. 113 no. 5, Jan. 31, 1924, p. 371, 4 figs. New type for use on metal in shop, applicable to various shapes.

MILLING MACHINES

DUPLEX HEAD. Duplex Head Milling Machine. Machy. (Lond.), vol. 23, no. 591, Jan. 24, 1924, pp. 554-555, 2 figs. Developed to meet requirements of manufacturers for either slab or face-milling operations.

TOOL FIXTURES. The Standardization of Tool Fixtures for Milling Machines (Die Normung der Werkzeugbefestigung an Fräsmaschinen), G. Schlesinger and K. Hegner. Werkstattstechnik, vol. 18, no. 1, Jan. 1, 1924, pp. 1-3, 9 figs. Recommendations for standardization of toolholders by standards committee of Assn. German Machine-Tool Builders.

MINE HAULAGE

COAL MINES. Recent Progress in Mine Haulage, Rob. M. Black. Coal Industry, vol. 7, no. 1, Jan. 1924, pp. 37-38. Developments during past year from technical and safety standpoint; new storage-battery locomotives added to list of permissible equipment.

MINERALS

BRITISH COLUMBIAN PRODUCTION. British Columbia's Record for 1923, R. Dunn. Can. Min. Jl., vol. 45, no. 1, Jan. 4, 1924, pp. 20-22. Mineral production for 1923; increase of 12.8 per cent in monetary value over that of 1922.

CANADIAN PRODUCTION. Canada's Mineral Production in 1923, S. J. Cook. Can. Min. Jl., vol. 45, no. 1, Jan. 4, 1924, pp. 5-9. Twelve per cent increase, to $214,102,000.

NON-METALLIC, CANADIAN PRODUCTION. Non-Metallics in 1923, N. B. Davis. Can. Min. Jl., vol. 45, no. 1, Jan. 4, 1920, pp. 19-20. Canadian production.

MINING

QUEBEC. Mining Activities in Quebec during the Year 1923, A. O. Dufresne. Can. Min. Jl., vol. 45, no. 1, Jan. 4, 1924, pp. 28-30, 1 fig. Activities in gold belt; gold companies and syndicates; transportation and other facilities; activities of asbestos mines and mills; new construction; non-metallics.

NOVA SCOTIA. Metalliferous Mining in Nova Scotia During 1923, A. E. Flynn. Can. Min. Jl., vol. 45, no. 1, Jan. 4, 1924, pp. 33-35. Reasons for low gold assays from dumps; arsenic ores; Harr concentrator; gold mining; gypsum mining; other minerals.

ONTARIO, CANADA. Mining in Ontario in 1923, T. W. Gibson. Can. Min. Jl., vol. 45, no. 2, Jan. 11, 1924, pp. 45-46. Notes on nickel, gold, and silver.

MOULDING METHODS

GREEN-SAND. Green Sand Moulding, J. D. Nicholson. Foundry Trade Jl., vol. 29, no. 387, Jan. 17, 1924, pp. 54-55 and (discussion) 55-57, 8 figs. Discusses essential operations, using an Erith loam sand, and defects produced if such operations are not carried out in a definite manner.

PROPELLERS. Sweeps a Differential Pitch, J. Edgar. Foundry, vol. 52, no. 2, Jan. 15, 1924, pp. 51-52, 7 figs. Describes characteristics peculiar to propellers in which pitch varies from that of a true screw; method employed in foundry to make mold.

MOULDS

HARDNESS TESTING APPARATUS. A Hardness Testing Apparatus for Moulds and Cores, L. Treuheit. Foundry Trade Jl., vol. 29, no. 387, Jan. 17, 1924, pp. 50-51, 3 figs. Describes horizontal and vertical mold-testing devices designed similarly to Brinell testing machine to determine hardness of molds and cores in gr./mm. 2, and in this manner to obtain a real supervision of all parts, and thereby ensure clean castings with a reduction in wasters. From paper read before Hamburg Conference of German Foundrymen.

ELECTRIC-RAILWAY-OPERATED. Extent and Kind of Bus Operation by Electric Railways. Elec. Ry. Jl., vol. 63, no. 1, Jan. 5, 1924, pp. 5-13. Summary of methods of 121 companies based on nation-wide survey of industry; feeder service is most common form of operation; great expansion planned for 1924.

FIELD AND FUTURE. The Field and Future of the Motorbus, J. A. Emery. Soc. Automotive Engrs.—Jl., vol. 14, no. 2, Feb. 1924, pp. 107-110. Relation of buses to railroads on routes not served by railroads, as adjunct to railways; substitute for unprofitable railway lines.

N

NATURAL GAS

CANADA. Natural Gas and Oil Possibilities in Canada, E. Coste. Natural Gas, vol. 5, no. 1, Jan. 1924, pp. 24-25 and 42. Notes on North Western Ohio—South Western Ontario and Rock Mountains "petroliferous provinces".

INDUSTRIAL UTILIZATION. Industrial Utilization of Natural Gas, H. J. Struth. Natural Gas, vol. 5, no. 1, Jan. 1924, pp. 32-33 and 42, 1 fig. Includes chart showing distribution of amount of gas produced in 1921; notes on industries using natural gas.

NICKEL PLATING

STEEL, RUST RESISTANCE. Rust Resistance of Nickel-Plated Steel, E. M. Baker. Soc. Automotive Engrs.—Jl., vol. 14, no 2, Feb. 1924, pp. 127-133, 9 figs. Numerical method of rating of appearance of plated steel after exposure to action of salt spray; rust resistance of steel plated with nickel is shown to be dependent on thickness of plating; effect of salt-spray resistance of some common variables in nickel plating; sets forth advantages of controlled electroplating at high current densities.

NICKEL STEEL

CARBURIZATION. Heat-Treatment of Steel with Special Reference to Production, J. W. Urquhart. Machy. (Lond.), vol. 23, no. 588, Jan. 3, 1924, pp. 446-449. Carburization of nickel steels.

O

OIL ENGINES

BRITISH INDUSTRY. The British Heavy-Oil Engine Industry—Record of 1923. Gas & Oil Power, vol. 19, no. 220, Jan. 3, 1924, pp. 59-60. Notes on developments in hot-bulb, high-compression, and Diesel engines.

HIGH-COMPRESSION. High Compression Oil Engines in Theory and Practice. Power Engr., vol. 19, nos. 214 and 215, Jan. and Feb. 1924, pp. 13-15 and 49-51, 6 figs. Jan.; Recent designs and new developments that may be expected. Feb.: Practical matters affecting erection and operation.

HYDRAULIC COUPLINGS. Marine Oil Engine Gearing. Times Trade & Eng. Supp., vol. 13, no. 284, Dec. 15, 1923, p. 342, 1 fig. Describes system advocated by Vulcan Works, Hamburg, of interposing hydraulic coupling between engine and tooth reduction gearing.

ROLLER-BEARING HOT-BULB. A Roller Bearing Oil Engine. Engineer, vol. 137, no. 3552, Jan. 25, 1925, pp. 92-94, 5 figs. Describes Richards hot-bulb engine, fitted with roller-type bearings throughout.

SCAVENGING, UPFLOW-VALVE. Uniflow Valve Scavenging of Two-Stroke-Cycle Engines, R. Matthews. Power, vol. 59, no. 59, Feb. 5, 1924, pp. 208-209, 4 figs. Obtaining air and fuel mixing; solid injection for high speeds; external mixing.

OIL FIELDS

CANADA. Recent Developments in the Fort Norman Oil Area, G. S. Hume. Can. Min. Jl., vol. 44, no. 48, Nov. 30, 1923, pp. 939-940, 1 fig.

ALBERTA, CANADA. Oil Prospects In Southern Alberta, M. Y. Williams, Can. Min. Jl., vol. 44, no. 48, Nov. 30, 1923, pp. 949-950. Geology and summary of exploration.

OIL FUEL

BURNERS. Correct Methods of Using Fuel Oil, H. A. Anderson. Iron Age, vol. 113, no. 7, Feb. 14, 1924, pp. 518-519. Analysis of four types of oil burners, three types of furnaces and combinations of furnaces with burners. Address before Southern & Southwestern Ry. Club.

EFFICIENT UTILIZATION. Power Plant Management, Rob. June. Elec. Light & Power, vol. 2, no. 2, Feb. 1924, pp. 58, 60, 62 and 79, 2 figs. Efficient utilization of fuel oil.

LOCOMOTIVE, STORAGE AND DISTRIBUTION OF. Typical Layouts for Storage and Distribution of Fuel Oil, Including Fuel Oil Stations, between Terminals. Am. Ry. Eng. Assn.—Bul., vol. 25, no. 260, Oct. 1923, pp. 66-95, 9 figs. Discusses unloading facilities, storage, delivery and heating. Tabulation of replies from 14 oil-using railways to a questionnaire covering general features of design of facilities for handling, storage and delivery of fuel oil, representative layout and detail plans of such facilities.

OIL TANKS

CONCRETE. New Uses For Cement In Oil Storage, R. T. Baker. Oil & Gas. Jl., vol. 23, no. 8, Jan. 24, 1924, pp. 36, 86, and 88, 3 figs. Discusses storage of oil in concrete retainers; reduces losses; more than 600 concrete oil storage tanks, having total capacity in excess of 1,000,000,000 gal. are in service in United States at present; safety precautions.

OIL WELLS

BACK PRESSURE, EFFECT OF. Effect of Back Pressure on Wells in Brock Field, J. M. Lovejoy. Am. Inst. Min. & Met. Engrs.-Trans., no. 1292-P. Jan. 1924, 5 pp., 1 fig. Describes tests carried out in Brock Field, Carter County, Okla., showing that back pressure on flowing wells is a waste rather than a conservation of natural forces: stop-cocking, however, gives encouraging results.

OPTICAL INSTRUMENTS

DEVELOPMENTS, 1923. Review of Optical Instrument Progress of the Past Year. English Mechanics, vol. 99, no. 3069, Jan. 18, 1924, pp. 8-10, 8 figs. Account of few of more typical developments of 1923.

ORE DRESSING

CRUSHING PLANTS, DUST CONTROL IN. Dust Control in Crushing Plants Important, G. E. Lynch. Eng. & Min. Jl.-Press, vol. 117, no. 4, Jan. 26, 1924, pp. 165-167. How unhealthful working conditions in mills and crushing plants can be remedied.

ORE TREATMENT

NON-FERROUS ORES, CANADA. Developments in the Treatment of Non-Ferrous Ores in Canada during 1923, G. J. Mackay. Can. Min. Jl., vol. 45, no. 1, Jan. 4, 1924, pp. 9-12, 4 figs. Describes developments of various companies.

ORES

SCREENING. Efficiency of Screening, R. K. Warner, Am. Inst. Min. & Met. Engrs. —Trans., no. 1293-M. Jan. 1924, 10 pp., 3 figs., also (abstract) Min. & Metallurgy, vol. 5, no. 205, Jan. 1924, p. 30. Suggests method for estimating quality of work done by a screen, consisting in considering only work done on "difficult" grains, that is, those grains of which intermediate diameters closely approach screen aperture; application of this method, together with derivation of formulas and an example of their use.

OXY-ACETYLENE WELDING

APPLICATIONS. Construction, Reclamation and Destruction. Iron & Steel of Canada, vol. 7, no. 1, Jan. 1924, pp. 13-16, 8 figs. Typical uses of oxy-acetylene torch.

FREIGHT-YARD REPAIRS. Welding and Cutting in Freight Yard Repairs, H. W. L. Porth. Ry. Mech. Engr., vol. 98, no. 2, Feb. 1924, pp. 88-90, 4 figs. Parts that may be needed, procedure to be followed, precautions that should be taken; scope for cutting.

ROTARY KILNS AND COOLERS. Largest Oxy-Acetylene Welded Equipment Ever Built, R. R. Orwig. Acetylene Jl., vol. 25, no. 7, Jan. 1924, pp. 325-328, 6 figs. Experiences in oxy-acetylene welding of 8-ft. by 125-ft. rotary kilns and 5-ft. by 50-ft. coolers, installed at plant of Union Carbide Co., by Reeves Bros. Co. of Alliance, Ohio.

OXYGEN

LIQUEFACTION PRODUCTION PROCESS. Economical Plant for Producing Oxygen by the Liquefaction Process, A. G. Wikoff. Chem. & Met. Eng., vol. 30, no. 5, Feb. 4, 1924, pp. 181-184, 5 figs. Describes process and points out its economic advantages.

OXYGEN CYLINDERS

MANUFACTURE. The Manufacture of "Shelby" Seamless Steel Cylinders, J. L. Smith. Acetylene Jl., vol. 25, no. 7, Jan. 1924, pp. 329-332, 9 figs. Details of "cupping" method for manufacture of oxygen cylinders, accessory of oxy-acetylene welding and cutting equipment.

OXYGEN REGULATORS. Design and Construction of Gas Regulators, E. L. Mills. Acetylene Jl., vol. 25, no. 7, Jan. 1924, pp. 336-340, 6 figs. Deals with devices for regulating pressure and volume of gas in cylinder (as used by oxy-acetylene and oxy-hydrogen industries) up to torch.

OZONE

PREPARATION AND USES. Ozone and its Technical Applications, N. B. Lewis. Chem. Eng. & Min. Rev., vol. 16, no. 183, Dec. 5, 1923, pp. 105-107. History, occurrence, modes of preparation, preparation of pure ozone, properties, and uses.

P

PAINTING

FIELD STRUCTURES. How Should Field Structures be Painted? Contract Rec. & Eng. Rev., vol. 38, no. 2, Jan. 9, 1924, pp. 26-29. Formulas for whitewash and cold water paints that may be used by contractors for either interior or exterior painting of field offices, bunk houses, camp structures and similar buildings.

PAPER MANUFACTURE

FILLERS. New Ideas on Paper Fillers, H. P. Biedermannsdorf. Paper, vol. 33, no. 12, Jan. 10, 1923, pp. 13-14. Use of starches; asbestos; blance fixe; gypsum; use of brilliant white; kaolin; chalk; magnesium carbonate; etc.

NEWSPRINT. The Manufacture of Newsprint Paper, W. C. Munro. Chem. & Industry, vol. 43, no. 2, Jan. 11, 1924, pp. 28-33, 6 figs. Cutting and driving operations; manufacture of sulphite chemical pulp — preparation of wood; digesting or cooking process; groundwood or mechanical pulp; preparation of furnish for paper machines.

Pulp Manufacture, Decayed Wood for. Decayed Wood for Sulphite Pulp, J. D. Rue, R. N. Miller and C. J. Humphrey. Paper Trade Jl., vol. 78, no. 4, Jan. 24, 1924, pp. 45-50, 8 figs. Report of results obtained at U. S. Forest Products Laboratory, dealing with determination of utility of wood as found. Description of wood samples and of types of decay represented; preparation of wood for pulping; conditions of pulping, and other pulping data; properties of woods and their relation to pulping value.

Sizing. Action of Rosin and Alum in Sizing Paper, C. C. Schwalbe. Paper, vol. 33, no. 14, Jan. 24, 1924, pp. 9-10. Scientific speculations concerning true sizing factor in rosin size; aluminum process. Translated from Papierfabrikant.

Pulp Manufacture. The De Vains Process In Detail, J. Strachan. Paper, vol. 33, no. 14, Jan. 24, 1924, pp. 5-7, 7 figs. Describes new method for manufacture of bleached pulp or isolation of pure cellulose from fibrous raw material. From World's Paper Trade Rev.

Talc. Use of. Use of Canadian Talc in Papermaking, W. C. Lodge. Paper, vol. 33, no. 15, Jan. 31, 1924, pp. 22-25, 4 figs. Describes laboratory tests. List of references on talc and related subjects.

Waste Fibers, from. De Vains Process for Paper from Waste Fibrous Materials, J. F. Clerc. Chem. & Met. Eng., vol. 30, no. 7, Feb. 18, 1924, pp. 262-265, 9 figs. How European mills utilize such fibers as straw, bagasse and bamboo for high grades of paper.

Water Removal. Felts and Mechanism of Water Removal, F. A. Rees. Paper, vol. 33, no. 15, Jan. 31, 1924, pp. 6-10, 11 figs. Result of research work carried on by laboratory of F. C. Huyck& Sons as reported to Canadian convention.

PAPER MILLS

Fuel Waste. Fuel Waste in the Paper Mill, J. T. Beard, 2nd. Paper, vol. 33, no. 12, Jan. 10, 1924, pp. 9-11, 3 figs. Practical article on how efficiency of power plant may be increased and money saved.

Groundwood Testing. The Matter of Groundwood Testing, C. S. V. Hawkings. Paper, vol. 33, no. 15, Jan. 31, 1924, pp. 11-15, 8 figs. Apparatus and methods in used at paper mill of Price Bros. & Co., Ltd., Kenogami, P. Q., Canada.

Well Water System in. The Well Water System in the Mill, T. H. Hammond. Paper, vol. 33, no. 14, Jan. 24, 1924, pp. 11-13, 4 figs. How a well water system works out in practice in paper mill (plant of Hammond Bag & Paper Co., Wellsburg, W. Va.).

PAVEMENTS, ASPHALT

Construction, Mixtures Inspection. Plant Inspection of Asphaltic Paving Mixtures, W. J. Emmons. Good Roads, vol. 66, no. 1, Jan. 1924, pp. 5-8 and 21, 3 figs. Arguments in favor of plant inspection; suggestions regarding inspection of materials.

PAVEMENTS

Foundations. Relation of Depth of Foundations of Pavements to Their Strength, C. D. Pollock. Am. City, vol. 30, no. 1, Jan. 1924, pp. 11-13. Improving subgrade vs. heavier foundation; damage from swelling of subsoil. (Abstract.) Paper read before Am. Soc. Mun. Improvements.

PETROLEUM

Canadian Resources. Petroleum Resources of the Dominion of Canada, M. Chose. Compressed Air Mag., vol. 29, no. 1, Jan. 1924, pp. 751-753, 7 figs. Brief review of petroleum situation in Canada.

PIGMENTS

Lithopone. Record of Experiments in Testing the Light-Resistance of Lithopone, H. A. Gardner and P. C. Holdt. Paint Mfrs. Assn. of U. S.—Sci. Section, circular no. 194, Jan. 1924, pp. 174-205, 11 figs. Effect of acidity of varnish and oil.

PIPE

Strength and Stiffness Determination. Charts for Bars and Pipe in Torsion, F. Szabo. Am. Mach., vol. 60, no. 8, Feb. 21, 1924, pp. 279-282, 2 figs. Two charts making possible rapid solution of problems dealing with round bars and pipe in torsion, for determining strength and stiffness or angle of twist.

PIPE COVERINGS

Tests. Commercial Efficiency of Single and Graded Steam Pipe Coverings. Heat & Vent. Mag., vol. 21, no. 1, Jan. 1924, pp. 48-52, 6 figs. Results of recent tests on magnesia, air cell, asbestocel, carocel, nonpareil, sponge felt and multiply types, conducted at State College of Wash. and reported in Eng. Bul. No. 12 by H. J. Dana.

PISTONS

Machining. Machining Pistons and Other Contract Work, H. P. Armson. Can. Machy., vol. 31, no. 3, Jan. 17, 1924, pp. 17-20, 3 figs. Describes method of Allatt Machine & Tool Co., Toronto, of machining cast-iron automotive engine pistons accurately and economically; salvaging worn cams by recutting raceways for larger rollers.

PNEUMATIC TOOLS

Storage and Handling. Pneumatic Tool Service. Machy. (Lond.), vol. 23, no. 589, Jan. 10, 1924, pp. 480-483, 14 figs. Methods of storage; handing out and receiving tools.

POWER TRANSMISSION

Electric, D. C. vs A. C. D. C. versus A. C., A. Scherbius. Electrician, vol. 92, no. 2383, Jan. 18, 1924, pp. 70. Comparison of the two systems for transmission purposes. Abstract from Elektrotechnische Zeit.

PRESSES

Inclinable Power. Design of Inclinable Power Presses, P. A. Friedell. Machy. (N. Y.), vol. 30, no. 6, Feb. 1924, pp. 442-445, 4 figs. Proportioning mechanical knockout, legs, and inclining mechanism for power press.

Manufacture. Making Power Presses for Quantity Production, H. P. Armson. Can. Machy., vol. 31, no. 5, Jan. 31, 1924, pp. 13-17, 3 figs. Description of methods employed in plant of Brown, Boggs Co., Hamilton, Can., with particular reference to inclinable type.

PRODUCER GAS

Hydrogen in. Determination of Hydrogen in Producer Gas. Fuels & Furnaces, vol. 2, no. 2, Feb. 1924, pp. 167-168. Percentage of hydrogen in gas serves as guide in successful producer operation; thermal conductivity of hydrogen used as basis for its continuous physical analysis.

PULLEYS

Machining. Machining Pulleys on a Big Production Basis, A. E. Granville. Can. Machy., vol. 31, no. 6, Feb. 7, 1924, pp. 27-30, 13 figs. Methods employed by different shops to expedite work vary in accordance with equipment available and ideas of men in charge.

PULVERIZED COAL

Boiler Furnaces. Burning Pulverized Fuel. Southern Engr., vol. 40, no. 5, Jan. 1924, pp. 87-92, 12 figs. Application of powdered fuel to boiler furnaces (steam-power stations), and reasons for installing the system.

Locomotive Shop. Powdered Coal for Locomotive Shop, Chas. Longenecker. Iron Age, vol. 113, no. 8, Feb. 21, 1924, pp. 565-569, 6 figs. Distributed to substations and thence to individual furnaces; special design necessary for forge-furnace temperatures.

Open-Hearth Furnaces. Pulverized Coal for Open-Hearth Furnaces, W. H. Fitch. Iron Age, vol. 113, no. 7, Feb. 14, 1924, pp. 521-522. Comparisons with producer gas and fuel oil; use in air and regenerative furnaces and soaking pits.

PUMPING PLANTS

Oil-Engine-Driven Generators. Cutting Pumping Costs with Oil Engine Driven Generator, A. L. Greene. Fire & Water Eng., vol. 75, no. 5, Jan. 30, 1924, pp. 207-208 and 224-225 5 figs. Particulars of new water works plant at Gloucester, N. J., having motorized pumps with Diesel-engine-driven generators furnishing motive power; reasons for installing motorized pumps; conditions governing use; summary of advantages gained.

Water Works. The Somerford Pumping Station, South Staffordshire Waterworks Company, F. J. Dixon. Engineering, vol. 117, nos. 3031 and 3032, Feb. 1 and 8, 1924, pp. 155-157 and 187-189, 10 figs. Pumping plant consists of 4-cylinder Sulzer Diesel engine, driving vertical-spindle centrifugal borehole pump; details of plant and auxiliaries. (Abstract.) Paper read before Instn. Water Engrs.

PUMPS

Drainage. Double-inlet Drowned Drainage Pumps, Engineer, vol. 136, no. 3550, Jan. 11, 1924, p. 52, 2 figs. Describes large drainage pumps manufactured for Renala irrigation scheme of Indian Government.

Mine, Metals for. Metals Used in Mine Pumps, G. A. Drysdale. Min. Congress Jl., vol. 10, no. 1, Jan. 1924, pp. 47-49. Relative value of their resistive properties.

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RADIOTELEGRAPHY

Development, History of. The Development of Wireless Telegraphy, A. Fürst. Eng. Progress, vol. 4, no. 12, Dec. 1923, pp. 245-249, 9 figs. Traces development step by step from first Marconi demonstrations, making brief mention of most important discoveries and inventions which have influenced present development.

Selective Reception. A New Invention for Selective Reception, J. Scott-Taggart. Radio News, vol. 5, no. 8, Feb. 1924, pp. 1056-1057, 1120, 1122, 1124 and 1126, 5 figs. With system described it will be possible to operate transmitters on waves with difference of but a few meters of each other; outline of invention patented by author.

Transmitters. Radio Set with Arc Transmitters. Eng. Progress, vol. 4, no. 12, Dec. 1924, pp. 250-253, 6 figs. Fundamental idea and development of apparatus; new transmitting method by means of magnetic control; Pungs' new method for arc telephony by means of microphone; 4-kw. Lorenz-Poulsen transmitter in Lingby, Denmark; most recent German arc transmitters.

RADIOTELEPHONY

Loud Speakers. Loud Speakers, E. K. Sandeman. Wireless World, vol. 13, no. 17, Jan. 23, 1924, pp. 521-524, 5 figs. Impedance measurements; response measurements; interpretation of frequency characteristics.

Transmitters. Wireless Telephony, C. W. Kollatz. Eng. Progress, vol. 4, no. 12, Dec. 1924, pp. 259-265, 12 figs. Transmission of speech waves; transmitters for continuous waves; radiotelephony with arc transmitters, high-frequency machines, tube transmitters; reception.

RAILS

Conductor, Under-Contact Type. Under-Contact Conductor Rails. Electrician, vol. 92, no. 2381, Jan. 4, 1924, pp. 10-11, 7 figs. Describes new design giving complete protection for high-tension traction.

Welding. Manganese Special Work Welding, E. J. Shuler. Elec. Traction, vol. 20, no. 1, Jan. 1924, pp. 32-33, 4 figs. Progress in welding of manganese special work, such as solid manganese crossings, frogs and switch tongues, and manganese insert work, on lines of New Orleans Public Service Co.; shows many economies.

RAILWAY EQUIPMENT

Progress in 1923. Manufacturers Make Note-worthy Progress in 1923. Ry. Rev., vol. 74, no. 1, Jan. 5, 1924, pp. 85-93, 28 figs. Brief general description of outstanding achievements of equipment builders; coaling stations, cranes and ditchers, water valves, tractors and trailers, motor cars, and machine tools.

RAILWAY MANAGEMENT

Forecasting Traffic. Forecasting Future Volume of Railway Traffic, J. B. Blood. Ry. Age, vol. 76, no. 6, Feb. 9, 1924, pp. 369-371, 3 figs. View presented on basis of mathematical study that recent estimates are not large enough.

RAILWAY MOTOR CARS

Gasoline. Canadian National High Power Motor Coach. Ry. Age, vol. 76, no. 5, Feb. 2, 1924, pp. 329-330, 4 figs. Seats 55 passengers; driven by 225 hp. Sterling motor; built by Nat. Steel Car Corp.

Specifications. American Gasoline Rail Car Specifications. Motor Transport (N. Y.), vol. 29, no. 12, Jan. 15, 1924, pp. 418-419. Specifications of different makes.

RAILWAY OPERATION

Expense Classification. The Proposed Operating Expense Classification. Ry. Age, vol. 76, no. 5, Feb. 2, 1924, pp. 325-328. Tentative revision of classification circulated by Bur. of Accounts of Interstate Commerce Commission.

Train Control. G. R. S. Train Control Demonstrated on C. & N. W. Ry. Elec. Engr., vol. 15, no. 1, Jan. 1924, pp. 25-26, 6 figs. Results of actual service test made by Chicago & North West, between West Chicago, Ill., and Forris (Elgin), showing praticability of Gen. Ry. Signal Co.'s system of intermittent inductive tapered train control.

Miller Train Control Stop and Speed Equipment. Ry. Elec. Engr., vol. 15, no. 1, Jan. 1924, pp. 17-19, 3 figs. Describes equipment as in service on Chicago & Eastern Illinois; pneumatic manual release positive stop valve to be mounted outside locomotive cab, and reversing mechanism to give proper protection for either forward or backward movements among recent developments.

Progress on Automatic Train Control. Ry Rev., vol. 74, no. 1, Jan. 5, 1924, pp. 75-76. Résumé of what has been accomplished to date, and prospect for 1924.

Train Control in Service on the Rock Island. Ry. Elec. Engr., vol. 15, no. 1, Jan. 1924, pp. 5-10, 5 figs. Describes Regan Safety Devices Co. automatic train control system, intermittent ramp contact type, with speed control, installed on double track main line of Chicago Rock Island & Pacific, between Blue Island (Chicago), Ill., and Rock Island, in compliance with Interstate Commerce Commission's order. See also Ry. Signaling, vol. 17, no. 1, Jan. 1924, pp. 9-13, 5 figs.

RAILWAY REPAIR SHOPS

Chicago Burlington & Quincy R. R. Burlington's New Shops Greatly Increase Facilities. Ry. Rev., vol. 74, no. 1, Jan. 5, 1924, pp. 64-73, 17 figs. Chicago, Burlington & Quincy R. R. has constructed a $3,000,000 repair plant at Utah Junction, near Denver, Col., to care for all heavy repairs on its western lines as well as for those of Colorado & Southern. Describes principal buildings erected as a preliminary unit, viz., machine and erecting shop, boiler shop, blacksmith shop, power plant, storehouse and oil house, all of which are of most modern construction. See also Ry. Jl., vol. 30, no. 1, Jan. 1924, pp. 22-26, 8 figs.

Street-Car. Repair Shops at Bathurst St., Toronto. Can. Engr., vol. 46, no. 1, Jan. 1, 1924, pp. 101-104, 5 figs. Description of new shops being built at Hillcrest by Toronto Transportation Commission; plant includes repair, assembly and subsidiary shops, large stores building, boiler house, office building, etc.

Electrical Repair Work. Electrical Repair Work on the Grand Trunk. Ry. Elec. Engr., vol. 15, no. 1, Jan. 1924, pp. 10-12, 8 figs. Describes testing of headlight armatures, winding equipment, and testing or rewound retors and armatures, at shops of Grand Trunk West. Ry. Co., Battle Creek, Mich.

RAILWAY SHOPS

Tire-Heating Plant. Electric Tyre Heating Plant at the Acton Works of the Metropolitan District Railway Company. Tramway & Ry. World, vol. 55, no. 3, Jan. 17, 1924, pp. 17-19, 6 figs. Comprises two Oerlikon tyre heaters, each having rating of 60 kva.; heaters consist of a transformer with a single primary winding. Describes installation and its operation.

RAILWAY SIGNALING

Automatic Block. Signal and Interlocking Construction Shows Nice Increase. Ry. Signaling, vol. no. 1, Jan. 1924, pp. 1730, 1 fig. Automatic train control, economics of signaling and remote operation of switches received market attention in 1923. Tables giving automatic block signals and interlocking plants installed during 1923, under construction Jan. 1, 1924, and contemplated for 1924.

RAILWAY TIES

Preservative Treatment. The Financial Aspect of Tie Preservation, H. S. Sackett. Ry. Age, vol. 76, no. 7, Feb. 16, 1924, pp. 423-424. Analysis of economy of protecting timber against decay and returns from treatment.

Wood Preservers Show Economy of Treatment. Ry. Age, vol. 76, no. 3, Jan. 19, 1923, pp. 233-235, 1 fig. Results of tests and service records on use of creosote-petroleum oil mixture for treating ties; increases tie life; promises to cut cost. Abstract of Am. Wood Preservers' Assn.' report.

RAILWAY TRACK

Double Tracking and Grade Reduction. Frisco Makes Important Line Improvements. Ry. Age, vol. 76, no. 4, Jan. 26, 1924, pp. 275-279, 10 figs. Double tracking and grade reduction at several points by St. Louis-San Francisco effect marked saving with limited expenditures.

Elevation. Rogers Park Track Elevation, C. M. & St. P. Ry., T. H. Strate. Ry. Rev., vol. 74, no. 3, Jan. 19, 1924, pp. 140-145, 13 figs. Describes work of elevating Chicago & Evanston division between Irving Park boulevard and Howard Street in Chicago, Ill., operated by Northwestern Elevated R. R. Co., eliminating grade crossing.

RAINFALL

Run-Off. The Intensity of Rainfall, J. W. Meares. Engineering, vol. 117, no. 3028, Jan. 11, 1924, pp. 40-42, 1 figs. partly on supp. plate. Intensity of rainfall and consequent run-off from catchment.

RAPID TRANSIT

Financing of Systems. Detroit Rapid Transit Plant Financed by Direct Assessment. Eng. & Contracting (Railways), vol. 61, no. 1, Jan. 16, 1924, pp. 131-134. New basis for providing funds for proposed system of subways or elevated lines.

RECLAMATION

British Columbia. Sumar Dyking and Reclamation Project of the B. C. Government, M. Montgomery. Contract Rec. & Eng. Rev., vol. 38, no. 3, Jan. 16, 1924, pp. 48-50, 4 figs. Present status of scheme for reclaiming area known as Sumas Lake and protecting, by dyking, area known as Sumas Prairie, which had always been inundated when Fraser River was in flood. It is, in the main, a pumping propcsition using special electrically-driven equipment.

RECTIFIERS

Mercury-Arc. High-Power Mercury-Arc Rectifiers, F. C. Bailey. Power, vol. 59, no. 4, Jan. 22, 1924, pp. 130-132, 6 figs. Construction and operation; auxiliary equipment; how rectifier is put into and taken out of service; parallel operation of rectifiers and rectifiers with other equipment; regulation, efficiency and power factor.

REFRACTORIES

Thermal Conductivity. Studies on the Thermal Conductivities of Some Refractory Materials. Am. Ceramic Soc.—Jl., vol. 7, no. 1, Jan. 1924, pp. 19-28, 2 figs. Describes tests made for purpose of obtaining reliable conductivity coefficients on several types of refractory bricks made from ceramic bonded electric furnace products, and results obtained; description of apparatus used.

REFRIGERANTS

Sulphur Dioxide. Thermal Properties of Sulphur Dioxide, D. L. Fiske. Refrig. Eng., vol. 10, no. 6, Dec. 1923, pp. 197-200 and 204, 3 figs. Work undertaken to derive results to cover properties of super-heated and saturated regions with a thermo-dynamically consistent set of equations.

REFRIGERATING MACHINES

Evaporating Systems. Evaporating Systems for Refrigerants, W. F. Davis. Ice & Refrigeration, vol. 66, no. 1, Jan. 1924, pp. 7-10 and (discussion) 10-12. Past and present evaporators; details of design; foundation for evaporators; purifying refrigerant. Paper read at N. A. P. R. E. Convention. See also Refrig. World, vol. 59, no. 1, Jan. 1924, pp. 23-24.

REFRIGERATING PLANTS

Ammonia Condensers. Investigations of Ammonia Condensers, T. Shipley. Ice & Refrigeration, vol. 66, no. 1, Jan. 1924, pp. 17-22, 2 figs. Discusses condensers used on ammonia compression plants. Results of earlier investigations; advantages of low condenser pressures; development of design of Hestonville condenser and author's reasons for assuming such a design would give better results than other types; results of tests. Paper read before N. A. P. R. E. Convention.

Electric Equipment Control. Control of Electrical Equipment in Refrigerating Plants, H. P. Hill. Ice & Refrigeration, vol. 66, no. 1, Jan. 1924, pp. 22-26, 3 figs. Discusses transformers, starting of synchronous motors, keeping ice plant in continuous operation, etc. Paper read before N. A. P. R. E. Convention.

REGULATORS

Pressure. An Automatic Pressure Regulator, L. E. Dawson. Indus. & Eng. Chem., vol. 16, no. 2, Feb. 1924, pp. 160-161, 1 fig. Apparatus satisfactorily maintains steady pressure for period of days with maximum variation of only 2 or 3 mm. of mercury when operating under 500 mm. vacuum.

RESEARCH

Electrical Engineering. Industrial Research, with Special Reference to Electrical Engineering Development, W. Wilson. Instn. Elec. Engrs.—Jl., vol. 62, no. 325, Jan. 1924, pp. 61-82 and (discussion) 83-107, 17 figs. Classes of research work; need for technical development; causes of present position; functions of development department; recording and filing of results; indexes of literature and information; industrial research organizations in Great Britain. Bibliography.

Statistical Methods, Application of. Some Applications of Statistical Methods to the Analysis of Physical and Engineering Data, W. A. Shewhart. Bell System Tech., Jl., vol. 3, no. 1, Jan. 1924, pp. 43-87, 13 figs. Deals with application of elementary statistical methods for finding best frequency distribution of deviations; points out limitations of theory of errors, based on normal law; advantages to be gained by physicist or engineer from an application of methods reviewed.

RETAINING WALLS

Step. Step-Retaining Walls at Astoria, Oregon, U. S. A. Engineering, vol. 117, no. 138, Feb. 1, 1924, pp. 138-139, 11 figs. (Partly on p. 146). Describes Aston type of step wall, of which 10,000 lin. ft. have been constructed at Astoria; its advantages and savings effected.

RIVETS

Pneumatic Handling of Red-Hot. Pneumatic Handling of Red Hot Rivets, G. F. Zimmer. Indus. Management (Lond.), vol. 11, no. 1, Jan. 10, 1924, pp. 19-21, 3 figs. Furman method; describes Penflex rivet gun, its air consumption and working costs; conveying distance and speed.

ROAD CONSTRUCTION

Improvements. Suggested Improvements in Construction Procedure to Reduce Road Maintenance Costs, H. S. Perry. Mun. & County Eng., vol. 66, no. 1, Jan. 1924, pp. 7-9. Suggests improvements for waterbound and penetration macadam and cement concrete.

Research Work Application. Recent Developments in Highway Construction, C. M. Upham. Eng. & Contracting (Roads & Streets), vol. 61, no. 1, Jan. 2, 1924, pp. 16-20, 3 figs. Describes practical application of research results in North Carolina. Address before Am. Assn. State Highway Officials Annual Mtg., Dec. 3, 1923.

ROADS

Maintenance. The Maintenance of Roads in a Large City, J. R. Findlay. Surveyor & Mun. & County Engr., vol. 65, no. 1670, Jan. 18, 1924, pp. 49-51. Deals especially with road widenings and road surfaces. From paper read at Scottish Road Conference, Edinburgh.

ROADS, CONCRETE

Construction. Nashville-Springhope Highway, F. W. Skinner. Public Wks., vol. 55, no. 1, Jan. 1924, pp. 1-5, 4 figs. Fifteen miles of 16-ft. concrete surface laid on existing clay-gravel road in eight months; describes construction methods; hand work reduced to a minimum and close analysis of weekly reports to secure maximum efficiency.

Design and Construction. Progress in Concrete Road Construction and Design in 1923. Concrete, vol. 24, no. 1, Jan. 1924, pp. 3-11, 24 figs. Discussions by different men covering outstanding developments of 1923, Missouri's design changes, new specifications in California, expansion joint changes in Nevada, practice in Delaware, road reinforcing, practice in Michigan, subgrade support, practice in Utah, etc.

Reinforcement Reinforcement Checks Cracking of Concrete Pavements, W. S. Edge. Eng. News-Rec., vol. 92, no. 5, Jan. 31, 1924, pp. 190-193, 3 figs. Weight and bond vital factors; location affects efficiency; faulty placing common; describes ideal construction.

Subgrade Insulating. A Method of Insulating the Subgrade of Concrete Roads, R. R. Dobelbower. Eng. & Contracting (Roads and Streets), vol. 61, no. 1, Jan. 2, 1924, pp. 55-56, 1 fig.

ROLLING MILLS

Alloy-Steel Rolling. Rolling Alloy Steel, J. Clausen. Blast Furnace & Steel Plant, vol. 12, no. 2, Feb. 1924, pp. 113-116 and 133, 5 figs. Practice at plant of Harrisburg Pipe & Pipe Bending Co.

Cold-Rolling Strip Mills. Acme Steel Expands Cold Strip Capacity, G. L. Lacher. Iron Age, vol. 113, no. 5, Jan. 31, 1924, pp. 353-358, 7 figs. Features include recoiler, cooling gas for annealing, automatic roll grinder; material-handling facilities. See also Iron Trade Rev., vol. 74, no. 5, Jan. 31, 1924, pp. 359-362, 8 figs.

Tolerances in Rolling Sheets. Tolerances in the Rolling of Steel Sheets. Iron Age, vol. 113, no. 7, Feb. 14, 1924, pp. 497-499. Causes of variations from gage and reasons for current practice presented from mill standpoint.

S

SAFES

Reinforced-Concrete. The Fortis Reinforced Concrete Safes and Strong Room Doors. Engineering, vol. 117, no. 3029, Jan. 18, 1924, pp. 72-73, 8 figs. Describes safes in which reinforced concrete is used for whole body of safe, as well as doors.

SAND, MOLDING

Testing. Points Need for Sand Test, Eugene W. Smith. Foundry, vol. 52, no. 3, Feb. 1, 1924, pp. 86-87. Suggests adoption of simple vibratory test for determining relation of silica and bond contents and influence upon casting losses. (Abstract.) Paper presented at Detroit Foundrymen's Assn.

SCALES

Locomotive. A Unique Locomotive Weighing Plant, C. C. Bailey. Baldwin Locomotives, vol. 2, no. 3, Jan. 1924, pp. 56-62. 7 figs. Comprises platform track scale of immense proportions, 24 individual wheel scales, concrete scale foundations of massive construction, and specially designed and well-equipped building which covers and protects scale and its mechanism.

SCREW MACHINES

Automatic. National-Acme Five-Spindle Automatic. Machy. (N. Y.), vol. 30, no. 6, Feb. 1924, pp. 473-475, 4 figs. Provision of five spindles instead of four permits distribution of cutting strains over larger number of tools, and as result, there is less tendency for strain to occur at points where heavy cuts are being taken.

SEWAGE DISPOSALS

PLANT OPERATING RESULTS. Operating Results of Baltimore Sewage-Works, 1919-22, C. E. Keefer. Eng. News-Rec., vol. 92, no. 6, Feb. 7, 1924, pp. 250-251, 17 figs. Graphical presentation on probability paper of range and frequency of chemical and bacterial data obtained.

PLANTS. The Sewage Treatment Plants of Rochester, New York, J. F. Skinner. Am. City, vol. 30, no. 1, Jan. 1924, pp. 37-41, 3 figs. Details of each of three sewage-treatment plants serving city.

PLANTS, ACTIVATED SLUDGE. Milwaukee's Sewage Disposal Plant. Public Wks., vol. 55, no. 1, Jan. 1924, pp. 17-20, 2 figs. Detailed description of activated sludge plant under construction; will have two low-level and two high-level siphons, maximum capacity of the four siphons being 317,000,000 gal. daily.

SHAFTS

WHIRLING. The Whirling of Shafts, J. Frith and F. Buckingham. Instn. Elec. Engrs.—Jl., vol. 62, no. 325, Jan. 1924, pp. 107-113, 8 figs. Seeks to explain phenomenon of whirling by proving that it is essentially case of vibration and obeys laws of vibration, especially those relating to phase change between disturbing force and resulting displacement; describes experimental verifications of theories put forward.

SMOKE ABATEMENT

STEAM PLANTS. Methods of Preventing Smoke in Small Steam Plants, and Cheap Furnaces That Will do It, O. H. Wood. Southern Engr., vol. 40, no. 5, Jan. 1924, pp. 84-87, 4 figs. Human element a factor, also design of furnace, and grates.

SNOW REMOVAL

COST AND METHODS. Methods and Cost of Snow Removal, F. F. Rogers. Mun. & County Eng., vol. 66, no. 1, Jan. 1924, pp. 12-16. Deals with snow removal in Michigan.

SOOT BLOWERS

TYPES. Soot and Soot Blowers. Southern Engr., vol. 40, no. 5, Jan. 1924, pp. 29-37, 30 figs. Why soot accumulates, on boiler tubes; cost of soot accumulation, methods of removing it and application of various types of soot blowers to different kinds of boilers.

SPARK PLUGS

ELECTRODE TEMPERATURE. The Effect of Electrode Temperature on the Sparking Voltage of Short Spark Gaps, F. B. Silsbee. Nat. Advisory Committee for Aeronautics—Report, no. 179, 1923, 10 pp., 4 figs. Investigation shows quite definitely that voltage required to produce spark across short spark gap is appreciably reduced by raising temperature of one electrode.

SPECTROGRAPHS

X-RAYS. The Müller X-Ray Spectrograph. Engineering, vol. 117, no. 3028, Jan. 11, 1924, pp. 46-47, 9 figs. Differs from other spectrographs by its wide range of applicability and its extreme compactness; can be utilized for work by several of chief photographic methods now in use.

SPRINGS

RING. Characteristics of the Ring Spring, O. R. Wikander, Am. Mach., vol. 60, no. 7, Feb. 14, 1924, pp. 253-254, 2 figs. Recently developed spring; material stressed in pure tension and compression under load; calculations for theoretical pressure; test results in railway work.

MATERIAL TESTING. What Are the Best Mechanical Tests for Spring Materials?, W. Rosenhain. Automotive Industries, vol. 50, no. 6, Feb. 7, 1924, pp. 278-280. Difficult to determine quantitative relation between various qualities such as strength, hardness, resistance to shock, etc.; actual value of test results should be considered; author claims adequate specifications are still lacking.

STEAM

CALORIMETRIC EXAMINATION. A Calorimetric Method of Surveying the Behavior of Steam, N. S. Osborne. Mech. Eng., vol. 46, no. 2, Feb. 1924, pp. 88-90, 2 figs. Describes elements of method forming basis of experimental program on properties of steam upon which Bur. of Standards is engaged.

PRODUCTION, EFFECT OF SULPHUR ON. The Effect of Sulphur on Steam Production, T. A. Marsh. Combustion, vol. 10, no. 2, Feb. 1924, pp. 123-124. The serious increase in cost of steam due to necessity for combating effect of this element in coal.

RESEARCH. Progress in Steam Research. Mech. Eng., vol. 46, no. 2, Feb. 1924, pp. 81-87 and 108, 13 figs. Contains following reports in abstract: Report on Progress in Steam Research at the Bureau of Standards, N. S. Osborne and H. F. Stimson; Progress of the M. I. T. Portion of the Steam Investigation, F. G. Keyes; Progress Report on Work at Harvard University on the Joule-Thomson Effect, R. V. Kleinschmidt; Progress Report on the Joule-Thomson Effect, H. M. Davis.

SUPERHEATING. Superheated Steam and Superheaters. Southern Engr., vol. 40, no. 5, Jan. 1924, pp. 93-100, 16 figs. Advantages of superheated steam, its characteristics, uses, application and particulars regarding several designs in common use.

STEAM-ELECTRIC PLANTS

COAL-MINE. A Modern Colliery Power Plant, E. L. Hann. S. Wales Inst. Engrs.—Proc., vol. 39, no. 5, Jan. 12, 1924, pp. 583-631, 29 figs. partly on supp. plates. Description of power scheme, of Powell Duffryn Steam Coal Co., Ltd., which has been installed in Rhymney Valley for purpose of providing a cheap power supply in such quantity as to enable machine mining to be developed to its fullest extent, and electrical drives to be employed in all cases in which it appears to be economically correct to do so.

STEAM METERS

TYPES. Measurement of Steam. Times Trade & Eng. Supp., vol. 13, no. 288, Jan. 12, 1924, p. 439. Types of steam meters; principles of operation; some actual devices.

STEAM POWER PLANTS

CONDENSER OPERATION IN. Profit Possibilities of Vacuum in the Power Plant Jas. T. Beard, 2nd. Indus. Mgt. (N. Y.), vol. 67, no. 2, Feb. 1924, pp. 115-119, 5 figs. Discusses possibilities of condenser operation and how to realize them.

FUEL FOR COAL-FIRED. Fuel for Small Coal Fired Steam Generating Plants, F. J. Paque. Combustion, vol. 10, no. 2, Feb. 1924, pp. 120-122, 2 figs. Discusses requirements to be met by a given fuel in relation to the various types of fuel available to average small plant.

MOTOR-DRIVEN AUXILIARIES. Power Plant Auxiliaries and Their Relation to Heat Balance, A. L. Penniman, Jr. Am. Inst. Elec. Engrs.—Jl., vol. 43, no. 2, Feb. 1924, pp. 118-121, 1 fig. Points out economy of stage bleeding together with electric drive, and describes use of auxiliary generator connected to and driven by main turbine.

SAND MILLS AND PITS. Ottawa Silica Co. Operates New Plant. Power Plant Eng., vol. 28, no. 4, Feb. 15, 1924, pp. 215-218, 7 figs. Expected economy realized by construction of new central steam-generating plant in place of two old boiler houses, which supplies steam for two sand-preparing mills and two sand pits.

STEAM TRAPS

APPLICATIONS. Principles and Applications of Modern Steam Traps, W. E. Biggs and W. R. Woolrich. Nat. Engr., vol. 28, no. 2, Feb. 1924, pp. 56-58, 2 figs. Factors to be considered in selection of a steam trap for a given purpose; classification and applications of different types with suggestions for their installation and operation.

TYPES. Steam Traps of Various Makes and Their Operation. Southern Engr., vol. 40, no. 5, Jan. 1924, pp. 51-63, 29 figs. Describes designs and discusses manner in which they perform their work.

STEAM TURBINES

BACK-PRESSURE. Performance Tests on a Back-Pressure Turbine in a German Sugar Refinery (Leistungsversuche an einer Gegendruckturbine der ersten Brünner Maschinenfabriks-Gesellschaft in der Nestomitzer Zuckerraffinerie in Nestomitz a. E.), E. Josse and A. Stodola. Zeit. des Vereines deutscher Ingenieure, vol. 67, no. 52, Dec. 29, 1923, pp. 1163-1168, 1 fig. Describes notable improvement in design of high-pressure turbines; results of tests on turbine built by Brünner Maschinenfabriks Gesellschaft show efficiency of 85 per cent.

FOUNDATIONS. Checking Foundations for Large Turbines. Power, vol. 59, no. 4, Jan. 22, 1924, pp. 135-137, 2 figs. Discusses requirements for foundations for Westinghouse turbines, as well as inspections before installing unit, such as ordinarily devolve upon service engineer in charge of erecting work.

ISOLATED PLANTS. Applications of Steam Turbines for Isolated Plants, C. L. Hubbard. Nat. Engr., vol. 28, no. 1, Jan. 1924, pp. 14-17, 7 figs. Description of the different types of steam turbines and their operating principles; comparative advantages of turbines and reciprocating engines; comparative performance of engines and turbines; factors to be considered in selection of a prime mover.

TYPES AND SELECTION. The Control of Power Production, Chas. L. Hubbard. Factory, vol. 32, no. 2, Feb. 1924, pp. 166-169, 204, 206 and 208, 18 figs. Types of steam turbines and their selection.

STEEL

MICROGRAPHIC STUDY. Micrographic Study of Plain Carbon Steel, R. Rimbach. Forging—Stamping—Heat Treating, vol. 10, no. 1, Jan. 1924, pp. 46-50, 33 figs. Presents very complete set of microphotographs showing effect of various heat treatments on 1.12 carbon steel.

NICKEL. *See Nickel Steel.*

TOOL. *See Tool Steel.*

STEEL CASTINGS

HEAT TREATMENT. Making Steel Castings as Tough as Forgings, L. R. Mann. Can. Foundryman, vol. 15, no. 1, Jan. 1924, pp. 16-17, 2 figs. Proper heat treatment insures properties being imparted to metal which are comparable to those found in best forged steel. Extracts from paper read before Wis. Foundrymen's Assn.

MANUFACTURE. Speeding Up the Production of Large and Superior Steel Castings, S. G. Roberts. Compressed Air Mag., vol. 29, no. 1, Jan. 1924, pp. 731-736, 16 figs. Use of compressed air and pneumatic tools in plant of Wheeling Mold & Foundry Co., Wheeling, W. Va.; time and money saved, and large castings of a complicated character can be turned out rapidly with assurance of success.

STEEL, HEAT TREATMENT OF

BRAZED AND WELDED STEEL. Some Effects of Brazing and Welding, H. C. Knerr. Forging—Stamping— Heat Treating, vol. 10, no. 1, Jan. 1924, pp. 33-37, 20 figs. Application of heat as in brazing and welding removes strength produced by cold working; effect of heat treatment on brazed and welded steel.

LIQUID HEATING. Advantages of Uniformity in Heat Treatment, A. E. Bellis. Can. Machy., vol. 31, no. 4, Jan. 24, 1924, pp. 17-18, 4 figs. Notes on method of heat treating using a liquid heating medium; its advantages; possibilities of overcoming temperature troubles by using this method becoming more widely recognized.

MILD STEEL. The Heat Treatment of Mild Steel, R. T. Rolfe. Metal Industry (Lond.), vol. 24, nos. 1, 2 and 3, Jan. 4, 11 and 18, 1923, pp. 9-10, 33-34, and 57-59, 10 figs. Structure of mild steel; need for heat treatment of mild steel; heat treating castings; mechanism of heat treatment; burnt steel; typical range of properties obtainable; heat treating forgings; work hardening; breaking-down of peralite; etc.

PISTON PINS AND SHACKLE BOLTS. Individual Heat Treatment Will Improve Quality of Product, C. N. Dawes. Automotive Industries, vol. 50, no. 4, Jan. 24, 1924, p. 177, 2 figs. Special furnaces developed for handling of piston pins and shackle bolts make it possible to treat each part separately; specific requirements should determine furnace type used.

STEEL MANUFACTURE

BASIC. Examination of Metallurgical Processes in the Basic Process According to the Flame Gases (Beurteilung der metallurgischen Prozesse beim Thomasverfahren nach den Flammengasen), G. Bulle. Stahl u. Eisen, vol. 44, no. 1, Jan. 3, 1924, pp. 9-11 and (discussion) 11-14, 8 figs. Flame gases in open-hearth and basic processes; practical examples with Thomas converter; conclusions; measuring device.

STEEL WORKS

ELECTRICAL DEVELOPMENTS. Achievements in the Steel Industry During the Year 1923, G. E. Stoltz. Iron & Steel Engr., vol. 1, no. 1, Jan. 1924, pp. 55-58, 4 figs. Large number of electric motors being installed to replace steam engines. Describes electrical installations made.

STOKERS

AUTOMATIC. Mechanical Automatic Stokers. Southern Engr., vol. 40, no. 5, Jan. 1924, pp. 74-83, 23 figs. Necessity of mechanical stoker from stand-point of capacity and economy; several types of stokers.

STONE

CRUSHING PLANTS. Modern Stone Crushing Plant at Dundas. Can. Engr., vol. 46, no. 3, Jan. 15, 1923, pp. 141-145, 9 figs. Describes new up-to-date plant of Canada Crushed Stone Corp. Ltd., at Dundas, Ont.; primary crusher is a mammoth McCully with double discharge having 42 by 136-in. opening, driven by 250-hp. Westinghouse motor with English system rope drive; describes the various buildings.

STREET RAILWAYS

CAR INSPECTION AND TESTING. Car Inspection and Testing in Berlin, E. Kindler. Elec. Ry. Jl., vol. 63, no. 3, Jan. 19, 1924, pp. 103-105, 2 figs. Describes a number of simple methods by which, with a voltmeter and battery, it is possible to test electrical equipment of a car for short and open circuits and other faults and failures.

CARS, ENERGY CONSUMPTION. Energy Consumption of Interurban Cars. Elec. Ry. Jl., vol. 63, no. 5, Feb. 2, 1924, pp. 171-173, 8 figs. Tests made to allocate energy used between cars of Detroit United Ry. and Detroit Street Ry. when operating on tracks of latter indicate average consumption of 120.4 watt-hr. per ton-mile; heater energy also measured.

Pneumatic Body Suspension. The Holden Suspension. Elec. Ry. & Tramway Jl., vol. 50, no. 1219, Jan. 11, 1924, pp. 33-34 and 36, 5 figs. Description of a low-pressure system of pneumatic suspension suitable for all classes of vehicles (buses, trams and the like), placed on market by Holden Suspension Co., Ltd., Manchester, Eng.

Reconstruction. Rebuilding a Section of Street Railway at Milwaukee. Eng. News-Rec., vol. 92, no. 8, Feb. 21, 1924, pp. 310-312, 3 figs. Methods and equipment used in reconstruction of track and paving; reinforced-concrete paving general and special vibrolithic test section; labor-saving machinery.

Track. Paving Troubles Along the Rail, W. S. Godwin, Elec. Ry. Jl., vol. 63, no. 3, Jan. 19, 1924, pp. 101-103, 9 figs. Discusses various causes of failure of bond between paving and rail under traffic, and suggests method for permitting rail movement while preserving bond and strengthening paving edge.

SUBSTATIONS

Automatic. Automatic Substations, R. F. Wensley. Iron & Steel Engr., vol. 1, no. 1, Jan. 1924, pp. 1-4 and (discussion) 4-8, 9 figs. Discussion of automatic control devices used, and functions which they perform.

Automatic A. C. Automatic Alternating-Current Substation, C. E. Schnell. Elec. World, vol. 83, no. 6, Feb. 9, 1924, pp. 279-281, 5 figs. Station used for lightly loaded but rapidly developing district; conditions to be met by automatic stations; details of installation and operation.

Remote Control. Supervisory Systems for Control and Indication of Remote Power Equipment, C. E. Stewart and J. C. Field. Gen. Elec. Rev., vol. 27, no. 2, Feb. 1924, pp. 121-129, 12 figs. "Supervisory system" as applied to power distribution field is defined as one which gives a load dispatcher direct control over rotating or switching equipment of a power network and a continuous visual indication of operating position of such equipment. Describes distributor, selector, and cable systems.

SUBWAYS

Train-Movement Noise, Reduction of. Reducing Noise in Train Operation. Elec. Ry. Jl., vol. 63, no. 4, Jan. 26, 1924, pp. 135-138. Results of extended series of tests made by Underground Elec. Rys. of Lond. Methods developed for preventing noise from entering cars; sound-absorbing material placed in roof, walls and floor; heavy closed windows, special ventilators and shrouding of trucks are principal features incorporated in new cars.

T

TELEGRAPHY

Speed Factors. Certain Factors Affecting Telegraph Speed, H. Nyquist. Am. Inst. Elec. Engrs.—Jl., vol. 43 no. 2, Feb. 1924, pp. 124-130, 3 figs. Discusses following factors: (1) signal shaping, i. e., giving signals best wave shape before impressing them on transmitting medium; and (2) choice of codes so as to transmit maximum amount of intelligence with given number of signal elements; also discusses certain telegraph systems which have been advocated.

TELEPHONY

Carrier-Current. Carrier-Current Telephony on the High-Voltage Transmission Lines of the Great Western Power Company, J. A. Koontz, Jr. Am. Inst. Elec. Engrs.—Jl. vol. 43, no. 2, Feb. 1924, pp. 122-123. Describes power circuits and radio equipment used in carrier-current system; method of calling employed, and use of system as trouble detector and recorder of switch operation.

Circuits, Transmission Efficiency. Measuring Methods for Maintaining the Transmission Efficiency of Telephone Circuits, F. H. Best. Am. Inst. Elec. Engrs. Jl., vol. 43, no. 2, Feb. 1924, pp. 136-144, 14 figs. Transmission characteristics of common types of telephone circuits; general method for measuring their transmission efficiency; describes modern types of transmission measuring sets together with brief mention of oscillators which supply power for testing.

TELESCOPES

Development. The Growth of the Telescope, Wm. J. S. Lockyer. Sci. Monthly, vol. 18, no. 1, Jan. 1924, pp. 92-104, 4 figs. History of development of astronomical telescope.

TERMINALS, RAILWAY

Freight. Clifton Forge (Va.) Terminal Involves Heavy Work. Ry. Age, vol. 76, no. 6, Feb. 9, 1924, pp. 365-367, 4 figs. Progress made in construction of new facilities by Chesapeake & Ohio; involve construction of enlarged and modern freight terminal, including total of 66 mi. of tracks over area of 636 acres. See also Ry. Rev., vol. 74, no. 6, Feb. 9, 1924, pp. 241-248, 16 figs.

THERMODYNAMICS

Third Law. A Statement of the Third Law of Thermodynamics, E. D. Eastman. Am. Chem. Soc.—Jl., vol. 46, no. 1, Jan. 1924, pp. 39-43. Argument is made that there is in ideal case no sharp dividing line between crystalline and (supercooled) liquid states; statement of third law is proposed which is in harmony with ideas expressed.

Water-Vapor Diagram. Straight-Line Water-Vapor Diagram for the Standard and High-Pressure Ranges. (Geradliniges Wasserdampf-Diagramm für Normal- und Hochdruckgebiet), M. Seiliger, Zeit. des Vereines deutscher Ingenieure, vol. 68, no. 2, Jan. 12, 1924, pp. 25-27, 2 figs. Based on the Callendar-Mollier formulas for water vapor, author develops a new diagram, and claims to show that nearly all changes of state of water vapor can be expressed by straight lines.

TOOL STEEL

Hardness Tests. Comparative Tests of Hardness of Various Steel Tools at High Temperatures (Essais comparatifs de dureté à chaud sur divers aciers à outils), J. Cohade. Revue Universelle des Mines, vol. 1, no. 2, Jan. 15, 1924, pp. 75-104, 16 figs. Brief review of previous work on subject and discussion of author's own tests, carried out at works of Schmidt & Co. at Creusot, France; describes heat treatment to which steels were subjected previous to tests and method of testing, and gives results obtained.

TOOLS

Cross-Slide Facing. Cross Slide Facing Tools for Automatics, F. O. Hickling. Machy. (Lond.), vol. 23, no. 589, Jan. 10, 1924, pp. 483-484, 3 figs. Discusses troubles that are encountered and gives examples of how difficulties have been overcome.

Economical Production. Economical Production of Workpieces (Wirtschaftliche Fertigung von Werkstücken), J. Marretsch. Werkstattstechnik, vol. 18, no. 1, Jan. 1, 1924, pp. 4-7, 46 figs. Use of economical devices in quantity and series production; economical production of turning, boring and milling tools in factory.

TRANSFORMERS

High-Voltage Testing. Transformers for Very High Voltage Tests. Elec. Rev., vol. 94, no. 2407, Jan. 11, 1924, pp. 61-62, 6 figs. Describes high-voltage testing transformers manufactured by Ferranti, Ltd., aggregating two million volts.

Insulation Test. Effects of Time and Frequency on Insulation Test of Transformers, V. M. Montsinger. Am. Inst. Elec. Engrs. Jl., vol. 43, no. 2, Feb. 1924, pp. 145-155, 24 figs. Investigation to determine proper and fair length of time to make induced-voltage test when frequency is higher than normal, and main points brought out in investigation.

TRANSPORTATION

Barge Line. Federal Barge Line Proving Costly Experiment. Ry. Age, vol. 76, no. 6, Feb. 9, 1924, pp. 381-383, 3 figs. Mississipi-Warrior service an unprofitable venture, although handling capacity traffic.

Co-ordination of National Systems. Declarations of the Transportation Conference. Ry. Age, vol. 76, no. 3, Jan. 19, 1923, pp. 237-243. Findings and conclusions of Nat. Transportation Conference called by U. S. Chamber of Commerce, in regard to governmental relations to railroad transportation, railroad consolidations, readjustment of relative freight-rate schedules, relation of highways and motor transport to other transportation agencies, development of waterways and co-ordination of rail and waterway service, and taxation of transportation agencies. See also Ry. Rev., vol. 74, no. 3, Jan. 19, 1924, pp. 154-156.

TUBES

Bending Stresses. Bending, Stresses in Thin-Walled Tubes, J. Case. Lond., Edinburgh, & Dublin Philosophical Mag. & Jl. Sci., vol. 47, no. 277, Jan. 1924, pp. 197-208, 6 figs. Investigation of stresses in thin tubular beam, such as steel factory chimneys, monocoque fuselages of airplanes, hulls of submarine vessels, and the like.

Charcoal-Iron, Manufacture. Producing Charcoal Iron Tubes, G. H. Woodroffe. Iron Trade Rev. vol. 74, no. 7, Feb. 14, 1924, pp. 482-487, 10 figs. Methods employed by Parkesburg Iron Co., Parkesburg, Pa., in manufacture of charcoal iron tubes.

Steel, Seamless. Manufacture of Seamless Steel Tubes and Cylinders, A. R. Chaytor. Mech. World, vol. 75, no. 1932, Jan. 11, 1924, pp. 27-29. Historical review; difficulties encountered in early processes; material for manufacture; process and plant employed in manufacture; cold drawing. Paper read before Jr., Instn. Engrs.

TUNNELS

Lining under Traffic. Relining a Tunnel Without Interrupting Traffic, W. B. Snow. Tech. Eng. News, vol. 4, no. 7, Jan. 1924, pp. 253 and 288, 1 fig. Describes construction of an interior concrete lining in Coulter tunnel, northeast of Pittsburgh.

TUNNELING

Colorado Rockies. Country's Longest Tunnel Project Well Under Way. Ry. Rev., vol. 74, no. 4, Jan. 26, 1924, pp. 174-181, 16 figs. Construction details of Moffat tunnel. 6.09 miles long, through Colorado Rockies.

TURBO-ALTERNATORS

Tests. Turbo-Alternator Tests, John Bruce. Elec. Rev., vol. 94, no. 2406, Jan. 4, 1924, pp. 4-6, 7 figs. Résumé of methods of making principal measurements and apparatus used in official and routine testing of turbo-alternator units, in case of large electricity supply undertaking.

TURBO-GENERATORS

30,000-Kv. 30,000 k. w. Steam Turbo-Generator at Rotherdam. Engineering, vol. 117, nos. 3029 and 3031, Jan. 18 and Feb. 1, 1924, pp. 65-67 and 134-136, 49 figs. partly on supp. plates. Machine is largest yet constructed in England, and one of largest in world to develop its power in single casing; built by Brit. Thomson-Houston Co. and is of their multi-stage impulse type.

U

URANIUM

Ontario, Canada. Uranium Minerals in Haliburton District, Ontario. Can. Min. Jl., vol. 45, no. 2, Jan. 11, 1924, p. 44. Two new occurrences recorded.

V

VACUUM TUBES

Thermionic Valve. The Principles Underlying the Operation of the Thermionic Valve, S. Barrell. Wireless World, vol. 13, nos. 16 and 17, Jan. 16 and 23, 1923, pp. 491-493 and 528-530, 7 figs. Discusses operating features and phenomena associated with thermionic valve, with view to indicating some of its constants and how they are controlled.

VENTURI METERS

Pulsating Flow. Venturi Meter for Pulsating Flow. Engineering, vol. 137, no. 3027, Jan. 4, 1924, pp. 7-9, 14 figs. Describes new type of instrument known as 1922 Venturi Recorder, which appears to have overcome serious objection to Venturi meter when working with pulsating flow.

VIADUCTS

Conversion of Truss Spans into. Through-Truss Spans Converted to Deck Girder Viaduct. Eng. News-Rec., vol. 92, no. 4, Jan. 24, 1924, pp. 150-152, 3 figs. Without halting traffic Chicago elevated railroad places columns and girders to carry-floor of two truss spans over Union Station; four large derricks handle new steel and old trusses.

VIBRATIONS

Machinery. Vibration and Structural Damage, E. Latham Engineering, vol. 117, no. 3022, Feb. 8, 1924, pp. 163-164, 4 figs. Describes physical results which may arise as result of vibration transmitted by operation of machinery in industrial plant.

VOLTAGES

Peak Measurement. A Scheme for Measuring Voltage Peaks, R. D. Mershon. Am. Inst. Elec. Engrs. Jl., vol. 43, no. 2, Feb. 1924, pp. 156-158, 2 figs. Scheme devised by author that requires only standard apparatus that is easily portable and that can be carried to any degree of accuracy desired, without especially skillful handling.

W

WATER FILTRATION

PLANTS. New Water Works Plant of the City of Sacramento, A. Givan. Nat. Engr., vol. 28, no. 2, Feb. 1924, pp. 49-52, 3 figs. Describes filtration plant and electrically-operated pumping equipment; capacity 48,000,000 gal. per day; construction cost approximately $3,000,000; constructed in two separate units for electric operation from two separate central station systems.

WATER METERS

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ILION, N. Y. City of 10,000 Builds $500,000 Water System, Chas. M. Niles. Am. City, vol. 30, no. 1, Jan. 1924, pp. 21-23, 4 figs. Large storage reservoir under construction at Ilion, N. Y.; dam will form lake holding 150,000,000 gal. of water, which insures 5 months' supply.

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CHLORINATION. The Paterson Chloronome for Sterilizing Water. Engineering, vol. 137, no. 3031, Feb. 1, 1924, pp. 142-143, 3 figs. Apparatus embodies means for delivering high-pressure gas from steel cylinders in which it arrives, in measured quantities at constant and lower pressure to water to be treated and ensuring its distribution through body of water; two types are described, the Pulser and the Manometer type.

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WELDING

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OXY-ACETYLENE. *See Oxy-Acetylene Welding.*

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Z

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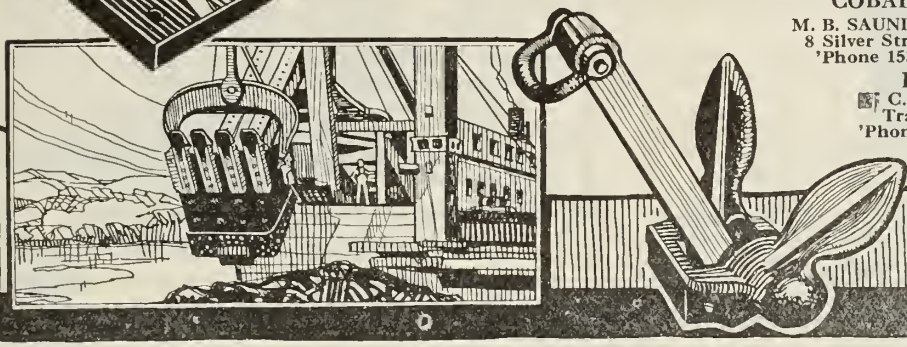

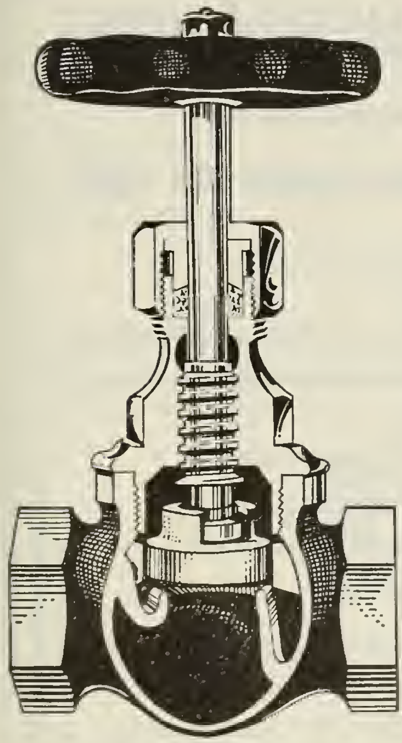

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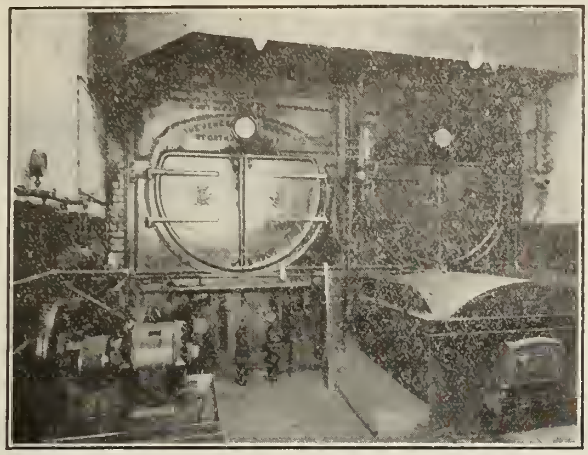

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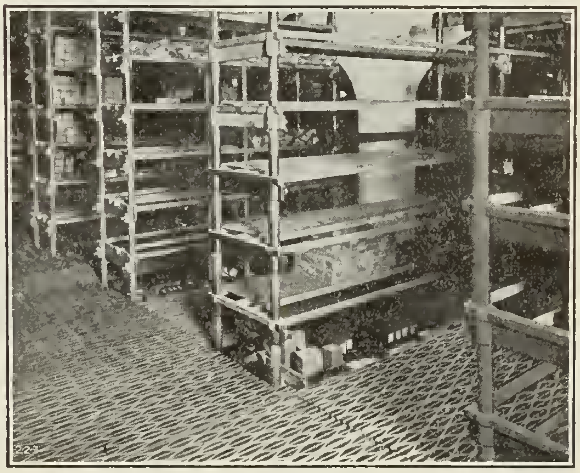

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For Alphabetical List of Advertisers see page 54

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TENDERS

CITY OF MONTREAL

Aqueduct Enlargement

Auxiliary Equipment

SEALED TENDERS addressed to the Executive Committee and transmitted by registered letter, will be received at the City Hall for the supply and installation of an Auxiliary Electrical Equipment in the new Pumping Station (Distribution Control and Auxiliary Building), consisting of slate panels, automatic oil switch, cable protectors, underground cables, conduits, etc., the whole as per specifications for the new Pumping Station contract, Part "D", provided said tenders be mailed not later than the 8th April, next, to be opened on the 10th April, 1924.

The specifications and any information required may be obtained at the office of the Montreal Water Board, No. 259 Joseph Street, Verdun.

RENE BAUSET,
City Clerk.

City Clerk's Office,
City Hall,
Montreal, 24th March, 1924.

CITY OF BRANTFORD

Tenders for Supplies

Sealed tenders addressed to Alderman C. S. Moyer, Chairman, Board of Works, care of the City Clerk, Brantford, will be received until 5 p.m.,

Thursday, April 10th, 1924

for the supply of Paving, Asphalt, Asphaltic Road Oil, Portland Cement, Limestone Dust, Vitrified Sewer Pipe, and Iron Castings for the City's requirements during the year 1924.

Specifications and forms of tender may be obtained from the City Engineer.

The lowest or any tender not necessarily accepted.

F. P. ADAMS,
City Engineer.

C. S. Moyer,
Chairman, Board of Works.

CITY OF KITCHENER

Tenders for Pavements and Walks

Tenders will be received by the undersigned, up to Thursday, 5 p.m., April 3, 1924, for the season's construction of asphalt pavements and concrete walks.

Specifications may be read and tender forms and other information obtained at the City Hall. The lowest or any tender not necessarily accepted.

S. SHUPE,
City Engineer,
Kitchener, Ont.

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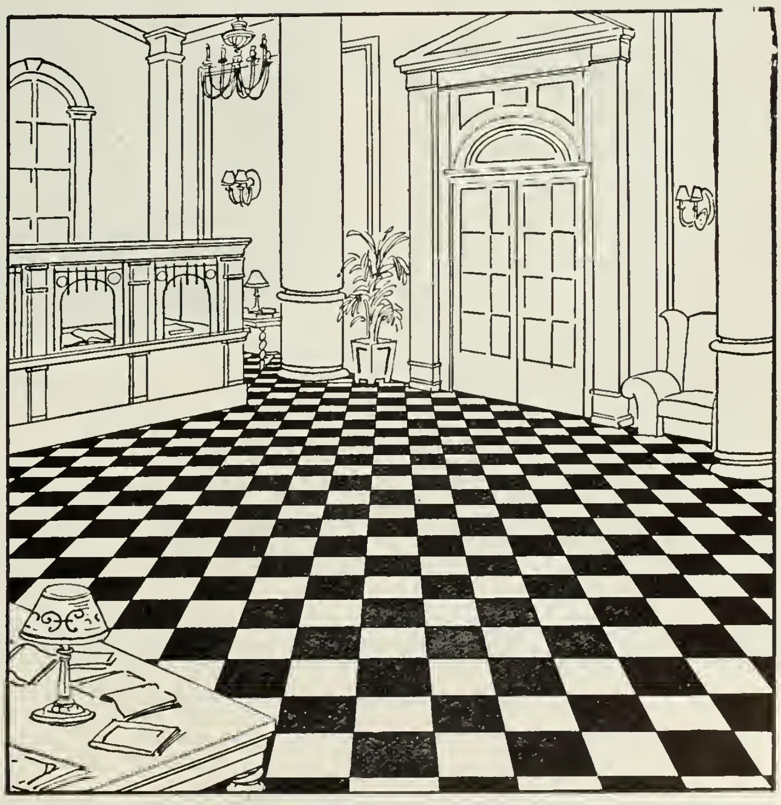

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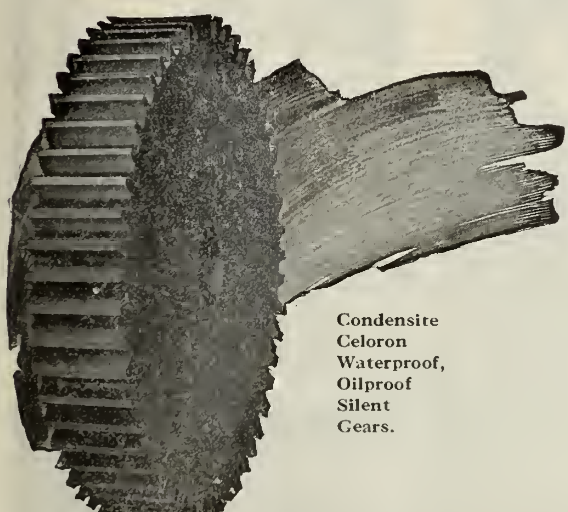

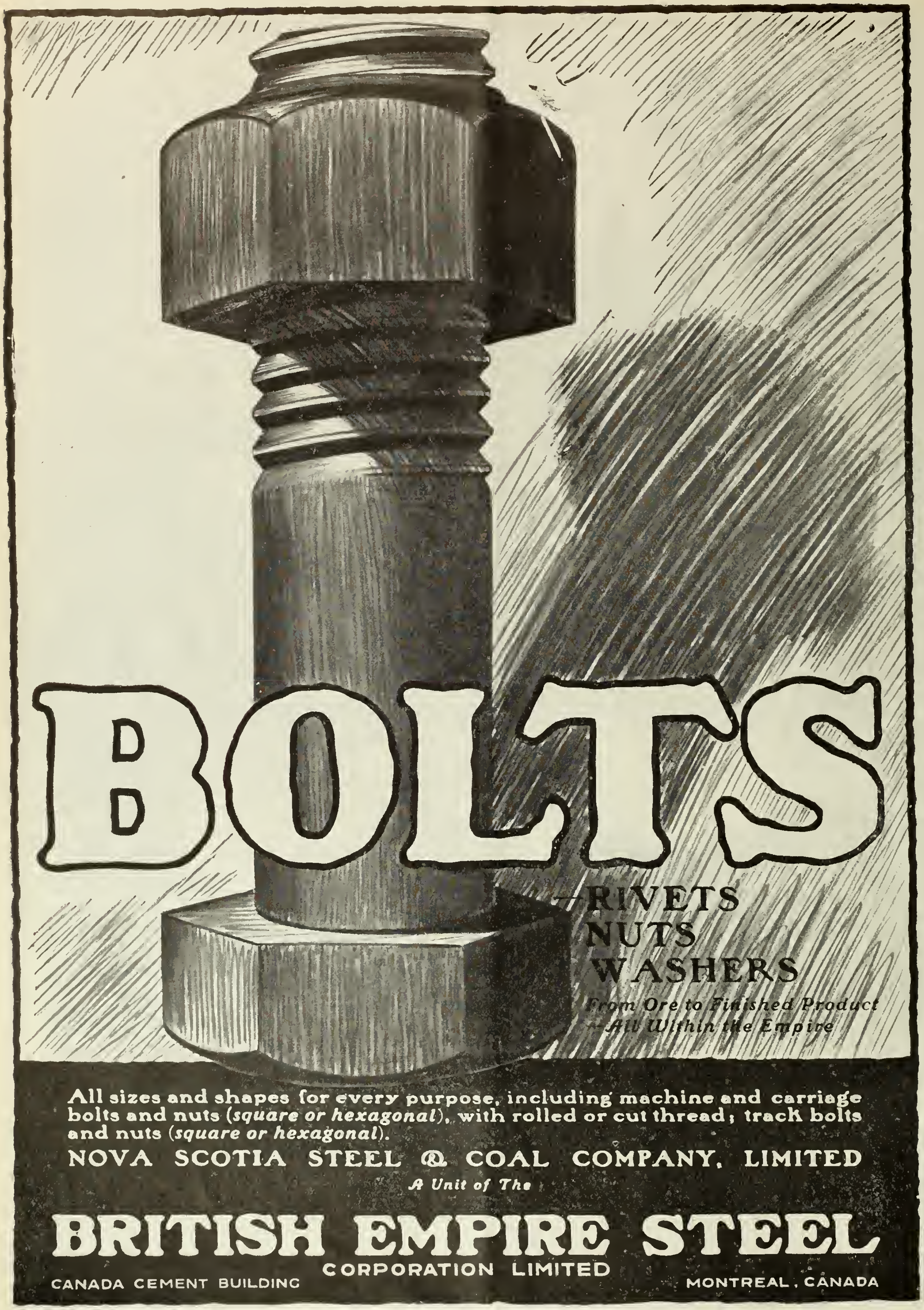
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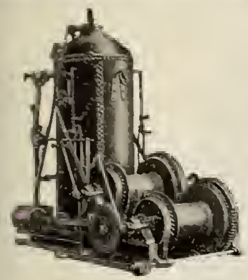
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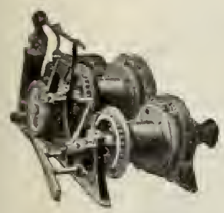
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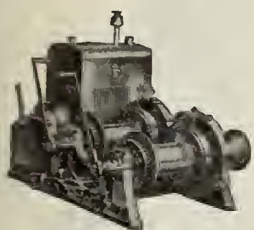
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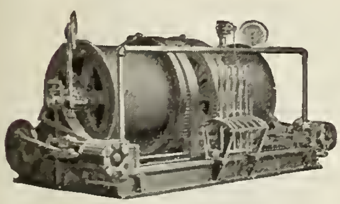
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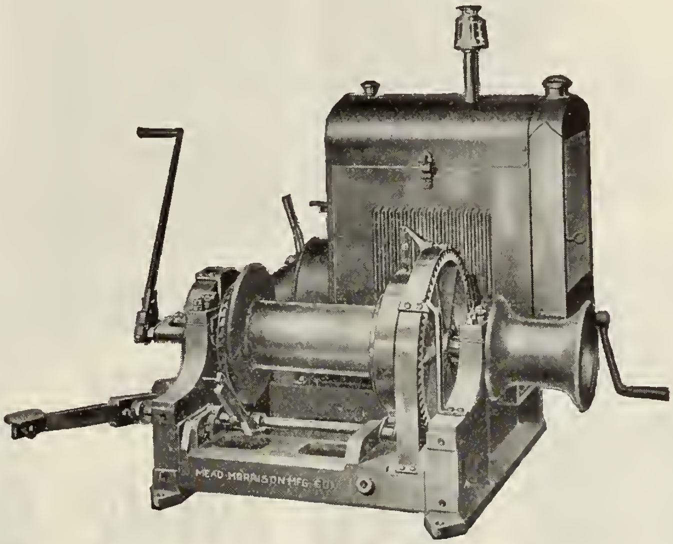

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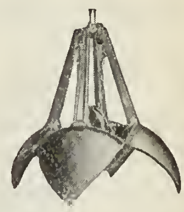
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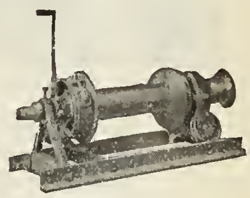
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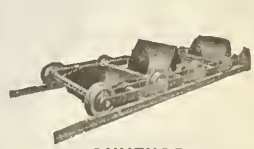
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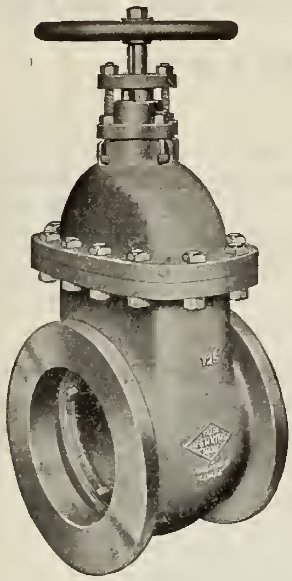

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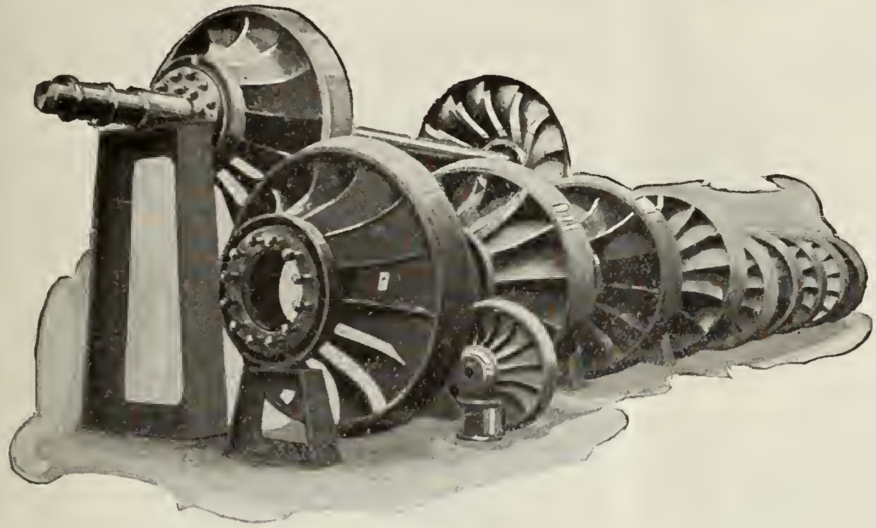

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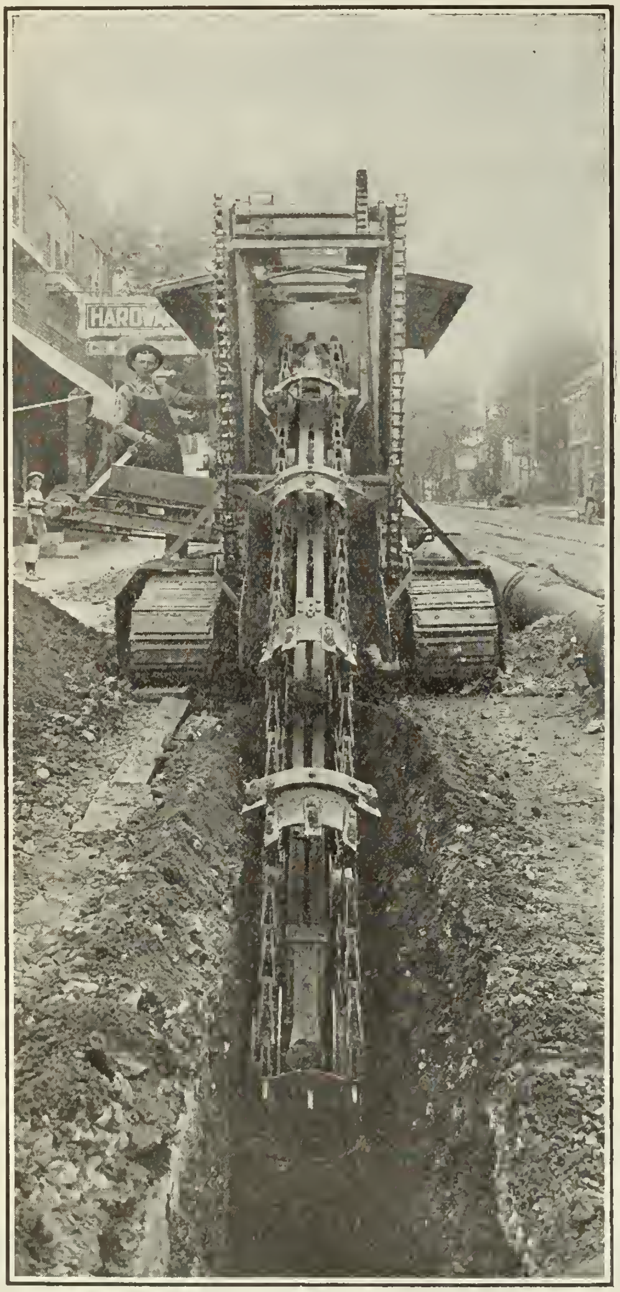

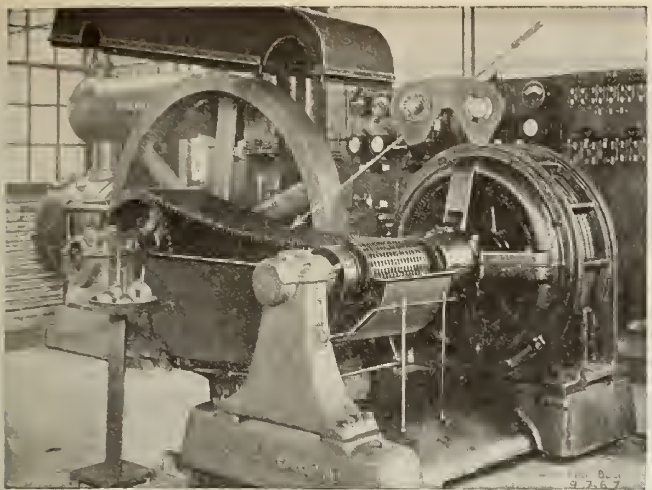

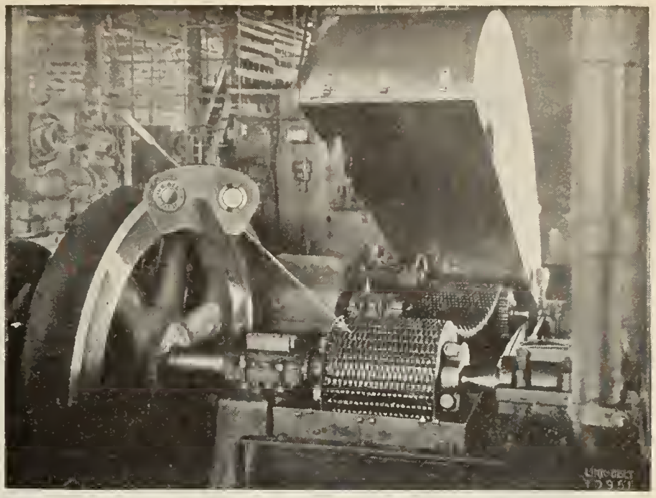

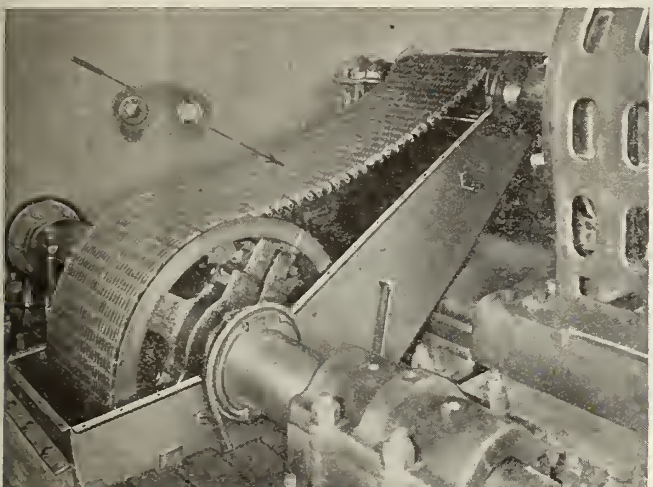

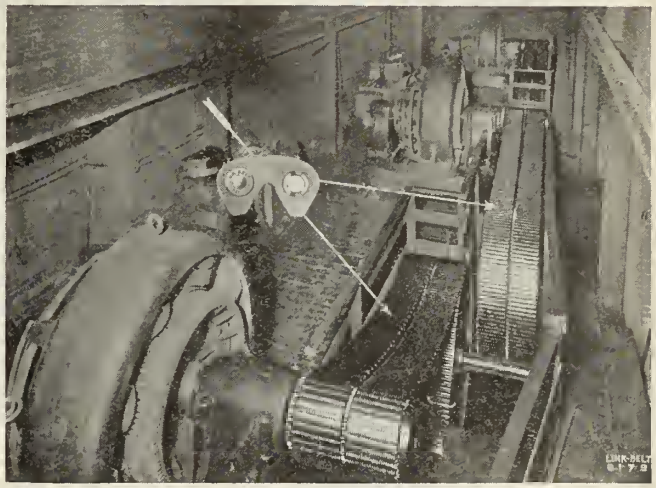

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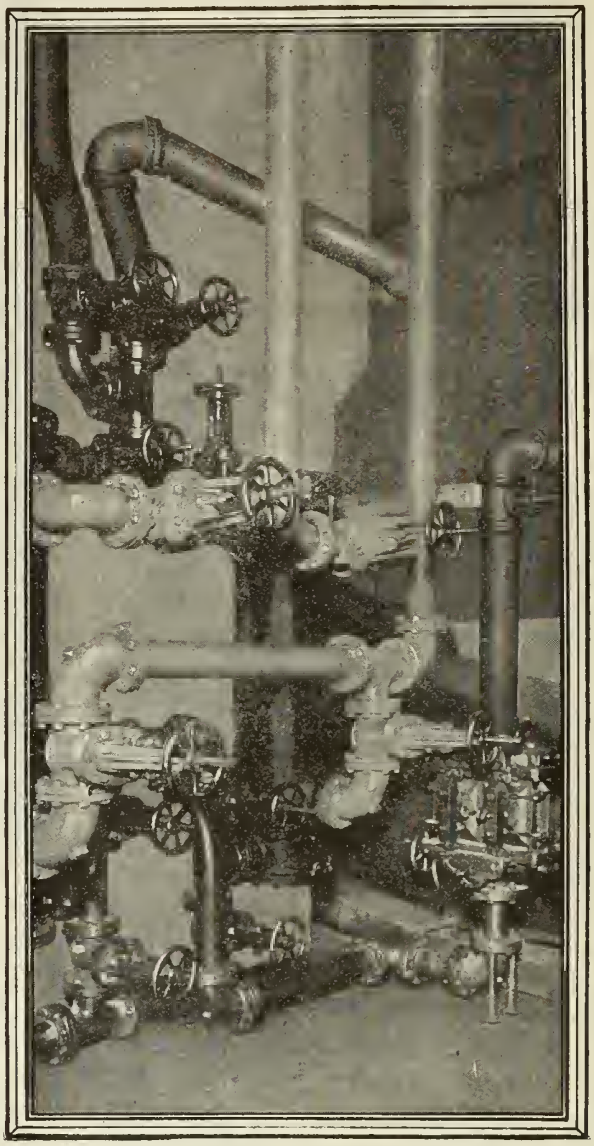

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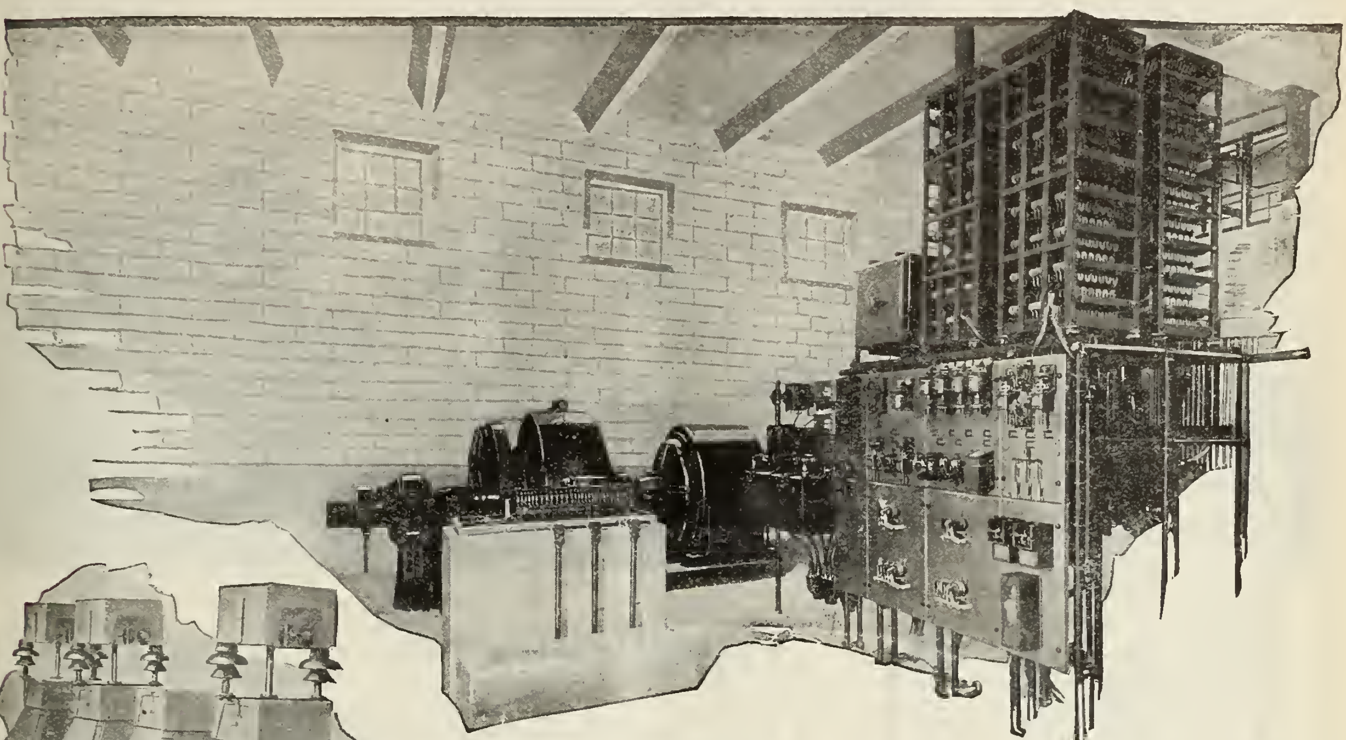

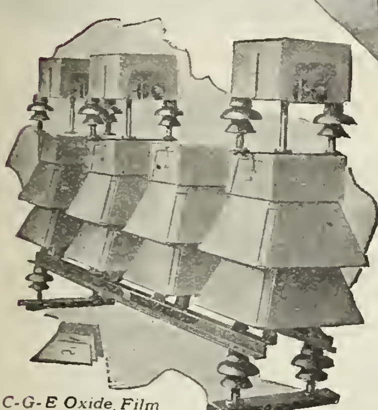

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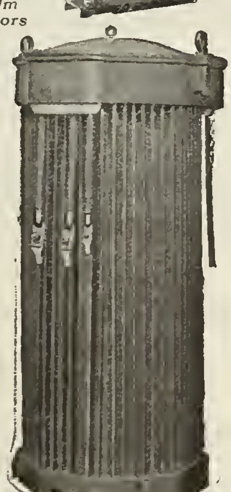

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MAY 1924

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Civil Aviation

The Present Status of Aerial Transportation, Plans for the near Future and possible Developments.

Sir W. Sefton Brancker, K.C.B.,
Director of Civil Aviation of Great Britain

Paper presented before the Annual General and General Professional Meeting, The Engineering Institute of Canada, Ottawa, January 23rd, 1924.

Speaking very broadly, the Air Ministry is divided into three departments. There is a military side, which is controlled by the chief of the air staff, Air Marshal Trenchard, and there is the civil side, which is controlled by the writer under the title of director of civil aviation. In between is the other department, controlled by the air minister,—supply and research. That department, which is at present under Air Marshal Salmond, is theoretically equally at the disposal of Air Marshal Trenchard and myself. He indicates what he wants as regards military requirements and I indicate what I want as regards research, design and so on for the civil side.

There are two burning questions at home in the matter of aviation, first and foremost, of course, being the development of new military machines. In England we have got to have the best fighting aeroplane and the best bomber in the world, so that most of the energy of that central Supply and Research department is being devoted to the development of the very best and highest types of military aircraft. On the other hand, my demands are rather overweighted by the air transport point of view. We have had now four years experience, and the air transport companies are beginning to know, or to think they know, what they want for their operating purposes and what they will want for the Imperial lines running possibly out to India and down to Australia and so on in the future.

Canada's Activity in Aviation

Your particular activity, aerial survey and forest patrol, has, I frankly admit, been rather lost sight of, because there has been no one there to press your requirements on me, and, through me, on the supply and research people. The result is that at present most of the experimental commercial machines are being developed toward travelling a speed of one hundred miles or more expressly for the purpose of flying over organized air routes. In one case we have three experimental machines on order, one an improved type for short European routes like London to Paris and London to Berlin; second, what I call the middle east machine, which is being specially designed for communication between India and Mesopotamia, and, third, what we call the Imperial route machine, which is being designed to jump from England to what is probably the nearest British possession toward the east, Malta; that is a distance of about fifteen hundred miles. The Air Council are placing orders for experimental machines of these three types, and, as you see, they are all for pure transport work and not for aerial survey.

During the last year at home I have been considering the question of the aerial survey machine but have never been able to get anybody to say definitely what he wanted, and as we have had practically no experience in this line outside of experimental work it was difficult to formulate what was required; consequently no machine has been ordered with that end in view. Now, yesterday I got from the forestry people very clear and definite specifications of what you in this country want for your aerial survey and for your forest patrol, and as soon as I get home I am going to try to get experimental machines of these two types ordered at once and tried out so that they may possibly meet your requirements in the future. It is all a matter of money, and any assistance which Canada can give by writing and asking that this be done or possibly by assuming some share of the expense will make it all the more certain that we will get these machines developed.

Progress in Aerial Transport

I think I had better just describe to you the progress we have made in aerial transport, because that progress will help you in aerial survey and forest patrol. For four years, or from 1919 to 1922, the government had a series of fluctuating policies as regards air transport.

Figure No. 1—Vickers E.V. at Air Station, Victoria Beach.

First they would not give it any sort of subsidy at all. Then they overdid it and gave a subsidy much too large for the limited amount of flying. We got that put right, more or less, and in 1922 we managed to get four lines running in different zones; first, the northern zone, to Berlin; second, the central zone, to Cologne; third, the southern zone, through Paris to Zurich, and the fourth across the water from Southampton to Guernsey. These were operated by four different companies, and they had separate zones to work in and were supported by moderate subsidies from the government, so that they were not cutting each other's throats. About the beginning of 1923 the then Secretary of State, Sir Samuel Hoare, assembled a committee called the Hambling Committee to consider the question of this air transport business across the channel. That committee recommended that the four companies should be absorbed by one big national company, and a month ago we signed the final agreement with what is going to be called the Imperial Air Transport Company. That transport company has been guaranteed a million pounds by the British government, to be spread over a period of ten years. The first year they get, I think, about one hundred and sixty thousand pounds, and so on in decreasing scale throughout the ten years. That company has the monopoly of subsidies from the government for British operations throughout Europe. Its activities extend as far as the borders of Arabia on the southern coast of the Mediterranean sea. We do not prevent other people from working over that area if they want to, but we undertake that we will not give any other British company a subsidy. So that company now has a ten years' policy to work out. It has money coming in from government every year during that time, and they ought to be able to develop things on a proper scale; and in addition they will be able to save money, because instead of having four sets of overhead charges there will now only be one. It is part of the arrangement with the government that the company is to have a capital of one million of which five hundred thousand is to be subscribed. The company is going to the public for its money in February and will take over the operations, I think, some time in March. So that for ten years we may sit back and study developments so far as British air transport goes in Europe.

In those four years during which we struggled, from the beginning in 1919 to the establishment of this Imperial Air Transport Company, we have learned a good deal about the commercial operation of aircraft. One thing we have proved is that an aeroplane can perfectly well fly for fifteen hundred hours without overhaul and that it ought to be kept sufficiently busy to cover that fifteen hundred hours within a year. Fifteen hundred hours with these fairly fast machines means 150,000 miles, so that that figure compares very favourably with any other form of transport in the world that I know of. The aeroplane, instead of being a fragile thing as we thought it was during the war, when it was shot about and roughly treated, has proved, under proper commercial organization where it is carefully looked after by the most efficient mechanics, to be a very long-lived thing as regards wear and tear. On top of that we have proved pretty well that if you are going to run aircraft to the extent of fifteen hundred flying hours in a year you should have three engines for every aeroplane, and that with types that we know well, such as the Siddeley Puma, the Rolls-Royce Eagle, and the Napier Lion we should be able to get from 180 to 200 hours from each engine without overhaul. Moreover, we have found conclusively that a pilot in a properly organized service and using these good machines should be able to do his six or seven hundred hours' flying in a year without any strain on his health. We watch our pilots very carefully from the medical point of view and so far we have discovered that that amount of flying will not hurt anybody. Now, these are useful data which we have obtained during these last four years, and data on which it is now possible to frame an estimate of the cost of any particular service much more closely than we could before.

Distances Travelled, and Record for Safety

As regards actual progress in operations, we have gone steadily forward so far as these services are concerned. During the four years the actual mileage has been in 1920, 168,000; then 599,000; then only 259,000 in 1921-22. That was due to the bad form of government subsidy which was given in the first instance. It went up to 778,000 in 1922-23, and during 1923-24 we have already done 800,000, that is, to the first of December, so we shall probably touch a million in this financial year which terminates at the end of March. That indicates steady progress in the operations carried out by these regular companies. As to the number of passengers carried, the figures in those five years were, successively, 1,155; 5,754; then a bad year, 5,692; then a boom, 11,460, and this year in only eight months we carried 13,528 passengers across the channel, so that the figure for this year ought to be about 16,000. These figures show that the public are beginning to use these cross channel services. In the same way the cargoes carried have gone up steadily.

As regards safety, we think that the record of these regular services is really a very good one. In 1920 we had one fatal accident, in which one passenger was killed. In 1920-21 we had one fatal accident in which two passengers were killed. In 1921-22 there were no fatal accidents, and the same applies to 1922-23. In August last, 1923, we had one unfortunate accident in which three passengers were killed. Well, that is not a bad record considering the mileage that has been flown in that time, covering roughly, as you have seen, two and three-quarter million miles; and they fly fairly regularly in very bad weather.

Cost Data becoming more Definite

As regards costs, we are getting down to something fairly definite, too. I think we can say now that an aircraft which can cruise at about one hundred miles an hour carrying a ton's weight over a stage of about 250 miles can be operated for 3/6 a mile if it has sufficient work to do. That means, really, that if the aircraft does its 150,000 or 200,000 miles in the year, we have boiled the

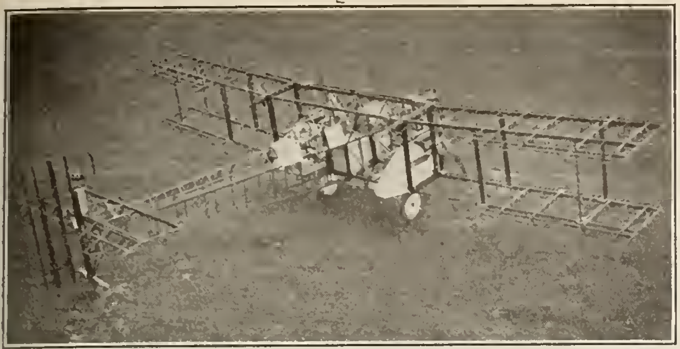

Figure No. 2—P-15 all Metal "Bolton."

cost down to about that figure; if you use slower aircraft than that you at once get a reduction in price. I hope also that with the national company and the consequent reduction of overhead charges we shall be able to get that figure lower still.

I think we are also making steady progress toward a reduction of cost, which of course is one of the greatest handicaps of air transport to-day. One of the factors in this reduction of cost is the new experimental machines which are being designed, those which I indicated to you just now, and in whose specifications we have demanded what practically means a 20 per cent addition to the paying load for the same horse power. That is, the new machines will carry 20 per cent more than the old ones did, for the same cost of operation and maintenance. On top of that we are making every effort to obtain a more reliable and wear and tear engine. There are at present on the stocks one or two engines which the designers claim will run 600 hours without overhaul. That means an enormous step in advance, because one of the biggest items of maintenance and operation is the constant repair and overhaul of the engines. If we can extend the length of the running life of an engine without overhaul from 200 to 600 hours, it means we can not only reduce the capital cost involved in buying the number of engines required, but can also reduce the work on those engines, labour, and spare parts, very materially, and with that we ought to be able to reduce the possibility of forced landings, because an engine that can run 600 hours without overhaul is more likely to be reliable than one which can run only 200 hours.

That condition of reliability will in its turn reduce the insurance costs. Insurance costs to-day are high, the rate being something like twenty-five per cent per annum on each machine. That is not because it is dangerous, but because if you happen to have one stupid little engine failure you may do a very large amount of damage to a machine without any injury to passengers or pilot. Insurance is afraid of that risk, and the result is that to-day the rates are high; and if we can only get the engines more reliable and eliminate the chance of forced landings, our insurance rates will drop considerably. Now, there are three things I have mentioned to you which are tending toward lowering the actual cost of operation, and I do not see why these three items should not bring the cost down to something in the neighbourhood of half a crown a mile for the type of machine to which I have referred.

Greater Stability

In addition to that we are making considerable progress toward greater stability: and greater stability will mean that we shall fly even more regularly than we do in really bad weather. When we do that we shall at once get greater patronage from the public. The fear of aviation on the part of the public, I think, is gone or is wearing off, but the uncertainty of aircraft operation in winter through bad visibility is rather deterring people from travelling by air, and when we can establish a higher standard of regularity in running, then we shall get greater patronage from the public, and so, of course, get the operation nearer to a paying proposition.

All these items of progress will help your aerial survey machine, because they all tend toward producing a machine which is cheaper to operate than those of to-day. What I gathered yesterday from your people at Montreal was that the specifications required were quite easy to fulfil; the really burning question being that we have got to produce a machine of which the original cost and the subsequent costs of operation will be as low as possible.

Airships are not Rivals of Aeroplanes

I must make some mention of airships. Airships and aeroplanes are not rivals. The aeroplane is a comparatively short range vehicle. Our experience in Europe, where you have a great many large cities within close range of one another, is that generally speaking it is unwise to fly for more than 300 miles without stopping to fill up with petrol, because if you go further than that you are merely carrying your fuel at a very exorbitant cost. Of course if you are flying across a desert country where there is nowhere to come down you can fly further, but it means a certain reduction of your paying load which will make that particular service rather expensive. With airships the reverse is the case; I think it is generally considered by the theorists, although we have no practical experience in the commercial working of airships, that to come down within less than a thousand miles flight is distinctly wasteful. You have to provide an expensive mooring mast, in some cases an expensive gas plant, sheds and so on, in order to have a safe harbour for your airship. With aeroplanes you can say, within limits, that the more aerodromes you have, the better; with airships the less the better.

After a very vacillating policy in England this last government hardened their hearts and we practically got what is called the Burney scheme approved. It would have been finally approved and set going if it had

Figure No. 3—Interior of Vickers "Vimy" Commercial Aeroplane.

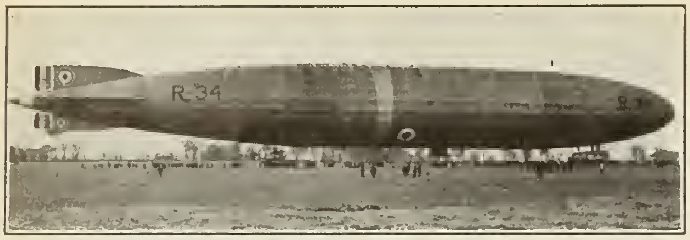

Figure No. 4—R-34 Airship, Official Design.

not been for this political crisis. We had everything cut and dried; the matter would have gone before parliament last December and I do not think there was any doubt that it would have gone through and that the contract would have been signed and operations commenced by this time. Unfortunately, however, the political crisis arose and the scheme had to be shelved. It is still in a state of suspension. It may be that this present government will put it through, it may be they will not; we cannot tell yet.

The Burney Scheme

Roughly, the Burney scheme is this. We have offered a big company, of which Burney is the leading spirit, four hundred thousand pounds for the first stage of the scheme and he is to put up two hundred thousand pounds in cash. In that first stage he is to construct one ship of five million cubic feet and fly it out to India from England in one hundred hours, stopping at Cairo en route. From our point of view, and from his point of view, it is a big thing, because a five million cubic feet ship is more than twice as big as any Zeppelin that has yet been produced. I think the biggest Zeppelin flown was 2,350,000 feet, and that is about the size of the Shenandoah and about the size of the German reparation ship that is coming over to the United States next spring. We are going to jump straight on to five millions, and the designing experts do not anticipate any serious difficulty. Our reason for going so big is that the smaller airship cannot be depended upon to pay commercially; you have got to get the big sizes before you can carry sufficient goods and sufficient passengers to make the thing really pay.

I reckon it should take Burney at least two years to build the ship and get her flying and out to India. Then we promise him four hundred thousand pounds a year for three more years, and he is to put up another lump sum, I forget just what the amount is. At the end of that three years we demand a regular weekly service between London and Delhi, or Bombay. Then, again, there is a third stage. We offer him another four hundred thousand a year for three years, and during that period he must operate a bi-weekly service to India. That is the scheme. Personally I think that if he gets through the first stage successfully the second stage will come more quickly than in three years; the third stage will come hot on the heels of the second, and if he gets through the first effort in two years I think in three or three and a half we should have a weekly service and perhaps in four years or four and a half a bi-weekly service, of one hundred hours between England and India. That is only the first step; we hope if that can be proved a commercial proposition that it will not take long for a service to spring up between Canada and England and, possibly, India and Australia; and then if it is carried down to the Cape you will have the most wonderful system of Imperial communication that could possibly be imagined. It may seem hardly conceivable, but you might almost say that you could go to India from here in 150 hours and on to Australia in another 100, or 250 hours; that is possible within the next ten or fifteen years, I should think.

But we are playing with things that we do not know very much about, and airships have a bad history. We broke our R-38 in half, as you know, with disastrous results, and I have no doubt that the Dixmude, which was lost the other day, also broke in half, judging from all the evidence that is available, but after all, the Dixmude was admittedly a weak ship. She was built in Germany during the last years of the war for extreme speed and extreme ceiling, designed to fly 20,000 feet or something like that; therefore her performance is not a fair test. The Shenandoah, on the other hand, is a stronger type of ship designed after the war. She put up a wonderful show under very difficult circumstances. Her performance has certainly increased my confidence in the airship generally; and we reckon we are going to design something very much better than the Shenandoah.

The Importance of Helium to Canada

There is another thing besides Imperial communications that should interest Canada and that is the question of helium. The danger of the combination of petrol and hydrogen cannot be neglected or denied; you have got two things which if mixed make a very explosive substance. We are working at home with a view to dispensing with the petrol engine in connection with airship construction and have an engine which will use kerosene or paraffine. I am not a scientific expert on fuels, but it would seem that the mixing of a heavy fuel with hydrogen gives very good results and avoids a considerable amount of the danger from fire. Beyond that we are even going in for the heavy crude oil engine, which I think is certainly to come out in the next two or three years. That is one step towards safety. The other is to obtain helium, and so far as I know Canada is the only portion of the British Empire that produces helium. It has not been of any use to anybody so far, so it has not been exploited and no one knows just how much helium you have got or whether it can be produced at anything like a commercial rate. But the question is a very interesting one, particularly to us in England, and I would like to suggest to you gentlemen that when you have time to think about it, do think about helium; try to find out how the matter stands in this country, just how helium could be produced on a commercial basis so that it would not be unreasonably expensive.

The Light Aeroplane

Before I conclude I wish to touch upon one other point, and that is the light aeroplane. The meet which took place last October in England was a very interesting experiment. We only had motor bicycle engines to play with, varying from the 450 C.C., engine, which we reckoned gave about 7 horse power, up to the 750 C.C., engine, which gave up to 12 or 15 horse power; and the results were rather remarkable. For instance, one type, the Wren, with a 400 A.B.C., engine, I think, giving about 7 horse power, carried a 60 pounds load per horse power, including its own structure, the pilot, and everything. Now, the cross channel machines flying to-day are considered to be heavily loaded if they carry 16.5 pounds per horse power, and this one actually carried 60. But the Wren was very lightly loaded as regards surface, only 2.8 pounds per square foot. Its speed ranged from 25 to 49 miles an hour and it actually covered 87.5 miles to one gallon. It had a poor climb and it came off the ground very slowly. It was a freak, but it was a very interesting freak and a very interesting experiment. It was going too far perhaps for practical purposes but it showed what can really be done; that a machine can actually fly 87.5 miles on one gallon, carrying an able-bodied, full-sized man.

I might mention the performance of another good, all-round machine the De Haviland 53. It did not win any prizes, because the prize winner is usually a sort of freak, it has either very low power, like the Wren, or is designed particularly for climbing, speed, or something else; but it was the best all-round machine there. That machine developed about 15 horse power; it carried 32.7 pounds of weight per horse power, and it had 4 pounds of weight per square foot of surface area. Its speed varied between 36 and 65 miles an hour, which is almost a good commercial proposition, 36 being a good slow landing speed. It actually covered 59.3 miles per gallon. Its climb was distinctly good. It got off the ground very well and it could be stunted just the same as you could stunt any single seater fighting machine; apparently it was very easy to manœuvre. These, I think, are very interesting results. One of the outstanding features of this competition was that all the machines, in spite of low power and high load per horse power were apparently very easy to fly. It is true that the pilots were good ones, but they were all unanimous in the view that these machines were very much easier to fly than anything they had flown before. Now, we are pushing on with that phase of it, and in July of this year we are going to have a competition to see if we can get a two seater training machine with a small powered engine. We have extended the size of the engine to 1,100 C.C., which I reckon will give something in the neighbourhood of 20 to 25 horse-power. We are demanding two seats and dual control, and it may be that we shall evolve a very good machine.

The Value of Light Aeroplanes

Well now, these machines have certain distinct values. First, the small machine seems to provide us with an opportunity of making small scale experiments of innovations fairly cheaply. To-day we have the wind tunnel and other scientific devices for the purpose of ascertaining the qualities of a machine before it is built, but before we can actually determine these things we have to build a full sized machine, which may cost anything up to eight or ten thousand pounds. We hope by means of the small machine to be able to produce a small model of any new development and try it out on a small scale before we go to the big expensive scale at all.

The second consideration is that of cheap military training, and that is why we are giving these prizes next summer to try to get a cheap training machine. On top of that, which to me is far more important, is the education of the public, because if these two seaters prove to be good and safe to fly and easy to fly we have a scheme for the development of flying clubs all over the country, of presenting them with so much comparatively cheap material and telling them to carry on simply as a civil institution. We hope by that means to get the spirit and the idea of flying spread throughout the country.

The development of the small machine is something which I think may also affect you, because two or three designers have indicated their desire to make a small flying boat or small seaplane on a design similar to these small aeroplanes. It seems to me that a small cheap machine of that sort would be invaluable to Canada for the purposes of forest patrol or for inspection purposes, and would also be a cheap means of educating the public and encouraging the young aviator and teaching him how to fly. Of course the weakness of the light aeroplane to-day is the engine. We have nothing but motor bicycle engines, and by the very nature of things it is obvious that the motor bicycle engine is not designed to meet the particular stresses and strains to which an aeronautical engine is subjected. We hope that this competition during the summer will inspire the engine designer to produce some small engine especially designed for aviation work.

Reserve Training School

There is just one other thing of general interest to which I might refer. After four years during which nothing was done we have now started reserve training schools. Six of these are running or just starting to run. The policy we have adopted is to use our big designers and manufacturers for this purpose, and to-day the Bristol Company, the De Haviland Company, the Siddeley Company, the Beardmore, the Avro and the Blackburn are all starting these civil training schools. The schools are to be run by the civil firms themselves, to whom a grant per head of reserve officers trained is to be made. We are arranging also for refresher courses with a view to bringing the war pilot back to a state of efficiency, and after that he will do an annual training of so many hours. The refresher course covers 15 to 25 hours, and I think we pay two hundred pounds for it. The annual training covers twelve hours. It can be taken in four different week ends in the four different quarters. At present the rate is about one hundred and fifty pounds, but as we get on to more modern machines instead of the old war stock I anticipate that we shall have to put those rates up.

These schools, I hope, are going to have a very good effect. First, they will do much in the way of educating the public. Second, they will have the effect of keeping the designers and manufacturers in close touch with actual flying operations and will give the experimental staff, which they are bound to keep up, some useful work outside their ordinary experimental activities, which are frequently very slack. Third, they will give the man in the street the opportunity of learning to fly without having to go into military service for the purpose.

Well, gentlemen, I think that is all I need say at the moment, but I am quite prepared to answer any questions that you may care to put to me on any point in aviation which may be of interest. I thank you very much for listening so patiently to my somewhat rambling address.

Discussion

Dr. Charles Camsell, M.E.I.C.: General Brancker has said that Canada is the only country in the British Empire producing helium. Unfortunately we are not producing helium at the present time, although from investigations the Department of Mines made during the war it was determined that helium existed in gases, particularly in the Bow Island field, Alberta. During last summer we made a re-examination of a number of natural gases through Alberta with a view to determining the content of helium in those gases. That investigation is not completed but is still under way. The other day when I was in Washington, in discussing this matter of helium with the United States Bureau of Mines, I was informed by the director that they were recovering their helium gas from the natural gases in Texas and that they had recently perfected their methods of recovering helium from the gases. That is to say, their method is much quicker; they are able to bring about the conditions under which helium is recovered much more rapidly than they formerly did. It is our intention to look over this process that the Bureau of Mines has developed.

C. H. Keefer, M.E.I.C.: I am sure we have all very much enjoyed Sir Sefton Brancker's most interesting address. There is just one question I was going to ask: about what is the cost of commercial flying per mile at present? With regard to Dr. Camsell's remarks, I am very glad to hear that you are really going into the question of helium. I know the Americans are making every effort to reduce the cost of production, and they seem to be fairly optimistic about doing it. As regards the cost of flying, I did indicate that at the beginning.

Sir Sefton Brancker: We reckon that at one hundred miles an hour carrying one ton over a stage of about 250 miles, the cost should be 3/6 a mile. By increasing the paying load with new types of machines as compared to the horsepower, by increasing the life of the engine from 200 hours before overhaul to about 600, by increasing the reliability of the engine and thereby saving insurance costs, I do not see why we should not get that figure down to about half a crown a mile. If you are prepared to fly slower, then you get it cheaper, but we find that in European services where you have the train and the boat to compete with, in order to run regularly you must have a speed of at least one hundred miles an hour. I may say that the figure I have given is the cost per machine per ton mile, flying at one hundred miles an hour, and the ton is actual paying load. The machines we are using now in the cross channel services carry 1,800 or 1,900 pounds. The machines of the immediate future, those that are being manufactured to-day, will put that weight up to a ton or perhaps a little more than a ton, and with the same type of engine it means you are carrying a ton at the same cost as you carrying 1,800 pounds to-day.

C. E. W. Dodwell, Hon. M.E.I.C.: Is it a reasonable expectation that travel by air will ever compete successfully with travel by rail or steamer, that is, from the point of view of the travelling public? Will aerial travel for the passenger ever compete in cheapness with travel by rail or steamer?

Sir Sefton Brancker: I do not think you could exactly say that air transport is going to compete with the older forms of transport. It seems to me that air transport fills a gap which the progress of civilization and the increase of trade throughout the world creates. I do not think that aircraft are going to cut out the railways or the steamships; they are rather going to supplement them, particularly in the carrying of mails or passengers where speed is required. It may help out in that it may eliminate the necessity of building certain new railways. For instance, take the case of Cairo to Bagdad: there is quite a strong movement to-day for the building of a railway right across the desert from Bagdad to the Mediterranean sea. Well, the cost of such a railway line would be something enormous, and communication by aircraft would probably require a much smaller capital investment and be much less expensive in the end than communication by rail. The capital required for an air service is as a flea bite compared to the capital required for a railway, although its operating cost may be considerably higher.

So far as an airship service say to India is concerned, it may compete to some extent with shipping, I do not know. But the number of passengers carried would be comparatively small, not more than about one hundred on each trip. The airship service, though, will rival the steamship lines in the future as regards the carrying of first class mail matter which can afford to pay the cost. I think in every case air transport must from its very nature be more expensive than other forms of transport; it is giving you the greatest speed and you must pay for it. Where you do effect economy is in such a case as that of communication between Bagdad and Cairo, the saving in capital expenditure as compared to railway construction being, as I have said, enormous. Another case came to my attention recently, that of a gold mine in Peru which has extraordinarily bad communications. It is fairly well proven that air transport will be the cheapest means of operating that gold mine. In such cases air transport may take the place of railway communications; otherwise, no.

A. A. Bowman, M.E.I.C.: It is quite apparent from the recent experience of the American airship Shenandoah that the devices for the mooring of airships are still in a crude state, and it may be possible that Canadian engineers will have to study the design of harbours for airships when we have this trans-Atlantic airship service. For instance, at present it would be very difficult to moor a large airship in Halifax harbour. Perhaps Sir Sefton Brancker could give *The Engineering Institute* some hints as to the line of design that may have to be followed in Canada for the providing of suitable air harbours for airships.

Sir Sefton Brancker: The first point is as to the Shenandoah incident, is that the mooring mast was invented, I think, before the war; it never came into real operation until after the war, so it is a comparatively new apparatus. It has revolutionized the use of airships, because before that if you had a cross wind blowing across the mouth of your shed it was practically impossible to put the airship into the shed until that wind had dropped, and the result was that you had to have 500 men on the ground hanging on to the airship. Of course, that was an impossible situation. Now the mooring mast has come in and the airship need never go into its shed except to be overhauled, just as a ship goes into dock for overhaul; all its operating life will be spent either in the air or moored to a mooring mast. We really do not know much about the strains and stresses inflicted on an airship at a mooring mast, but we do know a certain amount and we are learning. In the case of the Shenandoah, obviously the strength of the nose piece and of the arrangement by which that nose piece was attached to the body of the airship were too weak to withstand the enormous gusts that were blowing, the wind having a velocity of something like 60 miles an hour. But it is quite an easy matter to strengthen that part of the airship. It is an engineering job of no great magnitude, and I do not think there is any doubt that we can get a mooring mast and an attachment to it which will enable an airship to weather any gale. The only danger as regards the mooring mast is that the ship should strike something when being bumped about by the wind, and to obviate that you have got to have the mooring mast a certain height so that the ship will not strike the ground; and of course you have got to have an absolutely clear run all round in order that the ship cannot touch anything. To talk about the design of a harbour is a little difficult because I have not got the figures in my head, but I should think you must have round your mast an absolutely clear, open space of level ground of a diameter of something like 800 yards so as to give you plenty of room, and if you have a shed is ought to be somewhere outside that 800 yards. The height of the mooring mast for these big five million cubic feet ships is something in the neighbourhood of 160 feet. I am talking without the book and I may be wrong, but I think that is about right.

J. M. Oxley, M.E.I.C.: May I ask whether the results of researches made, for instance, by the Americans in the designing of their airships are available for the use of your department, or do you have to start with a clean sheet?

Sir Sefton Brancker: The American ship is practically a Zeppelin design. I think there is no doubt at all that the new company, once it has got the agreement signed, will have access to Zeppelin design. But you must remember that we had some of our leading firms on airship work right through the war, and they have very definite opinions on the development of airships as well as the Zeppelin people. They claim that they can go one better than the Zeppelin and even possibly avoid Zeppelin patents; but I do not know, it is too technical a question for me. I think you may say, however, that Zeppelin information is available to the world to-day. They are very hard up; all their people are looking for jobs and they are quite ready to let anyone with a real sound company, such as ours will be, have the full value of their information and the data that they have got together in the past.

There is one point that perhaps I did not make clear about the mooring mast. The mooring mast has obviated the necessity of having a large landing party. What happens now is that at the bottom of the mast, which, as I have indicated, goes to a height of probably 160 feet, is a winch with a steel cable running right up into the cap at the top of the mast. That steel cable is brought down to the ground and its length continued by means of a light rope, or something of the kind. The airship, as she works herself toward the mast, throws overboard a rope, just as a ship does when nearing a dock; that rope is linked up to the steel cable; eventually the airship pays out a steel cable and then you get on to the winch; the airship is pulled up to the mast, its nose goes into the cap, and there she is. Thus it is that a matter of half a dozen men can do the whole thing. Of course when she occasionally has to go into a shed, that is a job for a landing party.

J. G. MacPhail, M.E.I.C.: May I ask what progress has been made in connection with the development of the helicopter?

Sir Sefton Brancker: The helicopter is rather a delicate subject, because we have been trying to develop it since 1915. I think, gentlemen, — this is only my own personal opinion, but I know it is also the opinion of a good many others — that the helicopter, while a very interesting scientific experiment, is rather a blind alley so far as practical work goes. The reason for this is quite simple. The helicopter is a flying machine which is supported in the air by vertical propellers of some sort which are going around in a horizontal plane. The speed at the top of that propeller is very considerable; it must be running at a very rapid rate in order to keep the machine in the air. When you begin to move your machine through the air you at once add the speed of your machine to the speed of the top propeller as it is going forward, and there is a very definite limit to that speed. I am not a scientist, but I think I am right in saying that the head resistance varies as the square of the velocity, and in this helicopter you get such a tremendous head resistance that you cannot get high speed. The only thing that aviation is going to give you is speed as cheap as we can make it, and this helicopter, although it will take you off the ground straight, is going to fly comparatively slowly. What is more, it is very much more at the mercy of its engine than the aeroplane. If your engine stops in a helicopter you loose all your lift at once, whereas if your engine stops in an aeroplane you have the opportunity of making a nice comfortable glide and you can pick your place to come down. From the war point of view it seems that the helicopter can give us nothing more than the old blimp or the balloon did, because it will be a very vulnerable thing, very easily hit and subject to very serious damage if it is hit. So generally speaking I am rather anti-helicopter. But the French are trying hard to perfect this type of machine; we are still going on with our experiments, as I think they are in America. Personally I look upon it as an interesting aerodynamical experiment which will not help us very much from the commercial point of view. Your ships have to have a shore to come to, your railway trains must have railway stations to go to, and I think your aeroplanes have got to have aerodromes to go to. You cannot expect to fly from here to London from your back garden; it is not practical.

H. K. Wickstead, M.E.I.C.: You have mentioned that very few fatal accidents have occurred in the cross channel services, although the machines have been flown in very bad weather. Could you say to what extent these accidents were due to weather conditions and to what extent they were due to the machines themselves or to the operation of them? I think one accident was due to a collision, was it not?

Sir Sefton Brancker: The first fatal accident in 1919-20 was caused by bad weather. There was a fog in the neighbourhood of Kenley, twenty miles southeast of London, and the pilot, who was a very gallant fellow, took chances and ran into a hill. That, you can see, was directly due to bad visibility, which is our great bugbear. The second accident, in 1920-21, was caused by a machine stalling on the turn. That was due not to bad weather but to lack of experience and overloading. The machine was not in very good condition; she had been overloaded, and had just left the aerodrome en route to Paris. The pilot stalled her on the turn in avoiding some houses or a tree, something of that sort which he could not clear. I think, however, we have pretty well lived down bad management; we have only good management and our experience is pretty good. In 1921-22 we did not have any fatal accidents, and the same in 1922-23. I am referring, of course, only to accidents in which paying passengers were killed; you cannot include experimental flights and that sort of thing. This accident the other day was to some extent due to weather conditions, but it was really bad piloting. It was an extremely bad day, I was flying myself, it so happened, therefore I know the conditions. There was a very high wind; the clouds were down to about 300 feet and squalls of rain were blowing across from the northwest. The pilot in question had not had very much experience in air transport. He had been a good pilot in the fighting services but had only just come into civil life. He was flying with an experienced pilot alongside of him, who was practically giving him his last finishing flight. He came through a ridge of hills and evidently he saw a very heavy storm of rain approaching and he turned and tried to land. As he came down he suddenly saw some trees which were more in his way than he thought and he stalled the machine and crashed. That was really error of judgment brought about by bad weather. Had an experienced pilot been in the pilot's seat he would have gone on through that weather and have been perfectly safe. The collision we had was during the course of an experimental flight, so far as the

British machine went. It was a pilot who was trying over the course with a machine he had never flown before and he and his mechanic were killed. The collision was with a French machine in which I think two passengers were killed; I have not gone into the French figures at all. So far as accidents are concerned, when you come to look at the statistics you will find that there are a great many accidents in training new air forces which result in a certain number of casualties, and we have some experimental flying accidents. Our air transport, however, has been very free from accident.

Colonel H. J. Lamb, M.E.I.C.: Has very much progress been made since the war in reducing the time a machine takes to rise from rest to the desired flying elevation?

Sir Sefton Brancker: Well, yes, and no. As a matter of fact the demands of war required a very much bigger climb than those of peace. We used to have to get up to 15,000 feet as quickly as we could, but the flying height so far as this air transport goes is about 2,000 feet as a rule. You do not see the pilots, as they used to in the war, trying to climb fast; they climb up very quietly and steadily. The fact is that the engines are so reliable now that pilots do not mind flying at 300 or 400 feet, but as a rule for general comfort and to get out of the bumps they get off and work slowly up to 2,000 feet. It probably takes them ten minutes to get there. So that the necessity for an excessive climb does not exist to-day except where you have a very heavily loaded machine in a small aerodrome on a hot, still day. There, of course, you have got to climb in order to get off safely, but generally speaking these commercial machines are not climbed vigourously.

W. L. Brown, A.M.E.I.C.: What is the effect of snow in the operation of aircraft?

Sir Sefton Brancker: The only real trouble we have with aircraft to-day as regards reliability is bad visibility. The worst visibility is fog, and I think the next worst is heavy snow. You can fly in almost any rain; really heavy rain only occurs in patches and as a rule you can dodge the worst of it. Rain never stops a pilot who has a good machine and is equipped with wireless. Light snow causes no trouble at all, but heavy snow is practically as blinding as fog, and you have either got to fly over it or come down. I may say that on these regular services across the channel the pilots, or in some cases the navigators sitting beside the pilot, are in direct wireless telephonic communication with the ground. They can find out what the weather is like in front of them, and if they are absolutely lost in cloud or above the clouds they have only to call for their position and it is given to them within two or three minutes. We have two stations in England now, one down in Kent and one up in Norfolk, always listening in. As soon as they hear a call for a position from a pilot crossing the channel they both take his angle by directional: the fellow in Norfolk wirelesses down to the fellow in Kent his angle; the Kent fellow plots it and signals it to the pilot; and we have timed it to take about two or three minutes.

There is just one thing further that I would like to say. This year's cross channel services, between London and Paris and so on, I look upon really as only experiments. The real thing we have got to come to in this aviation business is Imperial communications. It is a curious fact that the military side of aviation is all to our bad. It has abolished the Channel; it has put us on terms of incontrovertible equality with the continental nations. We have lived for many centuries with that good twenty-five miles of blue water between us and the Continent, which has enabled us to avoid conscription and invasion and all the rest of it. Now we have suddenly been put on terms of equality with them as regards attack from the air. That is all to our disadvantage, and where aviation is going to be to our advantage is in this commercial work, because it is going to link the Empire more closely together; it cannot help it. If you look back over the record of history you will find that every great empire that ever existed hung on until its communications became too frail, too fragile to make for continued solidity. You have seen it in those ancient Empires where horse transport was the only means of communication; when that became insufficient for their needs their existence was no longer sure. The Romans depended on roads, and the Roman Empire broke up when those communications were not sufficient to enable the administration of the Empire to be carried on and the different parts of it to be kept together through the preventing of misunderstandings, and so on. Our empire has been built up on sea transport, backed, of course, by wireless, cables, and so on, and it looks to me as if air transport had come as a special antidote for the difficulties we have in connection with holding the empire together. That is where I think the development of aircraft is of such enormous importance to us — as a means of Imperial communication. It is well to bear in mind, therefore, that from the military point of view aviation has done us harm but from the commercial point of view it ought to do us a great deal of good.

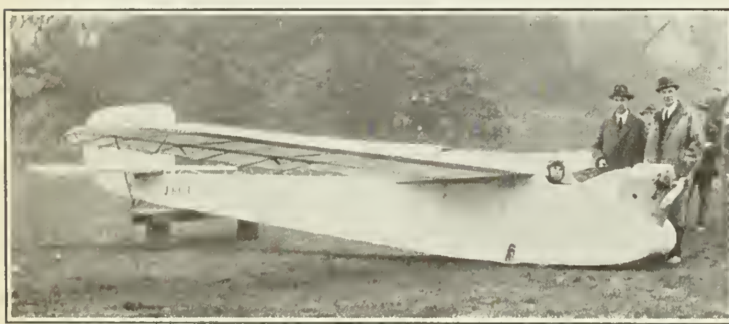

Figure No. 5—The "Wren" Light Aeroplane, The English Electric Company, Limited.

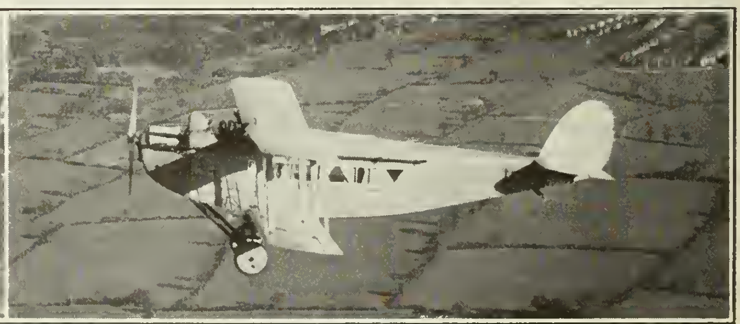

Figure No. 6—D.H.34. A Commercial Aeroplane in Flight, DeHavilland Aircraft Company, Limited.

Insulation and Heating Possibilities in Buildings

The Results of Observations and Investigations of the Advantages of Proper Insulation of Buildings.

James Govan, R.A.I.C.,

Architect and Inspector of Hospitals Ontario Government.

Paper read before the Toronto Branch, The Engineering Institute of Canada, March 13th, 1924.

Our Construction Methods Ridiculously Wasteful

To anyone who has given even a very little thought to the question of insulation in building construction in Canada, the sheer neglect of the subject by our people in such a climate as we have is a matter of more than astonishment.

Ontario newspaper readers have for several years been presented with facts and figures relating to our annual fuel bill in studying the prospects of getting coal from Alberta or Nova Scotia instead of Pennsylvania, whence the bulk of the supply now comes.

Yet, notwithstanding the scientific investigations which have been going on at the University of Toronto regarding heat losses since 1912, and the other research work, which has been done at the Bureau of Standards, Washington, the Research Laboratory, Pittsburg, and at many other universities on this continent and in Europe, the results of which have been published in recent years, there has been practically no attention given to the possibility of fuel saving by the proper application of the insulation data thus made available.

The tremendous influence of United States practice and ideas on Canadian life and standards is nowhere better illustrated. Here in Canada we have a more rigorous climate, less wealth to offset the climatic disadvantages in our building construction and, for the majority of our people, probably higher costs in the production of the necessary heat units in our buildings. Consequently the returns in Canada from conservation of these heat units are greater, but yet we do not lead the United States in the study of this question, indeed we must confess there is evidence all around us that their ways are our ways and their methods our models.

The lessons to be derived from the experiments conducted in the thermo-dynamics building of the University of Toronto by Professors Angus and Arkley were embodied in a bulletin written by Professor Arkley, (now at Queen's University, Kingston), and the writer.

This was published by the Advisory Council for Scientific and Industrial Research, Dominion Government, Ottawa, (Report No. 10, "Fuel Saving Possibilities in House Heating"). Without knowing the number of copies distributed in Canada and the United States by the committee at Ottawa, it is a fact worthy of comment that the majority of the copies issued on request through the Ontario government offices have gone to United States enquirers.

It is therefore a subject which should claim the serious attention of the members of this *Institute*, because, until trained engineers and architects wake up to the comfort and economic needs of Canadian construction as contrasted with what is suitable in California or Florida, we should not be astonished if the average speculative builder continues to ask us to contribute one shovelful of coal to improve outdoor temperatures every time we put one on the furnace for our comfort indoors.

Evidence accumulates rapidly however that the people to the south are awakening to the possibilities of insulation and when a magazine as widely read as the "Literary Digest" prints a full page article on the virtues of "Balsam Wool" in its news columns; the "Architectural Forum" prints a special article on "Insulation"; "House and Garden" shows a full page advertisement on the comfort producing qualities of "Celotex" and "The Garden Magazine" almost forfeits its dignity by carrying an advertisement "Underwear for Houses" showing a house clothed in the lingerie of "Cabots Quilt", we must at least "Keep up with the Joneses" and see what this fashion will do for us.

Reasons for Foregoing Conditions

If one must attempt an explanation of the meagre results so far in the application to actual construction of the data provided by the numerous bands of experimenters and investigators in the laboratories all over this continent, perhaps it may be found in the difficulty architects and builders experience in trying to translate into capital and maintenance dollars and cents for their clients the information so scientifically provided in terms of B.t.u., losses.

As a rule the architect brings in the engineer to calculate the heating requirements after he, (the architect), has decided on the materials to be used in the wall and roof construction, the type of windows, the heights of ceilings, the number of windows on the north side as compared with the south side of the building and even the number of coats of paint to be used on the inside of the walls. Yet all of these items have a very decided effect on the B.t.u., loss, therefore on the first cost of the heating plant and still more on the annual fuel bill.

Cost of Insulation

Without sacrificing architectural or aesthetic considerations one iota, it is possible for an engineer who knows insulation data to so advise his clients, if he is given the opportunity at the right stage of the proceedings, that the total cost of his consulting services and of effective insulation will be more than met out of the reduced cost of the heating plant and its first year's operation.

But how many engineers or architects have at hand the necessary information to enable them to figure scientifically the difference in B.t.u., loss per heating season that will result from the use of different materials in the construction of even a small building? Until this situation changes, we need not expect to get any very scientific adaptation of the numerous insulating materials now available to meet the needs of each particular situation. Yet I know of no item in construction costs which will justify itself as quickly in annual savings and increased comfort value to owners and tenants.

Summer Comfort Just as Important as Winter Savings

Apart altogether from the decreased fuel consumption in winter, insulation will more than justify its cost by the improved summer conditions it will produce in our

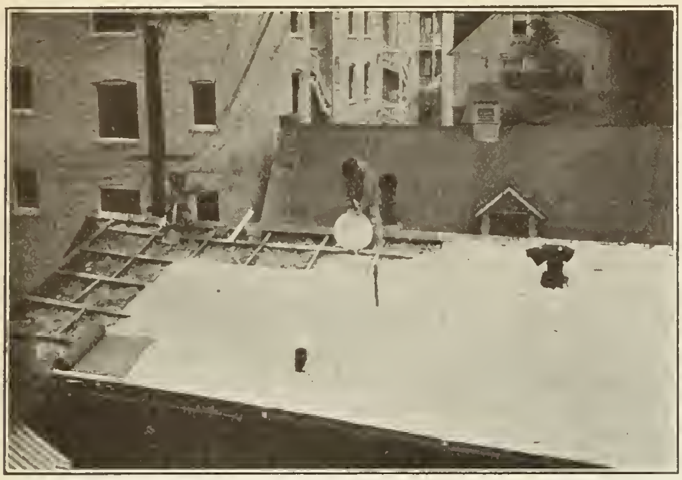

Figure No. 1.—Using Puffed Gypsum Insulation on Top of Old Shingles.

buildings. Since increased costs of construction have made every cubic foot of building valuable, the old idea of the unused attic to protect our bedrooms from the sweltering heat of summer has had to be abandoned. Now these attics in our cities are being put to use to house human beings instead of the horsehair sofa, and the old books. In new residences we don't plan unused attics any more, but design realtors' bungalows, with the roofs sloping down to the ground floor verandahs and the bedrooms under the roofs protected by some thin shingles, open jointed boarding, a thin lath and plaster ceiling, and, last but not least in the eyes of the speculative builder, the so called dead air space between the rafters.

Just how many million cubic feet of building in this country could be converted into excellent usable space, warm in winter and cool in summer, and what reduction could we make in our fire hazard by the use of adequate fireproof insulation of roof spaces, still unoccupied in spite of the rising prices of the materials and labour which go into their construction?

Unwarranted Claims for Insulation

Another factor in producing the prevailing scepticism on this subject is the extravagant claims in advertising made by the manufacturers and agents for a great many building methods and materials, which, although they have proven insulating value in themselves, yet, as generally built or applied, will produce only a very moderate saving in fuel consumption. Absolutely misleading information has been used to increase the sales of many materials and the trouble is that the proof that these claims are not founded on fact is not broadcasted all over the continent with an expenditure equal to the enormous sums spent on the fictitious advertising.

What we as engineers and architects must begin to realize is that the problem of preventing heat transfer through the walls and roofs of our homes and of commercial and public buildings, from the inside to the outside, is no different from the problem of preventing heat transfer from the outside to the inside of a cold storage room. In one case we try to keep inside heat units for which we, (in Ontario), pay dollars and cents to Pennsylvania coal magnates, whereas in the other we try to keep out heat which Providence provides free. The construction needs are in both cases very much the same.

With that thought firmly fixed we can appraise the value of much so called insulation. What would the owners of a packing plant think of us, for instance, if we suggested that he should build the walls of his cold storage rooms with 8-inch concrete hollow blocks, stuccoed on the outside and plastered directly on the inside? Yet that is exactly the kind of construction recommended by many people in this country for government aided housing in districts where the temperature drops to 50 below zero.

Even if we were more up-to-date in our ideas of heat transfer, would we convince our packer client of our sanity if we proposed using insulation not more than half an inch thick?

Nevertheless all the arguments for and against our commonly used building methods, such as frame construction, brick veneer, solid brick, hollow tile and stucco, prepared roofings, shingle roofs, etc., when we get down to the question of heat losses through them, do not get us very far in the reduction of our coal bills. Nor does it help us very much to read in the advertisements of many insulating materials that they are as efficient as cork per one inch thick when we discover that they are not generally made or sold one inch thick. In many cases they are not any more than half an inch thick and in some they are as thin as a quarter of an inch. That kind of insulation has undoubted value for many conditions met with in construction, but we must not expect it to perform miracles.

The following is part of a typical advertisement which is very liable to convey a wrong impression to many people:—

Name of Insulation	Conductivity B. t. u. 24 hour Sq. ft. per in. thick per 1° F.
1. Pure wool (firmly packed)	5.8
2. Balsam wool	6.1
3. Keystone hair felt	6.5
4. Cotton wool	7.0
5. Insulite	7.1
6. Linofelt	7.2
7. Cork board (pure)	7.4
8. Cabot's quilt	7.7
9. Flax linum	7.9
10. Fibrafelt	7.9
11. Rock cork	8.3
12. Waterproof Lith	9.8

The points to be studied carefully in such a statement are:—

1st. The fact that the values are based on materials one inch thick.
2nd. How many on the list are sold one inch thick?
3rd. What value in B.t.u., conductivity has each different material as sold?
4th. How much insulation per dollar of purchase price will each give after cost of placing in position has been reckoned?
5th. What relation does the cost of insulation bear to the saving in fuel that it will effect?

The answers to these questions will in most cases modify an opinion liable to be formed be merely comparing the figures given in the list.

On one particular job coming under the writer's observation recently, the owner had two trial panels of insulation made to determine the best way to stop a very serious heat loss in part of his plant. The panels were of very different types of material but both were 4 inches thick. To the touch of the hand they seemed about equally efficient, but an analysis of their cost showed that while No. 1 panel would cost, erected, approximately 93 cents per square foot, as compared with 27½ cents for No. 2, this difference increased to $2.79 for No. 1 if erected 12 inches thick as compared with about 52 cents for No. 2 material applied the same thickness. This meant that an increase in thickness to meet the needs of a particular situation would change the difference in cost from 238 per cent to 436 per cent.

More Useful Presentation of Heat Loss Data

The following table was given at the annual meeting of the American Society of Heating and Ventilating Engineers in New York in January 1924, by Messrs. Norris, Germond and Tuttle of the C. F. Burgess Laboratories, Madison, Wis., to illustrate their paper "An Improved Method of Determining the Heat Transfer through Wall, Floor, and Roof Sections".

Description	B. t. u. per hour per sq. ft. per degree F.
"Standard wall"...............................	K
5½ in. drop siding (cedar) tapered 5/16 in. thick 3 5/8 in. exposed	
Sheathing paper — Neponset building paper 90/M	
Hemlock sheathing (ship lap) 7 x 13/16 in.	
Douglas fir studding 2 x 4 in. (1.5 x 3.5 in.) actual on 16" centres	
Hemlock lath 7/16 x 1 3/8 in. spaced ¼ in.	
Gypsum plaster (well dried) thickness of lath plus plaster 9/16 in.	
Conductivity..................................	0.267
Same construction as standard wall except that the lath is replaced by "Insulite", the plaster being applied directly to the "Insulite"................	0.207
Standard wall with John's Manville "Acme Hair-felt" fastened between studding..................	0.200
Standard wall with ½ in. "Flaxlinum" fastened between studding with cleats.....................	0.192
Standard wall with "Cabots Quilt" ("Double ply") fastened between studding with cleats............	0.190
Standard wall with "Balsam wool" fastened between studding with cleats......................	0.179

Information of this kind is much more useful to the prospective builder than comparison of the thermal conductivities of a lot of materials which nobody buys as described in the tables.

Here at least is data which will enable an engineer to estimate what return his client may expect for every $100.00 he spends on such forms of insulation. He can also decide by calculation or experiment whether the saving shown in the table for Balsam wool as compared with Insulite, which is also a wood fibre product but which is compressed so that it forms a substitute for lath, will warrant its use, when the extra cost of the lath used with the Balsam wool is taken into consideration.

The reliable merits of 8-inch concrete block, 8-inch hollow clay block, 8-inch solid brick and 12-inch hollow clay block, plastered and unplastered, protected by papers, felts and waterproof coating, spaces empty and spaces filled with sawdust, shavings and gravel as disclosed by the tests at the University of Toronto have all been dealt with in writings by Professor Arkley and myself in the Dominion Government Report No. 10 to which reference has been made previously. The chimney effect of hollow walls with unobstructed vertical air spaces has also been dealt with in the same writing and by other writers elsewhere.

Such methods however of presenting the case for insulation seem to lack the "punch" necessary to make our clients realize the enormous economic waste resulting from present practice.

Fuel Savings of 50 per cent and 60 per cent Economically Possible

Savings of five, ten, fifteen or even twenty per cent in heating costs seem to be unworthy of consideration by our builders, but if we can get them to think in terms of fifty and sixty per cent cuts in coal bills we can hope to make very drastic changes in our manner of building. That such possibilities are not mere dreams can be proved by the experience of our cold storage companies in their construction and the question for us to deal with in other types of buildings is whether we can buy enough insulation to justify its cost economically.

Figure No. 2.—Removing Temporary Screeds from Poured-in-Place Roof Insulex. After Filling the Screed Spaces the Roof Would Require to be finished on Top with a Commercial Waterproof Roof Covering.

Apart however from cold storage practice, there is sufficient evidence here and there in other types of buildings to show that we do not romance when we speak of such remarkable savings. For two winters a building designed in my office and built for the Ontario government has been heated by less than half of the boiler horse power which would have been necessary had ordinary construction methods been followed.

This building has a wall insulation of a very narrow air space between the wall and a 2-inch hollow furring tile lining. This space was coated heavily with asphalt dampproofing compound. The roof was filled solid 10 inches thick with dry planer shavings protected top and bottom against moisture with waterproofing papers. The windows are only single glazed and the total area of window glass is much greater in proportion to floor space than is the case in most jobs. There is no weather stripping. Under these circumstances the results we are getting are simply remarkable and quite bear out the claims made by Professor Peebles of the Armour Institute of Technology, whose figures will be quoted towards the end of this paper.

A residence just nearing completion proved to be so effectively insulated that, with only some temporary sash in place of the permanent sash and only about half the radiators connected to allow plastering to proceed, the temperature all this winter has been so comfortable that we have decided not to connect all the radiators shown on our drawings. This result has been obtained although we had allowed what we considered would be a reasonable reduction in the total square feet of radiation because of the special attention we had given to the insulation of walls and roof.

These results in this case were obtained by using 2 inches of "Insulex" on the walls between strapping before lath was applied and one inch of "Lith" between the rafters, protected by waterproof paper on the underside. Our experience in this case convinces me that I would

Figure No. 3.—Using 10,680 sq. ft. of Celotex for Roof Insulation.

have been justified economically in putting even more than one inch of insulation on the roof.

Special Value of Roof Insulation

The effectiveness of preventing roof losses which we found at the job above referred to, has been confirmed by a public utility corporation in one of the large American cities. They found that two inches of effective insulation on the ceilings of some trial houses reduced the gas bills by 37 per cent. These houses were heated by gas heaters so it was possible to get an exact meter record of the saving; and it is interesting to note that they have decided they will not instal a gas heater in future in any house which has not been insulated.

This result may be contrasted with another only recently brought to my attention. A house was protected with 4 inches of mineral wool insulation on the walls only and but a very small part of the roof was insulated. While considerable saving in fuel has resulted from the very good insulation on the walls, the disadvantages of neglecting the more important part, the roof, are quite apparent, when comparisons are made with jobs where the roof has received the most attention.

A quotation from a private letter to a friend of mine written by one of your own members, (Henry K. Wicksteed, M.E.I.C.), bearing on this phase of the subject was so interesting to me that I obtained permission to use it here.

"I was very much interested in our discussion of samples of insulation materials on account of the side issues which we raised in the discussion as to the true causes of heat losses and resultant waste of fuel, which is so patent in our present style of building and which has become one of the burning questions of the day.

"Even those who do not need or desire to go to the last extreme of building economy think they have done all that can be done when they build thick walls of brick, masonry or tiles, with comparatively few and small windows, protected by double sashes. Very few seem to reflect that inasmuch as warm air is lighter than cold and rises to the top by every opening it can find, it is the roofs and ceilings of our buildings which we should render proof against conduction and radiation rather than the walls, or at any rate first of all.

"We have proofs all around us. An ordinary tent with a 6 foot wall of cotton drill is comparatively warm after a heavy fall of snow during the night, with only the heat from the bodies of half a dozen sleeping men to warm it.

"An old fashioned shanty in the woods with a heavy load of snow on its "Scoop" roof is delightfully easy to warm, even when the "chinking" in the walls is half fallen out and open cracks gape on all sides, but few of us seem to have grasped the "raison d'être !

"It was brought home forcibly to me one winter on lake Superior and I was forced to think it out, whether I would or not. We built a camp late in the fall with log walls intending to roof it with lumber and tar paper, but the lumber failed to turn up and the weather got very cold so we went in for the more primitive construction of poles with a matting of balsam "brush" on top. No sooner had we got this finished than the lumber and paper did arrive and having no other use for it and not much confidence in the capacity of our "brush" construction to keep out melting snow, we clapped the lumber on top of everything, which gave us a roof nearly a foot thick and extremely well adapted to resist conduction of heat, although it was the exclusion of moisture which we had aimed at.

"It was a large camp some 40 feet long by 20 feet wide and the walls were merely spruce poles, roughly chinked with moss; and the doors and windows were very roughly fitted so that we could see through in many places and there was no inside sheeting of any kind. There was only one box stove, of no great size and this went out at nine or ten p.m., and was never lighted until seven or eight next morning. But never did we have water frozen although the pail stood all night along-side the door of rough hewn planks, and this with temperatures of 30° to 40° Fahr. below zero. It was the warmest house I ever lived in and equally cool in summer. As I said before I was forced to think and my conclusion was, that, given reasonable shelter from the wind and a non-conducting roof, the walls were comparatively unimportant, cold air could not enter at a low elevation unless the warm air got out at a higher one and left room for it."

The party marooned on Wrangel island whose story claimed the world's attention and sympathy a few months ago found conditions particularly uncomfortable when the "lack of snow left them without snow blocks for roofing".

Knight, in his diary, described how, "They huddled about the stove trying to find topics for conversation". Noice's account of the relief expedition states that "just before Christmas the snow had hardened sufficiently to be cut into blocks and Crawford began roofing the tents". Later Knight writes in his diary of Christmas eve, "The snow roof was completed today, excepting the door, and it is nice and comfortable in here tonight."

What a commentary on our Canadian architecture ! Provided by an all-wise Providence with a natural insulator against severity of our climate, we do everything we can to make certain that we shall take no advantage of the assistance given. First we slope our roofs so that snow won't stay on them; and if by any chance we bungle things so that a little snow does remain around the expensive gables, dormers, turrets and valleys, we make absolutely certain of its removal by burning some equally expensive coal under it and interpose as little as possible in the way so that the coal will be 100 per cent effective.

During one of this winter's zero spells I saw a demonstration of the effectiveness of snow as an insulator. A ball of loose snow less than a foot in diameter was placed on the handrail surrounding a flat roof. On top of the snow we put a piece of pine board about 6 inches square and about one inch thick. In front of the board and with its lower end stuck in the snow we placed a small icicle about 1¼ inch in diameter and about 9 inches long. The sun's rays reflected by one of Dr. Harvie's "Luxostats" or combined mirrors set fire to the board in about fifteen seconds, then gradually thawed the icicle, but had scarcely any effect on the snow during the period of fifteen minutes or so we had the rays focussed on it.

Possible Influence of Canadian Architectural Design

If our architects and engineers would give some thought to this provision of nature we might begin to develop some character in our buildings not so slavishly copied from the architectural journals of the United States and other countries with distinctly different climatic conditions.

Not long ago when I was trying to impress a friend of mine, who is tagged with more than one university degree, with the advantages of flat roofs over sloping, he replied that the one thing which decided him against flat roofs was that he did not want the job of going up after every snow storm to shovel off the snow. Need we wonder if the "California" bungalow is popular in northern Canada or that Kipling got himself disliked here for his phrase "Our Lady of the Snows"?

Even without a revolution in the architectural shapes of our buildings it can be shown that we have only to get a few clients here and there convinced of the economic advantages of insulation to bring about a very radical change in the attitude of the public. One well insulated house in a neighborhood will very soon make the selling of uninsulated houses an unprofitable business.

Results of Tests and Studies at the Armour Institute of Technology

One of the best presentations of the whole case I have ever come across is by Professor J. C. Peebles of the Armour Institute of Technology, from whose report I have been permitted to use the following data, but before submitting his figures it should be noted that the results he gives could be obtained by the use of any insulating material which would have the same conductivity values as he shows for the different thicknesses of the particular insulation he used for the purpose of his report.

The indiscriminate use, however, of these figures should be guarded against, because without a fairly clear understanding of the laws of heat transmission and their special application to problems of building construction, the substitution of one material for another is liable to be based on the merest guess work.

Mr. Peebles makes his position quite clear in his report in which he says:—

"In order to estimate the probable heat losses from each house considered, from which the heating costs can be calculated, it is necessary to know the coefficient of heat transmission, air to air, for each type of construction used. These have been calculated, using coefficients of heat conductivity surface to surface, and factors of absorption and emission determined by the writer from laboratory experiments of all materials entering into the proposed constructions.

"In the following pages I submit a report covering estimates of the cost to heat a dwelling house of the bungalow type. Several types of wall and ceiling construction are considered, both with and without the use of special insulating material. In the case of the insulated house, the material used is Insulex, 2 inches thick in the walls and 3 inches in the ceiling. Estimates have also been made for 3-inch Insulex in walls and 4-inch in ceiling. The bungalow considered is 32 feet long by 26 feet wide, with a ceiling 10 feet high. The wall surface is 930 square feet, glass surface 230 square feet, and ceiling surface 832 square feet.

"In making estimates of this kind it is first necessary to decide upon the temperature which will be encountered, particularly the mean outdoor temperature during the heating season. In Table No. 1, herein, an entire set of assumed conditions is given, the mean outdoor temperature of 30 degrees F. being taken from records of the United States Weather Bureau at Chicago.

"Results are shown on accompanying data sheets:

Table No. 1.—Conditions Assumed in Heating Problem

Duration of heating season, days	200
Mean outdoor temp. during heating season, deg. F.	33
Daytime indoor " " " " "	70
Nighttime " " " " " "	55
Mean attic " " " " "	40
Minimum outdoor " " " " "	10
Minimum attic " " " " "	10
Complete air changes per hour due to ventilation	1

"NOTE: Official records show mean temperature at Toronto over a period of years for a heating season 212 days (October to April inclusive) = 31° F.

For any other parts of Canada with lower mean temperature the difference would be correspondingly greater".

Building Considered

Bungalow, 26′ x 32′ x 10′ ceiling, set in the approximate centre of a 50-foot lot, so that the building is exposed on all four sides.

Types of Construction Considered

1. Ordinary frame construction, consisting of 2-inch x 4-inch wood studs, with wood sheathing, building paper and drop siding. On the inside wood lath and lime plaster. Ceiling construction, wood lath and lime plaster on lower side of ceiling joists; no attic flooring. Single windows.
2. Same as No. 1, but with the addition of two inches of insulex in the walls between the studs, and 3 inches of insulex in the ceiling between joists.
3. Same as No. 1, but with the addition of 3 inches of insulex in the walls, and 4 inches in the ceiling; also double windows.

Figure No. 4.—Experiments at University of Toronto with Insulex, Puffed Gypsum.

4. Eight-inch brick wall, furring, wood lath and lime plaster. Ceiling construction same as No. 1; single windows.
5. Same as No. 4, but with addition of 2 inches of insulex in walls and 3 inches in ceiling. Single windows. (Furring thick enough to accommodate 2 inches of insulex in walls must be used).
6. Same as No. 4, but with addition of 3 inches insulex in walls and 4 inches in ceiling. Double windows. (Furring thick enough to accommodate 3 inches of insulex in walls must be used.)
7. Twelve-inch brick wall, furring, wood lath and lime plaster. Ceiling construction same as No. 1. Single windows.
8. Same as No. 7, but with addition of 2 inches of insulex in walls and 3 inches in ceiling. Single windows.
9. Same as No. 7, but with addition of 3 inches of insulex in walls and 4 inches in ceiling. Double windows.
10. Eight-inch hollow clay tile, with 1 1/8 inch of stucco on outside. Furring, wood lath and lime plaster. Single windows. Ceiling construction same as No. 1.
11. Same as No. 10, but with addition of 2 inches of insulex in walls and 3 inches in ceiling. Single windows.
12. Same as No. 10, but with addition of 3 inches of insulex in walls, and 4 inches in ceiling. Double windows.
13. Stucco, 1 1/8 inch thick over wood lath on 2-inch x 4-inch studs. On inside wood lath and lime plaster. Ceiling construction same as No. 1, single windows.
14. Same as No. 13, but with addition of 2 inches of insulex in walls and 3 inches in ceiling. Single windows.
15. Same as No. 13, but with addition of 3 inches of insulex in walls and 4 inches in ceiling. Double windows.
16. Eight-inch cement block, furring, wood lath and lime plaster. Ceiling construction same as No. 1. Single windows.
17. Same as No. 16, but with addition of 2 inches of insulex in walls and 3 inches in ceiling. Single windows.
18. Same as No. 16, but with addition of 3 inches of insulex in walls and 4 inches in ceiling. Double windows.

Fuels Considered

1. Anthracite coal, costing $18.00 per ton, giving 12,500 B.t.u., per lb., and burned with an over-all efficiency of 60 per cent.
2. Pocahontas coal, costing $12.50 per ton, giving 14,500 B.t.u., per lb., and burned with an over-all efficiency of 60 per cent.
3. Coke, costing $15.00 per ton, giving 13,000 B.t.u. per lb., and burned with an over-all efficiency of 60 per cent.
4. Fuel oil, costing 8 cents per gallon, 26° Beaume gravity, giving 19,400 B.t.u., per lb., and burned with an overall efficiency of 70 per cent.
5. Gas, costing $1.00 per 1000 cubic feet, giving 500 B.t.u., per cubic foot, and burned with an over-all efficiency of 75 per cent.
6. Gas, same as above, burned with an over-all efficiency of 100 per cent.
7. Electricity, costing 3 cents per kilowatt-hour, and used with efficiency of 100 per cent.

"From the above data on fuels considered, the following table is worked out, showing the number of B.t.u., actually delivered to the apartments to be heated, for $1.00 spent for fuel.

Table No. 2.—Useful B.t.u. from Various Fuels

Fuel	Useful B.t.u. for $1.00
Anthracite coal	833,000
Pocahontas coal	1,400,000
Coke	1,040,000
Fuel oil	1,260,000
Gas, 75 per cent efficiency	375,000
Electricity	113,700
Gas 100 per cent efficiency	500,000

Table No. 3.—Coefficient of Heat Transmission

Table of coefficients of heat transmission, expressed in B.t.u., transmitted per hour per square foot of surface per degree Fahrenheit difference in temperature between the inside and outside air.

Wall Number	Transmission Coefficient	Wall Number	Transmission Coefficient
1	0.266	10	0.190
2	0.130	11	0.108
3	0.102	12	0.0887
4	0.240	13	0.433
5	0.123	14	0.158
6	0.098	15	0.120
7	0.193	16	0.308
8	0.109	17	0.138
9	0.089	18	0.108

Ceiling Number	Transmission Coefficient
1	0.600
2	0.140
3	0.104
Single window	1.00
Double window	0.50

"Making use of the assumed temperature conditions, as outlined in table No. 1, and the estimated coefficients of heat transmission, given in table No. 3, and allowing for one complete air change per hour due to ventilation, the probable heat loss for the heating season is readily estimated. Making use of table No. 2, this annual heat loss is easily expressed in dollars for each type of fuel to be considered. The annual heat loss from each type of construction, together with the cost to supply that amount of heat with each of the fuels considered, is given in table No. 4 below:

Table No. 4.—Annual Heat Loss and Costs of Same for Various Types of Construction

House Number	Annual Heat Loss Million B.t.u.	Fuel costs — Dollars						Electricity
		Anthur.	Pocah.	Coke	Oil	Gas 75%	Gas 100%	
1	168.07	201.	120.	162.	133.	450	,336	1,480
2	91.47	109.50	65.20	87.70	72.50	244	183	803
3	66.16	79.75	47.25	63.50	52.50	177	133	580
4	164.48	198.50	117.50	158.20	130.50	438	328	1,448
5	90.56	108.50	64.60	87.00	71.85	241	182	800
6	65.66	79.20	46.90	63.10	52.20	176	132	577
7	158.58	191.25	113.30	152.50	125.90	422	317	1,395
8	88.56	107.50	63.25	85.10	70.20	236	178	780
9	64.33	77.70	46.00	61.80	51.00	173	130	566
10	158.18	191.00	113.00	152.00	125.60	421	316	1,390
11	88.36	106.30	63.10	84.75	70.15	235	177	776
12	64.14	77.25	45.80	61.65	50.85	171	128	564
13	192.68	232.00	137.50	185.00	152.90	513	385	1,695
14	95.46	115.00	68.15	91.75	75.75	255	191	840
15	68.70	82.80	49.10	66.10	53.75	185	151	605
16	174.88	210.60	124.70	168.00	138.60	467	350	1,310
17	92.60	11.50	66.15	89.00	73.50	247	185	815
18	66.198	80.75	47.80	64.40	53.15	179	134	589

Table No. 5—Sizes and Costs of Steam and Hot Water Plants

House Number	Max. Heat Loss Per Hr. B.t.u.	Radiation Required Sq. ft.		Cost of Heating Plant, Installed Dollars		Saving in First Cost Dollars	
		Steam	Hot Water	Steam	Hot Water	Steam	Hot Water
1	84,730	339	471	424	706	...	...
2	50,660	203	281	254	422	170	284
3	36,453	146	203	183	305	241	401
4	82,586	330	459	413	689	...	...
5	50,095	200	278	250	417	163	272
6	36,074	144	200	180	300	259	389
7	78,725	315	438	394	657	...	...
8	48,962	196	275	245	412	149	245
9	35,397	142	197	178	296	216	361
10	78,504	314	436	393	655	...	...
11	48,874	195	272	244	408	149	247
12	35,375	142	196	178	294	215	361
13	98,370	394	547	493	821	...	...
14	52,955	212	294	265	442	228	379
15	37,933	152	211	190	317	303	504
16	88,140	353	490	442	735	...	...
17	51,316	205	285	256	428	186	307
18	37,025	148	206	185	309	257	426

"If a steam or hot water plant is fired with fuel oil or gas instead of coal or coke, a certain addition must be made to the costs shown in table No. 5 above. Several makes of oil burning equipment for house heating are on the market, differing considerably in design and cost. A satisfactory system, automatic in its operation, is rather expensive and this fact appears to be one of the chief reasons why home owners are slow in adopting oil heat.

"It will be noted that this report deals in general with three classes of construction; (*A*) uninsulated; (*B*) medium insulation; and (*C*) heavy insulation. In all class *A* houses an allowance of $500. has been made to cover the cost of oil burning equipment. An allowance of $450.00 is made for class *B* houses and $400.00 for class *C* houses. These allowances are to be added to the plant costs shown in table No. 5, whenever oil is to be used in a steam or hot water plant.

"Unless natural gas is available, steam or hot water heating plants are rarely fired with gas. Such a system should be thermo-statically controlled and provided with pilot light so that the operation will be practically automatic. To cover the cost of such a system $400.00 has been allowed for class *A* houses, $350.00 for class *B*, and $300.00 for class *C*.

"The building may also be heated by means of gas stoves like the radiantfire, placed in the rooms to be heated, or by electric heaters similarly placed. Table No. 6, below, shows the heater capacity, both gas and electric, which will be required to heat these houses, and also the first cost of the heating equipment. In estimating the first costs, gas heaters have been figured at $1.00 per cubic foot per hour capacity, and electric heaters at $15.00 per kilowatt capacity.

Table No. 6—First Cost of Heating Equipment, Assuming Electric Heaters to Cost $15 per kilowatt Capacity, and Gas Heaters $1.00 per cubic foot per hour Capacity.

House Number	Maximum Heat Required per hr. B.t.u.	Heating Capacity Required per hr.		Cost of Equip. Dollars		Saving in 1st cost	
		Gas. cu.ft.	Elec. k.w.	Gas	Elec.	Gas	Elec.
1	84,730	170	24.9	170	374	...	...
2	50,660	101	14.8	101	222	69	152
3	36,453	73	10.7	73	161	97	213
4	82,586	165	24.2	165	363	...	...
5	50,095	100	14.7	100	221	65	142
6	36,074	72	10.6	72	159	93	204
7	78,725	157	23.0	157	345	...	...
8	48,962	98	14.4	98	216	59	129
9	35,397	71	10.4	71	156	86	189
10	78,504	157	23.0	157	345	...	...
11	48,874	98	14.4	98	216	59	129
12	35,375	71	10.4	71	156	86	189
13	98,370	196	28.8	196	432	...	...
14	52,955	106	15.5	106	233	90	199
15	37,933	76	11.1	76	167	120	265
16	88,140	176	25.8	176	387	...	...
17	51,316	103	15.0	103	225	73	162
18	37,025	74	10.9	74	164	102	223

"The total annual operating cost of a heating plant consists of, (1) direct expense and, (2) overhead expense. The direct expense is fuel and attendance, and the overhead expense is maintenance, depreciation, insurance and taxes. In many heating plants fired with coal or coke the owner does his own furnace work, so that no expense for attendance is incurred. However, a money value must be placed on this service in order to secure a fair basis of comparison with oil, gas and electric systems which are practically automatic in their operation.

"The item of overhead expense is subject to considerable variation so that no estimate can be made which will apply in all cases. Items of maintenance and depreciation depend upon the quality of the equipment and the care with which it is operated. Taxes and insurance are also subject to wide variations in different locations. In this analysis of heating costs an annual allowance of 10 per cent of the original cost of the equipment has been made to cover all items of overhead expense.

Table No. 7.—Annual Operating Costs of Heating Plants

Fuel	Fuel Cost	Overhead Expense Attendance	Steam	HotWater	Total Annual Expense Steam	HotWater
House No. 1						
Anthracite...	201.00	85.00	42.40	70.60	328.40	356.60
Pocahontas..	120.00	85.00	42.40	70.60	247.40	275.60
Coke........	162.00	85.00	42.40	70.60	289.40	317.60
Oil..........	133.00	.....	92.40	120.60	225.40	253.60
Gas.........	450.00	.....	82.40	110.60	532.40	560.60
Gas.........	336.00	.....	17.00		353.00	
Electricity...	1,480.00	.....	37.40		1,517.40	
House No. 2						
Anthracite...	109.50	85.00	25.40	42.20	219.90	236.70
Pocahontas..	65.20	85.00	25.40	42.20	175.60	192.40
Coke........	87.70	85.00	25.40	42.20	198.10	214.90
Oil..........	72.50	.....	70.40	87.20	142.90	159.70
Gas.........	244.00	.....	60.40	77.20	304.40	321.20
Gas.........	183.00	.....	10.10		193.10	
Electricity...	803.00	.....	22.20		825.20	
House No. 3						
Anthracite...	79.70	85.00	18.30	30.50	183.05	195.25
Pocahontas..	47.25	85.00	18.30	30.50	150.55	162.75
Coke........	63.50	85.00	18.30	30.50	166.80	179.00
Oil..........	52.50	.....	58.30	70.50	110.80	123.00
Gas.........	177.00	.....	48.30	60.50	225.30	237.50
Gas.........	133.00	.....	7.30		140.30	
Electricity...	580.00	.....	16.10		596.10	
House No. 4						
Anthracite...	198.50	85.00	41.30	68.90	324.80	352.40
Pocahontas..	117.50	85.00	41.30	68.90	243.80	271.40
Coke........	158.20	85.00	41.30	68.90	284.50	312.10
Oil..........	130.50	.....	91.30	118.90	221.80	249.40
Gas.........	438.00	.....	81.30	108.90	519.30	546.90
Gas.........	328.00	.....	16.50		344.50	
Electricity...	1,448.00	.....	36.30		1,484.30	
House No. 5						
Anthracite...	108.50	85.00	25.00	41.70	218.50	235.20
Pocahontas..	64.60	85.00	25.00	41.70	174.60	191.30
Coke........	87.00	85.00	25.00	41.70	197.00	213.70
Oil..........	71.85	.....	70.00	86.70	141.85	158.55
Gas.........	241.00	.....	60.00	76.70	301.00	317.70
Gas.........	182.00	.....	10.00		192.00	
Electricity...	800.00	.....	22.10		822.10	
House No. 6						
Anthracite...	79.20	85.00	18.00	30.00	182.20	194.20
Pocahontas..	46.90	85.00	18.00	30.00	149.90	161.90
Coke........	63.10	85.00	18.00	30.00	166.10	178.10
Oil..........	52.20	.....	58.00	70.00	110.20	122.20
Gas.........	176.00	.....	48.00	60.00	224.00	236.00
Gas.........	132.20	.....	7.20		139.40	
Electricity...	577.00	.....	15.90		592.90	

"Table No. 7 gives a complete summary of all the items of expense incident to the operation of a house heating plant. Detail costs are given for each of the six types of construction considered for each of the seven different kinds of fuel assumed. It will be noted that the costs to heat equally insulated houses differ but little no matter what the character of the construction may be. This is due to the fact that nearly all the heat-retaining capacity is in the insulation and very little in the original walls and ceiling.

"Consider for example house No. 5 which is 8-inch brick with medium insulation, as compared with No. 8 which is 12-inch brick with medium insulation. Assume hot water heat for both using anthracite coal. The total annual cost to heat house No. 5 is $235.20, and for house No. 8 it is $233.70, a negligible difference.

"In order to show the method used in making the foregoing calculations consider House No. 2, which is ordinary wood construction with 2 inches of Insulex in the walls and 3 inches in the ceiling. The data upon which the heat loss is estimated are as follows:—

Heating season days	200
Mean outdoor temperature, deg. Fahr.	33
Mean daytime indoor temp. (16 hr. per day) deg. F.	70
Mean night time indoor temp. (8 hr. per day) deg. F.	55
Mean attic temperature, deg. F.	40
Coefficient heat transmission for walls	0.13
" " " " ceiling	0.14
" " " " windows	1.00
Air changes per hour due to ventilation	1
Density of air, lbs. per cu. ft.	0.077
Specific heat of air, B.t.u. per lb.	0.25

Day time heat loss through solid walls 930 × 0.13 × 37 × 16 × 200	= 14,300,000
Day time heat loss through glass 230 × 1.00 × 37 × 16 × 200	= 27,200,000
Night time heat loss through solid walls 930 × 0.13 × 23 × 16 × 200	= 4,260,000
Night time heat loss through glass 230 × 1.00 × 22 × 8 × 200	= 8,100,000
Day time heat loss through ceiling 832 × 0.14 × 30 × 16 × 200	= 11,180,000
Night time heat loss through ceiling 832 × 0.14 × 15 × 8 × 200	= 2,800,000
Day time heat loss due to ventilation 32 × 26 × 0.077 × 0.25 × 10 × 37 × 16 × 200	= 18,200,000
Night time heat loss due to ventilation 32 × 26 × 10 × 0.077 × 0.25 × 22 × 8 × 200	= 5,400,000
Total heat loss for heating season, B.t.u.	91,440,000

"In the same manner as above the maximum heat loss from the building is calculated by substituting the maximum temperature difference for the mean and using the hour instead of the season as the unit of time. To the maximum hourly heat loss through the walls calculated in this way 10 per cent is added to cover extra losses from the exposed sides of the building. The calculations are as follows:

Maximum hourly heat loss through walls... 93 × 0.13 × 80	= 9,670
" " " " " windows 230 × 1.00 × 80	= 18,400
" " " " " ceiling.. 832 × 0.14 × 60	= 6,980
Add 10 per cent of above losses for exposure	= 2,800
Max. hourly heat loss due to ventilation.... 32 × 26 × 10 × .077 × .25 × 80	= 12,810
Total maximum hourly heat loss	50,660

$$\text{Steam radiation required} = \frac{50{,}660}{250} = 203 \text{ sq. ft.}$$

$$\text{Hot water radiation required} = \frac{50{,}660}{180} = 281 \text{ sq. ft.}$$

First cost of steam heating plant installed.. 203 × $1.25	= $254.00
" " hot water " " " .... 281 × 1.50	= 422.00
" " oil burning " " " .... 254 + 450	= 704.00
" " gas fired " " " .... 254 + 350	= 604.00
" " oil burning, hot water heating plant installed.... 422 + 450	= 872.00
" " gas fired do.... 422 + 350	= 772.00

$$\text{Maximum gas requirement per hour} = \frac{50{,}660}{500} = 101 \text{ cu. ft.}$$

Cost of gas burners = 101 × $1.00 = $101.00

$$\text{Maximum electricity required per hour} = \frac{50{,}660}{3{,}410} = 14.8 \text{ kw.}$$

Cost of electric heaters = 14.8 × $15.00	$222.00
Cost of fuel per season	109.50 (table 4)
Cost of attendance per season	85.00 (table 7)
Overhead expense per season (steam)	25.40 (table 7)
Total expense per season (steam)	$219.90

"In a similar manner the total expense per season is calculated for the different kinds of equipment and fuel considered. The purpose of these estimates is to show the saving both in fuel and in first cost of heating plant made possible by the use of proper insulating material in the construction of the house. In many cases the saving in first cost of heating plant will pay for the insulation so that all savings thereafter in operating expense are a direct gain.

"It will be noted from table No. 7 that an allowance of $85.00 per season has been made to meet the attendance in plants using coal or coke. In plants using oil, gas or electricity which are practically automatic in their operation this item is saved and can be balanced against greater capital expense with the automatic system.

"The fuel prices assumed in this report are approximately those prevailing in the Chicago market at the present time. Electricity, however has been figured at 3 cents per kilowatt-hour, the lowest rate prevailing for domestic use. The rate for the first 30 hours of the maximum demand is 10 cents, the medium rate is 6 cents, and the minimum rate of 3 cents is not reached until an amount equal to 60 hours of the maximum demand has been used. Thus the actual cost of electric heat in Chicago would average considerably higher than the costs shown in this report, unless a radical revision of rates were made. Electric heat cannot compete with other forms as to cost and must be classed as an expensive luxury."

Summary Based on Report by the Testing Department of the Armour Institute of Technology

Frame Bungalow 26 feet x 32 feet., Ordinary construction, Lath and plaster.

No insulation

Table A

Heat loss during season, 168,000,000 heat units (B.t.u's)

Pocahontas coal at $12.50 per ton produces 8,700 heat units to pound	Anthracite coal at $18.00 per ton produces 7,500 heat units to pound	Coke at $15.00 per ton produces 7,800 heat units to pound	Fuel oil at 8 cents gallon produces 99,120 heat units to gallon	In open fire Gas at $1 per 1,000 feet produces 500 heat units to foot	Electricity at 3 cts. k. w. produces 3,400 heat units to k. w.
Required for season 9-6/10 tons Cost $120	Required for season 11-1/4 tons Cost $201	Required for season 10-3/4 tons Cost $161	Required for season 1,700 gals. Cost $136	Required for season 336,000 feet Cost $336	Required for season 49,400 k. w. Cost $1,485

Same house insulated with 2 inches insulex in side walls and 3 inches in ceiling

Heat loss during season, 91,470,000 heat units. Saving by use of Insulex, 77,530,000 heat units

TABLE B.

Required for season 5-¾ tons Cost $68	Required for season 6.14 tons Cost $114	Required for season 5-¾ tons Cost $72.50	Required for season 927 gals. Cost $74.16	Required for season 183,000 ft. Cost $183	Required for season 27,000 Cost $810

Same house insulated with 3 inches insulex in side walls and 4 inches in ceiling

Heat loss during season, 66,160,000 heat units. Saving by use of Insulex 101,840,000 heat units

TABLE C

Cost with Pocahontas Coal for season $47.25	Cost with Anthracite Coal for season $79.75	Cost with Coke for season $63.50	Cost with Oil for season $52.60	Cost with Gas for season, $133.	Cost with Electricity for season $580.

Steam heating plant required.

Table A. Requires 312 ft. radiation at $1.25 per ft. $390.
Table B. Requires 176 ft. radiation at $1.25 per ft. $220.
Table C. Requires 119 ft. radiation at $1.25 per ft. $148.75

Hot water heating plant required.

Table A. Requires 434 ft. radiation at $1.50 per ft. $650.
Table B. Requires 245 ft. radiation at $1.50 per ft. $367.50
Table C. Requires 167 ft. radiation at $1.50 per ft. $250.50

Saving through use of insulation

Heat units saved in season 101,840,000. Saving in one season in Anthracite coal $121.25. Saving in first cost of hot water plant. $400.

Summary Based on Report by the Testing Department of the Armour Institute of Technology, Chicago, Ill.

Brick house with walls 8 inches thick

House 26 feet x 32 feet. Furring strips. Lath and plaster.

No insulation

Heat loss during season, 164,480,000 Heat Units. (B.t.u's.)

TABLE A.

Pocahontas coal at $12.50 ton Cost for season $117.50	Anthracite coal at $18. ton Cost for season $198.50	Coke at $15. per ton. Cost for season $158.20	Fuel oil at 8 cents gallon Cost for season $130.00	Gas at $1 per M. feet In open fire Cost for season $328.50	Electricity at 3 cents per k.w. Cost for season $1,448.00

Same house insulated with 3 inches insulex in side walls and 4 inches in ceiling

Heat loss during season, 65,660,000 heat units (B.t.u's.) Heat saving by Insulex 98,820,000 heat units

TABLE B.

Pocahontas Cost for season $46.90	Anthracite Cost for season $79.20	Coke Cost for season $63.10	Fuel oil Cost for season $52.30	Gas Cost for season $132.00	Electricity Cost for season $577.00

Summary

Brick house with walls 12 inches thick

House 26 feet x 32 feet. Furring strips. Lath and plaster.

No insulation

Heat loss during season, 158,580,000 heat units (B.t.u's.)

TABLE A.

Pocahontas coal at $12.50 ton Cost for season $113.36	Anthracite coal at $18. ton Cost for season $191.25	Coke at $15. per ton Cost for season $152.50	Fuel oil at 8 cents gallon Cost for season $125.00	Gas at $1. per M feet In open fire Cost for season $317.00	Electricity at 3 cents per k. w. Cost for season$1395.00

Same house insulated with 3 inches insulex in side walls and 4 inches in ceiling

Heat loss during season, 64,330,000 heat units (B.t.u's.) Heat saving by Insulex 94,250,000 heat units

TABLE B.

Pocahontas Cost for season $45.00	Anthracite Cost for season $77.70	Coke Cost or season $61.80	Fuel oil Cost for season $51.25	Gas Cost for season $130.00	Electricity Cost for season $560.00

Infiltration of Air Through Walls and Openings

No study of insulation and heating possibilities would be complete without some reference to the problem of air infiltration through walls and openings in buildings. The benefits of even the best insulation will be nullified if we pay no attention to the heat losses due to poor construction and badly fitting windows and doors.

The gains in efficiency due to sealing up wall construction and closing the cracks around window frames and window sashes in various ways were graphically shown by Messrs. Houghton and Schrader in their paper "Air Leakage Through the Openings in Buildings" (February issue, Journal of the American Society of Heating and Ventilating Engineers). I would therefore strongly recommend the study of this paper to all engineers and architects.

There the reduction, by simple methods, of air leakage from 225 cubic feet per minute to about 35 cubic feet through a test wall with one window in it is put in a form which would convince even the most indifferent client.

Ventilation Requirement for Health

Of course we must be prepared for the individual, who insists that if we insulate our buildings and control the air leakage around openings we shall all be dead in a few years. In Report No. 10 (Dominion Government), already referred to I attempted to summarize the position in this respect and if anyone wants to be convinced on this point I would refer him to the paper "On Ventilation" in the Public Health Journal (March 1920) by Professor MacLeod of the University of Toronto.

With buildings properly insulated and having window ventilation under proper control, it is always possible to admit air where and when desired.

Utilization of Sun Heat

On a par with our careless indifference to insulation values is our neglect of sun heating possibilities. The study of the work under the Federal Housing Loan in Ontario which came before me officially showed that it is the exception, rather than the rule, to find the orientation of the small house for sunlight given proper consideration in comparison with other factors determining location and plan. To anyone who has given attention to the heating value of southern windows in winter time and their coolness in summer, our present methods of being guided in the placing of our rooms by what our neighbor has done appear almost crazy.

With adequate protection against heat losses on the north, east, and west sides and through the roof a house properly opened up with windows on the south side could be comfortably heated during many of our coldest days, when we get our brightest winter sunshine, without the use of any artificial heat whatsoever.

Electric Heating Possibilities

Many people wonder whether electricity will ever play any considerable part in solving the heating problem. Already some of the conclusions arrived at in the pamphlet issued in 1918 by the Hydro-Electric Power Commission of Ontario can be discounted and it does seem possible that some day in the not distant future we shall be able to use electric power in the off-peak hours to heat some medium which will be so insulated against heat loss that we will be able to draw upon this store of B.t.u's. for use in our buildings as required, when the power is being used for other purposes. The coming of that day will be advanced by the use we make of the data and materials being developed to reduce the total number of heat units required in our buildings.

Figure No. 5.—Pre-casting Fireproof Insulex Slabs and Placing them between Furring Strips of Required Thickness for Wall Insulation.

New Heating Formulae Necessary

When the day of the insulated building arrives the heating engineer will have entirely revised his formulae and correspondence, school text books on house building will have been re-written.

As the editor of the "Lumber World Review" very aptly put it recently "Houses are requiring a new layer... insulation...; within a very few years the houses without this new layer will be about as stylish and desirable as a black velvet Easter bonnet".

Types of Insulating Materials

What are we to use to produce these results? The answer to that question depends on so many local factors that the only guidance which can be given here is to direct attention to the qualities that must be considered in addition to the price and conductivity of the very numerous insulating materials now available.

These qualities have been very well summarized in an article in the "Architectural Forum" (August 1923) on "The Insulation of Dwellings" by George D. Browne, from which I quote as follows:

"The analysis of insulating materials should show:—

1. Is the material a poor conductor of heat?
2. Is it inert?

3. Is it fireproof?
4. Is it subject to rot or decay?
5. Is it sanitary, or will it become a breeding place for germs or animals?
6. Is it easy to handle and apply?
7. Has it any characteristics of ductility or is it brittle?
8. Has it any structural value?"

A material which will show the necessary characteristics for the work in hand will be a good investment for the owner."

Considering above question No. 1, conductivity value in dollars and cents must be studied together with the B.t.u., loss per square foot per unit of thickness.

Number 2 will at once suggest to those who have used insulation in powder or loose form, the difficulty of maintaining the efficiency of their work. The prevention of settlement introduces a problem sometimes expensive to solve and more expensive if not solved.

Our enormous fire losses emphasize the advantage of non-combustible building materials. Even where insulation is used in non-fireproof buildings it is desirable and — fortunately — possible to reduce the fire risk very considerably by using fireproof insulation. Its very location to stop heat losses is generally favourable to blocking fire travel in and through the walls and roof structure.

Many an owner of an old cold storage plant could point out the folly of using substances liable to rot or decay. So great has been the objection to odours arising from damp insulation that I have known cases where buildings have had to be entirely remodelled to do away with the nuisance.

The importance of question No. 5 will probably be better realized by those of us who have used insulation favoured by mice and rats as nesting material. Recently my attention was called to a large room in a plant temporarily out of use because mice had tunnedlled into cork insulation and nested there.

The cost of skilled labour now-a-days, makes the study of question No. 6 imperative if we attempt to make an intelligent estimate of the return expected from insulating.

The last two questions are inter-related. It was to find an answer to them in connection with some hospital work on hand that trials were made at the University of Toronto, to prove whether an insulating material could of itself support a roof or floor load or was restricted to use in combination with other materials already used for such structural purposes.

The answer is that insulation need not necessarily be so limited in its application.

Special Conditions and Conclusion

Special work will require consideration of values I have not mentioned and there is also the whole field of high and low temperature insulation, which I have not attempted to discuss. The possibilities of that branch of engineering are probably better known to most of your members than they are to me.

What I want particularly to direct attention to now may be illustrated by a concluding reference to a recent publication describing "The Most Perfect House in America". The house has almost every conceivable device for comfort and labour saving, but there is no suggestion of insulation; so, when we find attention is directed to a security burglar alarm lock, should we not ask ourselves the question as to whether the lock is more needed on the coal bins than on the other cellar "vaults" or the front door?

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Income Tax of Engineers

In taking up the matter with the inspector of taxation of Montreal regarding tax exemption of dues paid to engineering societies *The Institute* was informed a year or two ago that no allowance was made in this connection. It is a pleasure to advise, however, that an official letter has been received from P. F. McCaffrey, Inspector of Taxation, Montreal, advising that engineering fees paid to *The Institute* as well as depreciation on an engineer's library and instruments, are considered a proper deduction in arriving at taxable income. This announcement will be received with interest by members of *The Institute*.

Publication of Discussions on Papers

Among the papers presented before the branches of *The Institute* which have appeared in *The Engineering Journal* are a number dealing with subjects of very wide interest and it has been the practice to publish in *The Journal* the discussions arising out of these papers from time to time. These discussions are not limited to those presented at meetings at which the papers are read, but may be contributed by any member of *The Institute* at any time subsequent to the publication of the papers. It is felt that many members of *The Institute* may wish to submit their views in the form of discussion on these papers, and if so, such discussions may be forwarded to the general secretary at any time.

First World Power Conference

There is every indication that Canada will go into the First World Power Conference, to be held in London next July, as well, if not better prepared, than any other nation. Information from London indicates that the Dominion's contribution will not be surpassed.

Primarily this is due to the unique character of our power resources, both coal and hydro, and the remarkable manner and extent of their development. Not only have Canadians pioneered in many of the most important phases of power production, but we have achieved the highest rate of power production per capita. Our waterfalls now produce three and one quarter million horse power, day in and day out. The steady but rapidly increasing use of water power in the Dominion will, if continued, require in the next twenty years, a further capital investment of at least $1,000,000,000. Much of this money will come from abroad. The World Power Conference will afford a timely opportunity to interest the British capitalist and the British manufacturer in the opportunities for investment and trade in power development matters in Canada.

Some idea of the scope of the Conference may be gathered from the fact that the British Committee has already been advised that twenty-four countries are participating, and have under actual preparation papers covering a more comprehensive field than has ever before been attempted. Owing to the international repute of the contributors, the transactions of the conference will form a standard work of reference for years to come. The importance of having a single great problem, for instance, the utilization of available water power resources, viewed from several different angles, and under widely varying conditions, by official representatives of the principal power-producing countries of the world, cannot be overestimated.

The programme of the First World Power Conference is the most extensive that has ever been attempted at a similar conference. Indeed, the conference is unique and without parallel. The transactions will represent the expert testimony and opinion of men of international importance and leading authorities in their respective spheres.

Under the chairmanship of Dr. Charles Camsell, M.E.I.C., Deputy Minister of Mines, a representative Canadian Management Committee has had charge of the Dominion's preparations for the conference. The bulk of the papers, by recognized authorities, covering the various aspects of power production, are now in the hands of the British Committee. They consist of the following:—

Water Powers of Canada: Their Nature, Extent and Administration.
A National Review by J. B. Challies, C.E., M.E.I.C., M.Am.Soc.C.E., Director and Chief Engineer, Dominion Water Power and Reclamation Service, Department of the Interior, Ottawa.

The Fuel Resources of Canada and Their Utilization for the Production of Power and Other Purposes.
By B. F. Haanel, B.Sc., M.E.I.C., Chief Engineer, Division of Fuel and Fuel Testing, Department of Mines, Ottawa.

The Generation of Hydro-Electric Power in Canada.
By H. G. Acres, M.E., M.E.I.C., M.Inst.C.E., M.Am.Soc.C.E., M.Am.Inst.E.E., Chief Hydraulic Engineer, Hydro-Electric Power Commission of Ontario.

The Transmission and Distribution of Electric Power in Canada.
By Julian C. Smith, E.E., LL.D., M.E.I.C., M.I.E.E., M.Am.Soc.C.E., F.A.I.E.E., Vice-President, The Shawinigan Water & Power Co.,
and
C. V. Christie, M.A., B.Sc., A.M.E.I.C., M.Am.Inst.E.E., Consulting Engineer, Associate Professor of Electrical Engineering, McGill University.

Utilization of Power in Canada.
A symposium by various authorities, prepared under the direction of P. T. Davies, A.M.I.E.E., President of the Canadian Electrical Association.

In "The Pulp and Paper Industry", by R. W. Leeper, of H. S. Taylor, Consulting Engineers, Montreal.
In "The Electro-Chemical Industry", by L. E. Westman, General Manager, Canadian Chemistry and Metallurgy, Toronto.
In "The Mineral Industries of Canada", by H. E. M. Kensit, M.E.I.C., Dominion Water Power Branch, Ottawa.
In "The Cement Industry", by W. G. H. Cam. A.M.E.I.C., Electrical Engineer, Canada Cement Company, Montreal.
In "The Lumbering Industry of British Columbia", by A. M. Smith, Chief Engineer, Vancouver Lumber Company, Vancouver.
In "Agriculture", by F. A. Gaby, M.E.I.C., Chief Engineer, Hydro-Electric Power Commission of Ontario, Toronto.
In "Grain Handling".
In "Transportation".
In "The Home".
For "Illumination", by W. H. Woods.
The Application of Compressed Air in Industry, Canadian Practice, by F. A. McLean, Canadian Ingersoll-Rand Company, Montreal.
Recent Development in Electric Lamps, by J. T. Scott, Sunbeam Lamp Works, Toronto.

Arrangements are also being made for adequate representation at the conference. Not only will the authors of the papers be present to participate in the discussions, but many other representatives of the Dominion and provincial governments, professional bodies, private corporations and consulting engineering firms will be on hand to strengthen the Canadian delegation. Subject to their public engagements it is fully expected that members of the Dominion and several of the provincial governments will be in attendance.

Arrangements have been perfected by the American Committee for a banquet in the Hotel Cecil on the night of July third, at which the official delegations of the several participating countries and their ladies will be the guests of the American Committee.

Requests for information regarding the Conference should be addressed to the General Secretary of the Canadian Management Committee, J. B. Challies, M.E.I.C., Dominion Water Power Branch, Ottawa.

The Leonard Foundation

Lieut.-Colonel R. W. Leonard, M.E.I.C., past-president of *The Institute*, has increased the amount of the original Foundation established on October 7th, 1916, to the amount of five hundred thousand dollars, for the purpose of establishing scholarships to be known as "Leonard Scholarships" in specified schools and colleges in Canada for selected students of certain defined classes from a Fund known as the Trust Estate of the Leonard Foundation.

The Toronto General Trusts Corporation has been appointed trustee of the Foundation with general supervision of its work, the custody and care of all books and documents and the administration of the Trust Estate.

A general committee has been appointed composed of twenty-five men and women in whom is vested the administration and maintenance of the Foundation as a permanent committee. This committee is given broad powers in connection with the administration of the Foundation and to select students or pupils of the classes described as the recipients of the said Scholarships, and to appoint a special committee or committees and to assign particular duties to each.

To be eligible for a scholarship a student or pupil must be a British subject, of the white race and of the Christian religion in its Protestant form, who, without financial assistance, would be unable to enter any of the selected schools, colleges or universities to continue his or her education. Preference in the selection of students for Scholarships shall be given to the sons and daughters respectively of the following classes or descriptions of persons, regardless of the order of priority in which they are designated:

(a) Clergymen.
(b) School Teachers.
(c) Officers, Non-Commissioned Officer and Men, whether active or retired, who have served in His Majesty's military, naval or air forces.
(d) Graduates of the Royal Military College of Canada.
(e) Members of *The Engineering Institute of Canada.*
(f) Members of the Mining and Metallurgical Institute of Canada.

Members of *The Institute* will appreciate Colonel Leonard's generosity in including the sons and daughters of members as eligible for the scholarships included in the Foundation.

In addition to Colonel Leonard and Mrs. Leonard the general committee includes the heads of a number of schools and colleges throughout Canada and representatives of the organizations included within the scope of the Foundation.

The following members of *The Institute* are on the committee: Lieut.-Col. A. L. Bishop, Jr.E.I.C., Doctor A. J. Macphail, M.E.I.C., Fraser S. Keith, M.E.I.C., C. V. Corless, M.E.I.C., and Brig.-Gen. C. H. Mitchell, M.E.I.C.

Consulting Engineers' Charges

In nineteen twenty a committee of the Toronto Branch was formed consisting of representative consulting engineers of the city of Toronto with a view to co-operating in the development of a suitable schedule of fees for consulting engineers. The Toronto Branch considered it advisable to continue its work which it has done with commendable thoroughness. The report of the Toronto Branch is published herewith in order that it might be studied by the members at large and also the committee of *The Institute*, with a view to discussing the subject further and possibly co-ordinating all the efforts of *The Institute's* committees in that direction.

Report of Committee
Adopted, March 13, 1924

Charges for the services of Consulting Engineers should be based upon:
A — A per diem rate;
B — A predetermined fixed fee;
C — A percentage on the cost of the work; or
D — Reimbursement and a percentage on the cost of the work.

A — *A per diem rate:*
(1) Charges for consultation, studies, opinions, reports, court proceedings and expert evidence vary according to the magnitude and importance of the work or subject involved, and experience and reputation of the engineer, from a minimum of $50.00 per six hour day to a higher figure, and necessary expenses. Time occupied in necessary travelling should be charged for as part of the work.
(2) Charges for assistants engaged on this class of work should be 100% or more than that actually paid to the assistants, together with their necessary expenses.
(3) Where conditions of professional retainers contemplate a long engagement for general advice, the engineer may accept such retainers on a yearly basis.

B — *A predetermined fixed fee.*
(1) A fixed fee for the services rendered may be charged, such fee varying according to the character, magnitude and importance of the work or subject involved, and the experience and reputation of the engineer.

(2) Such fee shall not be less than that determined on the basis of the percentages set forth in (C) below, or where this is impossible, on the basis of the daily rate.

C — *A percentage of the cost of the work.*

(1) For preliminary examinations, surveys, studies, plans, estimates and reports, from ½% as a minimum upon the estimated cost of the work, depending upon the character and importance of the services rendered.

(2) For such investigations, plans and specifications, and such preliminary examinations, surveys, studies, plans, estimates and reports, as are necessary up to the time of calling for or receiving tenders, 2½% or more upon the estimated cost of the work, depending upon the character and importance of the services rendered.

(3) For such investigations, plans and specifications, and such preliminary examinations, surveys, studies, plans, estimates and reports, as are necessary up to the time of calling for tenders, and in addition thereto:

(a) For awarding contracts, general supervision and issuing progress certificates, or when the work is undertaken by the owner, for consultation services and general supervision during construction, 5% or more upon the estimated cost of the work, depending upon the character and importance of the services rendered.

(b) For awarding contracts, general supervision and issuing progress certificates, or when the work is undertaken by the owner, for consultation services and general supervision during construction, together with the services of a resident engineer, 1% more than in C (3) (a), to cover the cost of the resident engineer, but if the said cost exceeds the 1% mentioned, the excess to be paid by the owner.

(c) For awarding contracts, general supervision and issuing progress certificates, and in addition thereto for the organization and management of the work and carrying to its full completion, 15% or more, upon the estimated cost of the work, depending upon the character and importance of the services rendered.

(4) For work involving a cost of over $1,000,000 the above percentage fees may be reduced in accordance with the following schedule:

For the first $1,000,000, 100% of the amounts specified above; for the second $1,000,000 or fraction thereof, 90% of the amounts mentioned; for the third $1,000,000, 80%; for the fourth $1,000,000, 70%, and for the fifth and additional amounts of $1,000,000, or fraction thereof, 60%.

D — *Reimbursement and a percentage of cost of the work.*

This method of charging calls for the engineer to be reimbursed for his services by a percentage upon the cost of the work, and his expenditure for assistants and for general office expense is reimbursed by the client as follows:—

The percentage to cover the services of the engineer should be approximately one-half of the respective percentages specified under C, and the charges for assistants should be computed from the pay-roll cost, together with an addition of 100% or more to cover "Readiness for Service" and general office expenses.

General

1. *Agreement.* — It is desirable that upon undertaking any engagement, the engineer and client should enter into a written agreement or have a memorandum drawn up stating as fully and clearly as practicable the conditions of engagement, the services to be rendered by the engineer, the amount or rates of his compensation, the terms of payment and the period of agreement.

2. *Magnitude of work.* — The per diem rates and percentage rates should vary in accordance with the magnitude of the work involved, but shall not be less than the above minima.

3. *Alterations.* — The engineer should charge the client for any alterations to the plans which the client calls for after the preliminary plans have been prepared and approved. This charge, it is suggested, should be on a per diem basis, with assistants charged for as stated under D.

4. *Work abandoned.* — Should the work entrusted to the engineer be abandoned at any stage of its progress by instructions from the client, the fee due to the engineer should be determined in accordance with the extent of the progress, expenses and obligations incurred, as subdivided under the various percentages stated in C.

5. *Alternative plans.* — Where alternative plans have been submitted at the request of the client, the engineer shall charge the client for the preparation of the non-accepted plans in accordance with the percentages stated under C.

6. *Extra services.* When services in addition to those contemplated in the agreement between the engineer and client are required, such as in connection with legal proceedings, negotiations, failure of contractors, franchises or right-of-way, a charge for the additional work involved shall be made.

7. *Expenses.* — Travelling expenses, blue prints (except the approved set to client), telegrams, and long distance calls shall be charged over and above the fees stated herein.

8. *Resident engineers.* — Except where otherwise expressly stated herein, all charges covering payment of resident engineers, and inspectors, are to be paid direct by the client at actual cost. In all agreements between the client and the engineer it should be expressly stated that the resident engineers and inspectors should be appointed by the engineer, and not by the client.

9. *Period of agreement.* — Except in cases where the compensation of the engineer is in the form of an annual retainer, the agreement between the engineer and his client should specify the period of time during which the compensation of the engineer, as determined by per diem charges, fixed fee, or agreed percentages, shall apply. If, through no fault of the engineer, the work should not be completed within the time so specified, additional charge may be made, the basis of which, if at all possible, should be agreed upon in advance.

10. *Cost of work.* — By "cost of work" is meant the total cost of the work to the client, as contemplated in the agreement, including all structures, permanent equipment, and machinery, all alterations and work done, and materials supplied by the contractor, or by the client, or otherwise, and such charges as are covered by Clause 8 preceding, and all other things excepting (unless where otherwise expressly stated) the engineer's fees, legal expenses and the cost of the land and land damages. The term "cost of work" as used refers only to such part or parts of the whole work or project as the engineer may be engaged to deal with in any of the stages.

11. *Ownership of drawings.* — Original drawings or tracings shall be regarded as the property of the engineer. The client shall be entitled to such copies of the originals or blue prints therefrom, and on such terms, as may be provided for in the agreement between the engineer and the client, or by subsequent arrangement.

12. *Contingent fees.* — Contingent fees are of two kinds:

(a) Those the payment of which in whole or in part is made contingent upon the successful outcome of the recommendations, opinions or estimates of the engineer, and

(b) Those the payment of which, in whole or in part, is made conditional upon the rendering by the engineer of certain recommendations, opinions or estimates.

Those of the first kind, where their character will not warp, consciously or unconsciously, the judgment of the engineer to the possible injury of his client or the public, are approved; those of the second kind are forbidden.

All of which is respectfully submitted and approved by—

(Signed) Frank Barber (*Chairman*)
T. T. Black
F. M. Byam
A. H. Harkness
R. E. W. Hagarty
E. A. James
P. H. Mitchell
*A. L. Mudge
Geo. H. Power
William Storrie
R. O. Wynne-Roberts
C. R. Young.

*Subject to reservation that smaller work which should be done by competent engineers will not stand the rates specified.

Invitation from Institute of Chemistry

Dear Mr. Keith:—

The Council of the Canadian Institute of Chemistry extends a cordial invitation to all members of *The Engineering Institute of Canada*, to attend our annual meeting at Queen's University, Kingston, Ontario, May 27th to 29th, inclusive. Visitors are welcome to take part in all technical sessions and social functions.

Yours very truly,

Canadian Institute of Chemistry,
(Signed) L. E. Westman,
Secretary.

American Society to Meet in Montreal 1925

February 19th, 1924

John H. Dunlap, Esq., Secretary,
American Society of Civil Engineers,
Thirty-three West Thirty-ninth Street,
New York, N.Y.

My dear Mr. Dunlap:—

It gives me much pleasure to advise you that the present Council of *The Engineering Institute of Canada* heartily concurred in the suggestion of co-operating with the American Society of Civil Engineers towards the success of the fall meeting of your Society in Montreal in nineteen twenty-five.

It is evident from the spirit of the resolution passed that every facility will be rendered by our *Institute* towards assisting your meeting, and I feel safe in assuring you that *The Institute* as a whole will be behind the resolution of Council and co-operate with you in the proposed meeting.

Yours sincerely,

(Signed) FRASER S. KEITH,
Secretary.

April 17th, 1924.

My dear Mr. Keith:—

Your letter of February 19, 1924, expressing the sentiments of the Council of *The Engineering Institute of Canada* toward the success of the coming meeting of the Society to be held in Montreal in the Fall of 1925, was presented to the Board of Direction of the Society at its meeting in Atlanta, Ga., April 8, 1924.

It gives me great pleasure to advise you that the Board of Direction appreciated greatly the sentiments expressed in your letter, and I am authorized by the Board to thank the Council of *The Engineering Institute of Canada* for its offer to co-operate toward the success of the coming meeting in Montreal.

With best wishes, I am,

Yours faithfully,

(Signed) JOHN H. DUNLAP,
Secretary.

Lignite Utilization Board Report

The first general report of the Lignite Utilization Board of Canada, submitted to the Hon. Charles Stewart, Minister of Mines, Ottawa, has been issued, the excellence of which reflects great credit on the board, consisting of R. A. Ross, E.E., D.Sc., M.E.I.C., chairman, J. M. Leamy, M.E.I.C., Hon. J. A. Sheppard, and Lesslie R. Thomson, M.E.I.C., secretary.

It is satisfactory to note that the board has demonstrated a complete process of making carbonated lignite briquettes absolutely successfully with full scale equipment. While the commercial end of the proposition is still to be demonstrated it is the belief of the board, with the process now perfected, that this can be done at the Bienfait plant, and it is urged that this be done, otherwise the money already expended will be wasted.

The report of this board is a further demonstration of the ability of engineers, given a problem, to work it to a successful conclusion if such is humanly possible.

The following is a summary of the work of the board as included in a letter to the Hon. Mr. Stewart.

The fuel stringency in Canada due to the war began to be acute in 1916. At the beginning of 1917 the Research Council appointed a Fuel Committee to study the western lignite problem. This Committee called into immediate consultation representatives of those Dominion government departments especially connected with fuels — namely, the Department of Mines, and the Commission of Conservation. As a result of these consultations the Department of Mines and the Commission of Conservation made certain investigations and special reports touching upon the question of the utilization of lignite for domestic use by carbonizing and briquetting. Agreeing with these reports, and focusing the opinion held by all parties to the preliminary review, the Fuel Committee recommended to the Research Council that a commercial demonstration of this process be made. In turn the Research Council recommended appropriate action to the government — contemplating that its execution would rest with the federal Department of Mines. Owing however to reasons outlined in Exhibit A, it was decided to create a special board to undertake the work.

The authority for the creation of the Lignite Utilization Board, its status, the relationships between the supporting governments, and the personnel of the board itself, are found in Dominion Order-in-Council No. P. C. 643 dated March 20th, 1918, in Dominion Order-in-Council No. P. C. 2064 dated August 22nd, 1918, and in a tripartite agreement dated July 20th, 1918, signed by representatives of the Dominion government, the Manitoba government and the Saskatchewan government.

With the above described status the board began its work on October 1st, 1918, with the objective (laid down by Order-in-Council) of demonstrating *the commercial feasibility of producing a carbonized lignite briquette for domestic consumption.*

When the work was started it was believed that the technical process had been developed beyond the laboratory stage. Upon personal investigation undertaken by the board of all processes and plants in America, (Europe was closed at that time), it became very apparent that no commercial process for the treatment of lignites was available. It therefore became necessary for the board to develop the technique of a *process* before any hope could be entertained of giving a commercial demonstraton of the project.

The fundamental research necessary to produce such a process occupied the board from February, 1919, until the spring of 1920. This entirely unexpected delay not only kept back the attainment of the objective by an equivalent amount of time, but also precipitated the construction of the plant into the most expensive building period ever experienced, a time quite unprecedented as far as prices and deliveries were concerned.

During the prosecution of the research just mentioned a process gradually began to develop. On account of previous work done in Ottawa by the Department of Mines, the board's engineers felt that the development of apparatus suitable for the commercial carbonization of lignite was a more difficult problem than the development of a process of briquetting. Attention therefore was concentrated on the carbonizing from February 1919 to October 1919, by which time it was felt that the principle and operation of a new type of by-product retort had been developed to a sufficient degree to permit the board to move forward to the construction of its main plant. In other words, as the objective of the board lay in a commercial demonstration, the inevitable risks always incident to full scale development of new processes had to be taken boldly and at once, as no laboratory experiment can ever give a satisfactory commercial demonstration. The commercialization of a process involves inevitably the operation of full scale commercial units.

With this view clearly held, construction of the Bienfait plant was started in June 1920, and the plant was finished in August, 1921.

The autumn of 1921 was thereupon given up to attempts to get the plant into operation. After these trial runs, all parts of the plant appeared reasonably satisfactory, with the exception of the carbonizing ovens and certain mechanical features of the briquetting layout. Of these two departments the carbonizing presented the graver and more ominous difficulties. After thorough investigation it was decided to rebuild three of the carbonizers in order to incorporate such changes as the preceding few months trials had indicated as essential. These changes were completed by August 31st, 1922, and trial runs were again instituted with a great reduction in the operating difficulties encountered. Successive attempts were made to operate the carbonizers, but by the beginning of January 1923, it became evident that hope would have to be abandoned of making these by-product carbonizers commercial. During this time a large number of further runs had been made in the briquetting building, which indicated that the layout and sequence of the machinery was far from right. The difficulties encountered lay in mechanical troubles with machinery rather in any mystery surrounding the *process.* In other words, it was a matter of accommodating large scale machinery to the execution of a process the details of which in small apparatus had been mastered in Ottawa.

The situation then in the beginning of 1923 was as follows: The board's own carbonizers were proved non-commercial. The full scale briquetting layout had proved not to be as suitable as it ought for the carrying out of the process developed in Ottawa. Therefore it was apparent that the real gap in the process was in carbonizing though the attainment of a complete process was an *absolute* prerequisite to any commercial demonstration of the project. In this contingency the board turned to the investigation of a new type of shaft carbonizing oven developed within the preceding few months by the combined efforts of the American Bureau of Mines and Dean Babcock of the University of North Dakota. Through the courteous co-operation of Messrs. Hood and Odell of the American Bureau, and of Dean Babcock, the board made a test of Souris lignites at Grand Forks in the one example of this oven then existing. The results of this run were sufficiently encouraging to warrant the Board in erecting at Bienfait one large size oven of this type with the idea of giving the principle and construction details a very thorough test. The retort was completed on June 23rd, and from the beginning of July to the end of December, 1923, was operated practically continuously with proper gas offtake connections during which time 3,000 tons of lignite were carbonized. As the result of this run the board states that within specific limits covered by the claims for this oven (see appendices) the oven can be termed a commercial success.

In order to demonstrate that the char produced by this oven is suitable for and can be briquetted, the supporting governments instructed the board to briquette 150 tons at the briquetting plant of the University of North Dakota at Hebron. Again Dean Babcock courteously acquiesced, and the briquetted test on this char held in December 1923, gave absolutely successful results.

The board has now reached the point where it can announce that taking in order the necessary steps to produce a carbonized lignite briquette for domestic consumption, the *technical process has been completely demonstrated with full scale apparatus suitable for commercial conditions.* It now remains (in order to reach successfully the objectives laid down by Dominion Order-in-Council) to give a working commercial demonstration of this process, without which the whole project will have proved abortive.

The board therefore submits the following as a brief digest of its work and results over a period of five years.

The Lignite Utilization Board started work October 1st, 1918, and to date over five years have lapsed.

This time has been spent as follows:

Occupation	Time in years approx.	Remarks
Investigation of all previous work.	½	To insure that the board would have complete information as to development of the process in America.
Fundamental research.	1	Necessitated by discovery that no lignite carbonizers were developed to a commercial degree in America.
Construction and equipping of plant.	1	Construction very slow owing to conditions obtaining in 1920-21.
Trial operations and reconstruction.	1½	Attempts to operate Board's own carbonizers, reconstruction of same, and renewed efforts — their final abandonment.
Demonstration of process now proved.	1	Investigation and demonstration of Hood-Odell oven. Briquetting of char. Completion of process demonstration.

The following is an approximate statement of receipts and expenditure from October 1st, 1918, to January 1st, 1924.

Receipts:—	Approx.
From Governments	$1,036,300
" Misc. sources (interest, etc.)	13,900
" House rentals and special services a–cs	9,500
	$1,059,700

Expenditure:—	Approx.	Per cent of total receipts.
Administration	$141,600	13.3%
Travelling	12,800	1.2%
Capital exp. in dwellings and boarding house	117,700	11.1%
Capital exp. in plant bldgs., equipment, ovens, etc.	604,700	57.1%
Preliminary operating, maintenance and repairs	107,200	10.1%
Miscellaneous	8,300	0.7%
Cash in hand	67,400	6.5%
	$1,059,700	100.0%

All above accounts were audited to March 31st, 1923.

Results

Making no allowance for any subsequent development of the work either by this board or others, the following constitutes a brief digest of the actual results obtained:—

(i) Immediately upon its inception in 1918, the board started a complete investigation of all existing methods of carbonizing and briquetting of lignite with the discovery that *no* commercial processes had been developed.

(ii) This discovery necessitated the embarking upon an extensive fundamental research into the chemistry and physics of lignite carbonization with a view of developing the basic information that would enable the board to develop a process. This work was done with the active co-operation of the Department of Mines, Ottawa. The information thus gained is available permanently.

(iii) As the work developed, semi-commercial carbonizing and briquetting plants were erected in Ottawa. The operation of these plants yielded information of considerable value, also available permanently.

(iv) A very thorough test has been given to a special type of lignite carbonizer, and it has been proven non-commercial. Therefore one important ghost has been laid.

(v) The board has erected a large plant of a solid permanent character at Bienfait, and for the operation thereof, has provided housing, water supply, power, chemical control laboratories, and complete mechanical equipment.

(vi) The board has aided materially in the development of a shaft oven carbonizer designed by the combined efforts of Messrs. O. P. Hood and W. W. Odell of the American Bureau of Mines, and of Dean Babcock of the University of North Dakota. This advance has been made possible by the very courteous co-operation extended by each of these three. During this work the American bureau acted as consulting engineers to the board.

(vii) The board has solved the technical problems of briquetting lignite char. All known binders were experimented with in Ottawa, and the most economic selected for commercial development at Bienfait. In addition the board has demonstrated under instructions from the three supporting governments, that the special char from the Hood-Odell oven presents no peculiar difficulties in briquetting, for 150 tons of this char, produced at Bienfait, were briquetted at Hebron successfully, through the co-operation of Dean Babcock, the University of North Dakota.

(viii) From the foregoing it is obvious that a *complete process* of making carbonized lignite briquettes has been demonstrated absolutely successfully, with full scale equipment. Thus the first half of the original objective *laid upon the board has been attained.*

Still to be Demonstrated.

The second half of the original objective laid down by Order-in-Council is the commercial demonstration of the process now perfected, including commercial quantity production and sale of product for at least six months. This demonstration can be made at the Bienfait plant, (provided certain revisions be incorporated). These changes include alteration to the briquetting layout, installation of the necessary additional carbonizing ovens, improvement of methods of water disposal, and of the shipping and switching facilities, and the completion of those revisions to conveyors and handling equipment, necessitated by change in carbonizing process. The necessity for commercial throughout lies in the fact that only by operation in quantity can there be determined the commercial cost of, materials, labour, repairs, replacements and technical supervision and control. If this step be not taken then the money already invested will have been largely wasted, for no commercial company will accept a process developed solely on its technical side. The alternatives are completion of objective with saving of funds already expended, or failure of project with resulting loss of capital.

The details of all the above mentioned matters are covered fully in a report dated January 24th, made to the board by the secretary, Lesslie R. Thomson, the text of which, with its appendices, appears as Exhibit "A" of this report of the Lignite Utilization Board.

Copies of the complete report, which are embodied in a splendidly designed volume of two hundred and sixty-one pages, with a large number of excellent plates, will be gladly forwarded to members of *The Institute* by Lesslie R. Thomson, M.E.I.C., secretary of the board, 288 St. James Street, Montreal.

The Moberly Fund

Although the name of the late Walter Moberly does not appear in the records of *The Engineering Institute of Canada* as having been an active member, the significance of his remarkable career in the romance of the pioneer days of British Columbia needs no introduction to those who follow the trails he blazed. The story of his life as an engineer, explorer and empire-builder, with its hopes successes and disappointments, its manly ideals and self-sacrifice, its courage, endurance and heroism, is one which cannot fail to stir the heart of every red-blooded Canadian, no matter what be his calling or where be his abode.

Walter Moberly passed into history at the age of 83, on May 14th, 1915. As a fitting tribute to his memory, the following resolution appears in the minutes of a general meeting of the Vancouver Branch of the Canadian Society of Civil Engineers, held on June 3rd, 1915:

Tribute to Mr. Moberly.

"This meeting of the Vancouver branch of the Canadian Society of Civil Engineers desires to place upon record, the loss that the Engineering Profession of Canada has suffered by the lamented death of its distinguished Honorary Member, Mr. Walter Moberly.

"Several years ago, our Branch, in appreciation of the brilliant services rendered to the profession by the great pathfinder, unanimously elected him our only Honorary Member, the highest mark of our esteem that was possible to show him.

"Walter Moberly was born in the village of Steeple, Ashton, Oxfordshire, England, on the 15th day of August, 1832, and came to Canada when ten years of age, and at the age of nineteen entered upon his career as a railway engineer in eastern Canada. It is, however, his association with British Columbia, that has for us the greatest interest — an association that began so long ago as 1858, when he arrived in Victoria after a long passage by sailing ship via New York and Cape Horn. Since that time, he has been famous as a pioneer, explorer and engineer of this province, and his name will be forever associated with the famous Eagle Pass through which we to-day travel between east and west, surrounded by magnificent mountain scenery, in comfort and pleasure.

"It is the wish of the local branch of the society that a full biographical study of Mr. Moberly's distinguished career be prepared and placed upon the printed transactions of our parent society. We, as the local branch of the Canadian Society of Civil Engineers, who are reaping the benefit of the great pioneer's engineering skill, have lost a true friend and a wise counsellor. In the affairs of our branch, he always took the greatest interest, and in recent years, often attended, in spite of his great age and failing health, many of our meetings. On May 14th, he passed into "the shadow of the valley" on his long and final journey, and we can truthfully say of him that he was "one who never turned his back, but marched breast forward", full of dauntless courage that made him a giant among men, and one whom, in our memories, we will long cherish as an engineer who never despaired, no matter what difficulties he encountered.

"We, as a local branch, hope that the memory of this great British Columbian will be honoured in some permanent form by the people of the province, and in any movement of this kind, our branch will give its most hearty support.

"The local branch of the Canadian Society of Civil Engineers also desires to convey to the family of our late friend, its sincere sympathy with them in the bereavement it has sustained by the death of our distinguished Honorary Member, and our tribute to a life that is worthy of our emulation and a stimulus to great achievements."

It was the spirit of this resolution which found expression in the creation of the "Moberly Fund", mention of which has, from time to time, been made in the pages of *The Journal*. The purpose of the subscribers was to erect a memorial tablet to his name, but for reasons beyond their control, the idea was never carried out. The fund, having passed into the hands of the Vancouver Branch of *The Engineering Institute of Canada*, as trustee, has been growing steadily, by reason of its investment in Victory Bonds: and at the last annual general meeting of the branch, held on December 19th, 1923, a committee was appointed to report on some suitable plan for using the fund to endow a memorial prize, the report to be presented at a general meeting in March, 1924.

The preliminary report was read at a meeting of the Executive Committee of the Vancouver Branch on February 29th, of this year. After thorough discussion, it was adopted with one or two amendments, and placed on the agenda of the March general meeting of the branch.

On Wednesday, March 26th, the report was presented to the branch, Dean R. W. Brock, of the University of British Columbia, being in attendance, by special invitation, to assist in the discussion. The text of the report is as follows:

Report of the Committee on the Moberly Fund

To The Chairman and Members,
Vancouver Branch,
The Engineering Institute of Canada.

Gentlemen;—

Your committee has the honour to report that the sum of money known as the "Moberly Fund" was raised through the joint action of the Vancouver Branch, Canadian Society of Civil Engineers, and the Old Time Settlers Society of B. C., during the Great War.

The purpose of the fund was to provide a suitable permanent memorial to perpetuate the name and achievements of the late distinguished pioneer engineer, Walter Moberly, who died in Vancouver, B.C., on May 14th, 1915.

Mr. Moberly's career may be found recorded in considerable detail, in the "History of British Columbia", Biographical Section, Vol. III, pages 969 to 985. Also, in the minutes of a general meeting of the Vancouver Branch, Canadian Society of Civil Engineers, held on November 25th, 1913, it is reported that a resolution, moved by Col. T. H. Tracy, M.E.I.C., and seconded by C. E. Cartwright, M.E.I.C., was adopted unanimously, making Walter Moberly an Honorary Member of the Vancouver Branch.

Although Mr. Moberly's name does not appear in the records of *The Engineering Institute of Canada*, as having been a member, the fact that he was held in very high esteem is further indicated by the following extract from the memorial resolution adopted at a general meeting of the Vancouver Branch, Canadian Society of Civil Engineers, on June 3rd, 1915, which reads:

"It is the wish of the local branch of the Society, that a full biographical study of Mr. Moberly's distinguished career, be prepared and placed upon the printed transactions of our parent Society..... We as a local Branch, hope that the memory of this great British Columbian will be honoured in some permanent form by the people of the province, and in any movement of this kind, our Branch will give its most hearty support."

Following the spirit of this resolution, the Executive Committee of the branch made efforts during 1919 and

1920, to have a permanent memorial erected at a suitable site in the Eagle Pass, to be selected by the late Lord Shaughnessy. From the Moberly Fund correspondence on file, it appears that some difficulty arose in the selection, which resulted in the matter being temporarily dropped.

The fund was reported in the minutes of a general meeting of the Vancouver Branch, held on May 25th, 1916, as amounting to $401.32. A resolution, moved by A. D. Creer, M.E.I.C., and seconded by E. A. Cleveland, M.E.I.C., was adopted by the meeting, authorizing the investment of the fund in Victory Bonds. Accordingly, four, One Hundred Dollar, 5% Victory Bonds, maturing on October 1st, 1931, were purchased by the committee, these being at present lodged with the Bank of Hamilton Branch of the Canadian Bank of Commerce, Hastings St. West. The interest has been regularly placed to the credit of a special savings account in the same office; and on February 28th, 1924, this account showed a balance of $191.07. The present rate of increase is about $25.00 per annum.

So far as your committee has been able to ascertain, the Moberly Fund is not the exclusive property of the Vancouver Branch of *The Engineering Institute of Canada.* It appears to have been placed in our care, as trustee, for purposes of administration. There is nothing to indicate, however, that the branch would be in error in assuming partial ownership to the extent of retaining control of the fund, so long as the purpose for which it was created, is strictly adhered to.

Therefore, your committee, having these points in mind, has the honour to submit the following recommendations, covering what we believe to be a thoroughly practical form of memorial, in keeping with modern ideas on such matters:

(1) The principal and accrued interest to be consolidated at the first opportunity into one principal sum, to be invested in first-class long term securities, par value $600.00, which will provide an annual income of at least $30.00.

(2) The consolidated fund to endow an annual cash or book prize, which shall be known as "The Walter Moberly Memorial Prize".

(3) The prize to be open to competition by all engineering students of the University of British Columbia who are either entering or in the graduation year.

(4) The basis of the competition to be engineering theses, topics to be submitted to the Executive Committee, Vancouver Branch, *The Engineering Institute of Canada,* before the theses are entered by the respective competitors.

(5) The judges of the competition to be the Professors of the Faculty of Applied Science, University of British Columbia.

(6) The prize to be presented by the chairman of the Vancouver Branch, *Engineering Institute of Canada,* or his deputy, on behalf of the trustees of the Moberly Fund.

Your committee wishes to point out that in recommending the inclusion of all engineering students, either entering or in the graduation year of the University of British Columbia, rather than the limitation of the competition to student members of *The Engineering Institute of Canada,* the Vancouver Branch recognizes the public nature of the funds in its trust.

We feel, however, that *The Institute* will be given the opportunity of retaining the prominence we believe it is justly entitled to through its active interest in this matter, by the conditions set forth in clauses (4) and (6) of the foregoing recommendations.

The purpose of clause (4) is to ensure the merit of the respective theses before they are entered for competition, it being the duty of the Executive Committee of the Vancouver Branch to insist on a high standard, in keeping with the ideals and achievements of the late Walter Moberly, in whose memory the prizes will be awarded.

Yours faithfully,

Vancouver, B.C. W. H. POWELL, M.E.I.C.
26 March, 1924. P. H. BUCHAN, A.M.E.I.C.
Committee.

After a short discussion, the report was adopted by resolution of the meeting, since when Dean R. W. Brock, M.A., of the Faculty of Applied Science of the University of British Columbia, has been officially notified. There has not been time for the Board of Governors to take any action, as yet, but an announcement may be expected in the near future.

The question involved in the choice of either an annual cash or an annual book prize will be the subject of further discussion by the Executive Committee of the Vancouver Branch, which will no doubt be influenced by the success of the investment of the consolidated fund.

P. H. Buchan, A.M.E.I.C.

World Power Conference Membership Privilege

Advice has been received from London, England that all members of *The Engineering Institute of Canada,* may have the privilege of membership in the World Power Conference at a fee of thirty shillings in place of the two pounds originally stipulated. Those who expect to be in London at the time of First World Power Conference, June 30th to July 12th, 1924, may secure the fullest information from the general secretary of the Canadian Management Committee, J. B. Challies, M.E.I.C., Dominion Water Power Branch, Department of the Interior, Ottawa, Ontario.

THE PRESIDENT, MANAGEMENT AND MEMBERS OF

The Franklin Institute

To *The Engineering Institute of Canada*
Greetings:

ON MARCH 30TH 1824 THE GOVERNOR OF THE STATE OF PENNSYLVANIA SIGNED AN ACT INCORPORATING The Franklin Institute of the State of Pennsylvania for the Promotion of the Mechanic Arts, AND WE – IN MEMORY AND IN RECOGNITION OF THOSE WHO IN THIS AND OTHER LANDS HAVE DEVOTED THEIR EFFORTS DURING THE PAST ONE HUNDRED YEARS TO THE DISCOVERY OF PHYSICAL LAWS AND THEIR APPLICATIONS – HAVE RESOLVED TO CELEBRATE THE

Centenary

OF THE SIGNING OF THIS ACT AND CORDIALLY INVITE YOUR PARTICIPATION

PARTICULARLY IT IS HOPED THAT YOU WILL APPOINT A REPRESENTATIVE TO CELEBRATE WITH US ON WEDNESDAY, SEPTEMBER 17TH 1924 AND THE TWO SUCCEEDING DAYS, THE FOUNDING OF THE INSTITUTE

GIVEN IN PHILADELPHIA, FEBRUARY 21ST 1924 UNDER THE SEAL OF THE INSTITUTE

PRESIDENT

SECRETARY

OBITUARIES

William Frederick Gronau, M.E.I.C.

William Frederick Gronau, M.E.I.C., died at his residence 284 Regent Avenue, Montreal, on April 11th, 1924, after a short illness. The late Mr. Gronau, was born at Baltimore, Md., on April 9th, 1866. After receiving his primary education at the public schools of Baltimore and Baltimore City College, he entered the Rensselaer Polytechnic Institute, from which he graduated with the degree of C.E. in 1887. He then joined the staff of the G. W. G. Ferris and Company, inspecting and consulting engineers of Pittsburg, Pa., with which firm he was inspector of structural steel work and assistant engineer for the following two years. In 1889 he became a member of this firm and for six years was in charge of the engineering department. Subsequently he was assistant engineer with the Edge Moor Bridge Works of Wilmington, Del., in the capacity of designing and contracting engineer. Between the following fourteen years, from 1899 he was engaged in contracting work with firms in New York City, his positions including charge of design and construction with the New York Shipbuilding Company, Camden, N.J., and chief engineer with J. H. Gray Company, contracting engineers. In 1913 Mr. Gronau came to Montreal where he was engineer with the Structural Engineering Company, and the following year he was appointed contracting engineer for the Dominion Bridge Company, Limited, with which company he was connected until the time of his death. The late Mr. Gronau, was responsible for the design of the Ferris Wheel for the World's Columbian Exhibition, Chicago, in the year 1892. The late Mr. Gronau was elected a Member of *The Institute* on December 19th, 1922.

William F. Campbell, A.M.E.I.C.

The death occurred at the Montreal General Hospital, on Wednesday, March 18th, of William F. Campbell, A.M.E.I.C., eldest son of William Campbell, of Grenville, Que.

Mr. Campbell was born near Grenville, Que., August 5th, 1885, and was educated there at the public school. He entered the employ of the government in 1905 during the preliminary survey of the Transcontinental Railroad and continued as resident engineer during the construction of same between Cochrane, Ont., and Sioux Lookout, Ont. On the completion of the road in 1914, he entered Queen's University to take a special course in engineering and enlisted there for overseas service with the Canadian Engineers in January, 1915. He served in France with the First Field Company Canadian Engineers and was wounded on October 10th, 1915, returning to France with the Second Field Company Canadian Engineers and was appointed Lieutenant in the 13th Battalion Railways Engineers May 30th, 1918. He returned to Canada May, 1919. Since then until his illness he was employed in the engineering department of the Canadian National Railways, Saskatoon, Sask.

He is survived by his father, William Campbell, two sisters, Mrs. W. F. Cole, Laval Rapids, and Miss Agnes Campbell, of Grenville, Que., four brothers, the Rev. Malcolm Campbell, of Montreal, and Lachlan, Arthur and Gordon, of Grenville, Que.

The late Mr. Campbell was elected an Associate Member of *The Institute,* on January 25th, 1921.

Robert Easton Hunter, M.E.I.C.

After a long illness Robert Easton Hunter, M.E.I.C., died at the home of his brother, J. H. Hunter, M.E.I.C., 731 Upper Belmont Avenue, Westmount, Que., on Friday, March 21st, 1924. The late Mr. Hunter was born at Sorel, Quebec, on November 8th, 1867, and after receiving his early education at the Sorel Model School and the Montreal Senior School, he entered the faculty of applied science of McGill University, taking a civil engineering course. His early work in engineering was on railway construction. As early as 1894 he was resident engineer on the construction of the Tring-Megantic branch of the Quebec Central Railway, and was later resident engineer on the construction of the Sorel bridge with the South Shore Railway, and in the same capacity he was engineer on the construction of the Montreal Park and Island Railway. In 1889 he became resident engineer of the West India Electric Company Railway, at Jamaica. Returning to Canada in 1900 he was for a year division engineer on the Great Northern Railway of Canada, his subsequent work taking him to Cuba. Returning again to Canada he continued his railway work and was for a number of years chief engineer of the Canada and Gulf Terminal Railway. The late Mr. Hunter's association with *The Institute* dates back to the earliest days of the Canadian Society of Civil Engineers, when in the year of its incorporation he became a student of the Society, was transferred to Associate Member on April 12th, 1900, and to Member on October 8th, 1910.

Augustus Burges Barry, M.E.I.C.

On April 22nd, 1923, Augustus B. Barry, M.E.I.C., died at his home in Toronto. The late Mr. Barry who was a member of *The Institute* since March 11th, 1892, was a native of Dublin, Ireland, where he was born on March 27th, 1842. He received a military training at London, England, but followed mechanical engineering, and was employed in England, France and Holland until 1869. He then became interested in sewage disposal and in treating Indian and West Indian fibres. In 1876 he came to Canada and entered as mechanical partner in the firm of Copp Bros. and Barry until 1884. During this period he was in charge of enlargements at the Hamilton water works pumping station under the direction of John Kennedy, M.E.I.C., of Montreal. From 1884 to 1888 he was outside manager for the Hamilton Bridge Works. He then practised as a consulting engineer in Toronto, devoting his attention to waterworks, sewage disposal, mechanical engineering works, etc. In 1895 he was appointed sanitary engineer for the health department of the city of Toronto, a position he held until his death.

The late Mr. Barry took an active interest in the organization of the Engineers' Club of Toronto, of which he was president in the year 1909. He was also a member of the Association of Professional Engineers of Ontario.

PERSONALS

R. L. Simpson, S.E.I.C., of Montreal, Que., is now with the Pennsylvania State Highway department with offices at Pittsburgh, Pa.

P. E. Biggar, S.E.I.C., who graduated from McGill University in 1922, is at present with the Eastern Engineering Company, of Montreal.

J. H. Ings, S.E.I.C., will be located at St. Joseph d'Alma, Lake St. John, with the Quebec Development Company, for the next four months.

H. T. Hazen, M.E.I.C., assistant chief engineer, operating department, Canadian National Railways, has been transferred from Toronto to Montreal.

J. W. Wallis, A.M.E.I.C., is at present located at Temiskaming, Que., with the Riordon Pulp Corporation, as efficiency engineer in the supplies department.

G. Lorin, S.E.I.C., is at present located with the Laurentian Hydro-Electric Company, at Mont Rolland, Que. Mr. Lorin is a graduate of McGill University, of the class of 1922.

A. Donaldson, Jr.E.I.C., of Edmonton, Alta, is on the city engineer's staff of Inglewood, California. Mr. Donaldson graduated from the University of Alberta in civil engineering in 1922.

C. T. DeLamere, M.E.I.C., is at present located at Island Falls, Ontario, with the Sir Wm. Arrol and Company, Limited. Mr. DeLamere, was formerly with Downing-Cook and Company, Montreal.

A. W. Swan, A.M.E.I.C., who since his return to England has been with the Sterling Telephone and Electric Company, Limited, has now accepted an appointment with Evershed and Vignoles, electrical instrument makers, Acton, London.

E. R. Woodward, Jr.E.I.C., has been appointed industrial oil sales representative for the Springfield district by the Tide Water Oil Sales Corporation of New York. Mr. Woodward was formerly associated with their refinery at Bayonne, N. J.

N. H. Bradley, A.M.E.I.C., has been transferred from the Peace River district, by the Department of Public Works, to Lethbridge, Alta. Mr. Bradley was district surveyor and engineer in charge of location and survey of roads in the Peace River district.

George Kydd, A.M.E.I.C., formerly a member of the staff of the Trent Valley canal, Orillia, has been appointed divisional engineer, section 8, Welland Ship Canal. Section 8 is the most southerly section of the canal, and includes the guard lock and harbour works at Port Colborne, on lake Erie.

Homer P. Keith, A.M.E.I.C., district engineer of highways, Department of Public Works, at Lethbridge, Alta., has been transferred to assistant and commissioner of highways with offices at Edmonton. Mr. Keith is a graduate of the class of '07 of the University of Toronto, and is a commissioned Dominion and Alberta land surveyor.

L. S. Adlard, S.E.I.C., assistant executive engineer, Ampello division, P.W.D., Punjab, India, has recently arrived in Canada on leave. Mr. Adlard is a graduate of the University of Toronto of the class of 1915. His address while in Canada will be 60 Howard Street, Toronto, Ontario.

H. F. Barnes, A.M.E.I.C., has resigned from the position of sewerage engineer in the Public Works department, Shanghai, China, to accept the appointment of municipal engineer, British Municipal Council, Tientsin. Mr. Barnes is a native of New Brunswick and received his engineering education at the University of New Brunswick, graduating in civil engineering.

Geo. E. Bell, M.E.I.C., until recently assistant to the president of the Dominion Engineering Works, Limited, Lachine, Que., has resigned to accept a position with The Seaman Kent Company, Limited, Toronto, Ont. Mr. Bell is an honour graduate in civil engineering, from McGill University of the class 1907, and was for a time western manager for the Dominion Bridge Company, Limited, with offices at Winnipeg, Man.

H. G. Thompson, Jr.E.I.C., has been transferred by the Combustion Engineering Corporation Limited from the head office in Toronto to Montreal, Que. Mr. Thompson was for a time sales engineer with the Canadian Sirocco Company Limited at Montreal and later on the engineering staff of the Riordon Company, Limited at Timiskaming, Que. Mr. Thompson is a graduate of the University of Toronto with the class of 1922.

Thos. H. Nicholson, A.M.E.I.C., is consulting engineer with the Brazilian Telephone Company with headquarters at Rio Janeiro, Brazil. With the exception of five years, 1906 to 1911, when he was with the New England Telephone and Telegraph Company. Mr. Nicholson was on the engineering staff of the Bell Telephone Company, at Montreal, continuously since 1904, so that he has had a long and varied experience in the work he is undertaking in his new position.

H. Alton Wilson, A.M.E.I.C., formerly technical editor with the McLean Publishing Company is a special representative of the Nash Engineering Company of South Newark, Conn. Mr. Wilson is a graduate in mechanical and electrical engineering of the University of Toronto, 1911, and was for a number of years engineer for the J. C. Wilson and Company, Glenora, Ont., engaged in the manufacture of turbines and power transmission machinery. During the war Mr. Wilson was engineer and manager in charge of a munition factory at Belleville, Ont., manufacturing high explosives shells and subsequently was appointed equipment engineer for the North East Electric Company at Rochester, New York.

New Engineering Organization

John G. Sullivan, M.E.I.C., past-president of *The Engineering Institute of Canada*, Theodore Kipp, Jr., A.M.E.I.C., and William G. Chace, M.E.I.C., have joined forces to carry on a consulting and contracting engineering business with headquarters at Winnipeg. The three members of the firm are all well known Canadian engineers and have all specialized in various fields of engineering, which should enable them to utilize their joint experience and ability to advantage. Mr. Sullivan is a past-president of *The Engineering Institute of Canada* and well known to all the members. He has carried on a successful engineering practice in Winnipeg since his retirement as chief engineer of western lines, Canadian Pacific Railway, with which company he still acts in a consulting capacity. He is one of the most able and experienced railway engineers in Canada. He has also been president of the American Railway Engineering Association. He is an alderman of the city of Winnipeg, and a member of the Administration Board of the Greater Winnipeg Water District.

Mr. Chace who has been an active member of *The Engineering Institute of Canada* and a former vice-

J. G. SULLIVAN, M.E.I.C.

president, is a graduate of the School of Science, 1903, with the degree of B.A.Sc. His experience includes that of resident engineer at Niagara Falls for the International Railway Company, electrical engineer for the Temiskaming and Northern Ontario Railway Commission, and later as a member of the firm Smith, Kerry and Chace of Toronto, he was interested in a large number of important hydro-electric developments. From 1913 to 1920 he was chief engineer for the Greater Winnipeg Water District in charge of the design and construction of the ninety-six mile aqueduct. He later became president of the Canada Lock Joint Pipe Company, which company in 1921 built a four mile reinforced concrete conduit for the city of St. John, N.B.

Mr. Kipp's early experience was a thorough training with his father who was an expert miller, followed by many years of mill construction and equipment.

The new firm will direct its energies to the railway, power and industrial fields, undertaking construction and delivery to owners of complete plants ready for operation, making a specialty of special engineering problems of power development and transmission, railway improvements and electrification.

A. W. Lamont, A.M.E.I.C. Appointed President of New Organization.

A. W. Lamont, A.M.E.I.C., of Winnipeg, Man., is president of the Western Engineering Company Limited, which has recently become affiliated with the Newark Electric Furnace Company. This company will specialize in electric furnace work throughout Canada, with branch offices in Montreal, Toronto, Calgary, Vancouver, with head offices in Winnipeg. Mr. Lamont is a graduate of the University of Toronto of 1910, and has been with the Canadian Westinghouse Company Limited, for a number of years, being in charge of their Winnipeg office as industrial sales engineer.

City Engineer for Vancouver

Charles Brakenridge, M.E.I.C., has been appointed city engineer of Vancouver, B.C. Prior to 1918 when he entered private practice as a consulting engineer, Mr.Brakenridge, was assistant city engineer of Vancouver. He is a native of Whitehaven, England, where he was born in 1885, and following his course at the Royal Technical College, Glasgow, he was articled with the late J. S. Moffat, C.E. His first work in this country was with the Grand Trunk Pacific Railway in 1907. Mr. Brakenridge was chairman of the Vancouver Branch of *The Institute* in 1922, and is at present on the Council of *The Institute* representing the Vancouver Branch. He was elected vice-president of the Association of Professional Engineers of the Province of British Columbia, for 1923.

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

CHARLES BRAKENRIDGE, M.E.I.C.

Abstracts of Papers read before the Branches

Special Tests on Concrete

I. F. Morrison,
Edmonton Branch, March 20th, 1924.

During the past two years a series of tests have been carried out at the University of Alberta which had for their object the determination of the effect of small quantities of lignite coal on the strength of concrete. Some of the sands used in the district, having Edmonton as its center, unavoidably contain this coal, and although it may be removed by washing, the economic problem of washing the sand to obtain an increase in strength of the concrete was thought worthy of consideration.

The standard colorimetric test made on these sands gives a very dark colour, and, even with a very small amount of coal, this would form a basis for rejection if the colour test is to be adopted as a qualitaive requirement. In these tests it has been conclusively demonstrated, however, that the decrease in strength is not comparable to the colour when lignite coal is present. Amounts of coal as small as 0.015 per cent gave a very dark colour.

The first series of tests were made on the strength of concrete cylinders made with the unwashed and the washed sand respectively as the fine aggregate. These tests were of a comparative nature, and they showed that the washing improved the strength about 4 per cent. Obviously the washing was not worth while.

A second series of tests was made in which washed sand, with definite amounts of the coal, was used. The results of this series confirmed those of the first. Only 0.05 per cent by weight of coal caused a decrease of about 8 per cent in the strength at 28 days, three months, six months and one year, below that of the concrete made with no coal in the sand. It is remarkable, however, that no further decrease in strength was observed at these ages for percentages of coal up to one per cent. According to the colorimetric test, this decrease should be more than 50 per cent. These results show that the colorimetric test cannot be taken as indicative of poor quality when such coal is present, even in quantities up to one per cent.

Some work has also been done to check up the mortar-void theory of Professor Talbot. The washed sand used in the tests already mentioned was used. The results of the tests published by Talbot and Richart in bulletin No. 137 of the University of Illinois seem to indicate that the maximum strength of a mortar occurs for a percentage of water about one per cent greater than that which gives the minimum voids. Possibly the extra one per cent is used in hydrating the cement.

These opinions have, in general, been confirmed by a small series of tests on 3 by 6-inch mortar cylinders. Eighty cylinders were made and broken. These tests show that:— (1), Above the percentage of water corresponding to the minimum voids the strength of the mortar decreases rapidly as the percentage of water increases. (2), The strength of the mortar increases with an increase in the ratio of cement to sand. Based on these conclusions an explanation of the water-cement ratio theory presents itself; because if there is a decrease in strength due to an increase in the voids caused by an increase in the amount of water i.e. of the water-sand ratio, and if there is an increase in the strength due to an increase in the cement content, i.e. the cement-sand ratio, then these two changes in strength may nearly offset each other for a constant water-cement ratio. This actually seems to be the case, but the relation is not an exact one as is shown by Professor Abram's work in bulletin No. 1 of the Lewis Institute due to the fact that the points plotted in the figure 1 fall in a broad band in the neighbourhood of the curve.

H. R. Webb, lecturer in civil engineering, deserves considerable credit for the excellent quality of work in all of these tests. Acknowledgement should also be made for the materials supplied by the city of Edmonton and for the cement supplied by the Canada Cement Company.

Breakwater Construction at Malta

J. A. Grant, A.M.E.I.C.,
St. John Branch, at Fredericton, N.B., March 28th, 1924.

The Maltese islands lie in the Mediterranean, 140 miles south of Europe. The population in 1917 was estimated at 207,000. The history of Malta dates back to bible times when Saint Paul was shipwrecked there, and at different times practically every European country, in addition to the Turks and Arabs, has occupied some of its islands. The Maltese speak their own language which is largely Arabic from an early occupation by the Arabs. Since 1802 the group, consisting of Malta, Goza and several smaller islands, has been a British protectorate.

The climate is temperate, ranging between 54°F., in winter to about 100°F., in summer. Frost and snow are almost unknown although serious hail storms occur during fall and winter months. There is so little rainfall between April and September that cement may be left uncovered in the open. During winter months violent wind storms cause mountainous seas to break against the coast.

Malta, the largest island, is 17¼ miles by 8¼ miles, with an area of 91 square miles. The harbour at Valetta prior to 1903 was exposed to north-east storms. To provide protection from storms and give an enlarged safe anchorage area for vessels two breakwaters were built by the British contractors, S. Pearson and Son, Ltd., between 1903 and 1910.

The range of tide in the harbour of Malta is 10 inches, increased by winds to 2 feet. During storms in the Mediterannean waves up to 30 feet high have been observed breaking on this coast. The breakwaters were built from two points, Point St. Elmo and Point Ricasoli, extending from opposite sides of the entrance to the harbour. The St. Elmo breakwater was 1,570 feet and the Ricasoli 530 feet long. The outer end of each breakwater was circular in plan, 67 feet diameter at sea level, on which was built a lighthouse about 50 feet high above mean sea level.

The St. Elmo breakwater started 226 feet from the shore in 34 feet of water below mean sea level, extending outwards for the greater length in 40 feet with a drop to 68 feet near the outer end; the gap at the shore was bridged by two 113-foot spans which were left to facilitate scour of refuse material in the harbour; advantage was also taken of the opening by smaller craft passing to and from the harbour, as clearance under girders at mean sea level was 30 feet. In plan there were two short curves of 180 feet radius at the centre line. The width at mean sea level was 48 feet and maximum width on bottom 56 feet. Top of breakwater was 13 feet 9 inches above mean sea level. On the seaward side a concrete apron was placed 30 feet outside the face forming a toe to the breakwater; this apron was of pre-cast concrete blocks 5 feet square with mass concrete placed by skips between blocks and breakwater. Access to and from lighthouse and shore was by a 5-foot by 7-foot tunnel in the breakwater.

Ricasoli was founded on shore at depth of 4 feet and stepped out rapidly to 68-foot depth at outer end; width at mean sea level was 39 feet and maximum at bottom 45 feet; the height above mean sea level was 9 feet 9 inches. A parapet with top 20 feet above mean sea level enabled men to reach the lighthouse. Wave-breaker blocks approximately 9 feet by 9 feet by 8 feet, weighing 42 tons, were thrown pell mell on the sea ward side when the main breakwater was completed.

The breakwaters were constructed by travelling cranes supported on a pile staging built on each side of the breakwaters. During the first two years of construction the stagings were twice destroyed by storms but subsequently the raising the level of top of stagings, stiffening same with lateral piles and lateral loading on stagings ensured their withstanding following storms. All under-water work was done from diving bells, in which as many as seven men worked, and by dress divers. The maximum number of divers employed on job at one time was about 50 bell divers and 60 dress divers. The larger diving bell was 17 feet by 9 feet with 7 feet inside and weighed 37 tons; the smaller one weighed 23 tons.

After the rock bottom at Ricasoli breakwater had been excavated to a level step, a bed of concrete dumped from skips was placed, and then levelled and trimmed by men working inside bells, a course of pre-cast concrete blocks was placed. The blocks, in courses 4 and 6 feet high varied in length from 8 to 14 feet, with uniform width of 7½ feet, and the larger blocks weighing 47 short tons. The blocks were constructed with horizontal and vertical joggles by which they were keyed in position.

The site where the blocks were made was 17 miles by water from the site of the breakwaters. The site selected covered about 60 acres and was off St. Paul's bay. Two nearby outcrops of stone provided coarse aggregate for the mix, while the sand was brought in barges and vessels from neighbouring islands. The blocks were cast in heavy molds placed on a concrete floor 600 by 80 feet. Generally the blocks remained eight days when they were picked up by a "goliath" and moved to storage space for at least a month. The blocks were removed to the breakwater both by rail and water. Practically a year was required to prepare the block yard and get it in running order, and nearly five hundred men were engaged here.

Work on the breakwater began at the shore end and as sections of the breakwater were finished the staging was removed from the sides of the completed section and the material used again in front of the work.

Concrete for blocks was 6 parts coarse aggregate to 1 part cement, the sand being calculated to fill voids in coarse aggregate; for foundations 4 to 1; and for mass work above water line 7 to 1. A 6 to 1 concrete had 6 parts coarse aggregate to 1 part cement.

The Engineer's attitude Toward Accountancy

F. A. Bowman, M.E.I.C.,
St. John Branch, at Fredericton, N.B., March 28th, 1924.

The speaker mentioned the former indifference of the engineer to anything except the essentially engineering phases of an undertaking and the growing realization of the importance of such things as depreciation, amortization, fixed charges, interest and other items to be accounted for and on which the commercial success or failure of the project depended. A project may be properly constructed and designed from an engineering point of view and yet an oversight or neglect of proper accounting methods may render it a commercial failure and as such react on the engineer personally and retard future engineering development. The necessity for an accurate cost record was emphasized, dating from the promotion stages even before actual construction of a project and followed through the several construction stages until actual operation begins and revenue is returned. After construction ends the keeping of accounts must continue during the operation of the plant, and the liaison between engineer and accountant must be continuous. An accurate record will often show that through depreciation, due possibly to inadequacy, obsolence, decay, or some combination of these causes, it may be advisable to scrap some article or plant which could still be used but operated at a loss. Continuous records must be kept in any plant whether a railway, mine, public utility or other engineering work.

Engineering Education not Taught in Colleges

K. H. Smith, M.E.I.C.,
St. John Branch, at Fredericton, N.B., March 28th, 1924.

In treating the subject from the viewpoint of the practising engineer the speaker deplored the present attitude of the engineering student, encouraged in some instances by the over-specialized courses in the purely technical subjects, in concentrating on scientific subjects to the neglect of the humanities. Attention was drawn to the fact that engineers are judged by other things in addition to their purely professional attainments. A man may be a capable designer and efficient constructor as an engineer, and yet in the estimation of the public placed at a disadvantage by his inability to speak in public or use good English in a business letter. Criticisms were not wholly aimed at the colleges as in many cases facilities were placed at the disposal of the student and he failed to realize their connection with his future life work.

Water Resources in Canadian National Parks

H. B. Muckleston, M.E.I.C.,
Vancouver Branch, March 26th, 1924.

Imagine, if you can, the whole of the mountainous area adjacent to Greater Vancouver, set aside as a National park, embracing the charming Capilano and Seymour creeks and the beautiful Coquitlam and Stave lakes, and imagine some well-meaning people insisting that these rivers and lakes should be preserved exactly as nature made them, despite the fact that Vancouver would thereby be deprived of water vital to its domestic needs and to the supply of power for running its street cars and lighting its houses. Would the citizens of Vancouver calmly accept such a doctrine as being in the best interests of the city?

Such was the question propounded to the Vancouver Branch at its general meeting held on March 26th, by H. B. Muckleston, M.E.I.C., past chairman of the Calgary and Lethbridge branches, who thus aptly illustrated the point of his address on "The Conservation of Water in Canadian National Parks".

Mr. Muckleston presented this paper for the information of the local members of *The Institute*, whose interest has recently been aroused in the problem of preserving the natural scenic beauty of Canada's matchless national parks without jeopardizing the future welfare and prosperity of those portions of the Dominion which are dependent upon the water resources within the parks.

In the course of his remarks the speaker showed how dependent the province of Alberta is upon the water supply from the adjacent mountains, particularly in the matter of irrigation. Conservation of the water within the national park reserves would provide for the irrigation of an additional 2,000,000 acres in the wheat belt, he declared, and further, the regulation of high water on the rivers would save flood damages amounting to millions of dollars annually. These statements were substantiated by facts and figures, and made a considerable impression on the meeting.

The discussion indicated that the local members of *The Engineering Institute of Canada* are in sympathy with the motives of the associations which are at present urging the preservation of the scenic beauties of Canada's National Parks, but at the same time they feel that the importance and utility of the water resources within the parks should not be entirely lost sight of.

The result of the discussion was that the Executive Committee of the branch was authorized to arrange as soon as possible, for a presentation of other viewpoints on the matter, at a meeting to which the public would be invited, it being consistent with the policy of *The Engineering Institute of Canada* to have the problem thoroughly studied from all angles before committing itself to a resolution.

The interest in this question at the present time has been stimulated by the active campaign of the Canadian National Parks Association throughout the Dominion, to establish numerous branches and increase its membership, with the immediate purpose of bringing pressure upon the Federal Government to enact a measure which will render the national park areas inviolate for all time. The reason of this widespread uneasiness is the fear that the granting, in the near future, of concessions to certain commercial enterprises for the purpose of exploiting natural resources within these areas, applications for which have already been made at Ottawa, may result in irreparable damage to the scenery in the parks.

There appears to be a feeling abroad that the engineering profession in Canada is rather inclined to take a cold-blooded, commercial view of the matter, and that those who are seriously interested in the preservation of the parks can look for scant sympathy from the various engineering bodies in the Dominion.

We know that such a suspicion is groundless. There are no men in Canada who have greater reason to protest against needless destruction of the beautiful places in our Dominion, than the engineers whose calling often causes them to be the first to witness and appreciate them. But the nature of our profession makes as practical men, and often forces us, against our esthetic inclinations, to have due consideration for utility, when the welfare of those whom we serve is at stake. It is doubtless this quality in our mental make-up which has given the fillip to the misgivings entertained by some of our fellow-citizens.

That the Vancouver Branch, and for that matter, every branch, is heartily in sympathy with the movement that is spreading throughout the Dominion, to preserve our national parks, need not be questioned by anyone who will give the doubt a moment's serious consideration. But at the same time, some members of *The Institute* have the very best reasons, in their estimation, for believing that the conservation of the water resources in certain of the parks, is a necessity vital to the needs of the country as a whole, and that the importance of granting permission to construct such engineering works, as may be required for this purpose, cannot be too greatly stressed before the proposed measure is submitted to parliament.

We owe it to ourselves, as members of *The Engineering Institute of Canada*, to take an active interest in the question, and to see to it, that this problem not only receives well-balanced consideration and an equitable solution by those to whom it is entrusted, but that no doubt may be left in the public mind of our entire concurrence in the principle of preserving our national parks.

Progress in Aviation

Wing Commander E. W. Stedman, O.B.E., M.E.I.C.,
Ottawa Branch, April 7th, 1924.

Col. Stedman outlined the progress made in air flight since the first experiments in this service to the end of last year, a development remarkable in its growth, but not as remarkable as it might have been, and, contrary to general opinion, the great war to a certain extent proved detrimental to this progress. The United States had been among the first leaders in aerial flight, when the Wright brothers made their famous experiments in 1903. From then until the present the history had been one of steady development, which divided into three main periods, the first scientific period, from 1906 to 1914; the war period, from 1914 to 1918, and the second scientific period from 1919 to the present.

The following figures show the progress made. The speed of machines during these years were: 1906, 25 miles an hour; 1912, 95 miles; 1914, 120 miles; 1918, 150 miles; 1923, 266.6 miles. These show that during the war the increase in speed was a bare 30 miles an hour, while since the war the speed has increased over 100 miles an hour. Altitude figures were: In 1909, 500 feet; in 1914, 20,000 feet; in 1923, 36,500 feet.

From 1909 to 1914 airplane progress in Europe had been rapid, particularly in France and England, while the United States was rather indifferent. During the war, when airplanes came into use, the demand had been for greater speed. In the Allied countries there was no time to experiment, material cost too much for new styles, and so old styles were used, and the speed was made up by greater horse power.

After the war the science of aeronautics was again studied, and matters of resistance, weight and power carefully taken up. The Americans were the most advanced in these lines, and their fastest machines, the Curtiss racers, were constructed to obtain the lowest possible resistance, and to attain great speed with light engines.

America was spending her time on racers, using obsolete naval and war planes. France, on the other hand, had great squadrons of war planes, but in three or four years they would be out of date, slow and clumsy. Britain was turning her attention to commercial planes. Col. Stedman expressed the opinion that Great Britain was sadly falling behind the United States in the science of air development, as evidenced when a Curtiss plane, of not the latest model in the States, last year captured the Schneider Cup, beating easily the best that European countries could put in the air.

After the war the victors had demanded that Germany must restrict her air development to light machines, stipulating among other things that single passenger planes should not have more than 60 horse power engines. "If the Allies had wished to develop Germany's air machines and resources, they could not have made a better stipulation," stated Col. Stedman. Germany had at once plunged into a thoughtful study of the science of the air, with the result that for some time she was far ahead of other nations in the art of gliding.

Striking Developments in Science

Dr. H. M. Tory,

Ottawa Branch, March 20th, 1924.

Dr. Tory was of the opinion that the past quarter of a century had been the most brilliant in the history of science and that the change created by the abandonment of the theory of the indestructibility of the atom had revolutionized many lines of investigation.

Dr. Tory said that prior to 1895 those who studied physics based most of their conclusions on the theory that the atom was the smallest particle of matter and that it was indestructible. The discovery by Sir J. J. Thompson and other scientists that the atom was not the fundamental unit and that it could be broken up completely disorganized all preconceived ideas of matter. The separation of the electron and the creation of the X-Ray had initiated a new scientific era. The X-Ray was now being used in all hospitals and was developed to such an extent that the doctor and the scientist could see not only through human flesh but through bone and steel. The General Electric Company had recently spent $600,000 on the development of the Coolidge tube and this expenditure would eventually bring them in hundreds of millions of dollars.

Dr. Tory spoke strongly on the subject of the proper organization of science for the benefit of the present and future generations. Germany was perhaps the only country in the world which had organized her scientific forces prior to 1916. In that year and since Great Britain had tackled this great problem and to-day her efforts towards conservation of agricultural wealth were an example to the world. On this continent unfortunately especially in the United States there was still terrible waste on account of the lack of scientific conservation. Last year 200,000,000 tons of fertilizer in that country had been wasted in the gathering of the crops. Some parts of the United States were now suffering agricultural bankruptcy as a result of this policy of waste, and banks in consequence would not lend a dollar to the farmers in certain areas.

The speaker said Canada must learn its lesson of true conservation and she could then face the future with unbounded confidence.

Airplane Photographs for Map-Making

Professor H. L. Cooke,

Ottawa Branch, March 24th, 1924.

Wide-angle lenses that photograph ten square miles of territory from 10,000 feet in the air, a new method of making time exposures from speeding airplanes, a new optical method of locating the airplane in space, and stereoscopic projections of the photographs contribute to Professor Cooke's improved method of surveying.

A rapid and accurate method of producing contoured maps from airplane photographs is urgently required in practically all the civilized countries of the world, Professor Cooke explained. In the United States there are still about two million square miles and in Canada a much greater amount which have not been covered by contour maps, and the need of maps is felt daily by large industrial interests. At the present rate of progress it will require more than forty years to complete this work in the United States alone, but now that the problem of airplane surveying has been solved it is certain that within a quarter of a century that country will be completely mapped.

Photographs made from airplanes by present methods are now sufficiently accurate for use in the making of government maps. In the near future it will be possible to run aerial traverses between geodetic control points at intervals of twenty to thirty miles and thereby eliminate the enormous cost of secondary and tertiary triangulation.

Some ground surveying will still be necessary with the new method, and detailed information not given by the photographs will be obtained by surveyors travelling around in small cars with enlarged prints of airplane photographs on which missing information will be sketched to be forwarded to the drafting room.

The accurate determination of the position of the airplane in space is effected by the projection of the photograph upon a glass screen upon which three known points of the landscape pictures are placed in correct relative position. If the relative position of the photographic plate and the projection lens is the same as when the picture was taken and if the fixed points on the screen and in the picture be made to coincide, the distances from the lens to the fixed points on the glass screen bear exact relations to the distances of the fixed points in the landscape which was photographed, and what is most important, to the height of the airplane above the ground when the picture was taken.

With the height of the airplane known, cross-bearings may be taken of all points of the landscape, and by means of stereoscopic projection, the landscape may be shown in relief, and the contour lines quickly mapped.

Professor Cooke attached great importance to the production of a camera capable of taking wide-angle pictures of relatively long exposures while moving at high speed. He has been at work for several years on the production of such an instrument, and said it was now possible to take photographs showing sharp definition while travelling 90 miles an hour and using an exposure of one second. The effect of the vibration of the airplane and the drift of the landscape are compensated for by suitable devices.

Forestry

Col. H. J. Stevenson,

Winnipeg Branch, March 20th, 1924.

The economic utilization of our forest reserves and their preservation, it is recognized, is a problem directly confronting the engineers of Canada. With this asseveration as introduction the speaker continued that he proposed to outline in general and go into details concerning some branches of the activities of the Dominion Government Forestry Department. He mentioned specifically the six forest reserves of Manitoba and stated that for the purpose of 'ranging' the province is divided into three districts. Each reserve is in charge of forest supervisors who have under them organizations which include patroling services. Up to three years ago patroling was usually done by trappers employed on a salary basis by the Forestry Department. The patrol men travel by canoes through the reserves. In 1921 the Forestry Department began to do patroling by means of the aeroplane, and in that year they had three aeroplanes. It was obvious that the use of the aeroplane was a big step in advance of the other methods of patroling and means for observation. Attention was drawn to the fact that in flat country towers did not provide a satisfactory means for observation and that forest rangers limited to particular water routes for travel could not readily reach the forest fires that might occur.

The information that Manitoba contains one hundred and thirty-seven thousand six hundred square miles of forest, and that an area of twenty-seven thousand square miles is at present covered by merchantable timber was of especial interest particularly when these figures were coupled with that of fifty-seven thousand square miles given as the area of agricultural land in the province.

The multifarious duties of the forestry engineer were drawn attention to. Mapping and estimating the stands of timber when no base lines from which to work, were available, provided one of the problems for him to solve. He must be able to make either a general or intensive survey. The way he handled that phase of his problem was outlined. He must be able to build roads, bridges and dams. He must be able to erect buildings, including the preparation of plans and estimates for them. He must be able to build and operate telephone lines. He must be acquainted with and be able to operate internal combustion engines.

An idea was given of the quality of the merchantable timber in Manitoba. White spruce 18 inches in diameter is of frequent occurrence. White spruce reaches that diameter at from fifty to sixty years old, which in comparison with other countries and other sections of Canada is a short interval. In Manitoba white spruce occurs up to 4 feet in diameter. It was mentioned that areas east and north of Winnipeg contained the best merchantable timber; this aside from the forest reserves.

It was emphasized that at the present rate of depletion of Canadian forests that twenty-five years will find Canada without readily available merchantable timber. Fire prevention is essential. Keep the fires out and the timber will grow although the forest will not come back to the best species.

In connection with the culture of thees a number of interesting points were enlarged upon.

Nature undirected does not produce the quality that grows under direction and does not choose the best sites in a district for the production of particular species. An example was given of a reserve which is covered with scrub spruce where pine would grow to much better advantage.

Studies for the proper density for the best growth; for proper sites for particular species in which to improve on nature; and study of soil were undertaken by the forestry enginer. It was noted that trees do not thrive best in agricultural soil. Attention was drawn to the fact that most European forests are maintained by supervised cutting and that they are not, as commonly thought, planted originally by man. In the forest reserves in Manitoba marked trees, only, are removed by the loggers and this is done under the direction of a forester. Some tree diseases were mentioned and destruction by insects was referred to.

In summing up the speaker reverted to the matter of destruction by fires and compared that destructive agency with the others operating. He stated that one electrical storm in Manitoba had started eight fires in one area and six in another area and said that as a result of the speed with which places of origin of the fires could be reached by aeroplane a great quantity of valuable timber had been, in this particular instance, saved. These fires which were started by the storm on a Sunday had all been put out by the following Tuesday.

The Klydomograph

J. F. Peters,
Hamilton Branch, March 28th, 1924.

It has long been known that voltages considerably higher than normal appeared at times on transmission lines and often produced undesirable results such as damage to apparatus. The commoner causes of these surges were lightning and switching. However, the magnitude and duration of these surges, or the steepness of their wavefront, were not definitely known. The manner in which such surges would travel along a transmission line, and be reflected and absorbed, had been investigated mathematically.

By means of Mr. Peter's invention, the magnitude, polarity, duration, steepness of wave front and direction of travel of lightning and switching surges have been measured within a few per cent. It is obvious that this detailed information regarding the surges which occur on transmission systems should be of considerable help in solving the important engineering problem of how best to provide reliable insulation for high voltage systems.

The basis of the invention is a little-used scientific observation, known for over a century, that symmetrical figures are formed on an insulating plate which separates conductors leading to a gap across which a spark is passed. These figures can be observed by sprinkling dust over the plate, or by using an ordinary photographic plate as the insulating plate and then developing it. The latter is the method used by Mr. Peters.

It is to be understood that no spark occurs on the plate, as that would fog it, but a circular pattern of finely traced branching lines is observed on the developed plate. The useful facts are that a positive voltage shows a distinctly different pattern from a negative voltage, and that the diameter of the circular pattern depends exactly on the peak value of the transient voltage.

The apparatus has no metallic connection with the high voltage transmission system, but is coupled electrically with it, first electrostatically and then electromagnetically, in order to obtain different kinds of information. In the electrostatic method, the apparatus is connected to a plate placed near a line insulator so as to take on a fraction of the potential of the line, equal to about 4,000 volts at normal voltage. When transient voltages appeared, the apparatus would give consistent results up to about 15,000 volts on the plate. By making a calibration, the peak value of the transient voltage could be determined.

In the electromagnetic method, the apparatus is connected to a wire placed parallel to the transmission line, and so its readings are proportional to the rise of current due to the surge, and this gives a measure of the steepness of the wave front. From readings by both methods it can be deduced in what direction the surge is travelling.

The time which it takes for the circular pattern to build up has been measured by leading a surge through two parallel, unequal branches to the plate. It was found that the pattern was formed while the surge was travelling with the speed of light over a comparatively small number of feet. Since the time for the making of the record has thus been found to be of the order of one fifty-millionth part of a second, the apparatus is seen to be suitable for the measurement of transients of extremely short duration or extremely steep wave front. For instance, it has indicated an appreciable time-lag in the break down of a sphere gap.

EMPLOYMENT BUREAU

Situations Wanted

Chemical Engineer

Business and mill experience. At present as a non-technical salesman, wishes to become connected with an industrial firm or manufacturer's agent. Apply box No. 142-W.

Civil Engineer

Graduate, age 30, desires position with engineering or contracting firm. Eight years field and office experience, surveys and estimates, concrete structures, highway and pavement construction. Apply box No. 143-W.

Electrical Engineer

Electrical engineer with thorough training in both A.C., and D.C., work, at present located in England, wishes to secure position with prospects in Canada. Age 32 years; would appreciate opportunity to present further details of experience. Apply box No. 144-W.

Civil Engineer

Young man with experience in testing and inspection of cement and concreting materials, and a knowledge of the proportioning of concrete mixes, desires a position. Junior of *The Institute*, and Member of the American Society of Testing Materials. At present employed. Apply box No. 145-W.

Recent Graduate in Civil Engineering.

A student of *The Engineering Institute*, graduating this year from the Nova Scotia Technical College in civil engineering, wishes to secure a position with a firm of engineers or contractors in Ontario or Quebec. Experience includes summer vacation work on construction, draughting, assistant to cost accountant, and topographical and railway surveying. Apply box No. 146-W.

Situations Vacant

Vacancies for Officers in R.C.N.V.R.

The Royal Canadian Naval Volunteer Reserve, recently organized and established by the Department of National Defence (Naval Service), is a force having peculiar interest to this Institute, apart from the patriotic standpoint, in that it promotes valuable instruction and training to certain men employed normally at the various engineering trades.

What is described under the Regulations as list II ratings includes journeymen, mechanics or artificers of those trades; motor mechanics, enginemen, electricians, shipwrights, etc., in addition to the various grades of stokers. The training afloat of these men, it will be appreciated, provides a variety of naval and marine engineering practice, which, when added to their knowledge of shore installation work, must react largely to their advantage and incidentally result in much benefit to the mechanical side of the country's activities.

The force includes in its establishment a number of Commissioned Engineer Officers or Engineer Lieutenants. These officers are being recruited from young gentlemen interested in patriotic work of this nature, who have obtained university degrees in engineering science, and who feel they can support the service with their interest and assist in promoting the education and training of the ratings under their immediate charge. It is of interest to note that applications for commissions as engineer officers are still being received at the Department of National Defence (Naval Service), and that particulars of these appointments will be furnished upon application to the department.

Members' Exchange

Engineers' Instruments.

For Sale:—1 "Buff and Buff" Transit; and 1 "Cook" Level (Dumpy). Both in A-I. condition and practically new. Apply box No. 7-E.

Transit Theodolite

For Sale:—One Troughton and Simms, transit theodolite in perfect condition. Price $300. Apply box No. 8-E.

ELECTIONS AND TRANSFERS

At the meeting of Council held on April 29th, 1924 the following elections and transfers were effected:—

Members

ANDRUS, Donald Allan, St. Catharines, Ont., gen. mgr. and engr. in Canada to Sir Wm. Arrol & Co. Ltd., of Glasgow, Scotland.

BOYLE, Robert William, B.Sc., M.Sc., Ph.D., (McGill Univ.) dean of the faculty of applied science, University of Alberta, Edmonton, Alta.

MURRIN, William George, vice-pres. British Columbia Electric Railway, Vancouver, B.C.

RISLEY, Wilfrid Cary, B.S. (Dartmouth College), supt. of mtce., rlys. and shipping terminals, British Empire Steel Corporation, Sydney, N.S.

VATCHER, Allan, B.A.Sc. (Univ. of Toronto), asst. chief engr., Reid Newfoundland Company, St. John's, Nfld.

WILSON, Alfred William Gunning, B.A. (Univ. of Toronto), A.M., Ph.D. (Harvard Univ.), chief engr., Mineral Resources Divn., Mines Branch, Dept. of Mines, Ottawa, Ont.

Associate Members

BRYDONE-JACK, Herbert Diskrow, B.Sc. (McGill Univ.), supt. for the Sydney E. Junkins Co. Ltd., engrs. and constructors, at Glacier, B.C. lining Connaught tunnel.

CONNELL, Charles, technical instructor C.N.Rly. and Ottawa Technical School, Ottawa, Ont.

DAVIS, Frank Leslie, asst. engr., the John S. Metcalfe Co. Ltd., Cartierville, Que.

DONKIN, Robert Percy, B.Sc. (N.S. Tech. Coll.), asst. professor of mech. engrg., N.S. Tech. Coll., Halifax, N.S.

DUNSMORE, Robert Lionel, B.Sc. (Queen's Univ.), engr. in charge of constrn. of refinery, Imperial Oil Company, Calgary, Alta.

FITZGERALD, George G., supervisor of manual training, Regina public schools, Regina, Sask.

FORREST, Edward Brydges, tech. service dept., public works, City of Montreal.

FREEMAN, Correll Hunter, B.Sc. (Queen's Univ.), mineral technologist, (Grade I), Mines Branch, Dept. of Mines, Ottawa, Ont.

FURLONG, Henry Walter, B.Sc. (Univ. of London), responsible charge of struct'l. steel design and dfting. at Boston office, New York Steam Corpn. of New York City.

GELINAS, Charles Edouard, B.A.Sc. (Laval Univ.), city engr., Three Rivers, Que.

GOUDGE, Monson Fraser, B.Sc. (N.S. Tech. Coll.), engr. (Grade II), Mines Branch, Dept. of Mines, Ottawa, Ont.

INGLIS, Thomas McFarlane, steam boiler inspector for prov. of Saskatchewan, 1400 Robinson Street, Regina, Sask.

LEIGHTON, Chester Adam, A.B. (Bowdoin Coll.), constrn. engr. for Northern Construction Company, Vancouver, B.C.

MACKINTOSH, William John, asst. engr., dept. of highways, Saskatchewan, Regina, Sask.

McCOUBREY, James Addison, res. engr. on constrn., C.P.R., Shaunavon, Sask.

MOFFATT, Robert Roy, asst. chief dftsman., Dominion Iron & Steel Company, Sydney, N.S.

ROGERS, Alvah Burphee, asst. engr., Shawinigan Engineering Co. Ltd., Montreal, Que.

RUTTER, Walter Ayburne, B.Sc. (Univ. of London), heating, ventilating and consulting work with Walker & Gibson, archts. and engrs., Toronto, Ont.

SANGDAHL, George Stanley, B.S. (Univ. of Ill.), district manager, Horton Steel Works, Ltd. (of Bridgeburg), Montreal, Que.

SEARS, John Joseph, B.Sc. (N.S. Tech. Coll.), field engr., N.S. Tramways & Power Co., Halifax, N.S.

SMYTHIES, Reginald Eric, vice-pres. and chief engr., Lincoln Electric Co. of Canada, Ltd., Toronto, Ont.

Juniors

BROSSEAU, Joseph Charles, asst. to H. Hadley, A.M.E.I.C., city engr. of Verdun, Que.

COPLEY, John Edward, automatic telephone switchman, Dept. of Telephones, Regina, Sask.

LOW, David Duncan, B.Sc. (Univ. of Sask.), instr'man., C.N.R., Regina, Sask.

REID, George Graham, engr. in partnership with A. W. Connor, M.E.I.C., Toronto, Ont.

ROACH, Charles Lawrence, B.Sc. (N.S. Tech. Coll.), plant dept., N.B. Telephone Company, St. John, N.B.

SCHIPPEL, Walter Herbert, B.Sc. (McGill Univ.), senior demonstrator in electrical engineering, McGill University, Montreal, Que.

WILFORD, Harold James Deacon, B.A.Sc. (Univ. of Toronto), with F. R. Wilford & Co. Ltd., engrs. and contractors, Lindsay, Ont.

Transferred from the class of Associate Member to that of Member

d'ABBADIE d'ARRART, Camille Arnauld, B.S. (Poitiers Univ., France), res. engr. on constrn. Kenogami dam, for Quebec Streams Commission.

D'AETH, John Bancroft, B.Sc. (McGill Univ.), gen. constrn. and designing engr., Fraser Brace Limited, Montreal, Que.

Transferred from the class of Junior to that of Associate Member

DANAIS, Pierre, B.Sc. (Queen's Univ.) engr. dept. of highways of Quebec, Baie St. Paul, Que.

GAUTHIER, Henri, B.A.Sc. (Laval Univ.), road materials engr. (senior asst.), road materials and ceramics divn., Mines Branch, Dept. of Mines, Ottawa, Ont.

McCAMMON, John Whyte, B.Sc. (McGill Univ.), sales mgr., Charles Walmsley & Co. (Canada), Ltd., Montreal, Que.

NESHAM, Lionel Charles, B.Sc. (McGill Univ.), res. engr. on hydro-electric development for Beaubien, Busfield & Co., Montreal, Que.

ROSS, William Ewart, engr., industrial control dept., Can. Gen. Elec. Co., Peterborough, Ont.

Transferred from the class of Student to that of Associate Member

McFARLANE, Maynard Leslie Deedeo, of London, England.

Transferred from the class of Affiliate to that of Associate Member

LYNCH, Francis Christopher Chisholm, supt., Natural Resources Intelligence Branch, Department of the Interior, Ottawa.

Transferred from the class of Student to that of Junior

BULMER, Clarence Edward, B.Sc. (Queen's Univ.), instructor to apprentices, Hamilton Technical School, Hamilton, Ont.

BURPEE, C. Miles, B.Sc. (Univ. of N.B.), instructor in charge of dept. of dfting and descriptive geometry, college of engrg., Marquette Univ., Milwaukee, Wis., U.S.A.

FOUNTAIN, George Frederick, B.A.Sc. (Univ. of B.C.), asst. city surveyor, City of Vancouver, B.C.

PINEL, William Gordon, B.A.Sc. (Univ. of Tor.), inspector with Dept. of Public Highways of Ontario, on road constrn. at Dundas, Ont.

WILLIAMS, Arthur Samuel, B.Sc. (Univ. of Man.), dftsman. on station electrical layouts, H.E.P.C. of Ontario, Toronto, Ont.

The following students were admitted:—

BENTLEY, Percy Jardine, P.O. Box 154, Truro, N.S.
BRITTAIN, Charles Leslie, 20 Dalton Road, Toronto, Ont.
BROWN, F. Gordon, Moncton, N.B.
BROWNELL, George Wilson, 51 Hollis Street, Halifax, N.S.
FINDLAY, William Fraser, Carleton Place, Ont.
FLEMING, Canmore Drake, Windsor, Ont.
GOODALL, Ernest Lorne, 304 Prince Arthur West, Montreal, Que.
HENDERSON, Gordon Roberts, Kingston, Ont.
HODINA, Frank Albert, 2590-B Waverly Street, Montreal, Que.
KAYE, John Robert, 196 Milton Street, Montreal, Que.
KILLAM, Kenneth Amasa, 410 Robie Street, Halifax, N.S.
LYNDE, Jr., Carleton John, Ste Anne de Bellevue, Que.
MACGREGOR, Kenneth Roy, Kingston, Ont.
McINTOSH, John Cameron, Kingston, Ont.
NEROUTSOS, Cyril Holton, 26 McTavish Street, Montreal, Que.
NOYES, John Whiting, 11 Buckingham Avenue, Montreal, Que.
PARR, Charles Carlisle, Swastika, Ont.
RINFRET, Guy Raoul, 173 Mansfield Street, Montreal, Que.
RUTHERFORD, James Forest, 4210 Western Avenue, Westmount, Que.
SMITH, Herbert Carson, 92 Pacific Avenue, Toronto, Ont.
SMITH, Thomas Hayden, 348 Sherbrooke Street West, Montreal, Que.
SNYDER, Horace Hemstreet, Kingston, Ont.
STEWART, William James, Kingston, Ont.
THERIAULT, Omer Philip, 770 Cadieux Street, Montreal, Que.
TRENHOLME, George H., 601 Clarke Avenue, Westmount, Que.
WHITELY, Frederick Bryan, Swastika, Ont.
WEIR, Ronald Stanley, 756 Sherbrooke Street West, Montreal, Que.
WYSE, James Wilson, Moncton, N.B.

BOOK REVIEWS

Rotary and Other Conventers

By W. S. Ibbetson

Reviewed by H. B. Dwight, A.M.E.I.C., Chief Designing Engineer, Canadian Westinghouse Company, Limited, Hamilton, Ont.

This book is written for substation attendants, and gives a description of the elementary theory and practice connected with alternating and direct current machines used in substations for the supply of direct current.

The information in the book is clearly and concisely written, and has a high degree of accuracy. Very little mathematics, and that only the simplest, is used. Reference is assisted by printing numerous paragraph headings in bold face type.

Among other points, the question of the various voltage ratios in different types of synchronous converters is taken up in detail, and instructions given for numerical computation. Descriptions are given of the matters of power factor, voltage control, hunting and flashing of synchronous converters, and considerable space is devoted to various methods of starting.

The list of devices to prevent flashing of converters is open to some criticism, especially to one accustomed to the practice in America, for three of the most important devices are not mentioned, namely, high reluctance commutating poles, extra high speed circuit breakers and flash barriers on the commutators. The device of carrying the feeders out a half-mile or so from a 600-volt substation before tapping on to the trolley wires is similar to the suggestion in the book of inserting resistance in short feeders, and has met with success in practice.

In the paragraph on brush position, it is stated that in actual practice it may be best found by locating by experiment the position for least sparking. The method of taking "brush curves" by a low reading voltmeter between brush and commutator usually gives more reliable results than observation of the sparking, especially as good parallel operation is often as important as the sparking, in determining the brush position.

In the chapter on motor-generators it is stated that the field coils of synchronous motors must be divided into sections and left on open circuit during starting. Later in the book it is mentioned that the latest practice with converters is to short-circuit the shunt field during starting. In America, the fields of synchronous motors are also usually short circuited during starting, thus obviating troubles from high induced voltages.

The detailed sequence of operations for starting converters by starting motor, etc., should be understood to apply only to certain particular arrangements of apparatus. So many different arrangements have been used and are being used by different manufacturers, that it would be almost impossible to give sets of instructions for starting which would be applicable to all cases which might be met in practice.

The criticisms which might be made of this up-to-date book are of comparatively minor points. Considering its size, the book admirably fulfills the purpose for which it is intended, and it will prove interesting reading to those interested in converters.

The book is published by E. and F. N. Spon, Limited, 57 Haymarket, London, S.W.1, England.

The Elements of Railroad Engineering

(Fourth Edition)

By William G. Raymond

Reviewed by John E. Armstrong, A.M.E.I.C., Assistant Engineer, Canadian Pacific Railway Company, Montreal, Que.

Although this book is evidently intended primarily as an engineering school text book, it is none the less interesting to the practising railway engineer. The introduction outlines briefly the life history of a railway project from its inception to its failure or success, showing wherein the engineer shares in the responsibility for either outcome. The permanent way, the locomotive and its work, and railroad location, construction and betterment surveys are clearly and considely treated and an appendix giving an account of actual railway location shows the practical use and value of subjects treated elsewhere in the text which, to the beginner, might otherwise appear too theoretical for actual use.

It is to be regretted that the money values used in working out examples of the principles stated have not been revised to present day figures but this, after all, does not affect the demonstrations. The chapter on valuation is a clear presentation of general principles of public utility valuation and, in general, the whole book is interesting as well as instructive reading.

The book is published by John Wiley and Sons, Incorporated, New York.

The Design of Steam Boilers and Pressure Vessels

By Haven and Swett

Reviewed by Professor L. M. Arkley, M.Sc., M.E.I.C., Professor of Mechanical Engineering, Queen's University, Kingston, Ontario.

There are ten chapters containing 435 pages in this book. It is therefore quite a comprehensive treatise on the Design of Steam Boilers and other Pressure Vessels.

The first chapter deals in a general way with the information necessary before the design of the boiler is begun and contains a summary of the Massachussets Boiler Rules, these are amongst the oldest in use on this continent and they have been copied by many states. This calls attention to the fact that each state in the American Union and each province in the Dominion of Canada has its own set of rules for boiler design and what may be considered quite safe design in one province may be inadequate in another. The American Society of Mechanical Engineers and *The Engineering Institute of Canada* are trying to remedy this state of affairs for the respective countries by compiling a uniform set of rules which could be used throughout each country.

Chapters II to IV inclusive deal with the design of such items as thin and thick cylinders, spherical heads, flat plates, rivetted joints, tube sheets, stays and so forth in the conventional manner.

In chapter III there are some very handy tables giving pitch and efficiency for different forms of rivetted joints.

Chapters V to X cover the actual design of return tubular and water tube boilers, locomotive type boilers and Scotch boilers. The book contains many excellent plates and drawings and should be of value either as a text book or as an aid to the practical designer.

The book is published by John Wiley and Sons, Incorporated, New York.

Elementary Steam Power Engineering

By Edgar MacNaughton

Reviewed by Professor L. M. Arkley, M.Sc., M.E.I.C., Professor of Mechanical Engineering, Queen's University, Kingston, Ontario.

The author states that the chief differences between this book and others written on the same subject is that the practical part of the work is given before the theoretical, the inference being that there is an advantage in this. Many engineers believe that the more logical method in writing a book of this kind is to have practice follow theory, as it has in so many cases in the actual development of power plant machinery. The fact is that it does not make so much difference which has precedence, as long as they are closely associated in the development of the subject. This is especially true where the book is to be used as a text for students.

The book naturally divides itself into two sections, the first treating, as it should, of steam making equipment, including boilers, furnaces, stokers, etc., and following these a chapter on fuels and the theory of combustion, gas analysis and boiler lenses.

The second part of the book describes the power generating equipment and auxiliaries usually found in the engine room of a modern steam power plant.

The book is not unnecessarily technical, is easily read and is illustrated by many excellent cuts which is a very desirable feature of treatise of this nature. It forms a very useful addition to the literature of this subject, either for the college student or the practical designer and operator.

The book is published by John Wiley and Sons, Incorporated, New York.

Workshop Routine

By W. J. Hiscox

Reviewed by J. S. Cameron, A.M.E.I.C., Assistant General Superintendent, Northern Electric Company, Limited, Montreal, Que.

This book covers in a comprehensive manner, the need of definite organization and the application of system by means of standing instructions to carry on a daily routine in the average factory.

It deals with manufacture in all stages: The handling of raw materials, issuing and scheduling shop orders, day and piece work time tickets, process and final inspection; the issuing of raw materials from the stockrooms, tool drafting and tool costs. It touches briefly on plant and tool maintenance departments, the packing of factory products and the handling of the repair department. It ends up with a few notes on first aid, holiday routine, and the posting of output analysis as an incentive to increased efforts from the manufacturing departments.

There is a good deal to commend this book. To the student, it should give a broad outline of the framework of factory organization. To one who is conversant with factory organization in a few departments, it will help him to see how the work of these departments fits into the whole. It should also be useful to the cost accountant and executive in that it is written in a clear and concise manner, unencumbered with diagrams and tables of figures so commonly found in many books on this subject, which more or less tend to make difficult reading.

The book is published by Chapman and Hall, Limited, London, England.

The Gyroscope, Its Practical Construction and Application

By P. P. Schilovsky

Reviewed by Arthur R. Roberts, M.Sc., A.M.E.I.C.,
Associate Professor of Mechanical Engineering, McGill University.

The gyroscope as a scientific toy is well known and many engineers are familiar with the present state of its development for stabilization purposes. Much misunderstanding, however, exists as to the real properties of the gyroscope and as to what it can or cannot do, and this is probably due to the fact that most of the literature on the subject is in the form of mathematical papers which are too complicated to be readily understood by the average student. One of the principal aims of the author of this book is to make the action of the gyroscope intelligible to the reader having little mathematical training.

Part I is devoted to a study of the behaviour of the gyroscope in its various forms, with examples of its application in such devices as the gyro-compass, fixator, ship stabilizer and the mono-rail car. The treatment is non-mathematical, the use of technical terms and symbols being avoided as far as possible. In Part II the author discusses the mono-rail system of locomotion, the problem of stabilization, advantages of the system, details of proposed designs of rolling stock and permanent way and estimates of cost. Part III consists of a few short extracts on the theory of the mono-rail car.

The book is published by E. & F. N. Spon, Limited.

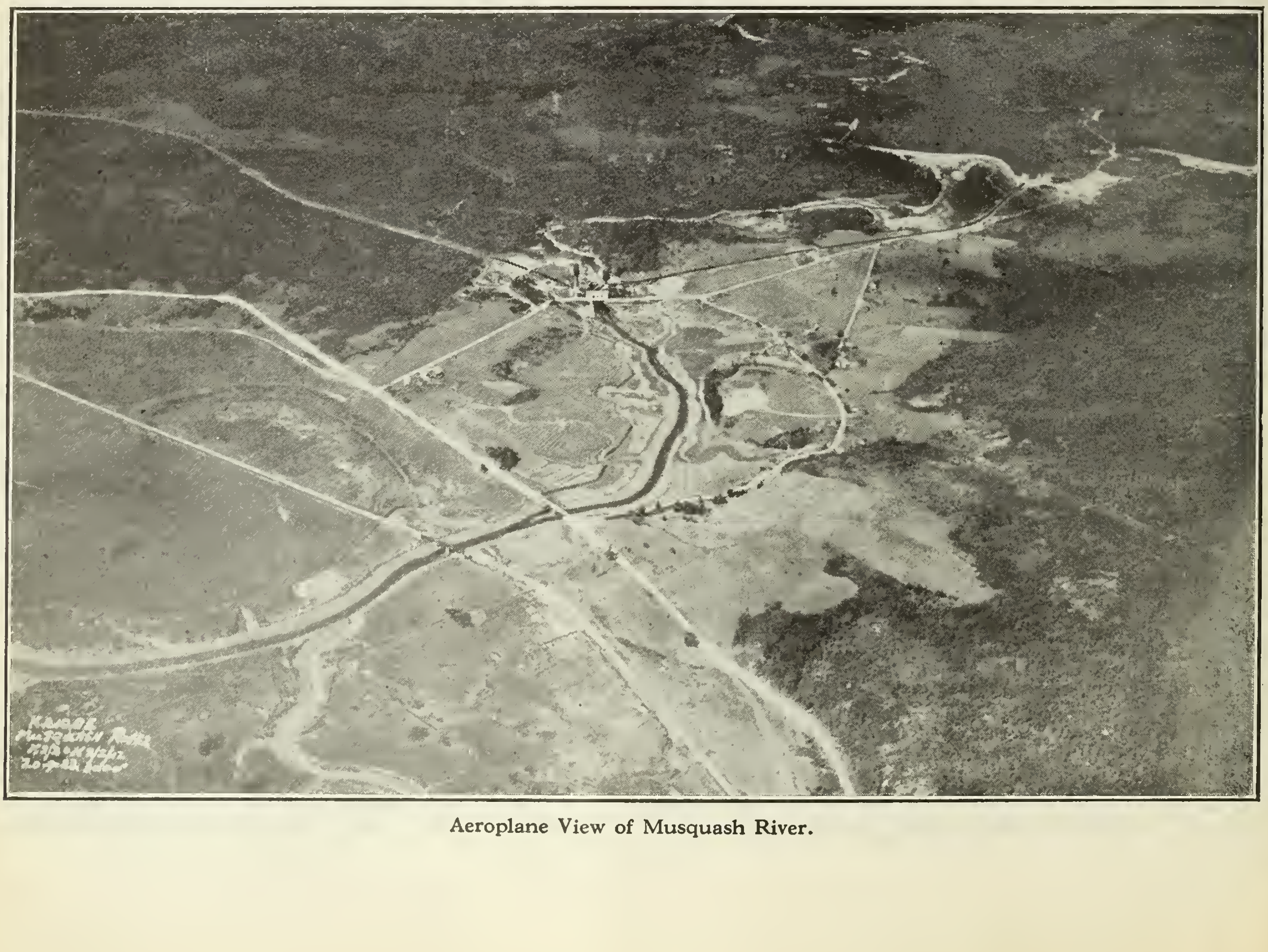
Hydro-Electric Power in New Brunswick

The New Brunswick Electric Power Commission, of which S. R. Weston, A.M.E.I.C., is acting chief engineer, have recently issued their fourth annual report which is the first to contain information relative to the actual operation of the central electric station industry by the commission. It is interesting to note from this report that hydro power is now available to about twenty-five per cent of the population of the province, and that it is estimated in the report of the Grand Falls Investigation that the preliminary plan for the development of the Grand Falls site is based upon an initial development of 40,000 h.p. in two hydro-electric units of 20,000 h.p. each and upon an ultimate extension to 140,000 h.p. in seven units. The proposed development includes a head dam of piers and Stoney Sluice type steel gates to maintain the water in the head pond at spring freshet elevation; a canal around the town of Grand Falls to carry the ultimate capacity water supply; forebays at either end of the canal; a power house at the shore of the lower basin parallel to the lower forebay, and separate steel penstocks from the latter to each unit. The whole construction will be upon ledge rock foundation. Static head at Grand Falls with head water at elevation 235 and mean tail water 103 will be 132 feet.

The amount of power available at Grand Falls will vary from 10,000 continuous h.p. with no storage to 70,000 h.p. with full storage development in the dryest years. At a commercial load factor of fifty per cent there will be between 20,000 h.p. and 140,000 h.p. depending upon the amount of storage developed.

Of the natural storage sites, *i. e.*, existing lakes, seventy-three per cent of the capacity is located in Maine, twenty-three per cent in Quebec, and four per cent in New Brunswick. Further study is being made with a view to concentrating the storage in larger reservoirs near the head pond.

The estimated capital cost of the power development is from $150.00 per h.p. for the initial development to $100.00 for the ultimate installation, the estimates not including real estate damages.



Aeroplane View of Musquash River.

BRANCH NEWS

Sault Ste Marie Branch

W. S. Wilson, A.M.E.I.C., Secretary-Treasurer.

A regular meeting of the branch was held on March 28th, at the Y.W.C.A. building. The meeting was preceeded by a dinner.

The Iron Ore Bodies of Algoma District

Wm. Seymour, M.E.I.C., vice-chairman, introduced the speaker of the evening G. W. McLeod, mining engineer, and chairman of the Branch of the Iron Ore Association, who addressed the meeting on "The Occurrence, Characteristics and Commercial Importance of Iron Ore bodies in Algoma District". He described the location and dimensions of the ore bodies and the work that had been done to establish the quantity of ore. Also the mines that had been commercial producers and the character of their ores and the treatment necessary were dealt with, compared with the treatment in the new experimental plant at Babbitt, Wisconsin, where magnetites are sintered to 65 per cent iron content and sold to Henry Ford. The large body at the Helen Mine of Siderite or iron carbonate, the Josephine deposit and the ore body in the Mississaugi Forest Reserve and others were specially mentioned. Roasting in kilns was compared with the sintering process and the fuel economy of the latter noted.

Considerable discussion ensued focussing on the relation of the formations and deposits in the United States and in other parts of Ontario including the Belcher islands and west of Port Arthur. The work of the provincial Geological departments were discussed and the point made that there had been very little commercial geological field work done in the district of Algoma as compared to the Cobalt and Porcupine areas. It was suggested that an effort be made to obtain effective assistance from the mines departments in more intensive field work in the more promising sections of the district.

Winnipeg Branch

P. Burke-Gaffney, A.M.E.I.C., Secretary-Treasurer.
James Quail, A.M.E.I.C., Branch News Editor.

Forestry*

The Winnipeg Branch heard Col. H. J. Stevenson, district forest inspector for the Dominion government, speak on a subject in which he is interested viz., 'Forestry', on the evening of March 20th, at a regular branch meeting. A. McGillivray, A.M.E.I.C., chairman of the branch, occupied the chair.

Col. Stevenson's address was listened to attentively and with interest by the audience.

Col. Stevenson's lecture was concluded by a display of slides accompanied by running remarks which were most interesting and instructive.

Victoria Branch

E. P. Girdwood, M.E.I.C., Secretary-Treasurer.

The chief activity of the branch during March and April was confined to visits and meetings as follows:

E. E. Brydone-Jack, M.E.I.C., read a paper on "Moveable Bridges". There was a good attendance of members. The paper was illustrated with lantern slides, depicting many bridges and their designs, from early types to the more modern types of swing and lift bridges. Based on the wide experience Mr. Brydone-Jack has had on bridges, this paper proved most interesting and instructive.

On March 26th, Capt. E. A. Wheatley, A.M.E.I.C., of Vancouver, registrar of the Association of Professional Engineers, addressed the local members at a lunch at Spencers' restaurant.

An informal meeting of the branch was held at the home of the chairman, F. C. Green, M.E.I.C., 347 Foul Bay Road, on Friday evening, to meet Fraser S. Keith, M.E.I.C., general secretary, on his annual visit from Montreal. About forty members and their wives were present. Mr. Keith gave an interesting talk on the aims and accomplishments of *The Institute*, which has now a membership of over 5,000, and his address and the ensuing discussion brought out ideas for further advance. An invitation, extended through G. B. Mitchell, M.E.I.C., to the members to visit the new drydock on April 12th, was much appreciated. The evening was brought to a close by the serving of refreshments, the table being presided over by Mrs. Girdwood, and Mrs. Clarence Hoard. Votes of thanks were proposed by Messrs. Brydone-Jack, Mitchell and Fowler, to Mr. Keith and to Mrs. Green.

Hamilton Branch

W. F. McLaren, M.E.I.C., Secretary-Treasurer.

In the course of the address by Geo. W. Fuller, M.E.I.C., the chairman of the American Water Works Association, on "Water Purification" before a joint meeting of the Hamilton Branch and the Canadian Section of the Association, on February 27th, which was reported in detail in the April *Journal*, it was pointed out that at Rochester, New York, the custom was adopted quite recently of adding an iodine salt directly to the water supply to correct deficiency of this element. Its purpose is to lessen the prevalence of common goitre and it is said the results are gratifying, although convincing data are not yet available. The field of water purification involves not only the elimination of objectionable elements but may also involve the addition of deficient constituents to water supplies when the welfare of the whole community is involved.

The meeting closed with a vote of thanks to the speaker and to the singers who furnished entertainment during the evening.

The Klydomograph*

The annual joint meeting of the Hamilton Branch of *The Engineering Institute of Canada* and the Toronto Branch of the American Institute of Electrical Engineers was held on March 28th, 1924, in the Canadian Westinghouse Company's auditorium. The visitors included a considerable number of engineers from Toronto and St. Catharines.

The speaker of the evening was J. F. Peters, of the engineering department of the Westinghouse Electric and Manufacturing Company, of Pittsburgh. Mr. Peters gave a lecture, illustrated with lantern slides, on an apparatus, called the klydonograph, which he has recently invented, and which makes measurements, heretofore unobtainable, of high voltage surges on transmission lines.

There was an hour's discussion, in which Mr. Peters answered a number of questions. It was agreed by several speakers that the scientific and accurate measurement of transients constituted a distinct step ahead in transmission engineering.

The meeting closed with a hearty vote of thanks to the speaker. The chair was occupied by J. W. Tyrrell, M.E.I.C., at the start and by C. E. Schwenger of Toronto at the close. The Westinghouse Company kindly furnished cigars and refreshments which were much appreciated.

Peterborough Branch

R. C. Flitton, A.M.E.I.C., Secretary-Treasurer.

The Commercial Urge from Town Planning

Among notable papers presented before this branch this year was one by Horace L. Seymour, M.E.I.C., on "The Commercial Urge for Town Planning". This paper was presented at a meeting held on January 10th, with James Mackintosh, A.M.E.I.C., in the chair.

The speaker emphasized the importance of scientific planning, giving many instances to show that vast amounts of money had been wasted by lack of foresight in this respect. He reviewed, in an interesting manner, the work which had been recently done under his direction, in the cities of Kitchener and Waterloo, Ontario. Having made a brief study of the conditions existing in Peterborough, the speaker made some suggestions as to the present needs of this city: (1) A better map of the environs of the city so that there can be prepared a plan of development of main roads in the present unbuilt areas in the vicinity of the city and within the five mile urban zone. (2) Adequate steps being taken to develop vacant properties now served with sewer and water, sidewalks, electric lights and, in some instances, permanent pavements before new areas unserved with local improvements are thrown open for settlement. (3) The development of a parkways system to link up the parks. (4) The preparation and enforcement of a building zone by-law that will stimulate industrial and business development and discouraging residential development therein and that will stabilize land values by preventing the unnecessary intrusion of undesirable buildings in an area devoted to a preferred class, such as, for instance, a private detached residence.

Steam Boilers

A meeting held on January 24th, under the chairmanship of J. A. G. Goulet, M.E.I.C., was addressed by Thomas H. Fenner, A.M.E.I.C., chief engineer and manager of the boiler department of the General Accident Assurance Company of Canada on the subject of "Steam Boilers". The speaker traced, in an interesting manner, the development of the steam boiler from the early, primitive types to the most modern boilers in use to-day. He discussed the common causes of boiler failures with suggestions as to how many failures could be prevented. An excellent series of lantern views were shown, depicting various types of boilers, boiler settings and mechanical stokers.

*An abstract of this paper appears on another page of this issue.

Asphalt

Germain P. Graham, of the Asphalt Association, gave a very good talk on the subject of "Asphalt" before this branch, on the evening of February 6th, the meeting being under the chairmanship of city engineer, Roy H. Parsons, M.E.I.C. There were present at this meeting members of the City Council and Utilities Commission.

Laboratory Test Work at Hydro

On February 28th, W. P. Dobson, M.E.I.C., director of laboratories for the Hydro-Electric Power Commission of Ontario gave an interesting description of the inspection and testing work as carried on in the well-equipped laboratories maintained by the commission in Toronto. The paper was illustrated by lantern slides. James Mackintosh, A.M.E.I.C., occupied the chair.

Good Roads

E. L. Miles, M.E.I.C., F.R.S.A., county engineer and road superintendent for the county of Victoria, presented an address on the subject of "Good Roads" before this branch on the evening of March 13th. Roy H. Parsons, M.E.I.C., city engineer acted as chairman. Besides treating the subject of good roads generally, Mr. Miles told of the progress that had been made in Victoria county. Some lively discussion ensued at the close of the address particularly with regard to the relative merits of day labour and contract work in road building and paving. Several reels of moving pictures were shown.

Montreal Branch

E. A. Ryan, A.M.E.I.C., Secretary-Treasurer.

W. H. Abbott, A.M.E.I.C., Branch News Editor.

On March 20th, a very interesting paper was read by O. O. Lefebvre, M.E.I.C., chairman of the Montreal Branch. F. P. Shearwood, M.E.I.C., occupied the chair, and the meeting was very well attented. Mr. Lefebvre outlined the water power possibilities in the Lake St. John district, and described the work being carried out at Grande Décharge and lake Kénogami. There were several distinguished members of *The Institute* from other branches present at this meeting, who took part in the discussion following the paper. Among others, A. S. Dawson, M.E.I.C., vice-chairman of the Calgary Branch, and F. A. Bowman, M.E.I.C., vice-president of *The Institute*, representing the maritime provinces.

Municipal Section Inaugurated.

The regular weekly meeting of the branch, on Thursday, March 27th, was given over to the inauguration of the Municipal Section. J. L. Busfield, M.E.I.C., vice-chairman of the Montreal Branch, presided, and in a few well chosen words introduced the chairman of the new section, namely, Geo. R. Macleod, M.E.I.C., who then took the chair. Many prominent engineers and city managers from this district were present, and enthusiastically recommended the formation of the new section. Mr. Macleod in opening the meeting pointed out the greatly improved position of municipal engineers as compared with a few decades ago, when they were regarded as a species of handy men to be utilized for anything nobody else wanted to do. Now the profession of municipal engineering had grown to the status of an important branch of both engineering and of civics, the municipal engineers being regarded as among the most important experts in connection with the affairs of towns and cities, especially the larger ones, such as Montreal, whose engineering problems involved much skill and huge sums of money. It was in recognition of this increasing importance of the profession of municipal engineering that the new section had been formed, and he hoped to see it well under way this spring, so that a regular programme might be arranged for next fall.

J. A. Duchastel, M.E.I.C., city engineer of Outremont, followed and spoke of the advantage such a section would be to the various municipal engineers of the island of Montreal, giving them a valuable meeting ground to exchange ideas. He pointed out that nearly all the city managers in Canada and United States were engineers, and suggested that the new section had been formed at an opportune time, since the annual convention of the Association of City Managers of the United States and Canada will be held here next September.

Ald. Stewart Rutherford, M.E.I.C., of Westmount, congratulated the branch inaugurating this new section. In Westmount, he said, the city engineer was regarded as the council's right-hand man, with the city manager, and they relied greatly on the advice of these two.

Brief addresses by A. Lalonde, A.M.E.I.C. of the Montreal roads department, and others, closed the inaugural meeting, after which refreshments were served and a social evening spent.

The Hudson Bay Railway and Port Nelson

L. C. Nesham, Jr.E.I.C., gave a most interesting paper on the Hudson Bay Railway and Port Nelson, on Thursday, April 3rd, at which meeting the chair was occupied by J. L. Busfield, M.E.I.C. This subject which is one of a national importance at the present time, was very ably handled and illustrated by excellent lantern slides showing the actual conditions at Port Nelson and the Nelson river. Mr. Nesham's paper will be published in *The Journal*. In the discussion which followed the paper, A. D. Swan, M.E.I.C., was curious to know how the project had ever been started, as it appeared that the whole scheme had had no thorough investigation before embarking on the expenditure of such a large sum of money. H. J. Tait, A.M.E.I.C., spoke on the subject from the marine point of view, and stressed the high cost of marine insurance which would probably result from the difficulty and danger of navigation in the Hudson strait. Captain Taylor who has had long experience in navigation in Hudson bay, spoke briefly in a humourous vein of this locality.

Voice Highways in the Making

"Voice Highways in the Making" was the title of the paper read by W. Stanley Vipond, M.E.I.C., on April 10th. This paper proved very interesting and was illustrated by moving pictures showing methods of construction of cables. L. H. Marrotte, M.E.I.C., presided.

Papers and Meetings Committee

On April 7th, a meeting of the Papers and Meetings Committee was held at the Engineers' Club. W. C. Adams, M.E.I.C., presided, and several chairmen and vice-chairmen of the different sections were present. Satisfactory progress was reported, and the indications point to a very successful season for 1924-25. It was remarked that a great many members of *The Institute* probably were not aware of the fact that discussions on papers might be written and published in *The Journal* after the publication of the paper. The matter of incidental expenses in connection with entertainment, etc., of speakers from outside points was taken up, and it was pointed out that the present method was very unsatisfactory.

Lethbridge Branch

Geo. S. Brown, A.M.E.I.C., Secretary-Treasurer.

"*And —*

It ain't agoin' to rain no mo', no mo'
It ain't agoin' to rain no mo'......"

That's not all of it, by any means — there's a lot more, but, it's a fact that, —

When Fraser S. Keith, M.E.I.C., general secretary, came to Lethbridge on Thursday night the 3rd of April, and "sat in" at the chicken dinner arranged in his honour, there was not a cloud in the sky.

"*And — It ain't agoin' to rain no mo', no mo'...*"

There were other musical tit-bits, notable among which was the performance of Master Constanescu a boy of twelve years, who showed himself a musical genius on an Italian instrument of 150 keys, the Chromatic Accordion. Mr. Branch sang the "Song of the Shirt" and Mr. Lawrence "The Village School". The branch is already famous for its orchestra. But, Oh boy! you should hear our Quartette led by Sam Porter. To the Quartette must be attributed the refrain,—

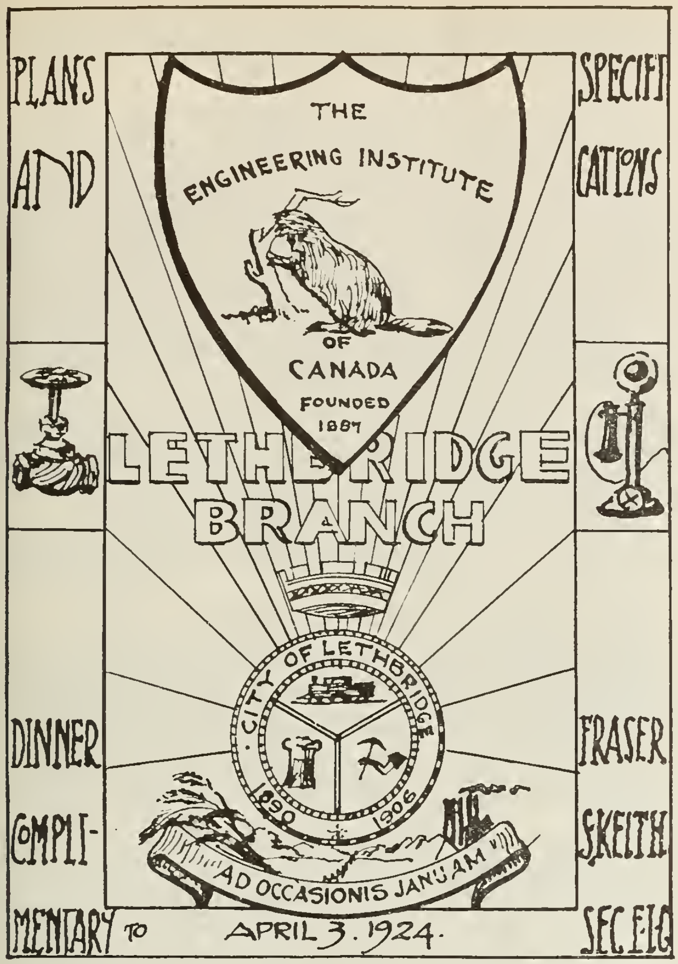
"It ain't goin' to rain" etc., a sentiment which was the keynote of the evening. *There was no gloom.*

The most dignified engineer forgot his dignity and let himself go when the community singing swung into "Barney Google" and "Yes, We Have no Crepehangers".

Branch affiliates, of whom Lethbridge possesses many, vied with dyed-in-the-wool members in making known to the general secretary that Lethbridge is an active branch of *The Institute.*

Mr. Keith, in his address complimented the branch on its success in interesting Affiliates. Lethbridge, he stated, leads the Dominion in this respect. Taking occasion to emphasize the importance of the Affiliate, he said in effect: "The Branch Affiliates are our link with the lay public, and should be encouraged to join you."

Mr. Keith went on to give a general survey of *The Institute* work. Dealing particularly with engineering education, he stated that the time was approaching when the number of engineers would have to be dealt with. "I believe we cannot have too many men receive training in technical education," he said, "but it is a mistake to continue to permit men so trained to believe they must follow engineering in order to get the most out of their education. An engineering training is the finest kind of an education. It is an education that fits into every walk of life."



Mr. Keith referred briefly to the World Power Conference, and paid tribute to the valuable contributions that Canadian engineers were making to it. He referred also to the Leonard Foundation for providing higher education for the sons of various classes of professional men included among which were the sons of Canadian engineers.

Mr. Keith concluded his talk with a plea for greater pride in the profession of engineering. He urged greater contact with public affairs. "Our interest in the Community and in the Nation as a whole is as great, if not greater than that of any other profession. We are the greatest purchasers of materials. We have a direct and active interest in the building up of Canada. It is a duty we owe ourselves, that we should seek to assume public as well as personal responsibility."

In the general discussion following Mr. Keith's remarks, Harry Meech, M.E.I.C., emphasized the value of publicity to the engineer, not personal publicity, but publicity that would interpret the work of engineering in the vernacular of the lay public. "It is time we broke away from the 'dry-as-dust' treatise bristling with technical terms and got our language down to a popular level. It is the lay public we want to interest," said Mr. Meech.

Other speakers expressed similar sentiment. The feeling being that while *The Journal* was indispensable and of the greatest value as a medium of intercommunication between members, publicity of a wider scope should be sought through popular magazines with articles that would be both instructive and interesting to the lay public.

Taking it "by and large" it was a great night and Mr. Keith's next visit is being looked forward to with joyful anticipation.

Occasion was taken of the special meeting to announce the appointment of the following committees for the current year:

Entertainment Committee........	S. G. Porter, M.E.I.C.
House and Fellowship Committee.	J. H. Turner, M.E.I.C.
Membership Committee..........	Chas. Raley, A.M.E.I.C.
Credentials Committee...........	P. M. Sauder, M.E.I.C.
Attendance Committee...........	Jas. Haimes, Branch Affiliate.
Programme Committee...........	G. N. Houston, M.E.I.C.
Publicity Committee.............	C. J. Broderick, Branch Affiliate.

Calgary Branch

G. P. F. Boese, A.M.E.I.C., Secretary-Treasurer.
W. St.J. Miller, A.M.E.I.C., Branch News Editor.

On March 31st, a number of members gathered together at a luncheon in the Tapestry Room of the Hudson Bay Company, in order to welcome once again our general (and genial) Secretary-Manager Fraser S. Keith, M.E.I.C. One and all dared the devastating effects and evil results of rapidly consuming the victuals set before them in their eagerness to listen to the message that was to be conveyed to the assembly by the guest of the day.

Chairman R. S. Trowsdale, A.M.E.I.C., announced the speaker in a few suitable words, stating that an introduction was scarcely necessary.

Address by the General Secretary

Mr. Keith's opening remarks were in the nature of greetings, and he lead up to the extraordinarily pressing need to-day of keeping the status of the engineering profession at a high elevation, pointing out that so long as we as a body elevate the mass, this in turn must reflect on the elevation of the individual member. He emphasized the importance of recognizing the E.I.C., as a national organization, and impressing this fact on the public on every opportunity. The main scope of such an organization of some 5,000 members is to interpret what engineering is, what engineers are, and set forth, what they are doing. He emphatically stated that *The Institute* is so assuredly behind the individual.

Referring to our connection with the parent body at headquarters Mr. Keith congratulated the branch on its selection of B. L. Thorne, M.E.I.C., as its representative on the Council. Delving into a few statistics on the engineering profession he pointed out that out of thirty-nine presidents of leading railroads in the United States thirteen were engineers. Engineers, he believed, should be more prominent in high offices than is the case, as by virtue of his training an engineer is well adapted to positions of responsibility and those requiring technical knowledge. He went on to state that there was no denying the fact that the engineering profession is fast becoming overcrowded. Some two thousand young men were being taught in the Dominion universities at present, and five hundred were being turned loose in the spring. Hence it seemed to him that the older members should take a very keen interest in the students' welfare, helping them in every possible way to obtain a good start in life.

His opinion was that, after a four years course and a degree, most young men imagined that they were fullfledged engineers, whereas in reality they had merely established the foundation of a profession, and it was during the following five years or so that they really "found" themselves. He went so far as to urge a technical training in every walk of life, for the banker, doctor, business man, lawyer, etc. Touching on the matter of the committee on classification he said that their principal recommendation had been the assignment of certain responsibilities to certain schedules.

In offering encouragement and advice to the branch he suggested that a committee be formed to encourage acquaintanceship and a general effort to attract Affiliates, claiming that it was fundamental that all members must meet one another frequently, and that the local branch must come before the public as much as possible. He added that we must claim it a basic duty as a branch to elevate the status of the individual. He also suggested a committee on classification and remuneration. The speaker called attention to the employment pages of *The Journal*, both from the employers' and employee's point of view. In conclusion he fittingly eulogized *The Institute* and profession to which we are all so proud to belong.

A warm vote of thanks was tendered by A. S. Dawson, M.E.I.C., who extended further greetings of the branch members. This was suitably seconded by W. Pearce, M.E.I.C.

During the question period F. K. Beach, A.M.E.I.C., asked if publication of papers in the local press would be permissible in the probability of the new by-law under section 22 coming into effect. In reply Mr. Keith stated that the more publicity we accorded the papers and affairs the better, and the by-law was not intended to prevent this but referred more specifically to the publication in journals of general circulation prior to publication by *The Institute* in *The Journal*.

Following the lunch Major F. G. Cross, A.M.E.I.C., gave a delightful skit entitled "At the Movies", in his inimitable manner, which called forth a round of applause.

Civic Financing

On April 8th a very interesting paper was read at a branch meeting by A. G. Graves, one of the city commissioners. The subject was civic financing, and proved extremely interesting, being illustrated with several charts relative to the problem of taxation, city improvements, and public utilities. The occasion presented an opportunity for engineers to further promote their interest in matters pertaining to civic government, and those present were well repaid for their attendance.

Vancouver Branch

P. H. Buchan, A.M.E.I.C., Secretary-Treasurer.

The A. D. Swan Book Prize

On November 21st, 1921, a $25.00 book prize was offered by the Vancouver Branch, on behalf of the donor A. D. Swan, M.E.I.C., for an essay competition open to Students of *The Engineering Institute of Canada* in the Vancouver Branch. The offer unfortunately met with no response, probably owing to the fact that the Students at that time were few in number, coupled with the stipulation that the topic of the essays should be "Town Planning in Relation to Vancouver". Consequently, the prize was never awarded.

At the general meeting of March 26th, it was decided to offer this prize on behalf of Mr. Swan, for the second time, under the following conditions:

(1) The prize to be called "The A. D. Swan Special Book Prize".

(2) Competition to be open to only the Students of *The Engineering Institute of Canada* who will be in attendance at the University of British Columbia during the 1924-25 session.

(3) The basis of the competition to be the summer theses, topics to be at the option of the respective competitors.

(4) Theses entered for the competition to be handed in at either the office of the secretary-treasurer of the Vancouver branch, or at the office of the Dean of the Faculty of Applied Science, University of British Columbia, on or before November 15th, 1924. In any case the secretary-treasurer of the Vancouver Branch must be notified in writing, by each competitor.

(5) The judges of the competition to be the professors of the Faculty of Applied Science of the University of British Columbia.

Mr. Swan states in a recent letter in reference to this matter, that his idea was simply to show a little interest in the younger engineers, and to give a book prize for some paper which was really meritorious. That is the spirit of the offer.

Chas. Brakenridge, M.E.I.C., Appointed City Engineer

The recent appointment of Charles Brakenridge, M.E.I.C., to the post of city engineer, Vancouver, B.C., unquestionably meets with the unanimous approval of the local members of *The Institute.*

The fact that he is a past-chairman of the Vancouver Branch and at present represents us on the Council of *The Institute* is further proof of his ability, and the high place which he occupies in the respect and esteem of his fellow members cannot be too greatly emphasized.

We all join in heartiest congratulations upon his well-merited success, and take personal pride and pleasure in the fact that one more of our leading members has risen to a post of higher responsibility and greater influence in the destiny of our city and province.

Ottawa Branch

F. C. C. Lynch, A.M.E.I.C., Secretary-Treasurer.

Progress in Aviation*

A graphic description of the progress of the airplane and other forms of air mastery by man was given in a lecture before the Ottawa Branch, in the Victoria Museum on the evening of April 7th, by Wing Commander E. W. Stedman, O.B.E., M.E.I.C., late of the technical staff of the Royal Naval Air Service, afterwards technical director of the Handley Page Company, and now with the Air Board, (R.C.A.F.).

Striking Developments in Science*

Treating of some striking developments in the progress of science during the last 25 years Dr. H. M. Tory, president of Alberta University, addressed the members of the Ottawa Branch at luncheon at the Chateau Laurier, March 20th.

A gathering which completely filled the dining room gathered to hear the distinguished Western scientist, the following being noted among the visitors at the headtable: Hon. Dr. H. S. Beland, Hon. Charles Stewart, Robert Forke, M.P., Hon. Hewitt Bostock, Dr. W. L. Ritchie, Dr. S. D. Adams, Col. O. M. Biggar, Rev. G. D. Kilpatrick, Dr. S. J. McLean, Dr. J. F. Argue, and Charles Cowan.

J. L. Rannie, M.E.I.C., the chairman, introduced the speaker, prior to which he made a feeling reference to the great loss suffered by *The Institute* and Canadian science by the lamented death of President Walter J. Francis, M.E.I.C. He announced that Mr. Arthur Surveyer, M.E.I.C., formerly vice-president, had succeeded Mr. Francis.

Aeroplane Photographs for Map-Making*

The surveyor by taking to the air will be able to make more accurate contour maps with greater speed than now possible, Professor H. L. Cooke, of Princeton University, indicated in a lecture on March 24th, before the Ottawa Branch, at the Victoria Memorial Museum, when he announced the development of a new method of taking and interpreting airplane photographs for map-making.

St. John Branch

W. J. Johnston, A.M.E.I.C., Secretary-Treasurer.

On the afternoon of March 28th, a party consisting of twenty-three members of the St. John Branch, with F. A. Bowman, M.E.I.C., vice-president of *The Institute*, K. H. Smith, M.E.I.C., Halifax, and John T. Farmer, M.E.I.C., Montreal, left St. John for Fredericton. The object of the trip was the holding of a joint meeting of the branch and the Engineering Society of the University of New Brunswick at Fredericton.

On arrival at Fredericton the members went directly from the train to the university, and were guests at supper of the Engineering Society, served by some of its members and for which courtesy the branch members formally expressed their thanks.

At the joint meeting, B. B. Manzer, president of the Engineering Society, presided and called on Dr. C. C. Jones, chancellor of the university, who formally welcomed *The Institute* members on this the second visit the St. John Branch had paid to the university, and expressed the hope that such visits be made frequently.

The chair was taken by G. N. Hatfield, A.M.E.I.C., chairman of the St. John Branch. The object of the meeting was defined as being an effort to exchange view points between the practising engineer and the student at present in college.

*F. A. Bowman, M.E.I.C., gave an address on "The Engineer's Attitude toward Accountancy", which was illustrated by lantern slides.

*An interesting talk on "Engineering Education not taught in Colleges" was given by K. H. Smith, M.E.I.C., who treated the subject in retrospect whereby a practising engineer may realize his failure to have received the greatest possible benefit from school days.

*J. A. Grant, A.M.E.I.C., delivered a short address on the "Breakwater Construction at Malta". This paper was illustrated by lantern slides and was most interesting as Mr. Grant spoke largely from personal experience.

Hon. W. F. Todd, lieutenant-governor of New Brunswick, mentioned previous gatherings of engineers, held by *The Institute*, which he had attended and the pleasure and information he always derived from attendance at such meetings. The speaker paid a personal tribute to the work of the engineer gained through his association with many members in both public and private life. Better appreciation of the varied work of the engineer would be obtained by every layman could he attend meetings of engineers such as the one the speaker was addressing.

R. L. Phillips, mayor of Fredericton, thanked the members of the St. John Branch for making possible a meeting such as the present one, and welcomed its members to the city of Fredericton.

A vote of thanks on behalf of the members of the St. John Branch to the Faculty and Engineering Society of the University of New Brunswick was tendered on motion of C. C. Kirby, M.E.I.C., and A. R. Wetmore, M.E.I.C., and reciprocated on behalf of the university to the St. John Branch by Professor John Stephens and Professor E. O. Turner, A.M.E.I.C.

The members of the St. John Branch returned to St. John the following day. All fortunate enough to make the trip agreed it had been worth while and highly enjoyable throughout.

Students visit Engineering Works in St. John

On April 5th, about thirty engineering students from the University of New Brunswick, accompanied by Professor E. O. Turner, A.M.E.I.C., Professor John Stephens and Professor A. F. Baird, A.M.E.I.C., visited St. John and inspected the drydock and other engineering works. The visitors and some twelve members of the St. John Branch were guests at dinner of the St. John Drydock and Shipbuilding Company.

Trade Publications

Electric Control Limited, 177, Reid Street, Bridgeton, Glasgow, have issued a descriptive leaflet on automatic pump control for dock, railway and public authorities. This leaflet contains full page illustrations, each page being faced with descriptive matter of interest on the subject. A copy will be sent to any interested enquirer upon request.

The Okonite Company, Passaic, N.J., have issued an attractive booklet of illustrations showing a number of insulated wire and cable installations on various railroads and power plants.

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*An abstract of this paper appears on another page of this issue.

The Utilization of Water Power in Canada in relation to Coal Production, Importation and Consumption.

The Dominion Water Power Branch of the Department of the Interior of Canada has recently prepared an analysis of the use of water-power in Canada for industrial purposes, with particular reference to the saving which has been effected in the importation and consumption of coal due to the use of water-power.

This bulletin deals with the annual coal equivalent of developed water power, i.e., the tons of coal replaced by each horsepower of water power in use; the coal consumption and imports by provinces and the corresponding water-power resources and development; the fuel necessities of Ontario and western Quebec, and how enormously these necessities have been diminished by water-power development; the strikingly smaller coal consumption per capita in Canada than in the United States in spite of a colder climate; the proportion of water-power and fuel power in use; and other related subjects.

The bulletin states that any such examination establishes indisputably two main points: (1) that the development of water power constitutes the only real and large relief yet achieved to the fuel problem in the Acute Fuel Area and (2) that it is our water power resources and the low average cost of power therefrom that has made possible such rapid development of our manufacturing industries that the net value of product of our factories (deducting duplication) is now greater than that of agriculture.

Extent of Resources and Present Development

The continuous 24-hour power capacity available at minimum stream flow is over 18,000,000 h. p. In practice power is rarely used continuously and the actual capacity is therefore considerably greater. The commercial capacity is estimated at over 32,000,000 h.p., and this would correspond on the basis of present installations to nearly 42,000,000 turbine horsepower installed.

The turbine horsepower installed as at January 1st, 1924, was over 3,227,000 h.p., and this represents, with transmission and distribution, a capital investment of over $687,000,000.

Coal Equivalent of Developed Water Power

This is an important point in the matter of the relation of water power to the coal problem and has received very full study by this branch. It may be arrived at by two distinct methods — (1) on the basis of the average coal used per horsepower per hour in steam plants, and (2) by analysis of official statistics of coal consumption, population and use of coal in industries.

These two methods give closely similar results, i.e., 9 tons of coal per annum per horsepower installed.

Coal Consumption and Imports in Relation to Water Power

The accompanying diagram, entitled "The Coal Situation in Canada, 1923", is to illustrate by provinces the total annual coal consumption and imports and the coal equivalent of the water power developed in each province.

The total coal consumption in 1923 is the highest on record. However, the consumption in 1922 was the lowest since 1916, due to the shortage of coal caused by the United States strike, and supplies were only maintained by serious depletion of the reserve stocks of dealers, railroads, public utilities, institutions, etc. — *the marked rise in 1923 therefore does not represent any special increase in consumption but is* probably mainly a renewal of reserve stocks, with in many cases increased reserve against future risks.

The present position may be shown in figures comparing the average coal consumption and imports during the past five years with the coal equivalent of the present water power development in tons and value per annum.

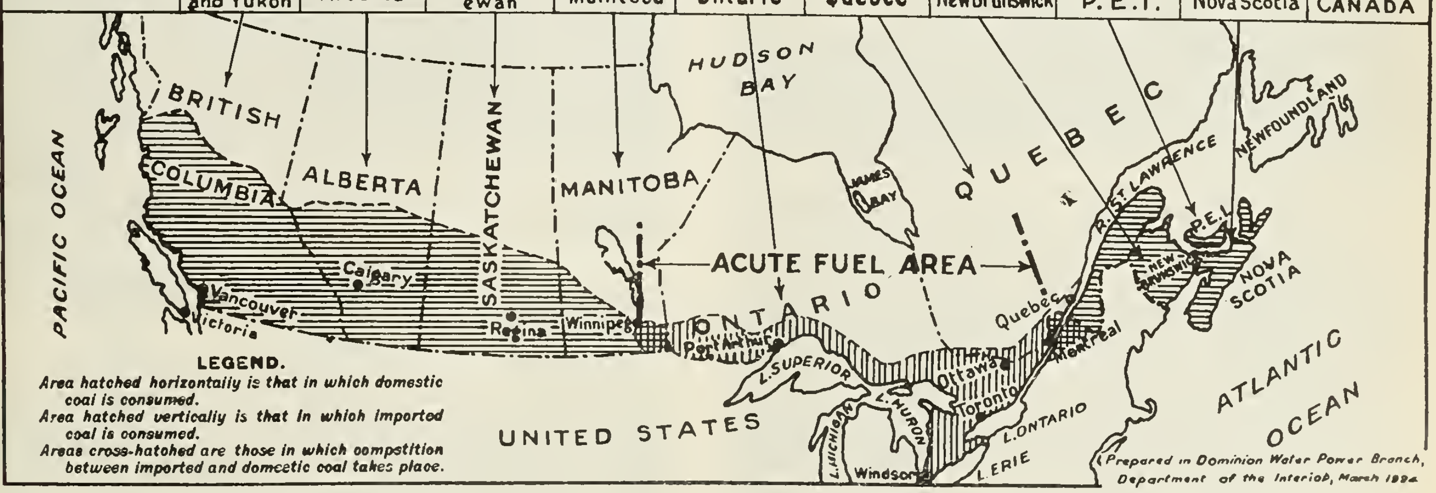
Coal

Average annual consumption, 1919-1923.....32,147,000 tons
" imports " .....17,577,000 "

Water Power

Installed horsepower, Jan. 1, 1924............. 3,227,000
Coal equivalent in tons per annum............. 29,000,000
Ditto, value at $10 per ton....................$290,000,000

	B.C. and Yukon	Alberta	Saskatchewan	Manitoba	Ontario	Quebec	New Brunswick	P.E.I.	Nova Scotia	CANADA
Output	2,823,317	6,848,538	439,892	—	Acute Fuel Area		276,603	—	6,595,672	16,984,022
Other provinces										
Received from	108,676	18,054	1,249,549	785,314	80,755	1,540,283	561,258	80,916	—	4,424,805
Shipped to	62,151	1,933,144	222,178	—	—	—	32,112	—	2,175,220	4,424,805
Exports (1)	838,063	605	11,510	8,213	877	3	115,364	—	679,771	1,654,406
Imports (2)	20,429	1,110	3,898	167,990	17,212,768	4,976,898	192,625	5,566	106,036	22,687,320
Consumption (4)	2,052,208	4,933,953 (3)	1,459,651	945,091	17,292,646	6,517,178	883,010	86,482	3,846,717	38,016,936
Foreign imports in % of consumption	0.01%		0.03%	17.8%	99.8%	76.4%	21.8%	6.4%	2.7%	60%
Coal equivalent of developed water power (annual) (5)	3,318,000	298,000	—	1,458,000	13,009,000	10,058,000	401,000	20,200	492,000	29,554,000
	B.C. and Yukon	Alberta	Saskatchewan	Manitoba	Ontario	Quebec	New Brunswick	P.E.I.	Nova Scotia	CANADA



The Coal Situation in Canada, 1923
Preliminary Figures, Short Tons

The Future Position

With normal increases in all respects along the lines shown by results over the last 15 years, the coal equivalent of developed water power will equal the total coal consumption about the year 1927; in other words by 1927 Canada will be using only one half the coal she would have required if there had been no water power development.

By 1940, assuming regular increase in coal consumption, the coal equivalent of developed water power will probably be some 64 per cent greater than the total coal consumption (76,500,000 tons against 46,000,000).

Coal Output in Relation to Water Power

It is of interest to consider what degree of relief has been given to the coal situation during the last decade by native coal and by water power respectively, as shown in the following table:—

Coal output and water power development comparison of increases

	Coal Output Tons	Water Power.	
		Installed Turbine h. p.	Coal Equivalent in Tons
1910	12,909,000	965,000	8,700,000
1911	11,323,000	1,348,000	12,100,000
1912	14,513,000	1,467,000	13,200,000
1913	15,012,000	1,674,000	15,050,000
1914	13,638,000	1,936,000	17,400,000
1915	13,267,000	2,078,000	18,700,000
1916	14,483,000	2,194,000	19,760,000
1917	14,047,000	2,260,000	20,350,000
1918	14,978,000	2,352,000	21,200,000
1919	13,919,000	2,444,000	22,000,000
1920	16,947,000	2,482,000	22,360,000
1921	15,057,000	2,680,000	24,100,000
1922	15,157,000	2,974,000	26,750,000
1923	16,984,000	3,227,000	29,000,000
Increase per cent	31.5%	235%	235%

It will be seen that, from 1910 to 1923, while the production of native coal has only increased 31.5 per cent the coal made unnecessary by water power has increased 235 per cent.

In terms of production per head of population, the coal output over that period has been stationary, but the water power development and coal thereby replaced has increased 157 per cent.

In the shorter period since 1920, in spite of the shortage and high prices of imported coal, the coal output has made practically no increase, but the water power development and coal thereby replaced has increased 28 per cent in the same three years.

It will also be seen that while the coal equivalent of water power was 33 per cent below the coal output in 1910, by 1923 it had become over 70 per cent greater than the output.

A study of the foregoing will show clearly how little our own coal resources have done over this long period towards the relief of coal importation compared with the direct saving due to water power development.

The Acute Fuel Area

The foregoing statistics have applied to the Dominion as a whole but the relief afforded to the coal situation by water power development is even more striking when the acute fuel area is considered separately. It is now agreed that this term can only be applied to Ontario and Quebec and that it is the supply of coal to these provinces that constitutes the "fuel problem of Canada." For the moment they may be considered as a unit.

Ontario and Quebec contain over 60 per cent of the total population of Canada and nearly 80 per cent of the total manufacturing development. They use over 60 per cent of the total coal consumption of the Dominion and 93 per cent of their combined coal consumption is imported from abroad.

In water power these provinces have between 12 and 18 million horsepower available and of this over 2,563,000 horsepower is already developed, this developed water power representing an increase of 215 per cent since 1910.

The combined coal consumption of Ontario and Quebec for 1923 was 23,810,000 tons, — the coal equivalent of developed water power in the same area is over 23,000,000 tons. It will therefore be seen that but for this developed water power, Ontario and Quebec would require about twice their present supply of coal.

It may however be pointed out that had these great industrial provinces been dependent on imported coal for their manufacturing power they could never have attained their present commercial development.

Coal Consumption per Capita, Canada and United States

The average coal consumption per capita for all uses of coal from 1918 to 1922 inclusive, on exactly the same basis for each country, was, United States 5.11 tons, Canada 3.65 tons, or 29 per cent less in Canada than in the United States.

In view of the colder average climate of Canada the opposite result might be expected. Analysis shows that this lower consumption in Canada is directly due to the much greater use of water power in industry, as shown in the following paragraphs.

Uses of Coal and Power

Uses of coal. The United States superpower survey found as the result of an exhaustive study that of all the coal used in the United States approximately one-half was used for producing power and one-half for producing heat but that in producing power only about 5 per cent of the total energy in the coal is utilized while in producing heat about 50 per cent is utilized. The great saving in coal by the use of water power is therefore in producing power, not heat.

Uses of Coal in Per Cent of Total Consumption

	Canada 1921	United States 1920
Steam railways	29%	27%
Bunker coal	4 "	2 "
Industries and coke	34 "	49 "
Electric light and power	2 "	3 "
Domestic use and gas making	31 "	19 "
	100%	100%

It will be seen that the proportion used for domestic consumption is much higher in Canada and that the proportion used for railroads is also higher in Canada — the latter might be expected since the population per mile of track is only one-half of that in the United States.

For industries Canada uses 34 per cent and the U. S. 49 per cent of the respective total consumptions. This is not 15 per cent difference it is a difference of 15 in 49 or 31 per cent, so that proportionately Canada uses 31 per cent less of her coal in industry than does the U. S.

It naturally occurs to one that this may be due to a greater degree of industrialism in the United States than in Canada. However, investigation shows that on a per capita basis Canada is nearly on a par industrially with the United States and this fails to account for more than a small portion of the large difference.

It appears therefore that the use of coal for domestic purposes (which is comparatively little affected by water power) and for steam railways (so far very slightly affected by water power) is relatively greater in Canada than in the United Station, but that the use of coal for industries is relatively some 31% less in Canada than in the United States.

These conditions are fully accounted for by the greater development of water power in Canada than in the United States, as follows:—

The hydraulic horsepower installed per 1000 of the population is over 350 in Canada to about 100 in the United States or 3½ times as much. Of all the primary power in use in Canada (excluding steam railroads) 70% is supplied by water power, 30% by fuel power; in the United States the position is more than reversed.

Uses of power. Power is used in Canada for different purposes in approximately the following proportions:—

Power for all purposes except railways	51%
Electric light and domestic use	9%
Electric railways	4%
Steam railroads. Estimated average h. p. actually used	36%
	100%

Proportions of water and fuel power. These stand in Canada approximately thus:—

	Including Railroads	Not Including Railroads
Water Power	45%	70%
Fuel Power	*55%	30%
	100%	100%

Copies of the complete bulletin may be obtained free of charge on application to the Director of Water Power, Ottawa, Canada.

Note. — *The 55% for fuel power divides into 19% for industrial uses and 36% for steam railroads.

Preliminary Notice

of Applications for Admission and for Transfer

April 19th, 1924.

The By-laws now provide that the Council of the Institute shall approve, classify and elect candidates to membership and transfer from one grade of membership to a higher.

It is also provided that there shall be issued to all corporate members a list of the new applicants for admission and for transfer, containing a concise statement of the record of each applicant and the names of his references.

In order that the Council may determine justly the eligibility of each candidate, every member is asked to read carefully the list submitted herewith and to report promptly to the Secretary any facts which may affect the classification and election of any of the candidates. In cases where the professional career of an applicant is known to any member, such member is specially invited to make a definite recommendation as to the proper classification of the candidate.*

If to your knowledge facts exist which are derogatory to the personal reputation of any applicant, should be promptly communicated.

Communications relating to applicants are considered by the Council as strictly confidential.

The Council will consider the applications herein described in May, 1924.

FRASER S. KEITH, Secretary.

*The professional requirements are as follows:—

Member shall be at least thirty-five years of age, and shall have been engaged in some branch of engineering for at least twelve years, which period may include apprenticeship or pupilage in a qualified engineer's office, or a term of instruction in a school of engineering recognized by the council. The term of twelve years may, at the discretion of the council, be reduced to ten years in the case of a candidate for election who has graduated from a school of engineering recognized by the council. In every case the candidate shall have held a position in which he had responsible charge for at least five years as an engineer qualified to design, direct or report on engineering projects. The occupancy of a chair as a professor in a faculty of applied science or engineering, after the candidate has attained the age of thirty years, shall be considered as responsible charge.

An Associate Member shall be at least twenty-seven years of age, and shall have been engaged in some branch of engineering for at least six years, which period may include apprenticeship or pupilage in a qualified engineer's office or a term of instruction in a school of engineering recognized by the council. In every case a candidate for election shall have held a position of professional responsibility, in charge of work as principal or assistant, for at least two years. The occupancy of a chair as an assistant professor or associate professor in a faculty of applied science of engineering, after the candidate has attained the age of twenty-seven years, shall be considered as professional responsibility.

Every candidate who has not graduated from a school of engineering recognized by the council, shall be required to pass an examination before a board of examiners appointed by the council. The candidate shall be examined on the theory and practice of engineering with special reference to the branch of engineering in which he has been engaged. This examination may be waived at the discretion of the council if the candidate has held a position of professional responsibility for five or more years.

A Junior shall be at least twenty-one years of age, and shall have been engaged in some branch of engineering for at least four years. This period may be reduced to one year, at the discretion of the council, if the candidate for election has graduated from a school of engineering recognized by the council. He shall not remain in the class of Junior after he has attained the age of thirty-three years.

Every candidate who has not graduated from a school of engineering recognized by the council, or has not passed the examinations of the first year in such a course, shall be required to pass an examination in the following subjects: geography, history (that of Canada in particular), arithmetic, geometry, euclid (books I, IV and VI), trigonometry, algebra up to and including quadratic equations.

A Student shall be at least seventeen years of age, and shall present a certificate of having passed successfully an examination equivalent to the final examination of a high school or the matriculation of an arts or science course. He shall either be pursuing a course of instruction in a school of engineering recognized by the council, in which case he shall not remain in the class of student for more than two years after graduation; or he shall be receiving a practical training in the profession, in which case he shall pass an examination equal to that prescribed for admission to the grade of Junior in the foregoing section and he shall not remain in the class of Student after he has attained the age of twenty-seven years.

An Affiliate shall be one who is not an engineer by profession but whose pursuits, scientific attainments or practical experience, qualify him to co-operate with engineers in the advancement of professional knowledge.

The fact that candidates give the names of certain members as references does not necessarily mean that their applications are endorsed by such members.

FOR ADMISSION

BABBITT—ARCHIE RANDOLPH, of Halifax, N.S. Born at Fredericton, N.B., Sept. 4th, 1889; B.Sc., (C.E.), Univ. of N.B., 1910. Post-graduate course, Univ. of N.B., 1911 in maths. and chemistry; 1908, dfting. crown land office, Fredericton; 1909, timekeeping, force account with Hugh Nawn Constrn. Co., Boston, Mass.; 1912, instr'm., mtce. of way, C.P.R., Fort William, Ont.; 1912-14, mgr. of Medicine Hat, Alta., office of Cumming & Day, land surveyors and civil engrs., of Edmonton; 1915-17, overseas, Can. Engrs.; 1917-21, attached to Royal Can. Engrs., Halifax, N.S. as Lieut.; 1921 and part of 1922, civilian supt., Royal Can. Engrs., Halifax, N.S.; 1922-23, res. engr., Prov. Highway Board, Halifax, N.S. (At present awaiting commencement of summer highway constrn. with Highway Board.)

References: R. W. McColough, H. F. Lawrence, R. L. Waycott, A. K. Grimmer, C. McN. Steeves.

BELL—CHARLES HINDMARSH, of 444 Walmer Road, Toronto, Ont. Born at London, Ont., Feb. 15th, 1894; Educ., Junior matric. with honour matric. Maths., Montreal Technical School (Struct'l. Design); 1911-13, dftsman., Canadian Steel Foundries, Welland, Ont.; 1915 (Aug.-Dec.), dftsman., Can. Steel Foundries, Montreal; 1916-18, dftsman with Darling Bros., Limited, Montreal, New Welland Ship Canal, St. Catharines, Canadian Aeroplanes Limited, Toronto, Eastern Car Co., New Glasgow, N.S.; 1918 (Mar.-Oct.), field engr., U.S. War Dept.; 1919 (Jan.-Aug.), office engr., archt'l. dept. Public Works, Santa Domingo; 1919-20, asst. engr., Messrs. Tata Oil Mills Co. Ltd., Ernakulam, South India; 1920-22, contractor and engr., Ernakulam, South India; 1922-23, clerk of works, for Messrs. Martin & Co., Calcutta, India; At present, dftsman., power house layout, Messrs. Kerry & Chace Ltd., Toronto, Ont.

References: J. B. Bladon, C. L. Hays, A. T. C. McMaster, H. R. McClymont, A. L. Mudge.

BOURNE—HERBERT FREDERICK, of 852 Wollaston Street, Esquimalt, B.C. Born at London, England, April 21st, 1890; Educ., Private tuition; 1907-14, with C.P.R. on location and constrn. work as rodman, asst. dftsman, dftsman., instr'man., and for last year performing duties of res. engr.; 1914-16, designing and constructing sewerage system for Esquimalt municipality for C.H. Topp & Co., Victoria, B.C.; 1916 (Mar.-Dec.), employed by Esquimalt municipality as asst. engr. designing and constructing sewerage system; Jan. 1917 to date, municipal engr., Esquimalt municipality, B.C.

References: C. H. Larson, H. M. Bigwood, F. M. Preston, M. P. Blair, J. B. Lambert.

CALDWELL—ALEXANDER CLYDE, of Ottawa, Ont. Born at Lanark, Ontario, June 3rd, 1874; Educ., Grad. R.M.C., 1898; 1899-1900, on staff of Commanding Royal Engrs. western lines of communications, South Africa; 1900 (April-Nov.), staff, field intelligence dept., South Africa. May 1901 appointed to 14th, Regt. as Lieut. August 1902, transferred to Can. Engrs. April 1903, Captain, Corps of Guides. July 1903, appointed Intelligence Staff Officer. Feb. 1904, promoted Major, Corps of Guides. March 1905, transferred to Royal Can. Engrs. as Captain. July 1905, appointed asst. director of intelligence. Oct. 1907, promoted Major, Royal Can. Engrs. May 1911, appointed chief engr., 2nd divisional area. May 1915, promoted Lieut.-Col. Oct. 1917, Brevet Colonel. March 1918, appointed General Staff Officer, Grade I, Militia Headquarters. June 1922, promoted substantive colonel, Royal Can. Engrs. and appointed Director, Engineer Services, Dept. National Defence, Ottawa.

References: A. G. L. McNaughton, L. Sherwood, W. P. Anderson, H. F. H. Hertzberg, J. B. Cochrane, H. J. Lamb.

CHAMBERS—EDWARD COULTHURST GIBBONS, of Ottawa, Ont. Born at Shortlands, Kent, England, June 2nd, 1887; Educ., Northampton Institute, London. City and Guilds of London cert. in electric lighting and power; Four years ap'ticeship to Langdon Davies Motor Co., elec. engrs., London, England (workshops, dfting and design); One year in charge of the test room of above company; four years as engr. to Langdon-Davies Motors Canada Ltd., and three years, until proceeding overseas, mgr. for the same company, mfg. and installing electrical plant of all kinds; At present captain and adjutant, Royal Canadian Engineers, Ottawa, Ont.

References: C. P. Edwards, A. F. Duguid, J. H. Ralph, W. S. Lawson, F. G. Bird.

CHINA—ERNEST, of 1958 Halifax Street, Regina, Sask. Born at Bath, Somerset, England, July 16th, 1883; Educ., technical schools; 1907-08, rodman and transitman, Sask. prov. surveys; 1909-10, rodman, etc., Dominion surveys; 1911-13, dftsman and transitman in charge of grade, tunnel and bridge work, G.T.P.Rly.; 1914, transitman and dftsman., Pacific & Great Eastern Rly.; 1915-19, overseas; 1919, dftsman with C.N.R. in B.C.; 1920-21, transitman for R/W surveys dept., C.N.R.; 1922-24, asst. engr. with the highways dept., Regina, Sask.

References: H. S. Carpenter, W. G. Swan, S. H. Sykes, H. R. MacKenzie, C. Ewart, H. L. Johnston.

COOK—WILLIAM HENRY, of 6415 Chambord Street, Ahuntsic, Montreal, Que. Born at London, England, March 26th, 1886; Educ., 1903-07, London and South Western Rly. Tech. Inst. City and Guilds of London Institute and Kensington Arts; 5 years ap'ticeship with London and South Western Rly. Co.; 1907-08, asst. marker for all mill work, Birmingham Railway Carriage & Wagon Co. Ltd.; 1908-11, dftsman., master car builders office, C.P.R.; 1911-13, dftsman., Northern Elec. & Mfg. Co.; 1913-16, dftsman., rolling stock and plant mtce., Montreal Tramways Co.; 1916-17, checker in dfting room for all machine design, mtce. and shell work (munitions), Wire & Cable Co.; 1917 (Feb.-May), dftsman., plant design, Canadian Explosives; 1917-18, dftsman in charge of machine design, Canadian Consolidated Rubber Co. Ltd.; Jan. 1918 to date, chief dftsman., mech., bldg., and mtce., Canadian Consolidated Rubber Co. Ltd., Montreal.

References: R. P. Raynsford, A. H. Pattenden, H.W.B. Swabey, J.A. Duchastel, F. Irvine.

CRAWLEY—FREDERICK AUSTIN, of Oxford, N.S., Born at Wolfville, N.S. June 16th, 1886; Educ., Matric. from Horton Collegiate Academy, Wolfville, 1905. Completed first year Acadia Univ., 1906; 1906-08, topog'r., levelman and dftsman. on rly. location and townsite subdivision, G.T.R., Prince Rupert, B.C.; 1909 (May-Aug.), transitman on stadia surveys for logging rly., with MacDonell, Gzowski & Co., Vancouver, B.C.; 1909-10, dftsman. and transitman on rly. location with Oregan Trunk Rly., The Dalles, Oregan; 1910-11, dftsman., N.T.C.Rly., Ottawa, Ont.; 1911 (Jan.-May), mtce. engr. on elec. rly., Hull Electric Rly., Deschenes, Que.; 1911-13, with Eastern Constrn. Co., Pensacola, Florida, first four months as transitman on rly. location, (Gulf, Florida & Alabama Rly.), balance of time of asst. engr. and res. engr. on location and constrn. of same rly.; 1913-14, dftsman. and calculator, C.N.R., Winnipeg; 1914-15, reconnaissance engr., (Prince Rupert to Christina Lake, Alta. 350 miles), with Peace River & Pacific Rly.; 1915-17, only occasionally employed on engrg. work; 1917-19, overseas. Can. Engrs.; 1919-20, constrn. engr. on road constrn., and from March 1920 to date, divn. engr. in charge of divn. No. 3 (Colchester and Cumberland Counties), highway system of 2,100 miles, for Provincial Highways Board, Halifax, N.S.

References: R. W. McColough, H. F. Laurence, G. A. Bernasconi, J.F.C. Wightman, R. R. Murray, J. E. Belliveau, E. A. Crawley.

CUNNINGHAM—ROY HERBERT, of London, Ont. Born at London, Ont., Oct. 2nd, 1888; Educ., B.A.Sc. Univ. of Tor. 1909; Post Grad. at Univ. of Illinois; 1910-11, National Electric Lamp Assn., Cleveland, Ohio; 1911 (Jan.-Oct.), illuminating engr., Byran Marsh Lamp Co.; 1911-12, illuminating engr., Macheth Evans Glass Co.; 1912-13, sales engr., Hoskins Mfg. Co., Detroit, Mich.; 1914-21, manager, Canadian Hoskins, Ltd., Furnace Engrs. Also known as Hiram Walker & Sons Metal Products Ltd., Walkerville, Ont.; April 1921 to date, R. H. Cunningham & Co., Industrial Engineers, London, Ont.

References: E. V. Buchanan, H. B. R. Craig, A. J. Stevens, F. M. Brickenden, J. M. Moore.

FORTIN—JOACHIM, of Chicoutimi, Que. Born at L'Islet, Que. Sept. 15th, 1881; Educ., B.Sc. Levis College; 1907-09, field dftsman and topog'r., Transcontinental Rly.; 1909-13, on hydro-elec. development for Dorchester Electric Co.; 1913-14, office in Quebec; 1914-20, in charge of hydro-elec. developments for the Chicoutimi Pulp Co.; 1920-21, in charge of a party on Quebec and Chihougaman rly. survey; 1921-22, general constrn.; At present supt. for the Nova Scotia Constrn. Co. at Portage des Roches, Que.

References: E. Lavoie, G. E. Lamothe, H. B. Pelletier, A. Duperron.

PHILP—WILLIAM MELVILLE, of 477 River Road, Niagara Falls, Ont. Born at Colborne, Ont., April 23rd, 1889; Educ., B.A.Sc., Univ. of Toronto, 1914; 1910, dftsman., Canadian Westinghouse Co.; 1911-12, dftsman., 1913, elec'l. constrn., Can. Gen. Elec. Co.; 1914-19, overseas. Can. Engrs.; 1919-23, asst. engr. of constrn. (elect'l.), H. E. P. C. of Ontario; April 1923 to date, plant engr., Queenston generating station, of the H.E.P.C. of Ontario.

References: R. W. Downie, H. W. Buck, E. I. W. Jardine, T. V. McCarthy, H. W. Wagner.

ROY—GEORGES, of 137 Cartier Street, Ottawa, Ont. Born at Quebec, Que., August 8th, 1878; Educ., B.Sc. Laval Univ. 1901. Law course, Laval Univ. Exams. not taken owing to proceeding to South Africa, 1902; 1904-12, survey work in Alta. Passed all promotion exams. Instructor, Field Artillery; 1912-15, instructor, Coast Defence and Heavy Artillery; 1915-17, chief instructor and inspr. of artillery, Commanding Royal Can. Artillery; 1917-19, service in England and France; 1919-22, in command coast defences; 1922 to date, officer administering the Royal Canadian Artillery and staff officer for artillery for same period. Chairman, Standing Arms Committee.

References: G. J. Desbarats, A. G. L. McNaughton, H. F. H. Hertzberg, E. W. Stedman, J. B. Cochrane, A. F. Duguid.

SPENCER—EVERETT BENJAMIN, of 41 Union Street, Sydney, N.S. Born at Glace Bay, N.S., June 7th, 1898; Educ., mech. elec. engrg. course, A.C.S. Two terms mech. dfting class local night school; 1908-1912, employed in accounting dept., and from 1912 to date, secretary to mech. supt., Dominion Coal Company, Glace Bay, N.S. (In addition to mech. dept. had charge of all constrn. work from 1914-1918).

References: J. S. Whyte, A. L. Hay, K. H. Marsh, H. C. Chipman, A. P. Theuerkauf.

STODART—JAMES, of Hamilton, Ont. Born at Grange, Banffshire, Scotland, Feb. 8th, 1885; Assoc. Member, Inst. of C.E.; 1903-08, app'ticeship, city engr's. office, Aberdeen, Scotland; 1908-10, asst. engr., Aberdeen, main drainage, water design and constrn.; 1911-12, asst., city engr's office, Toronto; 1912-14, city engr's. office, Hamilton, Asst. engr. in charge of Hamilton waterworks extensions. Constrn. west end disposal works. Constrn. McKittrick bridge; 1915-21, sewer engr., city engr's. office, Hamilton; 1921 to date, engr. for Messrs. A. Cope & Sons, Contractors, Hamilton, Ont.

References: W. Hollingworth, H. B. Stuart, H. S. Philips, C. J. Nicholson, W. E. Stephens.

FOR TRANSFER FROM CLASS OF ASSOCIATE MEMBER TO THAT OF MEMBER

BARNES—HARRY FAIRWEATHER, of Tientsin, China. Born at Buctouche, N.B., June 27th, 1889; Educ., B.Sc. Univ. of N.B., 1912; 1912-15, asst. engr., C.P.R., Ont. divn., mtce. work and constrn. of yards etc.; 1915-17, professor of rly. engrg., Chinese Govt. Engineering College, Tangshan, North China; 1917-19, overseas; 1919-24, sewerage engr. with the public works dept. of the Shanghai Municipal Council, in charge of design and constrn. of sewerage scheme (separate system), for Shanghai; At present, municipal engr., British Municipal Council, Tientsin, China.

References: A. P. Walker, J. A. Stiles, W. B. Cartmel, H. F. Bennett, A. F. Baird, R. F. Armstrong, N. I. Foster, H. F. Morrisey, S. R. Weston, N. Wilson.

DeLAPORTE—ANTOINE VALENTINE, of 189 Robert Street, Toronto, Ont. Born at Toronto, July 24th, 1889; Educ., B.A.Sc. Univ. of Toronto 1910; asst. supt. Temiskaming & Hudson Bay Mining Co., Cobalt; Served as Capt. Hydrological Corps. Lieut. Royal Can. Engrs., 2nd Lieut., Royal Engrs.; 1913-24, asst. engr. Prov. Board of Health of Ontario, in charge of experimental station. Reporting on the different water and sewage purification plants in the province of Ontario, and responsible for the recommended changes and installations required by the Prov. Board of Health. At present, special lecturer to the course in municipal engrg., Univ. of Toronto. Asst. sanitary engr., and in charge experimental station, Prov. Board of Health of Ontario.

References: F. A. Dallyn, W. S. Lea, E. H. Darling, P. Gillespie, R. O. Wynne-Roberts, J. C. Keith, T. R. Loudon, C. R. Young.

FOR TRANSFER FROM CLASS OF JUNIOR TO HIGHER GRADE

MacNEIL—HECTOR, of Longlac, Ont. Born at Arichat, N.S., Sept. 8th, 1889; Educ., 1894-1909, Richmond County Academy; 1909, rodman, 1910-13, instr'man. and res. engr., N.T.C.rly.; 1914-18, engr. in charge of party on munic. work, surveys and constrn., Town of Mount Royal, Montreal; 1918-19, instr'man. in charge of C.N.R. yard at Cartierville, Que.; 1919-20, dftsman. and instr'man., Mount Royal Tunnel, Montreal; 1920-21, instr'man. mtce of way, C.N.R., Montreal divn.; 1921-23, asst. engr., mtce. of way, eastern lines, C.N.R., Toronto; Jan. 1923 to date, res. engr., constrn., C.N.R., Longlac, Ont.

References: H. T. Hazen, G. C. Dunn, G. P. MacLaren, R. A. Baldwin, W. E. Joyce, F. A. Snyder, W. D. Robertson.

WALTON—FREDERICK STANLEY, of Prince Rupert, B.C. Born at Hull, England, June 12th, 1888; Educ., Grammar School, Hull, England; 1911-12, rodman and inspr. on constrn. work of branch lines, G.T.P. Rly.; 1912-14, instr'man and dftsman., G.T.P.Rly.; 1914-20, overseas (prisoner of war from 1915); May 1920 to date, instr'man. on Smithers Divn. of G.T.P.Rly. now C.N.R., Prince Rupert, B.C.

References: J. A. Heaman, W. Fetherstonhaugh, W. H. Tobey, R. W. Ross, M. A. Burbank.

FOR TRANSFER FROM CLASS OF STUDENT TO HIGHER GRADE

BENNETT—WILLARD ERLANDSON, of Larder Lake, Ont. Born at Ottawa, Ont., August 16th, 1898; Educ., B.A.Sc., Univ. of Toronto, 1923; Ex-Cadet, R.M.C. Kingston. War Cert. Gazetted Lieut., July 1918; 1919 (Feb.-Apr), time-keeper and material clerk, constrn. demobilization barracks, Toronto; 1919 (June-Sept.) chainman and recorder, 1920 (Apr.-Sept), instr'man. (leveller), 1921-22 (summers), instr'man., 1923 (May-June), topog'r. and leveller, Dominion Water Power Branch survey parties; At present res. engr., Swastika-Wendigo Lake Branch, Nipissing Central Rly., Larder Lake, Ont.

References: S. B. Clement, W. J. Bishop, J. B. Challies, T. H. Dunn, C. G. Cline.

KIRKPATRICK—HAROLD THOMPSON, of 308 Prince Arthur West, Montreal, Que. Born at Cape d'Or, N.S., July 18th, 1896; Educ., B.Sc. (Mech. Eng.), McGill Univ. 1920; 1913-15 (summers), operating gas marine engines, surveying lumber, surveying land, and repair work around mill for J. W. Kirkpatrick; Oct. 1915 to Feb. 1916, operating milling and boring machines in the manufacture of shrapnel forgings; 1916 (Feb.-Sept.), inspection, 18 lb. shrapnel forgings, at Canadian Locomotive Works; 1919 (May-June) on estimates for 2500 ton wooden ships for Fraser Brace Ltd.; June 1917-Aug. 1918, cadet R.F.C.; 1918-1919, layout and inspn. of reinforced concrete bridges and concrete highway for Toronto-Hamilton Highway Commn.; 1920-21, engr. in charge of physical testing for the Northern Aluminum Co. at Shawinigan Falls, Que.; 1921-22, 2 mos. on survey party, estimating work of hydraulic dredge, laying out track, etc. Later supervision of constrn. of retaining walls, and foundations for air compressors, rotary convertors and the Michigan Central Rly. Bridge, at Montrose; 1922-23, with Fraser Brace Ltd. on the installation of two 28,000 H.P. turbo-generator units at Great Falls, Man.; 1923 (Apr.-Sept.), with the Mich. Central Rly. at Detroit on supervision of construction of harbour dock walls, bridge foundations, etc.; at present dftsman., Dominion Tar & Chemical Co. Montreal, Que.

References: B. S. McKenzie, J. B. D'Aeth, F. M. Buchanan, C. M. McKergow, A. R. Roberts, H. W. McKiel, S. A. Cummiford, W. S. Orr.

OLIVER—CUTHBERT JACK, of 310 Huron Street, Toronto, Ont. Born at Brighton, Sussex, England; July 20th, 1894; Educ., B.Sc., McGill Univ. 1923; 1920-21 (summers), station inspr., station constrn. dept., Toronto Hydro-Electric System; 1922 (summer), power house layout and electr'l. designing and transmission line calculations, Manitoba Power Co., Winnipeg; 1923 (June-Aug.), travelling electrician under Mr. R. J. Needham, mech. and elec. engr., central region, C.N.R., Toronto; Sept. 1923 to Jan. 1924, substation design and relay protection work, station constrn. dept., Toronto Hydro-Electric System; Jan. 1924 to date, power house layout and design work, Messrs. Kerry & Chace Ltd., Toronto.

References: F. H. Martin, G. R. Dalkin, A. T. C. McMaster, A. R. Roberts.

Engineering Index

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A

ABRASIVES

Papers and Cloths. Finishing with Abrasive Paper, John M. Cook. Iron Trade Rev., vol. 74, no. 9, Feb. 28, 1924, pp. 613-615, 13 figs. Methods employed in making abrasive paper and cloth.

ACCOUNTING

Installation of Systems. Some Problems in the Installation of Accounting Systems, Wm. A. Ullrich. Jl. Accountancy, vol. 37, no. 3, Mar. 1924, pp. 193-201. Discusses problems showing how ingenuity of accountant is taxed to find new ways to solve difficulties which present themselves.

Public-Utility. Unit Plan of Accounting for Public Utilities. H. J. Johnson. Am. Gas Assn. Monthly, vol. 6, no. 3, Mar. 1924, pp. 147-153, 9 figs. Describes system which is a modification of plan known as "bookkeeping without books"; is exceedingly rapid in its operation as well as 100 per cent complete and is designed to meet most exacting requirements.

AIR COMPRESSORS

Angle Compound. An Angle Compound Air Compressor. Engineer, vol. 137, no. 3557, Feb. 29, 1924, pp 224-225, 5 figs. New type of air compressor, manufactured by Sullivan Machy. Co., London, cylinders of which are set at right angles in horizontal and vertical positions, round single crank; engine is of uniflow class, but has valves to control exhaust.

Electric Motors for. The Application of A. C. Polyphase Motors to the Drive of Piston Air Compressors (Remarques sur l'application des moteurs électriques à courants alternatifs polyphasés à la commande de compresseurs d'air à pistons), A. Barjou. Revue Générale de l'Électricité, vol. 15, no. 5, Feb. 2, 1924, pp. 167-173, 6 figs. Based on study of function of compressors of constant speed, author concludes that only self-starting synchronous and asynchronous induction motors are suitable for drive of such compressors, and in most cases, former is preferable.

Pulsations Due to Synchronous-Motor Drives. Pulsations Due to Synchronous Motor Drives, Q. Graham. Power Plant Eng., vol. 28, no. 6, Mar. 15, 1924, pp. 342-344, 4 figs. Use of synchronous motors for driving compressors may cause severe pulsations in power on line supplying motors; cause and effects of pulsations.

AIR PUMPS

Water-vs. Steam-Jet. Water- vs. Steam-Jet Air Pumps (Wasserstrahl- oder Dampfstrahlluftpumpe?), S. v. Le Juge. Wärme, vol. 47, no. 3 Jan. 18, 1924, pp. 21-23, 2 figs. It is shown by comparison that the steam-jet pump, because of inadequate sub-cooling of mixture, delivers a much poorer vacuum with same steam consumption than a water-jet air pump, as constructed by H. P. Müller.

AIRPLANE ENGINES

Compression Pressure, Increasing. Increasing the Compression Pressure in an Engine by Using a Long Intake Pipe, R. Matthews and A. W. Gardiner. Nat. Advisory Committee for Aeronautics—Tech. Notes, no. 150, Feb. 1924, 9 pp., 5 figs. Investigation covering engine speeds between 500 and 1800 r.p.m.; data obtained are included in form of curves.

Design. Airplane-Engine Designing for Reliability, Geo. J. Mead. Soc. Automotive Engrs. — Jl., vol. 14, no. 3, Mar. 1924, pp. 277-285, 13 figs. Recent performances; lessons learned from duration testing; design of connecting rod; defects developed by duration running; Wright T-3 engine; application of experience to future design; developmen., production and operation of design.

Specifications. Aircraft Engine Specifications. Automotive Industries, vol. 50, no. 8, Feb. 21, 1924, p. 463. American and British specifications.

Water-Cooled. Water-Cooled Aero Engines, A. J. Rowledge. Automobile Engr., vol. 14, no. 186, Feb. 1924, pp. 50-54, 12 figs. Consideration of design; cooling system; cylinder construction; crank-shafts; lubrication; engine suspension; gearing.

AIRPLANES

Commercial Possibilities. The Commercial Possibilities of the Airplane, A. Black and D. R. Black. Mech. Eng., vol. 46, no. 3, Mar. 1924, pp. 133-137, 6 figs. Estimates of capital required for financing air lines and of cost of their operation; curves showing rapid drop in operating costs with increased operations; possible further increases; figures are given to show that night air service could practically eliminate competing night-letter telegraph services for distances up to about 1,200 mi.; it is concluded that large-scale operations will bring airplane into direct competition with extra-fare train.

Construction. Building Government Airplanes, F. G. Steinbach. Iron Trade Rev., vol. 74, no. 10, Mar. 6, 1924, pp. 665-670 and 673, 11 figs. Difficulties encountered; fabrication of aluminum alloys important phase of construction; seasoned organization essential. Methods employed at plant of Glenn L. Martin Co., Cleveland.

Induced Drag. Induced Drag of Multiplanes, L. Prandtl. Nat. Advisory Committee for Aeronautics—Tech. Notes, no. 182, Mar. 1924, 22 pp., 8 figs. Calculation is based upon assumption that lift on wings is distributed along wing in proportion to ordinates of semi-ellipse; formulas and numerical tables are given for calculating drag; most favorable arrangements of biplanes and triplanes are discussed and results are further elucidated by means of numerica examples. Translated from Technische Berichte, vol. 3, no. 7.

Specifications. Airplane Specifications. Automotive Industries, vol. 50, no. 8, Feb. 21, 1924, pp. 458-462. Specifications for American and foreign airplanes.

Wings. Interference of Multiplane Wings Having Elliptical Lift Distribution, H. von Sanden. Nat. Advisory Committee for Aeronautics—Tech. Notes, no. 181, Feb. 1924, 3 pp. Examination as to whether calculation of mutual induction or interference of two-wing surfaces are substantially altered by assuming elliptical instead of uniform lift distribution. Translated from Technische Berichte, vol. 3, no. 7.

AIRSHIPS

Shenandoah. Rigid Airships—United States Ship "Shenandoah". H. T. Bartlett. U. S. Naval Inst. Proc., vol. 50, no. 2, Feb. 1924, pp. 161-172, 3 figs. Description of the Shenandoah; length 680 ft., diameter 78.7 ft., height 96 ft., gas capacity 2,150,000 cu. ft., deadweight about 74,000 lb., speed about 60 m.p.h.

ALLOYS

Aluminum. *See Aluminum Alloys.*

Cadmium-Lead-Zinc. The Cadmium-Lead-Zinc System, M. Cook. Inst. Metals —advance paper, no. 3, for meeting Mar. 12-13, 1924, 17 pp., 10 figs. Numbering of alloys; preparation of alloys and thermal method; liquidus surface; solidus; binary eutectics; region of partial miscibility; microscopic examination.

Copper. *See Copper Alloys.*

Ferro-. *See Ferro-alloys.*

Non-Ferrous. The Practical Value of Modern Non-Ferrous Alloys, S. F. Barclay. Foundry Trade Jl., vol. 29, no. 389, Jan. 31, 1924, pp. 85-87, 1 fig. Shows that if founder is to give best service to his customers he needs to know exact use to which his castings will be put, so that he can bring out relevant quality in highest degrees; discusses different alloys.

ALUMINUM

Die Casting. Die-Casting Aluminum, S. Swan. Metal Industry (Lond.), vol. 24, no. 6, Feb. 8, 1924, p. 123. Chief practical precautions that must be taken for successful casting of aluminum in permanent molds.

Tensile Strength. The Tensile Properties of Aluminum at High Temperatures, Thos. Martin. Inst. Metals—advance paper, no. 10, for meeting Mar. 12-13, 1924, 32 pp., 18 pp. Examination of tensile strength at all temperatures up to neighborhood of melting point of metal in its fully annealed state; test on commercial metal; comparison of results with those for pure metal; practical significance of results.

ALUMINUM ALLOYS

Aluminum-Copper. The Aluminum-Copper Alloys. Alloys of Intermediate Composition, D. Stockdale. Inst. Metals—advance paper, no. 13, for meeting Mar. 12-13, 1924, 16 pp., 4 figs. Study of alloys by thermal and photomicrographic methods; results show that their behavior is even more complex than has been thought, and it is probable that diagram here put forward is only approximately correct.

Duralumin. *See Duralumin.*

ANEMOMETERS

Hot-Wire. The Measurement of Air Flow, R. O. King. Engineering, vol. 117, nos. 3031 and 3034, Feb. 1 and 22, 1924, pp. 136-137 and 249-251, 9 figs. The Callendar hot-wire anemometer, its arrangement for practical use in air measurement, calibration, and comparison with other methods from experimental results.

ARCHES

Calculation. Calculation of Arches with Two Joints Balanced by a Polygonal Anchorage (Calcul de l'arc à deux rotules équilibrées par un chaînage polygonal), C. Molitor. Génie Civil, vol. 84, no. 5, Feb. 2, 1924, pp. 105-109, 17 figs. Describes method of calculation for particular case; determination of fundamental lines of influence according to two methods.

ARMATURES

Reconnecting D. C. Reconnecting Direct-Current Armatures — Common Mistakes in Connections, A. C. Roe. Power, vol. 59, no. 12, Mar. 18, 1924, pp. 446-447, 5 figs. Effects in changing from right-hand to left-hand winding, or from progressive to retrogressive connection.

Reconnecting Direct-Current Armatures. Wave Windings, A. C. Roe. Power, vol. 59, no. 9, Feb. 26, 1924, pp. 331-334, 8 figs. Two-layer wave windings as used on drum-type armatures; comparisons between lap and wave windings; effects on speed and voltage when windings are reconnected.

AQUEDUCTS

TULSA, OKLA. Building the 54-Mile Aqueduct for the City of Tulsa, Oklahoma. Contractors' & Engrs.' Monthly, vol. 8, no. 1, Jan. 1924, pp. 53-55, 3 figs. Water from Spavinaw Creek in the Ozarks to be brought through 54 mi. of concrete pipe; four 25-ton locomotive cranes on flanged-track wheels and one 10-ton locomotive crane on continuous chain treads are used to place pipe sections in trench.

AUTOGENOUS WELDING

COAL-GAS. Welding with Coal Gas (Schweissungen im Leuchtgasfeuer), Fr. Messinger. Wärme, vol. 47, no. 4, Jan. 25, 1924, pp. 31-32, 6 figs. Autogenous welding and cutting; success of complete welds by means of coal gas without welding medium; welding tests to determine welding limit; experiences with welds in coal-gas fire; tests with low-pressure gas, compressed air and compressed gas.

AUTOMOBILE ENGINES

ASSEMBLING FIXTURE. Special Fixture Used in Assembling Packard Cylinder Block to Crankcase. Automotive Industries, vol. 50, no. 10. Mar. 6, 1924, pp. 564-565, 3 figs. Preserves alignment standards of connecting rods, pistons, and rings previously installed; device is operated pneumatically and, by simplifying work, makes possible more rapid production.

BALANCER. The Harmonic Balancer, J. N. Morris. Autocar, vol. 52, no. 1478, Feb. 15, 1924, pp. 283-284, 8 figs. Description of device originally introduced by F. W. Lanchester for obtaining, in a 4-cylinder engine of orthodox type, perfection of balance attainable in a 6-cylinder engine, and its action.

CRANKCASE-OIL DILUTION. Dilution of the Crank Case Oil of Automotive Engines, C. M. Larson. Armour Engr., vol. 15, no. 2, Jan. 1924, pp. 53-54 and 63, 6 figs. Causes and prevention; results of tests; describes Dilut-O-Meter, and Vis-Gage, instruments for testing life of crankcase oil.

The Serious Evils of Crankcase-Oil Dilution, W. F. Parish. Automotive Mfr., vol. 65, no. 11, Feb. 1924, pp. 24-25. Effect of dilution on wear of motor-vehicle engines; statistics of recent replacements; practical improvements in methods; preventing contamination. Abstract of paper read before Automotive Service Assn.

DETONATION, CONTROL OF. Control of Detonation, G. A. Young and J. H. Holloway. Soc. Automotive Engrs.—Jl., vol. 14, no. 3, Mar. 1924, pp. 315-318. Discusses methods of controlling temperature of charge before and after mixture enters combustion chamber, and before normal ignition occurs; results of tests are that, when care is exercised in maintaining mixture, spark plugs, valves and combustion chamber at proper temperature, compression pressure of 125 lb., per sq. in. can be used without detonation by addition of small amount of anti-knock compound to fuel with enough increase in efficiency of engine to warrant additional expense.

AUTOMOBILE FUELS

PRODUCTION FROM SOLID FUELS. The Bergius Process. Motor Transport (Lond.), vol. 38, no. 990, Feb. 18, 1924, pp. 183-184, 1 fig. Principle of newly developed method of oil-distillate production from solid fuels.

VOLATILITY. Economic Motor-Fuel Volatility, R. Birdsell. Soc. Automotive Engrs. —Jl., vol. 14, no. 3, Mar. 1924, pp. 267-273, 9 figs. Results obtained from acceleration tests made on road and in laboratory, to determine whether rates of acceleration obtainable at any given temperature are different for fuels compared, and whether, when carburetor settings are such as to give maximum acceleration with each fuel, fuel consumption under constant speed and load conditions will be greater with one fuel than with other. Appendix contains analytical description by W. S. James of design of disk used to simulate inertia of car.

AUTOMOBILE INDUSTRY

STANDARDIZATION. Tentative Standardization Work. Soc. Automotive Engrs.—Jl., vol. 14, no. 3, Mar. 1924, pp. 338-341. Color code for cable proposed; wire-cloth standard revision; bolt and nut standardization; sheet steel problems; revision of tube fittings. Reports of Standards Committee of S. A. E.

AUTOMOBILES

CHARCOAL-PRODUCER-GAS-BURNING. Charcoal-Burning Automobiles (L'Automobile à charbon de bois), A. Troller. Nature (Paris), no. 2601, Feb. 9, 1924, pp. 94-96, 4 figs. Describes Berliet system of using charcoal producer gas for automobiles and motor trucks; shows Berliet car equipped with gas producer which is placed in rear and does not alter general appearance of car.

CHASSIS LUBRICATING SYSTEM. Tecalemit. Auto-Motor Jl., vol. 29, no. 9, Feb. 28, 1924, p. 187, 1 fig. Description of a new high-pressure lubrication system for motor-vehicle chassis, introduced by Tecalemit, Ltd., Lond., Eng., consisting of a grease gun of special type and a special grease plug for parts to be lubricated; can be installed in all cases where usual type of screw-down grease lubricators have been used.

AVIATION

PROGRESS. Some Aspects of Aviation, Flight, vol. 16, no. 6, Feb. 7, 1924, pp. 78-79. General discussion on interesting aviation matters, including development of light airplanes in England and progress of aviation in United States. Paper read before Cambridge Univ. Aeronautical Soc.

WIND EFFECT IN. The Effects of Wind in Aviation (Les effets du vent, en aviation), A. Lainé. Génie Civil, vol. 84, no. 5, Feb. 2, 1924, pp. 112-113, 2 figs. Effects of wind on taking off and landing; effects of wind in flight; fog and storms; drag.

B

BEARING METALS

CHARACTERISTICS. Bearings and Characteristics of Bearing Metals, W. E. Biggs and W. R. Woolrich. Nat. Engr., vol. 28, no. 3, Mar. 1924, pp. 106-108. Composition and characteristics of different bearing metals; hints on proper procedure in babbitting bearings; points to be considered in selecting a bearing metal.

BEARINGS

LUBRICATION. The Proper Lubrication of Modern Industrial Bearings, A. F. Brewer. Indus. Mgt. (N. Y.), vol. 67, no. 3, Mar. 1924, pp. 177-183, 9 figs. Discusses characteristics and requirements of each type of bearing.

SLEEVE. Some Ways to Cure Sleeve Bearing Troubles, R. Pruger. Indus. Engr., vol. 82, no. 3, Mar. 1924, pp. 113-117, 10 figs. Design and construction of motor sleeve bearings, their advantages, and improvements which have been made to overcome troubles that are sometimes encountered.

TESTS. Bearing Tests (Lagerversuche), G. Meyer-Jagenberg. Werkstattstechnik, vol. 18, no. 3, Feb. 1, 1924, pp. 41-46, 27 figs. Gives proof of agreement between test results and theory; numerical dependence of bearing friction on working conditions; determination of most suitable oil and calculation of friction corresponding to given working conditions.

WASTE-PACKED. Waste-Packed Bearing Design and Operation, C. Bethel. Elec. Jl., vol. 21, no. 3, Mar. 1924, pp. 115-118, 4 figs. Information regarding oil flow and action of waste packing.

BEARINGS, ROLLER

RAILWAY CARS. Comparison of Ball and Roller Bearings (Comparaison des paliers à billes et à rouleaux), A. Bijls. Génie Civil, vol. 84, no. 7, Feb. 16, 1924, pp. 159-161, 6 figs. Comparison of two systems in their application to railway rolling stock, showing advantages of roller bearings.

BEAMS

CHART FOR DESIGNING. Chart for Designing Beams in Compression or Tension, E. M. Royds-Jones. Concrete & Constructional Eng., vol. 19, no. 2, Feb. 1924, pp. 83-85. Gives chart, expressing graphically results of calculations by writer, which will be found very useful in designing beams or slabs subjected to compression or tension as well as bending moment.

CONTINUOUS, TWO-SPAN. Moments in Two-Span Continuous Beams With Various Span Ratios, C. S. Gray. Concrete & Constructional Eng., vol. 19, no. 2, Feb. 1924, pp. 91-99, 4 figs. Gives values of bending moments at support and in both spans for all cases of uniformly distributed loading where ratio of spans varies from 1: 1 to 1: 0.1.

BLAST-FURNACE GAS

CLEANING. Practical Tests on a Blast-Furnace-Gas Wet-Cleaning Plant (Betriebsversuche an einer Hochofengas-Nassreinigungsanlage), M. Steffes. Stahl u. Eisen, vol. 44, no. 4, Jan. 24, 1924, pp. 92-96, 14 figs. Results of six-day tests; determination of best operating conditions; degree of purification; water and power consumption and efficiency of different plants.

BLAST FURNACES

LOW-VS. HIGH-PRESSURE BLOWING. Relation Between Cross Section of a Blast Furnace and Its Manner of Blowing. (Relation entre le profil d'un fourneau et son mode de soufflage), M. Derclaye. Revue Universelle des Mines, vol. 1, no. 3, Feb. 1, 1924, pp. 146-184, 7 figs. Investigation to determine whether manner of blowing, that is, at low or high pressure, has relation to cross-section of blast furnace; characteristics of different types of blast furnaces; comparison between low-shaft and tall-shaft furnaces, showing advantages of former, with low-pressure blowing.

BOILER FEEDWATER

REGULATORS. Mechanical Control of Boiler Feed Water, C. E. Wolff. Power Plant Eng., vol. 28, no. 5, Mar. 1, 1924, pp. 277-278, 4 figs. Points out that diverse demands of engineers in feedwater-regulation practice are being met by modern regulators, and sets forth requirements which must exist in regulators for effective results.

HEATING BY EXTRACTION. Economy Characteristics of Stage Feedwater Heating by Extraction, E. H. Brown and M. K. Drewry. Mech. Eng., vol. 46, no. 3, Mar. 1924, pp. 118-122, 5 figs. Authors point out influence of each possible factor in computations, present practical method for computing extraction cycles, and deal with various factors affecting turbine-room economy. (Abridged.)

BOILER FURNACES

DRAFT. Draught and its Effects on the Working and Efficiency of Boilers, J. T. Ruddock. Eng. & Boiler House Rev., vol. 37, no. 8, Mar. 1924, pp. 279-281, 1 fig. Deals with plants working with induced or chimney draft only; shows necessity for securing necessary draft pressure in combustion chamber itself. From paper read before Elec. Power Engrs.' Assn.

CHAIN-GRATE-STOKER. Furnaces for Burning Small Sizes of Anthracite, A. R. Mumford. Mech. Eng., vol. 46, no. 3, Mar. 1924, pp. 138-142, 7 figs. Design as indicated by results of systematic investigation of furnace of water-tube boiler of 10,000-sq. ft. heating surface, fired by two chain-grate stokers. (Abridged.)

OIL-FIRED. Burning Oil Under Power Boilers, R. F. Burke. Power Plant Eng., vol. 28, no. 6, Mar. 15, 1924, pp. 328-330, 3 figs. Points out that localization of heat in furnace must be avoided if brickwork and boiler maintenance are to be kept low; flame impingement causes tube failures; short flame may result from high per cent of excess air.

BOILER HOUSES

CONTROL. Records and Efficiency at a London Power Station. Eng. & Boiler House Rev., vol. 37, no. 8, Mar. 1924, pp. 269-270 and 272, 4 figs. Notes on methods of boiler-house control at Central Elec. Supply Co., Ltd., London.

BOILER OPERATION

DRAFT REGULATION. The Craig System of Better Draft Control. Steam Power, vol. 2, no. 12, Jan. 1924, pp. 7 and 10, 1 fig. Describes Craig regulator and its operation; automatically maintains a constant over-fire draft by controlling position of uptake damper.

To Regulate Fuel Expense, Control Draft, Jas. T. Beard. Power Plant Eng., vol. 28, no. 6, Mar. 15, 1924, pp. 331-334, 6 figs. Points out that height of stack limits strength of draft; stokers are more efficient than grates; correctness of air supply indicated by CO_2 percentage.

BOILERS

ACCIDENTS. Peculiar Cases of Accidents to Containers and Boiler Parts (Eigenartige Zerstörungen von Gefässen und Kesselteilen), M. Grellert. Gesund-heits-Ingenieur, vol. 47, no. 7, Feb. 16, 1924, pp. 49-52, 4 figs. Gives a number of concrete examples showing that accidents are often due to causes other than those assumed or anticipated; all the cases cited were due to inadequate calculation of design or to careless construction.

DAMAGES. Peculiar Cases of Damages Containers and Boiler Parts (Eigenartige Zerstörungen von Gefässen und Kesselteilen), M. Grellert. Gesundheits-Ingenieur, vol. 47, no. 7, Feb. 16, 1924, pp. 49-52, 4 figs. Gives a number of concrete examples showing that accidents are often due to causes other than those assumed or anticipated; all the cases cited were due to inadequate calculation of design or to careless construction.

EXHAUST-GAS. Waste Exhaust Gases of Low-Powered Oil Engines. Oil Engine Power, vol. 2, no. 2. Feb. 1924, pp. 90-91, 2 figs. Design and results of two types of small exhaust-gas boilers, one for a 2-cycle surface-ignition unit and other for a 4-cycle Diesel engine.

LOCOMOTIVE. *See Locomotive Boilers.*

BOILERS, WATER-TUBE

TWO-FLOW RING-CIRCUIT. The Kidwell Two-Flow, Ring-Circuit Boiler. Pac. Mar. Rev., vol. 21, no. 2, Feb. 1924, p. 119, 1 fig. Boiler is said to introduce entirely new principle of arrangement in water-tube boilers.

TYPES. Water-tube Boilers, C. C. Pounder. Mech. World, vol. 75, nos. 1932 and 1936, Jan. 11 and Feb. 8, 1924, pp. 26-27 and 84-86, 6 figs. Description of various types.

BOLTS

TENSION CALCULATION. Charts for Tension in Bolts and Torsion in Shafts, E. Patterson. Am. Mach., vol. 60, no. 11, Mar. 13, 1924, pp. 401-402, 2 figs. Two simple alignment charts intended to provide quick solutions for problems in stresses.

BRAKES

AIR. A Review of Power Brake Operation and the Results Obtained on the Southern Pacific, J. Kruttschnitt. Ry. & Locomotive Eng., vol. 37, no. 3, Mar. 1924, pp. 72-74. Developed in testimony before Interstate Commerce Commission.
I. C. C. Continues the Brake Investigation. Ry. Age, vol. 76, no. 10, Mar. 8, 1924 pp. 551-554. Am. Ry. Assn. observers disagree with Bur. of Safety report on Norfolk & Western tests of automatic straight air brakes.

BRASS

ANNEALING, EFFECT OF. Effect of Anneal on Brass Surfaces, J. L. Christie. Iron Age, vol. 113, no. 11, Mar. 13, 1924, pp. 783-785, 6 figs. High ductility obtained only by losing smoothness; grain size under microscope a measure of both ductility and amount of annealing.

BRITTLE RANGES. The Brittle Ranges in Brass as Shown by the Izod Impact Test, D. Bunting. Inst. Metals—advance paper, no. 2, for meeting Mar. 12-13, 1924, 22 pp., 15 figs. Investigates (1) brittle ranges of brass varying in composition from 100 to 50 per cent copper; (2) effect of rapid cooling on brittle ranges; (3) cause of brittle ranges.

DEZINCIFICATION. A Further Study of the Dezincification of Brass, C. F. Nixon. Am. Electrochem. Soc.—advance paper, no. 3, for meeting, Apr. 24-26, 1924, pp. 29-41, 2 figs. From experimental evidence it is concluded that, with exception of 90 per cent, or more, copper alloys, commercial brasses are subject to dezincification.

HEAT TREATMENT. Relation of Heat Treatment to the Microstructure of 60-40 Brass, R. S. Williams and V. O. Homerberg. Am. Inst. Min. & Met. Engrs. —Trans., No. 1305-N, Mar. 1924, 15 pp., 40 figs. Description of a double heat treatment of 60-40 brass; gives photomicrographs showing changes that take place in microstructure on reheating waterquenched specimens.

BRIDGE ERECTION

ABUTMENTS, NIAGARA GORGE. Michigan Central Niagara Bridge Abutments Completed. Eng. News-Rec., vol. 92, no. 10, Mar. 6, 1924, pp. 398-399, 3 figs. Excavation and concreting of abutments and piers on American side of Niagara Gorge done in six months.

BRIDGE PIERS

COFFERDAM WRECKAGE. Cofferdam Wrecked by Splitting of Concrete Seal, C. B. McCullough. Eng. News-Rec., vol. 92, no. 11, Mar. 13, 1924, pp. 460-461, 3 figs. Foundation for bridge pier in Oregon damaged by remarkable accident attributed to effect of heavy storm.

BRIDGES, CONCRETE

ARCH. Concrete Bridge with Longest Arch Completed in France. Eng. News-Rec., vol. 92, no. 12, Mar. 20, 1924, pp. 476-479, 4 figs. Clear span of 432.44 ft. provided in structure bridging Seine River near Rouen; twin ribs of large section are hollow; precast floor beams hung from arch by concrete-encased steel hangers. See also editorial on p. 474.

BRIDGES, HIGHWAY

CONCRETE. Reading Bridge, Ferro-Concrete, vol. 15, no. 6, Dec. 1923, pp. 126-137, 6 figs. Main arch crosses river in single span of 180 ft.; total length, including approach viaduct, abutments and wing walls, is nearly 600 feet.

DESIGN. Outstanding Problems in Highway Bridge Design, E. F. Kelley. Eng. & Contracting (Roads & Streets), vol. 61, no. 2, Feb. 6, 1924, pp. 296-302, 3 figs. Discusses live loads, roadway widths, approaches, bridge floors, wearing surfaces, protection of structures and traffic.

SUSPENSION. Spanning the Hudson River at Bear Mountain, V. H. Vandiver and A. S. Taylor. Compressed Air Mag., vol. 29, no. 2, Feb. 1924, pp. 769-773, 15 figs. Particulars regarding suspension highway bridge to be constructed which will link east and west shores of Hudson river where it will prove great boon to automobilists; estimated to cost $3,500,000; will consist of six sections of structural steel, as follows: main span 1,632 ft. between centers of main towers, east-shore span 210 ft. long, and west-shore span, consisting of four sections 410 ft. long.

BRONZES

COLD DRAWING AND ANNEALING, EFFECT OF. Note on the Effect of Cold-Drawing and Annealing on Some Electrochemical Properties of a Low-Tin Bronze, S. H. J. Wilson. Inst. Metals—advance paper, no. 14, for meeting Mar. 12-13, 1924, 11 pp., 5 figs. Investigation which is result of discovery by Alkins of a critical range in curve relating the amount of cold work received by copper or bronze wire to several physical properties.

SAND-CAST ZINC. The effect of Casting Temperature on the Physical Properties of a Sand-Cast Zinc-Bronze, F. W. Rowe. Inst. Metals—advance paper, no 12, for meeting Mar. 12-13, 1924, 6 pp., 8 figs. Investigation to determine for works use, optimum casting temperature to give required mechanical properties in gun metal of composition specified.

C

CABLES, ELECTRIC

UNDERGROUND SYSTEMS. Transmission Problems, A. M. Taylor. Electrician, vol. 92, no. 2385, Feb. 1, 1924, pp. 128-131, 7 figs. Description of author's hexaphase system by means of which. he claims, transmission of power by underground cables at a cost comparable with that of transmission by overhead lines can be accomplished; designed so that pressures of 120,000 to 150,000 volts can be utilized with underground cables without maximum stress on insulation reaching appreciably higher values than now obtaining on 33,000-volt transmissions; discusses resonance.

CALORIMETERS

IRON-MERCURY. An Iron-Mercury Calorimeter, F. H. Schofield. Jl. of Sci. Instruments, vol. 1, no. 5, Feb. 1924, pp. 141-144, 4 figs. Describes calorimeter which is specially suitable for measuring specific heat of materials of low thermal conductivity which react with water.

CAR WHEELS

WROUGHT-STEEL, GAGING OF. Gaging Wrought Steel Wheels for Car and Tender, A. Knapp. Ry. Mech. Engr., vol. 98, no. 3, Mar. 1924, pp. 164-167, 13 figs. Discussion on use of new A. R. A. steel wheel gage for determining defects, turning wheels and hilling. Abstract of paper before Car Foremen's Assn. of Chicago.

CARS, FREIGHT

GONDOLA, HOPPER-BOTTOM. 57½-Ton Hopper Bottom Gondola for C. & O. Ry. Mech. Engr., vol. 98, no. 3, Mar. 1924, pp. 161-164, 6 figs. Are stronger and of greater capacity than previous cars of same weight; steel construction; length 31 ft. 6 in., width 10 ft., height from rail to top of body 11 ft.

HART CONVERTIBLE. New Ballast Cars of the Michigan Central R. R. Ry. Rev., vol. 74, no. 10, Mar. 8, 1924, pp. 435-438, 4 figs. Describes Hart convertible car; can be used as a gondola or dump car in ordinary traffic; capacity of 50 tons.

CARS, REFRIGERATOR

VENTILATED. Ventilated Rock Island Refrigerator Cars. Ry. Age, vol. 76, no. 10, Mar. 8, 1924, pp. 547-549, 5 figs. Special attention given to method of insulating in cars built by Gen. Am. Car Co., Chicago; Acme ventilation system installed.

CARS, TANK

CAN. PACIFIC RY. New Tank Cars for Canadian Service. Ry. Rev., vol. 74, no. 8, Feb. 23, 1924, pp. 324-327, 3 figs. Description of cars built by Can. Pacific Ry. to A. R. A. Class III specifications; tank capacity 12,480 gal.

CAST IRON

CARBON CONTROL. States Carbon Control Theory, A. C. Porter. Foundry, vol. 52, no. 5, Mar. 1, 1924, pp. 194-195. Sulphur to manganese ratio said to exert regulating influence on amount of carbon in gray cast iron and on ratio of combined to graphitic carbon.

GAS AND OXYGEN DETERMINATION. Gas and Oxygen Determinations in Iron, Especially Cast Iron (Ueber Gas- und Sauerstoffbestimmungen im Eisen, inshesondere Gusseisen), P. Oberhoffer, E. Piwowarsky, A. Pfeifer-Schiessl and H. Stein. Stahl u. Eisen, vol. 44, no. 5, Jan. 31, 1924, pp. 113-116, 5 figs. Oxygen contents in low-carbon steel and cast iron; determination of oxygen from gas contents through hot extraction in vacuum; influence of oxygen contents on properties of cast iron.

MANUFACTURE. The History of the Manufacture of Cast Iron, T. Makemson. Foundry Trade Jl., vol. 29, no. 392, Feb. 21, 1924, pp. 153-157. Ancient iron workers; iron making in Middle Ages, discovery and early uses of cast iron; early use of coke; evolution of blast furnace and foundry; etc.

WELDING. Expansion in Iron Castings, D. Richardson. Welding Engr., vol. 9, no. 2, Feb. 1924, pp. 19-20, 4 figs. How distribution of mass in casting determines correct procedure in pre-heating.

CASTINGS

BRONZE AUTOCLAVE BODY. Making Bronze Autoclave Body, David Whyte. Metal Industry (Lond.), vol. 24, no. 8, Feb. 22, 1924, pp. 174-175, 2 figs. Method of producing sound hydraulic castings of this type of following alloy: 86 Cu, 13 Sn, 1 Zn.

ELECTRIC-GENERATOR. Canadian Foundry Producing Record Castings, F. H. Bell. Can. Foundryman, vol. 15, no. 2, Feb. 1924, pp. 18-21 and 29, 4 figs. Methods of Can. Westinghouse Co., Ltd., Hamilton, in producing large electric generators.

CEMENT

MAGNESIUM-OXYCHLORIDE. Magnesium Oxychloride Cement, J. H. Paterson. Chem. & Industry, vol. 43, no. 9, Feb. 29, 1924, pp. 215-218, 1 fig. Important features and applications, mechanism of setting and factors which control it.

RAPID-HARDENING. A Rapid Hardening Slag Cement. Rock Products, vol. 27, no. 4, Feb. 23, 1924, pp. 40-41, 3 figs. Particulars of a cement being introduced by French cement manufacturers which in two days has strength of Portland cement in seven days. Translated from Revue des Matériaux de Construction et de Travaux Publics.

CENTRAL STATIONS

INSPECTION. Periodic Power-Plant Inspection. Power, vol. 59, no. 11, Mar. 11, 1924, pp. 404-405. List of general instructions issued by Fed. Light & Traction Co., New York City, to managers of their subsidiary companies.

WEYMOUTH, MASS. Some Engineering Features of the Weymouth Station of the Edison Electric Illuminating Company of Boston, I. E. Moultrop and J. Pope. Universal Engr., vol. 39, no. 2, Feb. 1924, pp. 14-23, 8 figs. Brief description of station and its equipment, with discussion of engineering features of more timely interest; initial main generating equipment to consist of two 32,000-kw. turbines each driving a main 30,000-kw. generator and a 2,000-kw. auxiliary generator direct-connected to shaft of main generator.

CHARTS

APPLICATION IN INDUSTRY. Application of Charts in Industry, D. B. Porter. Mgt. & Administration, vol. 7, nos. 1 and 3, Jan. and Mar. 1924, pp. 65-72, 12 figs.; and 329-336, 10 figs. Jan.: Management data summary; presents historical charts drawn chiefly from fields of sales and financial data. Mar.: Application of charts which show frequency with which events occur under conditions of non-historical nature.

CHIMNEYS

REINFORCED-CONCRETE. The Calculation of Tall Reinforced-Concrete Factory Chimneys (Il calcolo dei camini alti in cemento armato), N. Kelen. Ingegneria, vol. 3, no. 2, Feb. 1, 1924, pp. 61-63, 7 figs. Shows their superiority over those of brick, and discusses, with example, stresses by static load and by difference of temperature at inside and outside of wall.

CITY PLANNING

HEIGHT OF BUILDINGS. Higher Building in Relation to Town Planning, R. Unwin. Roy. Inst. British Architects—Jl., vol. 31, no. 5, Jan. 12, 1924, pp. 125-140 and (discussion) 141-150, 19 figs. partly on supp. plates. Arguments against adoption of high buildings, including effect of high buildings on transport problem.

CHROME-NICKEL STEEL

DEOXIDATION, INFLUENCE OF. The Influence of Deoxidation on Hot-Working Capacity and Properties of a Chrome-Nickel Structural Steel (Der Einfluss der Desoxydation auf die Warmverarbeitbarkeit und die Eigenschaften eines Chromnickel-Baustahles), W. Oertel and L. A. Richter. Stahl u. Eisen, vol. 44, no. 7, Feb. 14, 1924, pp. 169-175, 5 figs. Investigation of cracks; influence of casting temperature and speed, rolling temperature, and time required for heating rolling material; deoxidation and distillation; properties of steel produced under different conditions.

CLAYS

COLLOIDAL PLASTICITY. Kaolins, Clays, Etc. Colloidal Plasticity. Gel and Sol Phenomena (Kaolins, argiles, etc. Plasticité colloidale. Phénomènes de gel et de sol), A. Bigot. Académie des Sciences—Comptes Rendus, vol. 178, no. 1, Jan. 2, 1924, pp. 88-90. Points out that some kaolins (those produced by weathering of granite) are not plastic, whereas others (alluvial kaolins) are very plastic; incompletely dehydrated clays give, with appropriate reagents, gels and sols, but this is no longer the case after complete dehydration.

CLUTCHES

AUTOMOBILE. A New Flexible Coupling Device (Un nouveau dispositif d'accouplement flexible), E. Guilleaume. L'Industrie des Tramways, vol. 18, no. 205, Jan. 1924, pp. 11-14, 3 figs. Describes elastic device which is claimed to have many advantages over universal joint; gives results of tests and explains adaptation of this transmission to automobiles.
American Stock Clutch and Axle Specifications. Automotive Industries, vol. 50, no. 8, Feb. 21, 1924, pp. 446-450. Tabular data.

CONSTRUCTION AND USES. Construction Details and Use of Clutebes and Cutoff Couplings, F. E. Gooding. Indus. Engr., vol. 82, nos. 1 and 2, Jan. and Mar. 1924, pp. 5-9 and 127-130, 29 figs. Construction and operation of friction and magnetic clutches and cut-off couplings, and information necessary when ordering and installing them.

COAL

RECOVERY FROM ASHES. Fuel Recovery From Pan Ash. Gas Jl., vol. 165, no. 3167, Jan. 23, 1924, pp. 200-201, 3 figs. Description of dry-magnetic ash-separating process and equipment.

COAL HANDLING

LOADERS. One More Mechanical Loader Comes to Light. Coal Age, vol. 25, no. 9, Feb. 28, 1924, pp. 305-306, 2 figs. Wilson chain loader for low coal weighs 4,600 lb. and has maximum height of 32 in.; it has loaded 69 tons of coal a day and 120 tons of loose gob.

COAL MINES

ELECTRICAL SURVEYS. Electrical Surveys in Coal Mines, E. B. Stavely. Coal Industry, vol. 7, no. 2, Feb. 1924, pp. 68-72, 4 figs. Use of portable graphic instruments to determine voltage, current, power demand and power factor conditions; inefficient equipment often disclosed.

SIGNALING. The New "Simplex" System of Electric Signaling for Mine Sbafts (Le nouveau système de Signalisation électrique "Simplex" pour puits de mines), G. Paques. Annales des Mines de Belgique, vol. 24, no. 4, 1923, pp. 1007-1019, 7 figs. Describes installation of new type of electric signal in coal mines of Carabinier at Pont du Louî, which has given entire satisfaction; advantages of system.

UNDERGROUND MANAGEMENT. How Miner and Manager, Each with His Immediate Ends in View, Hamper Coal Production, S. E. Thompson. Coal Age, vol. 25, no. 11, Mar. 13, 1924, pp. 383-385, 5 figs. Discusses lack of co-operation between miner and management; points out that effect of two-shift work should be carefully studied in every mine from standpoint of economical management, equipment, development and personnel.

HUMIDIFICATION. Wetting Down Colorado Mines Is a Real Problem. Coal Age, vol. 25, no. 11, Mar. 13, 1924, pp. 386-387, 1 fig. Low bumidity in high and dry region makes dust serious menace; C.F. & I. Co. humidifies witb both live and exhaust steam and sprinkles lavisbly.

COAL MINING

MACHINE MINING. Machine Mining. Sci. & Art of Min., vol. 34, nos. 15 and 16, Feb. 16 and Mar. 1, 1924, pp. 228-229 and 246-247, 4 figs. Feb. 16: Laying out workings for machine mining. Mar. 1: Laying out working faces; advantages and disadvantages of conveyors.

V SYSTEM. Coal Mining by the V System, G. B. Soutbward. Am. Inst. Min. & Met. Engrs.—Trans., no. 1300-C, Feb. 1924, 9 pp., 6 figs. Describes mining system used at Norton mine of W. Va. Coal & Coke Co., a bigbly concentrated system consisting of a series of short faces arranged to get complete recovery of coal with maximum protection for men and equipment.

COKE

SURFACES AND STRUCTURES. Interpretation of Coke Surfaces and Structures, A. Thau. Chem. & Met. Eng., vol. 30, no. 8, Feb. 25, 1925, pp. 306-310, 13 figs. Interprets meaning of variations in coke appearance as affecting coke utility.

COLD STORAGE

PLANTS. Washington's Storage Plant. Refrig. World, vol. 59, no. 1, Feb. 1924, pp. 13-18, 14 figs. Describes new warebouse and raw-water ice plant of Terminal Refrig. & Warehousing Co.

COMBUSTION

MOLAR CALCULATION. The Molar Calculation of Combustion Processes witb Use of Nomograms (Die molare Berechnung von Cerbrennungsvorgängen unter Verwendung von Nomogrammen), W. Otte. Wärme, vol. 47, no. 2, Jan. 11, 1924, pp. 11-14, 5 figs. Advantages of molar calculation; formulas; use of nomograms in connection witb molar calculation of combustion process; examples.

COMPRESSED AIR

METERS. Compressed-Air Meters (Pressluftmesser), A. Grossmann. Mascbinenbau, vol. 3, no. 9, Feb. 14, 1924, pp. 249-250, 4 figs. Comparisons between compressed-air meters with and without shock-absorbing air cbamber; points to incorrect results obtained with meters when compressed-air tool is directly attached, and favourable results obtained by attachment of shock-absorbing air cbamber.

CONCRETE

PRODUCTION DEVELOPMENTS. Some Developments in Making Concrete. Eng. News-Rec., vol. 92, no. 11, Mar. 13, 1924, pp. 448-451. Abstracts of paper and committee reports read before Am. Concrete Inst. as follows: Principles of Design of Concrete Plant; Suggestions for Producing Better Concrete; Field Tests of Concrete, J. G. Ablers and S. Walker; Economic Value of Admixtures in Concrete, J. C. Pearson and F. A. Hitcbcock; Weigbing Concrete Aggregates on Higbway Pavements, R. W. Crum.

CONCRETE CONSTRUCTION

STRESS CALCULATION. Shortcuts for Solving Problems in Concrete Design, R. P. V. Marquardsen. Eng. & Contracting (Buildings), vol. 61, no. 2, Feb. 27, 1924, pp. 440-446, 7 figs. Presents shortcut for investigating an existing structure of rectangular cross-section subject to combined axial and bending stress; i.e., a method by which, given cross-section of structure and magnitude and position of resultant of all outside forces acting on section, existing unit stresses in concrete and steel reinforcement may be found readily.

CONDENSERS, ELECTRIC

STATIC v. SYNCHRONOUS. Selection of Corrective Equipment, M. A. Hyde. Elec. World, vol. 83, no. 10, Mar. 8, 1924, pp. 472-474, 4 figs. Chossing static or synchronous condensers on economic basis; comparisons as to cost, weight, volume and operation; graphical solutions to corrective problem.

CONDENSERS, STEAM

PERFORMANCE OF, CHECKING. Condenser Performance, J. Bruce. Elec. Rev., vol. 94, no. 2410, Feb. 1, 1924, pp. 164-166, 6 figs. Describes simple and easily applicable methods for checking condenser performance of generating set in few moments, and also system whereby continuous tabulated and graphical record of such performance can be recorded from day to day, showing behavior of plant at glance.

SURFACE. Efficient Operation of Surface Condensing Plant. Elec. Times, vol. 65, no. 1865, Jan. 31, 1914, pp. 117-119, 1 fig. Suggestions in regard to efficient operation; chart for determination of partial pressure of air under varying conditions of vapor temperature and absolute pressure.

Surface Condenser Operation, C. S. Tomlinson. Elec. Light & Power, vol. 2, no. 3, Mar. 1924, pp. 13-14, 60 and 62, 2 figs. Gives two formulas which can be used in studying condenser operation and shows how to apply them.

CONSTRUCTION WORK

PNEUMATIC EQUIPMENT, APPLICATIONS OF. How Pneumatic Equipment Speeds Up Winter Construction Work, F. A. McLean. Contract Rec., vol. 38, no. 5, Jan. 30, 1924, pp. 113-118, 11 figs. The applications of pneumatic equipment for work such as trenching and excavation, bridge building, etc.

CONVEYORS

CONTINUOUS VS. INTERMITTENT. Continuous Versus Intermittent Conveyors and Handling Methods, G. F. Zimmer. Indus. Mgt. (Lond.), vol. 11, no. 3, Feb. 7, 1924, pp. 77-80, 4 figs. General distinguishing features of the two systems; possibility of increasing capacity of an existing conveyor installation; comparison between working costs; continuous and intermittent industrial methods; etc.

PULVERIZED MATERIAL. Fuller-Kinyon System of Conveying Pulverized Coal and Other Materials. Indus. Mgt. (Lond.), vol. 11, no. 4, Feb. 21, 1924, pp. 103-106, 4 figs. Description of system whose outstanding characteristics are simplicity, safety and cleanliness.

COOLING TOWERS

CALCULATION. The Calculation of Cooling Towers (Berechnung von Kühltürmen), C. Geibel. Zeit. des Vereines deutscher Ingenieure, vol. 68, no. 7, Feb. 16, 1924, pp. 152-153, 1 fig. Setting up heat equations with aid of which cooling-plant values can be determined; points out that laws of current, speed of evaporation and state of outgoing air are unknown conditions wbich must be determined.

COOLING TOWERS

STEEL. Cooling Towers for Steam Condensing Plant. World Power, vol. 1, no. 2, Feb. 1924, pp. 119-123, 6 figs. Recent designs of steel cooling towers manufactured by Worthington-Simpson, Ltd., for whicb many advantages are claimed.

COPPER ALLOYS

COPPER-ALUMINUM. X-Ray Studies on the Copper-Aluminum Alloys, E. R. Jette, G. Pbragmén and A. F. Westgren. Inst. Metals—advance paper no. 9, for meeting Mar. 12-13, 1924, 14 pp., 7 figs. X-ray analysis has confirmed previous knowledge that at ordinary temperature four different stable phases appear in this system.

COPPER-CADMIUM. The Constitution of the Alloys of Copper and Cadmium, C. H. M. Jenkins and D. Hanson. Inst. Metals—advance paper, no. 8, for meeting Mar. 12-13, 1924, 16 pp., 33 figs. Deals with determination of constitution of alloys of cadmium with copper, especially in solid state; copper and cadmium in liquid state are mutually soluble in all proportions.

COPPER-TIN. On the Equilibrium Diagram of the Copper-Tin System, T. Isibara. Inst. Metals—advance paper, no. 7, for meeting Mar. 12-13, 1924, 31 figs. Equilibrium diagram of copper-tin system is obtained by means of electric resistance measurement; alpha constituent shows progressive transformation beginning at 480 to 580 deg. cent. according to concentration of tin; maximum solubility of tin in alpha is determined to be 11 per cent at room temperature.

COPPER-ZINC. On the Copper-Zinc Alloys Whicb Expand on Solidification, Kei Iokipe. Inst. Metals—advance paper, no. 6, for meeting Mar. 12-13, 1924, 27 pp., 12 figs. Amount of expansion depends upon percentage of copper and rate of cooling; force of expansion is of considerable magnitude; hardness and elastic limit of expanded alloys are low, and contain cracks and voids; inverse segregation and how its effect can be diminisbed; cause of inverse segregation.

COPPER METALLURGY

LEACHING. Ammonia Leaching of Calumet and Hecla Tailings, C. H. Benedict and H. C. Kenny. Am. Inst. Min. & Met. Engrs.—Trans., No. 1297-M, Feb. 1924, 16 pp., 5 figs. Description of 2,000-ton plant of Calumet & Hecla Min. Co., at Lake Linden, Mich., wbich has been in almost continuous operation for seven years, together with changes made in original plant, reasons for tbese cbanges and results obtained in eacb case.

CORROSION

ZINC AND LEAD. Tbe Relative Corrosion of Zinc and Lead in Solutions of Inorganic Salts, J. N. Firend and J. S. Tidmus. Inst. Metals—advance paper, no. 4, for meeting Mar. 12-13, 1924, 9 pp., 4 figs. Influence of alkali salts upon relative rates of corrosion of zinc and lead closely resembles that already observed in case of iron; satisfactory explanation can be offered to account for tbis.

COST ACCOUNTING

EXECUTIVES. Industrial Cost Accounting for Executives, P. M. Atkins. Am. Macb., vol. 60, nos. 6, 7, 9, 10, 11 and 12, Feb. 7, 21, 28, Mar. 6, 13 and 20, 1924, pp. 201-204, 287-290, 329-333, 353-356, 403-406 and 433-434, 1 fig. Feb. 7: Standard practice instructions; installing system of cost accounts. Feb. 21: Design of forms to be used in facilitating keeping of cost records. Feb. 28: Co-ordination of cost records and general accounts. Mar. 6: Cost statistics and two metbods of tbeir visualized presentation; comparative reports. Mar. 13: Cost-accounting service to production control; auditing work of planning department; comparative cost data for foreman. Mar. 20: factory control by means of cost accounts; analyzing qualities of executive.

INVENTORY METHODS. Keeping Perpetual Plant Inventory, W. C. Sponenburg. Telephony, vol. 86, no. 7, Feb. 16, 1924, pp. 21-23. Method, employed by Glen Telepbone Co., Gloversville, N.Y., found most helpful in preparing reports for state tax and public-service commissions. Paper read before N.Y. Up-State Telephone Assn.

JOB COSTING. A Simple System of Job Costing. Mar. Engr. & Nav. Arcbitect, vol. 47, no. 557, Feb. 1924, pp. 66-67, 2 figs. Costing as a science; cost-recording essentials; labour rate and materials rate; prime cost cards.

COUPLINGS

See Clutches.

CRANES

COMBINATION PILE DRIVER AND. Combination Heavy Duty Crane and Pile Driver. Ry. Age, vol. 76, no. 15, Mar. 15, 1924, pp. 757-758, 2 figs. Machine built by Brown Hoisting Co. for Northern Pacific is capable of driving piles straight ahead or on either side of track; it may be revolved 360 deg. in either direction and piles may be driven at any point within circumference of 32-ft. circle.

CUPOLAS

PRACTICE. A Day at the Cupola, A. R. Bartlett. Foundry Trade Jl., vol. 29, no. 389, Jan. 31, 1924, pp. 89-92. Describes operations of a day at cupola of foundry with which author is connected. See Discussion in Foundry Trade Jl., Feb. 7, 1924, pp. 113-116, 1 fig.

D

DAMS

CONCRETE. The Hartebeespoort Dam, Pretoria, Soutb Africa. Eng. & Contracting (Water Works), vol. 61, no. 2, Feb. 1924, pp. 340-342, 2 figs. Design and construction features of concrete water supply dam recently completed by Transvaal Irrigation Dept.; crest of dam is at elevation 3,989 ft., with outlet sill at 3,909.

DIESEL ENGINES

Bethlehem. The Bethlehem Two Cycle Diesel Engine. Mar. News, vol. 10, no. 10, Mar. 1924, pp. 75-78 and 95, 11 figs. Particulars of new Bethlehem oil engine which is of vertical, two-stroke cycle, single-acting type, constructed in units of 4, 6 or 8 cylinders and running at a speed of from 116 r.p.m. for land power and twin-screw marine installations down to 90 r.p.m. for single-screw marine use. Notes on 6-cylinder two-cycle oil engine developing 2,500 s.hp. at 90 r.p.m., installed on motorship Cubore.

Combustion Phenomena in. Combustion Phenomena in Diesel Engines (Verbrennungsvorgänge im Dieselmotor), H. V. Wartenberg. Zeit. des Vereines deutscher Ingenieure, vol. 68, no. 7, Feb. 16, 1924, pp. 153-154. Explains cause for poorer ignition and tendency to soot formation with burning of tar oils in Diesel engines, and points out that combustion can be accelerated by much finer breaking up of drops, probably through admixture of large quantities of water emulged in oil, and through employment of higher temperatures in compression space.

Heat Losses. Investigations of Diesel Engines (Untersuchungen an der Dieselmaschine), K. Neumann. Zeit. des Vereines deutscher Ingenieure, vol. 68, no. 4, Jan. 26, 1924, pp. 77-80, 5 figs. Thermodynamic circle process and working losses; heat diagrams of engine for complete and incomplete expansion; calculation of heat-transmission coefficient for combustion and expansion independent of piston diagram.

Opposed-Piston. Palmer's 3,000 s.h.p. Opposed-Piston Diesel Engine. Motorship, vol. 9, no. 2, Feb. 1924, pp. 118-119, 1 fig. Single-screw unit for 10,000-ton single-screw tanker, constructed on Fullagar principle with air injection.

Pipe-Line, Lubrication of. Pipe Line Diesels and Their Lubrication, F. Thilenius. Oil Engine Power, vol. 2, no. 2, Feb. 1924, pp. 67-76, 13 figs. Developments carried out on Prairie Pipe Lines. Describes new system which utilizes all available exhaust heat in conjunction with reclaimers, purifiers, and special filters, combined into standard units and eliminates all lubricating troubles.

Valve Setting. Setting the Valves of a Diesel Engine, H. F. Birnie and R. C. Baumann. Power Plant Eng., vol. 28, no. 4, Feb. 15, 1924, pp. 230-232, 6 figs. Setting fuel cams.

DRAINAGE

Roadbed. Roadbed Drainage and Crossing of Chicago Sewer; I.C.R.R. Eng. News-Rec., vol. 92, no. 10, Mar. 6, 1924, pp. 410-412, 3 figs. Siphon outlet for tile drains; double layer of slabs carried tracks and loads sewer having internal pressure.

DREDGES

Sea-Going. New Electric Federal Suction Dredge, W. D. Styer. Dredging Eng., vol. 1, no. 1, Dec. 1923, pp. 5-7, 4 figs. Describes the A. Mackenzie, new type sea-going hopper dredge built for U. S. Eng. Dept., first of four; power unit consists of three 1,000-b.hp. Diesel engines each direct connected to a 700-kw. 500-volt d.c. generator, and two auxiliary 225-b.hp. Diesel engines direct connected to a 150-kw. 250-volt d.c. generator.

DRILLING MACHINES

Multiple-Spindle. Multiple-spindle Drilling Machines. Machy. (Lond.), vol. 23, no. 593, Feb. 7, 1924, pp. 609-612, 6 figs. New tools operating on time cycle, more particularly for operation on railway-car details.

DRYDOCKS

Floating. New Floating Dry Dock for Southampton. Engineer, vol. 137, no. 3556, Feb. 22, 1924, pp. 198-199, 3 figs. partly on supp. plate. Shows progress of work and launching of individual sections; total weight of completed structure, including plates, rivets, and machinery, together with timber and hull equipment, will be 18,000 tons.

DURALUMIN

Improvement Process. The Researches on the Duraluminum Problem, W. Fraenkel and E. Scheuer. Testing, vol. 1, no. 1, Jan. 1924, pp. 33-39. Explains peculiarity of process of improvement, and gives hypothesis reached by authors, namely, that cause of improvement is explained as chemical reaction in quenched alloy taking place in forming solid solution.

DYNAMOMETERS

Types. Some New Dynamometers, J. S. G. Primrose. Mech. World, vol. 75, no. 1936, 1937 and 1938, Feb. 8, 15 and 22, pp. 87-88, 100-102, and 115-116, 7 figs. Review of some of the more modern means of measuring force, contrasting them with some of the older forms which are better known. Paper read before Manchester Assn. of Engrs.

E

EDUCATION, INDUSTRIAL

Training for Industries. Education and Training for the Industries. Mech. Eng., vol. 46, no. 3, Mar. 1924, pp. 145-147. Report of conference on subject, held at A.S.M.E. annual meeting; includes address by Rob. L. Sackett, on industrial education in Great Britain.

ELECTRIC CIRCUITS, A.C.

Resonant. Study of Resonant Circuits, L. Fleischmann. Elec. World, vol. 83, no. 9, Mar. 1, 1924, pp. 430-431, 1 fig. Analytical treatment of a.c. circuit containing iron core reactance and condenser in parallel.

ELECTRIC CIRCUITS, D.C.

Graphic Calculation. Graphic Calculation of D.C. Electric Circuits (Graphique pour les calculs électriques en courant continu), J. Mesnier. Revue Générale de l'Électricité, vol. 15, no. 7, Feb. 16, 1924, pp. 263-276, 7 figs. Presents chart developed by author for rapid determination of characteristics, intensity, tension, resistance (or power) of d.c. circuit when the two other circuits are known; its principal application is to determine starting resistances; but other applications are exemplified.

ELECTRIC CONDUCTORS

Eddy-Current Losses in Armature. Eddy Current Losses in Armature Conductors, R. E. Gilman. Am. Inst. Elec. Engrs.—Jl., vol. 43, no. 3, Mar. 1924, pp. 194-196. Extension to author's paper published in vol. 39, pp. 997-1047, of 1920, of Journal; addition formulas are given for cases where transposed coils are used and also methods for quickly estimating increased loss due to eddy currents.

ELECTRIC DRIVE

Machine Tools. A New Reversing-Gear Arrangement for Individual Electric Drives (Eine neue Umsteuergetriebeanordnung für elektrischen Einzelantrieb), E. Lauer-Schmaltz. Maschinenbau, vol. 24, no. 8, Jan. 24, 1924, pp. 203-206, 7 figs. Describes two different designs of new type of motor, the flywheel ring motor, which together with a new system of mechanical reversing arrangement, offers advantages for transmission of larger amounts of power.

ELECTRIC FURNACES

Heat Treating. Electric Furnace Proves Best, J. Watson. Elec. World, vol. 83, no. 8, Feb. 23, 1924, p. 376, 1 fig. Special application for hardening clipper plates proves very economical; costs and operating results.

ELECTRIC LOCOMOTIVES

Vibrations. The Vibrations on Electric Locomotives with Crank Drive (Die Schüttelerschienungen elektrischer Lokomotiven mit Kurbelantrieb), Iwan Döry. Elektrotechnik u. Maschinenbau, vol. 43, no. 4, Jan. 27, 1924, pp. 45-47, 3 figs. Discusses causes of periodic vibration and indicates that play in bearings is largely responsible for it; fact that vibrations occur under no load as well as at full load tends to support authors' conclusions; use of properly placed springs in gear mechanism is means for avoiding vibrating and resonating phenomena.

ELECTRIC GENERATORS, A.C.

Self-Exciting. Self-Exciting Alternators, F. Contell. Elec. Rev., vol. 94, no. 2411, Feb. 8, 1924, pp. 204-205, 1 fig. Describes machine for which it is claimed that it is possible to excite a.c. generator with current from generator itself; essential part of invention consists in special way in which alternator is excited and in use of auxiliary alternator when main generator is being started up.

Short-Circuit Currents. Alternator Short-Circuit Currents, A. Fraenckel. Electrician, vol. 92, no. 2388, Feb. 22, 1924, pp. 224-25, 4 figs. Calculation of sudden rushes based on physical phenomena. Abstract from Elektrotechnische Zeit.

ELECTRIC LAMPS, INCANDESCENT

Tungsten Filament. The Development of the Electric Incandescent Lamp, B. P. Dudding and C. J. Smithells. World Power, vol. 1, no. 2, Feb. 1924, pp. 106-110, 9 figs. The tungsten filament.

ELECTRIC MEASURING INSTRUMENTS

Repairing. Repair of Electrical Indicator Instruments, V. H. Todd. Ry. Elec. Engr., vol. 15, no. 2, Feb. 1924, pp. 40-42, 1 fig. Causes which may make them indicate incorrectly and remedies which may be applied.

ELECTRIC MOTORS, A.C.

Excitation. The Excitation of Synchronous Machines, R. G. Jakeman. Elec. Rev., vol. 94, no. 2410, Feb. 1, 1924, pp. 167-168, 7 figs. Use of distributed exciting windings and uniformly slotted exciting members.

Synchronous. Synchronous Motor Operation, H. Cotton. Electrician, vol. 92, no. 2388, Feb. 22, 1924, pp. 220-221 and 229, 4 figs. Analysis of phenomenon of pulling into step.

ELECTRIC TRANSMISSION LINES

Limitations of Output. The Limitations of Output of a Power System Involving Long Transmission Lines, E. B. Shand. Am. Inst. Elec. Engrs.—Jl., vol. 43, no. 3, Mar. 1924, pp. 219-229, 12 figs. Discusses conditions of stability of system and points out that degree of voltage regulation as determined by load conditions is important factor in determination of limit of output; proposes type of combined diagram whereby this factor and other characteristics of load may be included; considers numerical example of 300-mi. line and presents various characteristic curves.

Tower Erection. Erecting Towers Assembled on Ground. Elec. World, vol. 83, no. 8, Feb. 23, 1924, pp. 369-372, 8 figs. Entire steelwork assembled on ground and tower erected by shear leg carried and operated by caterpillar tractor; arrangements for receiving and distributing steel, handling work of assembly and erection.

220,000-Volt. Transmission at 220,000 Volts, H. A. Barre. Elec. World, vol. 83, no. 11, Mar. 15, 1924, pp. 515-518, 3 figs. Factors which led Southern Cal. Edison Co. to operate at this tension; line insulation; handling charging current and flashovers; new bus design; switching problem.

Vector Diagrams for. Vector Diagrams for Long Lines, E. A. Loew. Elec. World, vol. 83, no. 10, Mar. 8, 1924, pp. 477-480, 3 figs. Graphical solution for transmission problems which is both accurate and easy to comprehend; gives current, voltage, power factor, power regulation, etc., for line of any length with or without phase control.

ELECTRIC WELDING

Precision. One More Step in Electric Welding Progress, S. W. Mann. Am. Welding Soc.—Jl., vol. 3, no. 1, Jan. 1924, pp. 18-23, 2 figs. Discusses precision welding; describes process of repairing a crankshaft, which was accomplished at very great saving.

ELECTRIC WELDING, ARC

Problems and Uses. Electric Arc Welding (Aus der Werkstatt des Lichtbogenschweissers), A. Hochstimm. Zeit. des Vereines deutscher Ingenieure, vol. 68, no. 6, Feb. 9, 1924, pp. 129-132, 18 figs. Discusses useful field of arc welding; peculiarities of d.c. and a.c. arc welding; training of welders; and results obtained.

Sheet-Metal Parts. Arc Welding Sheet-Metal Parts, A. R. Luechinger. Am. Mach., vol. 60, no. 12, Mar. 20, 1924, pp. 425-427, 6 figs. What constitutes good welding; proper methods of welding different kinds of seams; how operators should be trained; use of fixtures in production welding.

Welders, Training of. Training Course for Electric Arc Welders. Am. Welding Soc.—Jl., vol. 3, no. 2, Feb. 1924, pp. 15-17. Analysis of work of an arc welder; qualifications for welders; some of the fundamentals in arc welding, together with a detailed statement of material classified under type welding jobs arranged in order of difficulty from standpoint of teaching.

ELECTRONS

Kinetic Energy. The Kinetic Energy of Electrons Emitted from a Hot Tungsten Filament in an Atmosphere of Argon and of Hydrogen, J. F. Congdon. Lond., Edinburgh, & Dublin Philosophical Mag. & Jl. Sci., vol. 47, no. 278, Feb. 1924, pp. 458-465, 3 figs. Average energy of electrons emitted from hot tungsten filament in vacuo is shown to be in close agreement with requirements of Maxwell's distribution law; presence of argon over wide range of pressures has no effect on measured average energy; presence of hydrogen, even at low pressures, appears to increase measured average energy considerably.

ELEVATORS

Hand and Power. The Design and Construction of Hand and Power Elevators. Mech. Wld., vol. 75, nos. 1932, 1934, 1937 and 1939, Jan. 11, 25, Feb. 15 and 29, 1924, pp. 24-25, 49-51, 98-100 and 129-130, 13 figs. Deals with elevators for raising or lowering goods of solid form between basement and intervening floors of a building or factory.

EMPLOYEES

Individual Differences of. What Makes Employees Differ? D. A. Laird. Indus. Mgt. (N. Y.), vol. 67, no. 3, Mar. 1924, pp. 184-190, 5 figs. Discusses from point of view of present-day science factors connected with individual differences with which employer should be familiar.

ENERGY

Conservation. New Ways of Conserving Energy, (Neue Wege der Energiewirtschaft), Löffler. Zeit. des Vereines deutscher Ingenieure, vol. 68, no. 8, Feb. 23, 1924, pp. 161-169, 18 figs. Present-day utilization of fuel energy; examples from mining and metallurgical, chemical and automotive industries; saving effected through high speed, high pressure and temperature drops; control of state of heat, especially through cooling; Diesel engines for trucks; electrical and mechanical power transmission in automobiles; gas and oil turbines; high-pressure steam turbines and boilers; use of high pressure and high temperature in chemical industry—refinement of fuel, liquefaction of coal; principles of modern high-pressure design and operation.

Utilization of Natural Sources. Contribution to the Theory of the Utilization of Natural Power Sources (Beitrag zur Theorie de Ausnützung von Naturkräften), Rob. I. Novotny. Zeit. des Vereines deutscher Ingenieure, vol. 68, no. 5, Feb. 2, 1924, pp. 101-106, 11 figs. Influence of working time and idleness of power plant on utilization of energy contained in a natural power source; improving power utilization and increasing efficiency by use of energy storage; comparison of cost of power generation with and without storage of energy.

EXCAVATION

Soil Characteristics. Characteristics of Quicksand and Other Soils Met in Ordinary Excavation, C. R. Cow. Boston Soc. Civ. Engrs.—Jl., vol. 11, no. 2, Feb. 1924, pp. 53-69 and (discussion) 69-79. Types of soil encountered and their characteristics.

EXPLOSIVES

Dynamite. Proofs That Dynamite Acts Equally in All Directions, J. E. Crawshaw. Eng. & Contracting (Railways), vol. 61, no. 2, Feb. 20, 1924, pp. 417-419, 3 figs. Shows error of belief that dynamite acts principally downward. Paper read before Coal Min. Inst. of Am.

Permissibles in Coal Mines. Progress in the Use of Permissibles, S. C. Jones. Coal Industry, vol. 7, no. 2, Feb. 1924, pp. 92-94, 2 figs. Future progress, it is claimed, depends largely on selecting proper explosive and knowing how to use it efficiently.

F

FANS

Mine. Experiments on the Distribution of Air in Centrifugal Fans and on Re-entry Phenomena, H. Briggs and J. M. Williamson. Colliery Guardian, vol. 127, no. 3295, Feb. 22, 1924, pp. 465-466, 21 figs. Experiments made at Heriot-Watt College, Edinburgh, and at Wellesley Colliery, Fife, bearing upon manner in which centrifugal fan of drum type deals with air it discharges; shows how uneven is distribution of air passing through wheel; different forms of re-entry of air. Paper read before North of Eng. Inst. Min. & Mech. Engrs.

Support and Drive. Auxiliary Equipment for Blast and Ventilating Fans, Chas. L. Hubbard. Power, vol. 59, no. 9, 1924, pp. 318-321, 6 figs. Methods of supporting fan and drive to meet various conditions; preventing vibration; air velocities; engine and turbine drives; d.c. and a.c. motor drives; speed regulation with motor drive.

Ventilators and Exhausters. Ventilators and Exhausters (Ventilatoren und Exhaustoren), H. R. Karg. Praktischer Maschinen-Konstrukteur, vol. 56, nos. 46-47 and 50-51, Nov. 27 and Dec. 24, 1923, and vol. 57, nos. 1-2 and 5, Jan. 8 and Feb. 5, 1924, 13 pp., 3 figs. Nov. 27: Critical discussion and recommendations. Dec. 24: Openings and admission velocities. Jan. 8: Determination of inside and outside blade angles. Feb. 5: Determination of speed of admission of gases in vane wheel.

FERRO-ALLOYS

Development and Uses. Ferro-Alloys, Fr. M. Becket. Chem. & Met. Eng., vol. 30, nos. 5, 8 and 10, Feb. 4, 25 and Mar. 10, 1924, pp. 186-188, 316-318 and 391-393. Feb. 4: Story and uses of ferro-silicon; status of industry; metallic silicon. Feb. 25: Developments and utility of ferro-chromium. Mar. 10: Ferro-alloys of tungsten and vanadium.

FILTERS

Installation and Operation Costs. Cost of Filtration Equipment and Operation, W. G. Whitman and T. Fuwa. Chem. & Met. Eng., vol. 30, no. 9, Mar. 1, 1924, pp. 355-359, 4 figs. Analysis and comparison of factors that determine cost of installation and operation of three principal types of filters.

FIRE PROTECTION

Building Design. Fire Protection in Building Design, E. A. Barrier and J. O. Taber. Boston Soc. Civ. Engrs. Jl., vol. 11, no. 3, Mar. 1924, pp. 85-106 and (discussion) 106-108, 3 figs. By E. A. Barrier: Early types of construction; interior construction; laboratory tests; vertical openings, partitions and fire walls; protection against outside exposure. By J. O. Taber. Exposure from external fires; design within building; ideal fire protection; Bost fire department.

FLOOD CONTROL

Seine, River, Paris. The Flooding of the Seine River in January 1924 and in 1910. (Les crues de la Seine en janvier 1924 et 1910). A. Bidault des Chaumes. Génie Civil, vol. 84, no. 4, Jan. 26, 1924, pp. 77-82, 11 figs. Describes protective works constructed in Paris and vicinity since 1910 and their effectiveness during recent high-water period.

FLOORS

Transparent. Tests on the Resistance of Transparent Floors. (Essais de résistance de dalles transparentes). Génie Civil, vol. 84, no. 5, Feb. 2, 1924, pp. 109-110, 3 figs. Results of tests on floors made of glass units with thickness of 10 cm. and max. diam. of 145 mm. set in reinforced concrete, they are said to be as transparent as floors made entirely of glass.

FLOUR MILLS

Diesel-Engine-Driven. America's Largest Diesel-Driven Flour Mill. Oil Engine Power, vol. 2, no. 2, Feb. 1924, pp. 80-84, 4 figs. How Red Star Mill, Wichita, Kans., effected pronounced economies by gradually discarding old steam machinery in favor of modern oil-engine power, which rendered them independent of local electric supply.

FLOW OF WATER

Pipes and Channels. The Flow of Water in Pipes and Channels, F. Heywood. Instn. Civ. Engrs.—Sessional Notices, no. 3, Feb. 1924, pp. 67-68. Attempt to co-ordinate available data relating to flow of water in conduits with entirely satisfactory results of tests on small-scale experimental pipe lines. (Abstract).

FLOW METERS

Electrically-Operated. The Electrically Operated Flow Meter, R. E. Woolley. Gen. Elec. Rev., vol. 27, no. 3, Mar. 1924, pp. 182-187, 8 figs. Reasons that gave rise to its development; description of complete device, function of its parts, its general principle of operation, and its applications.

FORGING

Copper. Distillery Apparatus in a Coppersmithing Shop, H. P. Armson. Can. Machy, vol. 31, no. 10, Mar. 6, 1924, pp. 27-30, 3 figs. Description of methods employed in making large sectional drums, pipe connections, etc., at Booth-Coulter Copper & Brass Co.'s plant, Toronto, Can.

Steel Shafts. The Rough Turning of Forgings (Le dégrossissage des pièces de forge sur le tour), N. Sawine. Génie Civil, vol. 84, no. 5, Feb. 2, 1924, pp. 110-112. Discusses best working conditions for steel shafts.

FOUNDRIES

American vs. European Practice. American Versus European Foundry Practice, H. M. Lane. Iron Age, vol. 113, no. 11, Mar. 13, 1924, pp. 803-804. Comparison based on relative, social and economic conditions; light building construction; machine-tool design.

Pneumatic Tools. Increasing Foundry Output With Compressed Air, R. G. Skerrett. Can. Foundryman, vol. 15, no. 2, Feb. 1924, pp. 22-27, 18 figs. How compressed air and pneumatic tools make it possible for foundryman to do more and better work than would be possible without these modern aids.

FREIGHT HANDLING

L. C. L. Freight. Departure in Handling Less than Carload Freight, E. F. Ford. Ry. Rev., vol. 74, no. 8, Feb. 23, 1924, pp. 320-321. Description of new method which reduces overtime, loss and damage and conserves equipment.

How English Cartage Practice Prevents Terminal Congestion, F. C. Horner. N. Y. Railroad Club-Official Proc., vol. 34, no. 3, Feb. 1924, pp. 7212-7222 and (discussion) 7222-7225. Description of English system of collection and delivery of l.c.l. freight.

FUELS

Factory Refuse. Generation of Power with Factory Refuse. F. Johnstone-Taylor. Power Plant Eng., vol. 28, no. 6, Mar. 15, 1924, pp. 326-328, 3 figs. Wood wastes and other refuse used for generating steam and producer gas; description of suction-gas producer; operating results; gas storage, boiler firing by gas.

Research. The Work of the Fuel Research Board, C. H. Lander. Instn. Min. Engrs.—Trans., vol. 64, Pt. 5, Feb. 1924, pp. 243-253 and (discussion) 253-261. Physical and chemical survey of national coal resources; carbonization of coal; structure of coke; water gas; gasoline mixtures for motor-car engines; hydrogenation of oils and coals; domestic heating; peat; alcohol; etc.

See also Coal; Oil Fuels; Pulverized Coal.

FLUIDS

Equation of State. On a proposed Empirical Equation of State for Fluids, S. Lees. Lond., Edinburgh & Dublin Philosophical Mag. & Jl., Sci., vol. 47, no. 278, Feb. 1924, pp. 431-446, 1 fig. Author puts forward a new equation of state.

FURNACES, ANNEALING

Steel Wire. Furnaces for Wire Annealing. Fuels & Furnaces, vol. 2, no. 3 Mar. 1924, pp. 245-246, 4 figs. Coal-fired pot furnaces for black and bright annealing and recuperative furnaces of German design.

FURNACES, HEATING

Sheet and Pair. Modern Sheet and Pair Furnaces Described, A. W. Peters. Fuels & Furnaces, vol. 2, no. 3, Mar. 1924, pp. 227-230, 2 figs. Well-insulated one-valve control furnaces effect saving of 43 per cent in gas consumption over old furnaces and secure uniform and controllable furnace atmosphere.

FURNACES, HEAT-TREATING

Gas- vs. Oil-Fired Hardening. Gas vs. Oil Firing for Hardening Plants (Gas- oder Oelfeuerung für Härteanlagen), Fr. Messinger. Wärme, vol. 11, no. 2, Jan. 11, 1924, pp. 15-16, 5 figs. Reconstruction of salt-bath hardening furnace by changing from oil to gas firing; hardening and maintenance of temperature; reduction of size of annealing chamber underneath crucible with gas firing; arrangement of burner; positive regulation of gas-air mixture; results with regard to time required for starting fire, hourly rate of fuel consumption, and quantity of heat consumed; efficiency.

FURNACES, REVERBERATORY

Iron and Steel. Reverboratory Furnaces for Heating Iron and Steel, W. Mason. Metal Industry (Lond.), vol. 24, no. 8, Feb. 22, 1924, pp. 177-178, 4 figs. Chief practical details of design, control, and repair of ordinary reverberatory furnace, and principal faults in operation.

G

GAGES

Special. Special Gages (Sonderlehren), E. Schuchardt. Maschinenbau, vol. 3, no. 9, Feb. 14, 1924, pp. 240-244, 32 figs. Points out that in addition to standard gages for standard parts as accepted by German industrial Standards Committee, there are special gages for special parts; author seeks to develop standard guides for special gages adhering strictly to gage system.

GAS ANALYSIS

Orsat Apparatus. The Technical Analysis of High-Quality Gases with the Orsat Apparatus (Die) technische Analyse von hochwertigen Gasen mit dem Orsatapparat), W. Stöckmann. Stahl u. Eisen, vol. 44, no. 6, Feb. 7, 1924, pp. 153-154. Describes method for joint combustion of methane and hydrogen with pure oxygen.

Thermal-Conductivity Method. Thermal Conductivity for the Analysis of Gases, P. E. Palmer and E. R. Weaver. U. S. Bur. Standards, Technologic Papers No. 249, Jan. 7, 1924, 100 pp., 40 figs. By a comparison of resistance of two electrically-heated wires surrounded, respectively, by gas for analysis and a reference gas, a determination is possible of concentration of certain constituents in a wide variety of gas mixtures of importance in industry and research. Results of an investigation with this method.

GAS ENGINES

Tests. Gas-engine Trials, N. Harwood. Mech. World, vol. 75, no. 1935, Feb. 1, 1924, p. 65, 3 figs. Describes trials undertaken with object of investigating whether clearance space in a gas engine is wholly or partly filled every suction stroke.

Vertical. Vertical Gas Engines (Les moteurs à gaz verticaux), J. Brunswick. Technique Moderne, vol. 16, no. 1, Jan. 1, 1924, pp. 7-10, 12 figs. Describes various types manufactured in different countries.

GAS PRODUCERS

Double-Grate. A New Method for Improvement of Gas Furnaces Directly Connected with Gas Producer (Ein neuer Weg zur Verbesserung der mit dem Generator in unmittelbarer Verbindung stehenden Gasfeuerungen), J. Hudler. Gas- u. Wasserfach, vol. 67, no. 2, Jan. 12, 1924, pp. 16-18, 2 figs. Describes patented double-grate producer which has a second combustion hearth directly over step grate, and points out its economic advantages.

GASES

Cylinders, Safe Handling of. Rules for the Safe Handling of Gas Cylinders. Am. Mach., vol. 60, no. 12, Mar. 20, 1924, p. 424. Rules prepared by Gas Products Assn., Chicago for handling of cylinders containing compressed oxygen, hydrogen and acetylene.

Dust Removal. Separating Dust from Gases with Dust. Geo. B. Cramp. Chem. & Met. Eng., vol. 30, no. 10, Mar. 10, 1924, pp. 400-401, 2 figs. System primarily developed by author for blast-furnace gases, but which should be effective and useful elsewhere, employs dust from gas as filtering medium for filtering out more dust.

The Elimination of Chimney Discharges by Means of Electric Gas Cleaning (Die Beseitigung des Schornstein-Auswurfs mittels elektrischer Gasreinigung), H. Schroeder. Feuerungstechnik, vol. 12, nos. 9 and 10, Feb. 1 and 15, 1924, pp. 65-66 and 73-77, 7 figs. Losses through soot, coke- and flue-dust particles, and their removal by means of flue-dust separators; describes Oski process and installation for gas cleaning and dust removal; its advantages, working costs, arrangement, and useful scope.

GEAR CUTTING

Bevel Gears. The Cutting of Bevel Gears on the Universal Milling Machine (Das Fräsen von Kegelrädern auf der Universalfräsmaschine), M. Raudnitz. Werkstattstechnik, vol. 18, no. 5, Mar. 1, 1924, pp. 135-141, 24 figs. Development of method, based on theoretical investigation of a bevel-gear tooth face, according to which bevel gears can be generated on universal milling machine with side-milling cutter, without aid of special devices, and more nearly approaching theoretically correct form.

The Cutting of Bevel Gears with Profile Cutters (Schneiden von Kegelrädern mit Formfräsern). Werkstattstechnik, vol. 18, no. 5, Mar. 1, 1924, pp. 156-158, 7 figs. Adjustment of cutter and bevel-gear rings; cutting of gear segments and of double-angle bevel gears. See also articles entitled Rough Turning of Bevel Gears (Schruppen von Kegelrädern), pp. 158-161, 11 figs.; and Cutting of Spiral Bevel Gears with Worm Hobs (Fräsen von Spiralkegelrädern mit Schneckenfräsern), pp. 161-167, 16 figs.

GEARS

Helical. The Graphical Solution of Helical Gear Problems, F. Szabo. Am. Mach., vol. 60, no. 11, Mar. 13, 1924, pp. 391-394, 11 figs. Method for investigating characteristics of helical gearing; approximate solution to problem easily obtainable; trial calculations eliminated; method adapted to all conditions.

Reversing, Tooth Position for. Calculation of Tooth Position for Spur-Wheel Reversing Gear (Berechnung der Räderstellung für Stirnräderwendegetriebe), K. Hoecken. Maschinenbau, vol. 3, no. 8, Jan. 24, 1924, pp. 197-200, 4 figs. For reversing gear with axially movable and disengageable change wheels, position of teeth when changing is calculated which is necessary to permit the engagement of teeth.

Spur. Spur-Gear Machining (Stirnräderbearbeitung), Barth. Werkstattstechnik, vol. 18, no. 4, Feb. 15, 1924, pp. 75-98, 119 figs. Describes different methods and machines for producing spur gears.

Teeth, Evolution of. Historical Notes on Gear Teeth, L. D. Burlingame. Machy. (N. Y.), vol. 30, no. 7, Mar. 1924, pp. 529-534, 10 figs. Evolution of gear teeth from crude beginnings and early equipment for cutting.

GIRDERS

Transverse Oscillations. Theory of Transverse Oscillations in Girders and Its Relation to Live-Load and Impact Allowances, Chas. E. Inglis. Instn. Civ. Engrs. Sessional Notices, no. 3, Feb. 1924, pp. 57-61. Author seeks to throw light on phenomena attending behavior of girders under influence of dynamical loads, and to bring out methods of mathematical analyses. (Abstract.)

GRAPHITE

Industrial Uses. Graphite and Its Industrial Uses (Le graphite et ses emplois dans l'industrie), G. Mesnard. Génie Civil, vol. 84, nos. 6 and 7, Feb. 9 and 16, 1924, pp. 138-139 and 161-164, 6 figs. Study of natural graphite, its properties, geographical occurrences, mining, and uses.

GRINDING MACHINES

Gear. A New Full-Automatic Gear Grinder. Eng. Production, vol. 7, no. 137, Feb. 1924, pp. 41-43, 6 figs. Details of involute gear grinder placed on market by Fellows Gear Shaper Co., Springfield, Vt.

GYPSUM

Analysis. Analysis of Gypsum and Gypsum Products, F. C. Welch. Indus. & Eng. Chem., vol. 16, no. 3, Mar. 1924, pp. 238-241, 3 figs. Samples of raw gypsum were analyzed for gypsum and anhydrite according to present recommended method of analyses and checked by microscopic analysis; method was found to be unsatisfactory, and method is here recommended which enables chemist to determine percentages of constituents present in their mixtures.

H

HARDNESS

Ball Testing Method. Ball Method of Hardness Testing and Its Importance Today in the Evaluation of Metallic Materials (La prova di durezza alla sfera e la sua importanza nell'odierno collaudo dei materiali metallici), V. Prever. Ingegneria, vol. 3, no. 1, Jan. 1, 1924, pp. 16-21, 10 figs. partly on supp. plate. Deals with load employed in penetration test and its influence in Brinell number; duration of application of load; influence of diameter of ball employed; ball deformation; and relation between hardness and tensile strength. Results obtained on carbon and alloy steels at research laboratory of Fiat Company in Turin.

HEATING AND VENTILATING

Theaters. Modern Ventilating in Theater Building. M. J. Phillips. Plumbers' Trade Jl., vol. 76, no. 5, Mar. 1, 1924, pp. 406-408 and 455, 7 figs. Description of installation, at Fort Armstrong Theater, Rock Island, Ill., including system for heating in cold weather and cooling in summer months.

HEATING, HOUSE

Oil Burners. Oil Burners for Residential Property, A. C. Carruthers. Safety Eng., vol. 47, no. 2, Feb. 1924, pp. 60-64, 3 figs. Principal data on ten oil burners, for installation in various types of hot-water heaters, steam boilers, and hot-air furnaces, which have received approval of Underwriters' Laboratories. Regulations issued for their construction and use.

Vapor. Vapor Heating System For Small Dwellings, T. E. Mason. Plumbers' Trade J., vol. 76, no. 4, Feb. 15, 1924, pp. 330-331 and 334, 4 figs. Details of an actual installation in representative building situated in high-altitude territory.

HEATING, STEAM

Oil-Burning System. Oil Burning Equipment, M. Griffith. Plumbers' Trade Jl., vol. 76, no. 4, Feb. 15, 1924, pp. 326-329, 7 figs. Details of storage tanks, apparatus and piping installation for large office building in accordance with requirements of Nat. Board of Fire Underwriters.

Practice. Modern Steam Heating, A. J. Assheton. Domestic Eng. (Lond.), vol. 44, nos. 1 and 2, Jan. and Feb. 1924, pp. 3-10, and 33-35, 12 figs. Discusses decomposition of air impurities and purities; course of convection currents; object of air eliminator; pipe sizes; vapor, mechanical return, and vacuum systems; etc.

HIGHWAYS

British Columbia. Highway System of British Columbia, P. Philip. Can. Engr., vol. 46, no. 9, Feb. 26, 1924, pp. 269-272, 1 fig. Review of history and development of provincial highways; mileage and location of principal highways in province.

Traffic Accidents. Highway Traffic Accidents, U. M. Isabella. Eng. & Contracting (Roads & Streets), vol. 61, no. 2, Feb. 6, 1924, pp. 291-295. Classification, causes, and preventive measures. Paper read before Am. Road Bldrs.' Assn.

HOBBING MACHINES

Spline. Sommer & Adams Rotary Spline Hobbing Machine. Machy (N. Y.), vol. 30, no. 7, Mar. 1924, pp. 555-556, 3 figs. Describes multiple-spindle machine in which eight pieces of work are finished by as many hobs, while practically entire machine, with exception of base, revolved past operator; it is believed same principle can be applied to hobbing of gears.

HOISTS

Electric. An Electric Hoist Controlled by Compressed Air, H. V. Haight. Can. Min. Jl., vol. 45, no. 8, Feb. 22, 1924, pp. 175-180, 8 figs. Particulars of two hoists recently built for use in Porcupine camp; double-drum type, the two drums being on one shaft and intended for operating normally in balance; both drums provided with band friction clutches so that either may be operated independently; drive is through single-reduction Falk herringbone gearing; 250-hp. 550-volt 60-cycle slip-ring hoist motor; designed for maximum rope pull of 12,000 lb. and a depth of 2000 ft.

Electric Drives for Mine Hoists, L. A. Umansky. Coal Industry, vol. 7, no. 2, Feb. 1924, pp. 75-82, 13 figs. Economic comparison of various systems in use; induction-motor drive and Ward-Leonard control with flywheel motor generator set is discussed.

Large Electric Winders at the Randfontein Central Gold Mining Company, Limited, Chas. Miles and A. W. Stoker. S. African Instn. Engrs.—Jl., vol. 22, no. 6, Jan. 1924, pp. 77-93 and (discussion) 93-94, 22 figs. Details of mechanical and electrical portions; designed to hoist rock load of 10,000 lb. from depth of 3,000 ft.; gear is operated by Ward-Leonard system with two main 2,500-hp. motors.

HOUSING

Industrial Community Plan. Plan for Industrial Community of Alcoa, Tennessee, Rob. F. Ewald. Eng. News-Rec., vol. 92, no. 9, Feb. 28, 1924, pp. 364-367, 2 figs. Aluminum and lumber companies occupy central area, with low lands for park areas forming five breaks, seven main thoroughfares and whole street system adjusted to contours.

HYDRAULIC ACCUMULATORS

Construction and Characteristics. Hydraulic Accumulators, H. S. Cattermole. Mech. Wld., vol. 75, no. 1938, Feb. 22, 1924, pp. 113-114. Characteristics and constructional details.

Design. Hydraulic-Accumulator Installation at the Hartmann Textile Mill at Munster (Alsace) (L'installation d'accumulation d'énergie hydraulique des Manufactures Hartmann, à Munster (Haut-Rhin). Génie Civil, vol. 84, no. 2, Jan. 12, 1924, pp. 29-32, 6 figs. Whole plant includes low-pressure hydro-electric station with head of 15 m., and accumulating station with its sets of Sulzer centrifugal pumps and installations for utilization of high pressure.

HYDRAULIC MACHINERY

Manufacture. Fabricating Hydro-electric Units, H. R. Simonds. Iron Trade Rev., vol. 74, no. 11, Mar. 13, 1924, pp. 732-735, 7 figs. Describes production of heavy castings and steel-plate sections for water-power machinery; new 70,000-hp. turbo-generator under construction by Allis-Chalmers Mfg. Co., Milwaukee.

HYDRAULIC TURBINES

Checking Performance. Checking the Operation of Hydro-Electric Units, Ralph Brown. Power, vol. 59, no. 10, Mar. 4, 1924, pp. 361-363, 4 figs. Detecting lost motion in operating-cylinder mechanism; checking output of unit; causes of reduced capacity; scheduling work when unit is taken out of service for repairs.

Double-Runner Horizontal. Turbines in Raanaasfoss Power Station, H. Thoresen. Power vol. 59, no. 8, Feb. 19, 1924, pp. 278-281, 8 figs. Plan contains six double-runner horizontal-shaft 12,000-hp. turbines operating under head varying from 31 to 46 ft.; turbines are set in open flumes and two different European designs are used.

Ice Formation, Prevention. Preventing Ice Formation on Water Turbines, R. S. Hyatt. Elec. World, vol. 83, no. 8, Feb. 23, 1924, p. 386, 1 fig. Describes what is said to be effective means of heating turbine and preventing adherence of ice.

Installation System. Hallinger System of Installing Francis Turbines with Horizontal Shafts (Francisturbinen mit liegender Welle nach der Einbauweise von Hallinger), C. Reindl. Zeit. des Vereines deutscher Ingenieure, vol. 68, no. 6, Feb. 9, 1924, pp. 119-123, 14 figs. Describes four power plants and two designs for double twin turbines, which are located in machinery house under sheet-metal cover and have high-suction head-water level; arrangement requires little space, is easily installed and controlled.

HYDRO-ELECTRIC DEVELOPMENTS

Gold and Silver Mines, Ontario. Hydro-Electric Development for Gold and Silver Mines of Northern Ontario, A. R. Webster. Ontario Dept. Mines—Bul., no. 46, 1923, 23 pp., 20 figs. Describes installations of different power companies and gives amount of turbine capacity connected to generators owned by each, aggregating 64,490 hp.

Manitoba. Great Falls Hydro-Electric Development of the Manitoba Power Company. Power, vol. 59, no. 12, Mar. 18, 1924, pp. 436-442, 12 figs. Complete project will consist of dam nearly mile long and installation of six 28,000-hp. turbines to operate under 56-ft. head, and each will require 5,200 cu. ft.-sec. of water at full load; turbines are of propeller type and are largest capacity of this type ever constructed; special features are incorporated in design of draft tubes and scroll cases.

San Francisco, Cal. The Hetch Hetchy Water Supply and Power Project, C. W. Geiger. Nat. Engr., vol. 28, no. 3, Mar. 1924, pp. 95-99, 4 figs. Will supply, when completed 400,000,000 gal. water daily to population of 4,000,000 people in San Francisco and other cities of metropolitan district, and will generate 200,000 hp.; describes O'Shaughnessy dam, and gives construction details of tunnel.

Sicily. A Sicilian Hydro-Electric Installation, J. S. Barnes. Elev. Rev., vol. 94, no. 2,411, Feb. 8, 1924, pp. 219-221, 8 figs. Details of Belice hydro-electric scheme near Palermo; main storage reservoir has total capacity of 32,800,000 cu. m., of which 21,000,000 cu. m. may be drawn upon; dam is 133 ft. high, 866 ft. long and is dry-built of stone; pressure tunnel is 850 m. long; in engine room are four Pelton wheels each of 3,500 b.hp. connected directly with four 3-phase alternators.

I

ICE PLANTS

EQUIPMENT. Essentials of a Modern Ice Plant, C. T. Baker. Refrigeration, vol. 34, no. 2, Feb. 1924, pp. 43-47. What modern plant should consist of as regards machinery and equipment.

IMPROVEMENTS. Improvement In Ice Plants. R. C. Doremus. Universal Engr., vol. 39, no. 2, Feb. 1924, pp. 23-28. Deals with water treatment, air treatment, ice-making system, harvesting equipment, condensers, water heating, electric drive, ice storage, etc. Paper read before N. A. P. R. E.

IMPACT TESTING

NOTCHED-BAR TESTS. On Notched-Bar Impact Tests, P. Filunger. Testing, vol. 1, No. 1, Jan. 1924, pp. 23-32, 7 figs. Refers to formula for expressing energy to produce deformation in notched-bar impact specimen, and in order to show that equation is borne out by test results, investigation is made of several notched specimens of identical material but with different eccentricities.

INDEXES

DECIMAL CLASSIFICATION. The Nature, Purpose and Aim of Decimal Classification (Die Dezimalklassifikation. Ihr. Wesen, Zweck und Ziel), E. Fontanellaz. Glasers Annalen, vol. 94, no. 4, Feb. 15, 1924, pp. 44-46. Discusses DK (Dewey) classification system and its advantages for arranging and indexing technical publications.

INDUSTRIAL MANAGEMENT

PLANNING. Planning System in a Car Manufacturing Plant. Ry. Rev., vol. 74, no. 9, Mar. 1, 1924, pp. 357-365, 15 figs. System of scheduling car-repair work in shops of Ralston Steel Car Co., Columbus, O.; exercises complete control of all manufacturing activities.

PRODUCTION ORGANIZATION. Production Organization. Eng. Production, vol. 7, no. 138, Mar. 1924, pp. 74-77. Reasons for organization and methods to be adopted; the ideal organization; laws governing manufacture; procedure in organizing a new factory.

SERVICE METHODS. Service, W. L. Wise. Soc. Automotive Engrs.—Jl., vol. 14, no. 3, Mar. 1924, pp. 274-276 and 318. Applications of basic principles of service as developed by Nat. Cash Register Co., Dayton, O., are suggested for promulgation in automotive industry, following statement of methods employed in servicing cash registers.

STOCKROOM METHODS. Extreme Variety Versus Standardization, J. H. Van Deventer. Indus. Mgt. (N. Y.), vol. 67, no. 3, Mar. 1924, pp. 129-135, 13 figs. Stockroom methods and stock handling at plant of Gen. Elec. Co. at Schenectady.

INDUSTRIAL PLANTS

MAINTENANCE. Modern Maintenance of Plant and Equipment, Wm. G. Ziegler. Indus. Mgt. (N. Y.), vol. 67, no. 3, Mar. 1924, pp. 167-174, 9 figs. Carpentry, masonry, and machine repair.

INDUSTRIAL RELATIONS

EMPLOYEES PUBLICATIONS. Co-operation through Plant Publications, W. R. Winans. Iron Age, vol. 113, no. 9, Feb. 28, 1924, pp. 647-649. Basic principles to be considered in planning such publication, and outline of kind and proper handling of items that will keep it sold.

CO-OPERATIVE PROGRAM, B. & O. SHOPS. New Co-operative Developments on the B. & O. Ry. Age vol. 76, no. 10, Mar. 8, 1924, pp. 543-545. Program of co-operation between federated shop-craft unions and management started a year ago now extended to all shops on system; sharing gains; stabilization of employment; ideas from shopmen.

INSURANCE

GROUP. Group Insurance as a Factor in Industrial Relations, Wm. F. Chamberlin. Indus. Mgt. (N. Y.), vol. 67, no. 3, Mar. 1924, pp. 149-150. Plans of group life insurance which have been found to be practical; formula in use by two or three well-known concerns.

INTERCHANGEABLE MANUFACTURE

MAINTAINING INTERCHANGEABILITY. Maintaining Interchangeability. Am. Mach., vol. 60, no. 10, Mar, 6, 1924, pp. 349-350. Cases that would defeat interchangeability. (Abstract.) Address before Cleveland Eng. Soc.

INTERNAL-COMBUSTION ENGINES

INTERNAL LOSSES. How Internal Losses in Power Plants Vary with Speed, P. M. Heldt. Automotive Industries, vol. 50, no. 10, Mar. 6, 1924, pp. 556-558. Determined by "motoring" engine with electric dynamometer; torque representing pumping loss is directly proportional to r.p.m. but frictional loss is independent of that factor.

LUBRICATION. Lubrication of Internal Combustion Engines, H. B. Warner. Ariz. Min. Jl., vol. 7, no. 18, Feb. 15, 1924, pp. 21-22. Data regarding cycle of operations of internal-combustion engines.

TEMPERATURE, INFLUENCE OF MIXTURE ON. Strength of Mixture Has Marked Effect on Engine Temperature, C. B. Dicksee. Automotive Industries, vol. 50, no. 10, Mar. 6, 1924, pp. 566-571, 7 figs. Influence not always realized sufficiently; recent researches show relationship; experiments indicate detonation is function of rate of flame propagation.

[*See also Airplane Engines; Automobile Engines; Diesel Engines; Motor Trucks, Engines; Oil Engines.*]

IRRIGATION

CORRUGATION METHOD. The Corrugation Method of Irrigation. Eng. & Contracting (Water Works), vol. 61, no. 2, Feb. 1924, pp. 359-360. Notes on method well adapted for efficient application of water to steep or irregular slopes.

IRON CASTINGS

DEFECTIVE. Defective Castings: Causes and Remedies. Foundry Trade Jl., vol. 29, no. 390, Feb. 7, 1924, pp. 125-128, 10 figs. Causes and remedies of different defects; eccentric-cores; venting-plates and gutters; small high-speed flywheels.

IRON ORE

ONTARIO, CANADA. The Iron Ore Report. Can. Min. Jl., vol. 45, no. 7, Feb. 15, 1924, pp. 154-156. Extracts from report of Ontario Iron Ore Committee, appointed to investigate extent and quality of deposits of low-grade iron ores in Ontario, best commercial methods of beneficiating them and generally what steps or measures should be adopted to enable low-grade and other iron ores of this Province to be utilized in production of pig-iron and steel.

INSULATING MATERIALS, ELECTRIC

VARNISH PAPER. Directions for the Study of Varnish-Paper and Varnish-Fabric Boards and Tubes. Instn. Elec. Engrs. Jl., vol. 62, no. 326, Feb. 1924, pp. 160-172, 10 figs. Definitions and classification; methods of test. Report from Brit. Elec. & Allied Industries Research Assn. See also report, entitled, Directions for the Study of Varnished Cotton Cloth (excluding Adhesive Tape), pp. 173-177, 2 figs.

INSULATORS, ELECTRIC

MANUFACTURE AND TESTING. The Manufacture, Development and Testing of High-Tension Insulators. Eng. Progress, vol. 5, no. 1, Jan. 1924, pp. 5-8, 10 figs. Manufacturing process; tunnel furnace which is newest type of baking furnace for ceramic industry; testing of insulators.

J

JETTIES

CLAY-CARGO. New China Clay Jetty at Fowey. Engineer, vol. 137, no. 3,556, Feb. 22, 1924, pp. 195-196, 5 figs. partly on p. 202. Jetty is 500 ft. long, has straight frontage of 300 ft., and is 50 ft. wide; has filling of brick arches and concrete, supported on 23 steel cylinders, 6-ft. diam., sunk to rock and afterwards filled with concrete; method of handling clay cargoes.

L

LATHES

TURRET, USE FOR CHUCKING WORK. The Ungeared Capstan Lathe as a Chucking Machine, E. W. Field, British Machine Tool Eng., vol. 3, no. 25, Jan.-Feb. 1924, pp. 3-7 and 28, 9 figs. Gives examples showing large range of chucking work small plain-head turret lathe will cover.

TURRET VS. LATHE WORK. Lathe and Turret Work Compared. J. Horner. Mech. World, vol. 75, nos. 1932 and 1937, Jan. 11 and Feb. 15, 1924, pp. 18-19 and 94, 10 figs. Describes procedure.

LIGHTNING

PROTECTION AGAINST. Thunderstorm Researches Versus No. Lightning Arresters, E. E. F. Creighton. Elec. World, vol. 83, no. 11, Mar. 15, 1924, pp. 521-523. Comments on article by H. Norinder in same journal, Feb. 2, 1924, describing researches on thunderstorm fields in Sweden and giving conclusions for application to system-protective devices.

LIQUIDS

FLUIDITY AND TEMPERATURE, RELATION OF. A Relation Between the Fluidity and the Temperature of Liquids, H. J. M. Creighton. Nova Scotian Inst. Sci.—Proc. & Trans., vol. 15, Pt. 3-4, Nov. 1923, pp. 165-168. Calculations.

LOCOMOTIVE BOILERS

DOME FLANGING. Flanging Locomotive Boiler Domes in One Piece. Boiler Maker, vol. 24, no. 2, Feb. 1924, pp. 31-36, 4 figs. Practice of Am. Locomotive Co., Schenectady, N. Y.; flanging throat sheets.

PERFORMANCE. Locomotive Boiler Performance, E. C. Poultney. Engineer, vol. 137, nos. 3556 and 3557. Feb. 22 and 29, 1924, pp. 192-195 and 218-221, 15 figs. Information on performance of locomotive boilers differing in proportion of their related parts when operating at various rates of power output, based upon tests made by Pennsylvania System on locomotive testing plant at Altoona, Pa.

LOCOMOTIVES

ADHESION AND RACK. A Modern Rack Locomotive. Ry. Gaz., vol. 40, no. 6, Feb. 8, 1924, p. 174, 1 fig. Principal data of recent type of 4-cylinder, 2-8-2 type combined rack and adhesion locomotive, built for German State Rys. for operation on Abt system.

DECAPOD. Decapod Type Locomotive for G. M. & N. R. R. Ry. Rev., vol. 74, no. 8, Feb. 23, 1924, pp. 317-320, 4 figs. Dimensions and principal data of 2-10-0-type locomotive of Gulf Mobile & Northern R. R. for heavy freight service; 215-lb. boiler pressure; 60,000-lb. tractive force. See also Ry. & Locomotive Eng., vol. 37, no. 2, Feb. 1924, pp. 35-36, 1 fig., and Railroad Herald, vol. 28, no. 3, Feb. 1924, pp. 16-17, 1 fig.

DESIGN. Locomotive Design. Ry. Jl., vol. 30, no. 3, Mar. 1924, pp. 18-19, 45 figs. pp. 19-31. Deals with starting capacity, hauling capacity and general economy in operation. Illustrations of American locomotive types.

The Locomotive of To-Day, J. Partington. New England Railroad Club, Feb. 12, 1924, pp. 245-257 and (discussion) 257-273. Discusses ways in which design must be definitely made to fit physical limitations of roadbed, bridges, tunnels, roundhouses, etc., and important connection between design and maintenance facilities especially as it applies to proper maintenance of appliances and materials now coming into general use. Review of three-cylinder locomotive; description of 3-cylinder locomotive No. 5,000 of Lehigh Valley R. R. and results of test made in Dec. 1923.

DIESEL-COMPRESSED AIR. Diesel-Compressed Air Locomotive. Times Trade & Eng. Supp., vol. 13, no. 295, Mar. 1, 1924, p. 615. Invention consists in applying compressed air by means of Diesel engine as motive power for railway traction; results of trials on Italian railways.

EVOLUTION. Railway Developments and the Evolution of High-Speed Locomotives (Le développement des chemins de fer et l'évolution de la locomotive à grande vitesse), M. Demoulin. Génie Civil, vol. 84, nos. 3 and 4, Jan. 19 and 26, 1924, pp. 60-64 and 85-89, 14 figs. Describes engine types built between years of 1850 and 1865, showing that many reputedly modern innovations are merely re-inventions, success of which was due to certain improvements in details or other factors.

4-8-2 TYPE. Southern Pacific 4-8-2 Type Locomotives. Ry. Mech. Engr., vol. 98, no. 3, Mar. 1924, pp. 141-146, 10 figs. Description of locomotives designed to haul trains of 12 passenger cars on 2 per cent grades and run 815 miles (between Los Angeles, Cal., and El Paso, Tex.); rated tractive force, 85 per cent, 57,510 lb., and with booster, 67,660 lb.

FUEL ECONOMY. Suggestions on Locomotive Fuel Economy, D. L. Franciscus. Ry. Rev., vol. 74, no. 7, Feb. 16, 1924, pp. 286-288. Abstract of prize-winning paper in Int. Ry. Fuel Assn. contest.

LUBRICATION. Force Feed Lubrication on Locomotives, A. H. Woodward. Ry. Mech. Engr., vol. 93, no. 3. Mar. 1924, pp. 151-152, 4 figs. Describes an original method by which oil is automatically supplied to the various bearing surfaces.

MIKADO. Mikado Type Locomotives, Canadian National Railways. Can. Ry. & Mar. World, no. 312, Feb. 1924, pp. 53-55, 4 figs. Belspaire boiler; 27 by 30-in. cylinder; working pressure 185 lb.; maximum tractive power 54,600 lb. See also Boiler Maker, vol. 24, no. 2, Feb. 1924, pp. 45-47, 2 figs.

Two Light Mikado Locomotives Built at Lima. Ry. Age, vol. 76, no. 9, Mar. 1, 1924, pp. 505-506, 2 figs. Designed for local conditions but approximately same capacity as U. S. R. A. light Mikados.

MOUNTAIN TYPE. Lehigh Valley Three-Cylinder Locomotive Tests. Ry. Age, vol. 76, no. 15, Mar. 15, 1924, pp. 755-757, 13 figs. 4-8-2 type built by Am. Locomotive Co. handles heavy tonnage with low fuel consumption; results of tests; performance on grades.

REBUILT. Modernized Power From Reconstructed Locomotives. Ry. Rev., vol 75, no. 9, Mar. 1, 1924, pp. 367-372, 9 figs. Account of overhauling of several classes of engines by Chicago Indianapolis & Louisville Ry. in its shops at La Fayette, Ind. illustrating methods by which Monon has practically made modern locomotives out of old, as engines pass through shops for repairs.

THREE-CYLINDER. Three Cylinder Superheated Steam Express Locomotive of the German State Railways. Ry. & Locomotive Eng., vol. 37, no. 3, Mar. 1924, pp. 75-78, 3 figs. German argument against use of two-cylinder compound locomotive; describes type of three-cylinder locomotive first built at Borsig shops in Tegel in 1922 and now being used somewhat extensively on German railways.

2-10-2. 2-10-2 Type Replace Mallets on Great Northern. Ry. Age, vol. 76, no. 8, Feb. 23, 1924, pp. 459-460, 1 fig. 3,000 tons handled over 1.8-per cent grade by locomotives of 87,130-lb. tractive force; built by Baldwin Locomotive Works.

TYPES. Some Recent Notable Locomotives, J. Partington. Can. Ry. Club—Proc., vol. 23, no. 1, Jan. 1924, pp. 21-32 and (discussion) 32-39, 2 figs. Characteristics and performances of several recent designs of locomotive. See also Ry. & Locomotive Eng., vol. 37, no. 2, Feb. 1924, pp. 39-41, 1 fig.

LUBRICATING OILS

INVESTIGATING METHOD. A Novel, Simple and Universal Method for the Investigation of Lubricating Oils and Bearings Alloys, R. von Dallwitz-Wegner. Testing, vol. 1, no. 1, Jan. 1924, pp. 58-71, 8 figs. New method is said to be free from all factors of uncertainty.

RECLAIMING PROCESS. A New Oil Reclaiming Process. Eng. Production, vol. 7, no. 138, Mar. 1924, p. 88, 2 figs. Describes method invented by T. D. Richards, an Australian; deals with all classes and grades of dirty lubricating oils. See also Elec. Times, vol. 65, no. 1689, Feb. 28, 1924, p. 251, 1 fig.

VISCOSITY. Variation of Viscosity of Lubricating Oils with Temperature (Zur Temperaturabhängigkeit der Viscosität), F. König. Zeit. für angewandte Chemie, vol. 37, no. 1, Jan. 3, 1924, pp. 8-10, 1 fig. Discusses equation given by Vogel in previous issue of same journal as expressing variation of viscosity with temperature and reaches conclusion that constants employed in it cannot be determined with sufficient accuracy to render them of any value as criteria in judging commercial oils; explains how these difficulties can be overcome.

LUBRICATION

LUBRICATORS. Methods of Applying Lubricating Oils (Méthodes d'application des lubrifiants liquides), J. Lévy. Technique Moderne, vol. 16, no. 3, Feb. 1, 1924, pp. 69-75, 14 figs. General principles and modern apparatus; describes different types of lubricators, including manual, semi-automatic, automatic and mechanical; accessory and special devices.

LUMBER

STANDARDIZATION. Engineering and Industrial Standardization. Mech. Eng., vol. 46, no. 3, Mar. 1924, pp. 167-169. Simplified practice recommendations on lumber.

M

MACHINE DESIGN

SELF-CENTERING DEVICES. Self-Centering Devices, A. Perham. Machy, (Lond.), vol. 23, no. 593, Feb. 7, 1924, pp. 625-627, 1 fig. Term self-centering is used to describe devices in which displacement, and recovery can be effected in each direction of movement; describes some of more usual and elementary forms of self-centering mechanism and useful forms that are less generally known.

MACHINE SHOPS

STEEL-FRAME ONE-STORY. Details of a Modern Steel Frame One-Story Shop. Eng. News-Rec., vol. 92, no. 11, Mar. 13, 1924, pp. 456-459, 7 figs. New plant of Sullivan Machy. Co., Michigan City, Ind., has specially fitted sawtooth roof and crane runways carried by main columns and jack columns; transfer table economizes yard space.

MACHINE TOOLS

ELECTRICALLY DRIVEN. Reglo Machine Tools (Reglo-Werkzeugmaschinen), O. Pollak. Werkstattstechnik, vol. 18, nos. 2 and 3, Jan. 15 and Feb. 1, 1924, pp. 21-28 and 53-57, 27 figs. Describes electric machine-tool drives of German Gen. Elec. Co. which form integral but interchangeable part of machine, so that such a machine works as whole unit in same way as turbo-generator, electric winding engine, etc.; numerous examples are described and illustrated.

SPEEDS AND FEEDS. Tool Engineering, A. A. Dowd and F. W. Curtis. Am. Mach., vol. 60, no. 9, Feb. 28, 1924, pp. 315-318. Speeds and feeds of machine tools; definition of cutting speed; relation between speed and feed; points in design affected by speeds and feeds.

STANDARD DATA SHEETS. Standard Data Sheets for Machine Tool Builders and Users, A. L. Evans. Am. Mach., vol. 60, no. 11, Mar. 13, 1924, pp. 381-386, 3 figs. Standard data sheets devised by author in order to simplify work of planning, routing, designing, equipping tools, making time studies, changing factory layout and similar tasks.

MAGNETS

STEEL, MAGNETIC TESTING OF. The Magnetic Testing of Small Specimens, T. F. Wall. Engineering, vol. 117, no. 3,036, Mar. 7, 1924, pp. 293-295, 7 figs. Method for testing magnetic qualities of specimen up to 2,000 gauss, leading advantage of which is that closed magnetic circuit is used.

MALLEABLE IRON

IRON-CARBON EUTECTOID. Identification of the Thermal Effect of the Iron-Carbon Eutectoid and Extrapolation of the Heating and Cooling Curve Values to Zero Rates, A. Hayes, H. E. Flanders and E. E. Moore. Am. Soc. Steel Treating—Trans., vol. 5, no. 2, Feb. 1924, pp. 183-194, 6 figs. Application of thermal-analysis methods have been applied to location of iron-carbon eutectoid in malleable iron containing 0.95-per cent silicon; method places this point on iron-carbon diagram at temperature of 771 deg. cent.

MANOMETERS

HIGH PRESSURE, MEASUREMENT OF. Measurement of High Pressures, F. H. Newman. World Power, vol. 1, no. 2, Feb. 1924, pp. 85-90, 7 figs. Compressed-gas type of manometer; elastic-membrane type of gage; optical lever and piezo-electrical manometer.

MATERIALS HANDLING

ACCIDENTS. A Study of Fatal Accidents in Material Handling, D. S. Beyer. Nat. Safety News, vol. 9, no. 3, Mar. 1924, pp. 27-28. Statistical data; and particulars of 16 fatal accidents reported to Liberty Mutual Insurance Co., Boston, Mass. Paper read before joint mtg. of Eng. Section of Nat. Safety Council and Am. Soc. Safety Engrs.

EQUIPMENT FOR. Trends in Handling Materials, F. E. Gooding. Indus. Engr., vol. 82, no. 2, Feb. 1924, pp. 81-89, 12 figs. Reviews present tendencies and practices in industrial plants in handling material by conveyors, industrial trucks, tractors, hoists, and similar equipment.

MEASURING INSTRUMENTS

OPTICAL. New Optical Measuring Methods for Tool and Machine Construction (Neue optische Messverfahren für den Werkzeug- und Maschinenbau), A. Steinle. Maschinenbau, vol. 3, no. 9, Feb. 14, 1924, pp. 244-249, 15 figs. New measuring instruments and favorable results obtained with them.

METALS

BRITTLENESS. Brittleness, W. R. Barclay. Metal Industry (Lond.), vol. 24, no. 7, Feb. 15, 1924, pp. 151-162 and 158. Causes and types of brittleness; its relation to toughness, ductility, plasticity, and crystal structure. Paper read before Birmingham Met. Soc.

COEFFICIENTS OF EXPANSION. Determination of the Thermal Coefficients of Expansion of Some Commercial Metals and Alloys, J. N. Friend and R. H. Vallance. Inst. Metals—advance paper, no. 5, for meeting Mar. 12-13, 1924, 4 pp. Describes apparatus used and results obtained.

FATIGUE. The Investigation of a Fatigue Failure of Brass Tubes in a Feed-Water Heater, with a Consideration of the Nature of "Fatigue", W. E. W. Millington and F. C. Thompson. Inst. Metals—advance paper, no. 11, for meeting Mar. 12-13, 1924, 23 pp., 18 figs. Description of failure; effects of mechanical deformation on close-packed cubic crystal; compares new theory of authors—that straight markings are cause of embrittlement which lead to fracture—with actually observed facts.

MILLING

BRAKES, DRUMS AND SPIDERS. Machining Sheldon Brakes, Drums and Spiders, F. H. Colvin. Am. Mach., vol. 60, no. 11, Mar. 13, 1924, pp. 387-389, 9 figs. Special fixtures and tools devised for machining work of odd shape; fixtures are shown in considerable detail so their construction can be more readily understood.

GROOVES. The Milling of Grooves (Das Fräsen von Nuten). Praktischer Maschinen-Konstrukteur, vol. 57, no. 5, Feb. 5, 1924, pp. 39-42, 4 figs. Describes different methods, tools and machines employed, and shows how running time of a Loeve milling machine can be calculated with aid of alignment charts.

MINES

BOREHOLE SURVEYING. Notes on Borehole Surveying, G. A. Watermeyer. Chem. Met. & Min. Soc. of S. Africa. Jl., vol. 24, no. 6, Dec. 1923, pp. 145-151, 5 figs. Notes on instruments patented for purpose of surveying boreholes some of which author has actually used in practice and investigated.

GAS SAMPLES, COLLECTION OF. Collection of Gas Samples. Sci. & Art. of Min., vol. 34, nos. 15 and 16, Feb. 16 and Mar. 1, 1924, pp. 231 and 244-245, 2 figs. Advantages of periodic analysis of air samples; hot to take sample.

MINING

MACHINERY, HANDLING OF. What Everyone in the Industry Should Know About Handling of Mining Machinery, T. F. McCarthy. Coal Age, vol. 25, no. 9, Feb. 28, 1924, pp. 307-310, 3 figs. Points out that many equipment failures are due to lack of understanding of machines; devices should be designed to meet mining conditions.

MOLDING MACHINES

DEVELOPMENT. The Molding Machine, R. E. Search. Metal Industry (N. Y.), vol. 22, no. 2, Feb. 1924, pp. 56-58, 9 figs. Early history and development. Simple forms of foundry machines.

MOTOR BUSES

GEAR-SHIFTING MECHANISM. Novel Gear Shifting Mechanism Chief Feature of German Bus, B. R. Dierfeld. Automotive Industries, vol. 50, no. 10, Mar. 6, 1924, pp. 575-576, 5 figs. New Kastner gate change incorporates original design; special method used for locking shifter bars has merit of compactness and simplicity; device evolved to prevent swaying of rear end; front-axle steering pivot operates constantly in bath of oil; chassis is brought out by Mannesmann-Mulag Co., Aix-la-Chapelle.

SELF-CHARGING. Self-Charging Principle Applied on 25-Passenger Bus. Bus Transportation, vol. 3, no. 3, Mar. 1924, pp. 109-112, 7 figs. Details of new bus in operation on 96th St. line, New York City; storage battery acts as a power reservoir; keeps engine-generator set working at constant output, combination permits use of a 20-hp. gasoline engine.

SPECIFICATIONS. American Gasoline Motor Bus Specifications. Automotive Industries, vol. 50, no. 8, Feb. 21, 1924, pp. 420-421. Table of statistics.

MOTOR-TRUCK TRANSPORTATION

CO-ORDINATION OF RAILROAD AND. The Co-ordination of Railroad and Motor-Truck Transportation, Rob. C. Wright. Soc. Automotive Engrs. Jl., vol. 14, no. 3, Mar. 1924, pp. 302-304. As result of study, Pa. R. R. system has become convinced that motor truck can co-operate with steam railroad in three lines of activity: (1) in substituting motor trucks for rail transportation for handling short-haul less-than-carload traffic (2) in motorizing terminals and (3) in door-to-door delivery service; advantages of motor truck in handling short-haul less-than-carload traffic; conclusions drawn.

MOTOR TRUCKS

ENGINES. A Solid Fuel Engine. Motor Transport (Lond.), vol. 38, no. 991, Feb. 25, 1924, pp. 219-220, 5 figs. Engine based on principle of injection of compressed air into solid fuel dust when in a glowing state, invented by A. Schnuerle; application to 4- and 2-cycle principle; applicable for truck or tractor work.

ONE-TRUCK. England's Largest Car Manufacturer Introduces One-Ton Truck. Automotive Industries, vol. 50, no. 9, Feb. 28, 1924, pp. 522-523, 1 fig. First British product in this class is expected to cut into practical monopoly of Ford; 3-by-4-in. engine and 122-in. wheelbase; constructed by Morris Motors, Ltd.

SPECIFICATIONS AND DESIGN. Recent Trends in Truck Design. Automotive Industries, vol. 50, no. 8, Feb. 21, 1924, pp. 424-439. American gasoline-truck specifications; British and Continental European truck-chassis specifications.

N

NITROGEN

FIXATION. The Fixation of Nitrogen as Cyanide, R. Franchot. Indus. & Eng. Chem., vol. 16, no. 3, Mar. 1924, pp. 235-238. When working at capacity of 40 million tons of pig iron, American blast furnace is fixing nitrogen at probable rate of 6,000,000 tons a year; this is double the rate at which it has been estimated that nitrogen is taken from soil in crops; hearth of blast furnace in United States develops 12 million kw. of which 25 per cent is apparently available for and absorbed in work done at 1,500 deg. cent.; there appears to be power of order of 2 million hp., not only developed and available, but actually already engaged in nitrogen fixation.

O

OILS

PURIFIERS. A New Centrifugal Oil Purifier. Elec. Rev., vol. 94, no. 2410, Feb. 1, 1924, pp. 174-175, 5 figs. Describes Empson machine designed to carry out processes of washing dirty hydrocarbon oils with water and afterward dehydrating them continuously in revolving drum.

OIL ENGINES

LIGHT-OIL. High-Speed Petrol and Paraffin Engines, J. Okill. Gas & Oil Power, vol. 19, nos. 220 and 221, Jan. 3 and Feb. 7, 1924, pp. 73-74 and 89-90 and 96, 3 figs. Deals with features and management of the lighter fuel types of oil engine.

SCOTT-STILL. The Type of Still Engine Required for Marine Service with Special Reference to the Scott-Still Engine, W. J. Still. North-East Coast Instn. Engrs. & Shipbldrs.—advance paper, no. 2698S, for meeting, Feb. 15, 1924, 25 pp., 17 figs. Discusses use of high-combustion m.e.n.'s and consequent production of excessive heat stresses in cylinder walls; fuel-injection troubles; insufficient ignition temperatures; water-circulation troubles; want of cylinder lubrication and wear of liners; bearing troubles.

OIL FUELS

BERGIUS PRODUCTION PROCESS. The Bergius Process (Le Procédé Bergius), P. Erculisse, F. Ranwez and P. Bruylants. Chaleur & Industrie, vol. 4, no. 44, Dec. 1923, pp. 931-943, 13 figs. Study of process which consists essentially in effecting a cracking under high hydrogen pressure; results of tests and practical experiences.

OIL SHALES

OIL EXTRACTION. Progress Reported in Shale Oil Extraction, R. J. G. Stewart and J. Trenchard. Automotive Mfr., vol. 65, no. 11, Feb. 1924, pp. 14-15. Experimenters find crushing not necessary; heating produces more oil; other items of progress.

OIL TANKS

INSULATION AGAINST EVAPORATION LOSSES. Insulation Against Evaporation Losses, E. H. Clausen. Min. & Oil Bul., vol. 10, no. 2, Feb. 1924, pp. 175, 177 and 179, 4 figs. Methods of preventing losses; insulating with hairinsul; advantages of Johns-Manville insulated tank top which can be applied to either wooden or steel decks.

OXY-ACETYLENE WELDING

BRASS. The Oxy-Acetylene Torch on Brass Work, D. Baxter. Am. Blacksmith & Motor Shop, vol. 23, no. 2, Feb. 1924, pp. 17-18 and 25, 5 figs. Peculiarities in action of brass under heat that must be considered when applying torch flame, and just how to work brass with gas torch.

IRON CONDUIT YOKES. Welding Large Iron Castings with the Oxyacetylene Torch. Elec. Ry. Jl., vol. 63, no. 7, Feb. 16, 1924, pp. 245-246, 3 figs. The successful welding of conduit yokes by New York & Harlem R. R.; castings are heated with gas while they are being welded and afterward cooled slowly in annealing ovens; cost of reclaimed yoke one-sixth price of new one.

MACHINE. Oxy-Acetylene Machine Welding, F. E. Rogers. Acetylene Jl., vol. 25, no. 8, Feb. 1924, pp. 377-380, 8 figs. Application of automatic machines and single and multi-flame welding torches to production work.

MINES. Applications of Oxy-Acetylene Welding and Cutting in the Mining Industry, H. Ulmer. Am. Welding Soc. Jl., vol. 3, no. 1, Jan. 1924, pp. 2-13. Describes the various applications and shows value of this process in mining industry.

P

PAPER

DEFINITION OF TERMS. Definition of Paper Terms, F. A. Curtis and C. J. West. Paper Trade. Jl., vol. 78, nos. 3, 4, 5, 6, 7, 8, 9, and 10, Jan. 17, 24, 31, Feb. 7, 14, 21, 28 and Mar. 6, 1924, pp. 51-54, 50-52, 54-57, 56-58, 60-62, 50-52, 51-54 and 59-62. Report of Sectional Committee on Definitions of Committee on Simplification of Paper Sizes appointed by U. S. Bur. Standards of Dept. of Commerce, Aug. 30, 1921.

PAPER MANUFACTURE

PULP TESTING. Effect of Pressure on Test Sheets, E. P. Cameron and J. M. Payne. Paper, vol. 33, no. 17, Feb. 14, 1924, pp. 5-11, 8 figs. Variations in pressures applied to sheets used in strength testing of pulp affect strength of ultimate sheet. Paper read before Can. Pulp & Paper Assn.

WOOD PULP PRODUCTION. Pulp-Wood Consumption and Wood-Pulp Production, 1922. U. S. Bur. Census, Forest Products, 1924, 16 pp. Compiled in cooperation with Dept. of Agriculture Forest Service.

PAPER MILLS

SUPERCALENDER ELECTRIC DRIVE. Electrical Supercalender Drive, O. C. Cordes. Paper, vol. 33, no. 19, Feb. 28, 1924, pp. 9-11, 5 figs. Description of system of dual frequency apparatus.

PAVEMENTS

MAINTENANCE. The Maintenance of Pavements, A. W. Brandt. Cornell Civil Engr., vol. 32, no. 5, Feb. 1924, pp. 57-62 and VI. Discusses maintenance as carried on in New York State, giving details concerning most important work, restoring roads to a safe and passable condition in early spring months, and discussion merits of different materials used.

ROUGHNESS. Roughness as a Factor in Pavement Life, A. T. Goldbeck. Can. Engr., vol. 46, no. 9, Feb. 26, 1924, pp. 275-278 and 282, 5 figs. Cause and effect of various types of road surface roughness; calculating pressure on surfaces; measurement of impact and fibre stresses; devices for measuring roughness. Paper read at Am. Road Bldrs' Assn. Convention.

SURFACE TESTING. Illinois Tests Pavement Surfaces by Profilometer, H. F. Clemmer. Eng. News-Rec., vol. 92, no. 12, Mar. 20, 1924, pp. 484-485, 3 figs. 16-wheel carriage hauled over pavement inscribes graph and casts up sum of vertical irregularities.

PAVEMENTS, ASPHALT

SAND-ASPHALT. Development of Bituminous Base and Sand-Asphalt Pavements, E. R. Oldbrich. Highway Engr. & Contractor, vol. 10, no. 2, Feb. 1924, pp. 55-60, 11 figs. Describes methods and costs in North Carolina. See also Eng. & Contracting (Roads & Streets), vol. 61, no. 2, Feb. 6, 1924, pp. 331-336, 4 figs.

PETROLEUM

PROGRESS, SURVEY. Survey of Petroleum Progress. Min. & Metallurgy, vol. 5, no. 207, Mar. 1924, pp. 132-137, 7 figs. Abstracts from symposium as follows: Alamo Pool, Mexico; World's Oil Production; Vanadium in Petroleum, E. S. Porter; Persia, E. DeGolyer; Argentine Development in 1923, C. W. Washburne; Settling Boxes for Rotary Mud, A. Knapp; Smith Pool, Seminole, County, Okla, S. Powers; Research in microfaunas; Cromwell Pool, Seminole County, Okla, S. Powers; Removal of Paraffin from Oil Wells.

PIERS

CONCRETE, PRECAST. Bremerton Navy Yard Pier Built of Precast Concrete, W. F. Way. Eng. News-Rec., vol. 92, no. 11, Mar. 13, 1924, pp. 436-440, 8 figs. Design avoids delays and dangers that menace concrete while setting in tidewater; beams, girder sides and cylinders with bell ends cast in yard.

PNEUMATIC CONCRETING OF CYLINDERS. Foundation Cylinders Concreted by Pneumatic Method, W. F. Way. Eng. News-Rec., vol. 92, no. 12, Mar. 20, 1924, pp. 479-480, 3 figs. Combination concrete lock and manway inserted in top of concrete cylinder and made tight with rubber skirt.

PIPE

JOINTS. The Victaulic System of Pipe Jointing. Engineering, vol. 117, no. 3033, Feb. 15, 1924, pp. 205-206, 4 figs. Describes modifications in Victaulic joint since first put on market and its advantageous features, among which is its flexibility.

LEAD-LINED. Making Lead-Lined Pipe. Chem. & Met. Eng., vol. 30, no. 9, Mar. 1, 1924, pp. 351-353, 5 figs. How piping and valves are produced so that they possess both chemical resistivity of lead and strength of iron.

THERMAL EFFICIENCY AND DIAMETER. Thermal Efficiency and Pipe Diameter (Wärmeleistung und Rohrdurchmesser), H. Fichtl. Gesundheits-Ingenieur, vol. 47, no. 4, Jan. 26, 1924, pp. 25-26, 3 figs. Calculation of hourly heat abstraction from pipe from its diameter.

PIPE, CAST-IRON

CENSUS OF MANUFACTURES. Cast-Iron Pipe. U. S. Bur. Census, 1923, 7 pp. Census of manufactures, covering operations of manufacturing establishments during 1921.

PIPE COVERINGS

STEAM-PIPE. Radiation Losses. Eng. & Boiler House Rev. vol. 37, no. 8, Mar. 1924, pp. 286-287, 2 figs. Saving to be effected by suitable and efficient steam pipe covering.

PIPE, STEEL

FAILURE. High-Head Penstock Failure Found Due to Bad Steel. Power, vol. 59, no. 10, Mar. 4, 1924, pp. 373-374, 1 fig. Section of 30-in. pipe for 1909-ft. head ruptures through laminated end of plate; welds not affected.

PLATES

CAST-IRON, PRODUCTION OF. Making Large Cast-Iron Plates, F. C. Edwards. Metal Industry (Lond.), vol. 24, no. 7, Feb. 15, 1924, pp. 153-154, 2 figs. Describes practice successfully followed at a foundry where large quantities are made.

POLES, WOODEN

PRESERVATIVE TREATMENT. Swedish Methods of Impregnating Poles, E. Hedenlund. Elec. World, vol. 83, no. 8, Feb. 23, 1924, pp. 373-375, 4 figs. New method involves charring pole and then treating it with creosote; relation between value of increased life and cost of impregnation; details of processes used in Sweden and conclusions as to best methods.

POLISHING

TUMBLING AND BURNISHING. Tumbling and Burnishing, B. G. Krause. Machy. (N. Y.), vol. 30, no. 7, Mar. 1924, pp. 501-502, 1 fig. Types of tumbling barrels; tumbling media or materials; ball-burnishing practice; plating and japanning; examples of work suitable for tumbling and burnishing.

POTASH

EXTRACTION FROM ORTHOCLASE FELDSPAR. A Study of the Extraction of Potash From Orthoclase Feldspar by Carbon Dioxide and Sulphur Dioxide, E. F. Whyse. Nova Scotian Inst. Sci.-Proc. & Trans., vol. 15, Pt. 3-4, Nov. 1923, 145-151. Historical review; description of method; results of experiments and brief description of apparatus used.

MANUFACTURE FROM LEUCITE. The Manufacture of Potash and Other Salts from Leucite, J. W. Hinchley. Chem. & Industry, vol. 43, no. 7, Feb. 15, 1924, pp. 158-165 and (discussion) 165-168, 5 figs. Discusses use of leucite, found principally along line of Italian volcanoes, as raw material for manufacture of potash salts.

POWER GENERATION

ECONOMICAL OPERATION. Increasing Efficiencies in Power Generation, R. W. Angus, Power House, vol. 17, no. 4, Feb. 20, 1924, pp. 22-24, 3 figs. Improvements in economical operation of power by steam; modern trend to be toward higher pressures with less superheat, and multi-stage feedwater heating processes.

PRESSWORK

DRAWING-PRESS TOOLS. The Calculation of Draw-Press Tools (Die Berechnung von Ziehwerkzeugen), W. Sellin, Maschinenbau, vol. 3, no. 9, Feb. 14, 1924, pp. 229-235, 10 figs. Discusses most accurate method of determining diameter of blank; calculation of punch diameter; development of proper relation between diameter of shell and drawing depth.

PRESSED-METAL PRODUCTION. Pressed-Metal Engineering, D. P. Cook. Mech. Eng., vol. 46, no. 3, Mar. 1924, pp. 123-128, 12 figs. Diversity and complexity of process; rapid growth of industry; lack of engineering standards and information; possibilities and limitations of press production; examples of pressed-metal design. (Abridged.)

PULVERIZED COAL

BOILER FIRING WITH. An Investigation of Powdered Coal As Fuel for Power-Plant Boilers, H. Kreisinger, J. Blizard, C. E. Augustine and B. J. Cross. U. S. Bur. Mines, Bul. 223, 1923, 90 pp., 48 figs. Results of 36 tests made on a 468-hp. Edge Moor boiler fired with pulverized coal at Oneida St. Station of Milwaukee Elec. Ry. & Light Co., Milwaukee, Wis., to determine what overall boiler efficiency could be obtained with pulverized coal under various conditions of furnace operation and with coal of different fineness and moisture content.

COMBUSTION. The Combustion of Pulverized Coal, E. Audibert. Fuel, vol. 3, no. 13, Feb. 1924, pp. 56-62, 4 figs. Account of results obtained in research carried out by Le Comité Central des Houillères de France; experimental arrangements; duration of combustion; inflammation of dust clouds; combustion chamber.

VELOCITY OF PARTICLES FALLING IN AIR. The Terminal Velocity of Particles of Powdered Coal Falling in Air or Other Viscous Fluid., J. Blizard. Franklin Inst. Jl., vol. 197, no. 2, Feb. 1924, pp. 199-208, 1 fig. Shows how velocity is affected by size and density of particle and density and viscosity of gaseous medium in which it falls. Terminal velocity acquired by a particle of powdered coal falling in combustion chamber of a furnace is important factor determining rate at which particle burns, for the higher the velocity the more rapidly will a fresh supply of oxygen be brought to its surface. Conclusions reached applicable to estimation of velocity with which small particles other than coal fall in fluids.

PUMPING PLANTS

MILLION-GALLON, FOR RAILWAY SERVICE. Southern Pacific Completes Million Gallon Pumping Plant. Ry. Eng. & Maintenance, vol. 20, no. 3, Mar. 1924, pp. 105-107, 5 figs. Large air-lift system at El Paso proves big improvement over prior arrangement.

PUMPS

GASOLINE. The "Shell" Kerbside Petrol Pump. Engineering, vol. 117, no. 3036, Mar. 7, 1924, pp. 301-304, 10 figs. Gasoline is raised from underground tank by hand-operated, semi-rotary pump and delivered into one or other of two measuring vessels, or containers, through four-way plug cock.

R

RADIOTELEGRAPHY

RECEPTION. The Relations between Damping and Speed in Wireless Reception, L. B. Turner. Instn. Elec. Engrs. Jl., vol. 62, no. 326, Feb. 1924, pp. 192-201 and (discussion) 202-207, 17 figs. Examination of ordinary method of recorder working in radiotelegraphic receivers, as affected by damping of receiver circuits; significances of decrement of any oscillatory system, and its bearing on possible speed of recording Morse signals; improved method of reception, called receiver curbing is described and analized.

RADIOTELEPHONY

BROADCASTING STATIONS. Radio Broadcasting Station KGO, General Electric Company, Oakland, California, A. Stein, Jr. Gen. Elec. Rev., vol. 27, no. 3, Mar. 1924, pp. 151-163, 42 figs. Description of antenna system, power station, control room and studio.

LOUD-SPEAKER HORNS. The Function and Design of Horns for Loud Speakers, C. R. Hanna and J. Slepian. Am. Inst. Elec. Engrs. Jl., vol. 43, no. 3, Mar. 1924, pp. 250-256, 10 figs. Discusses function of horn and design of horn to perform this function in best way; gives proof to show that exponential increase in section gives best results appendix gives analytical solution of sound propagation in exponential horns; formulas are developed which make possible design of horns.

SIGNALING SYSTEM. Radio Telephone Signaling, Chas. S. Demarest, M. L. Almquist and L. M. Clement. Am. Inst. Elec. Engrs. Jl., vol. 43, no. 3, Mar. 1924, pp. 210-218, 26 figs. Describes signaling system which serves to extend to field of radiotelephony same sort of calling facilities as are now available in wire telephony; by its means radio attendants or subscribers are enabled to signal each other without requiring that called party should have to listen with receiver system is intercommunicating with capacity for large number of stations on one wavelength; fields of usefulness, characteristics and apparatus employed.

SOUND-TRANSMISSION SYSTEMS. High Quality Transmission and Reproduction of Speech and Music, W. H. Martin and H. Fletcher. Am. Inst. Elec. Engrs. Jl., vol. 43, no. 3, Mar. 1924, pp. 230-238, 10 figs. General requirements for such transmission systems, and factors to be considered in design and operation; extent to which desired results can be obtained with means now available.

RAILS

CORRUGATION. Rail Corrugation Experience. Elec. Ry. Jl., vol. 63, no. 7, Feb. 16, 1924, pp. 255-260, 7 figs.
Survey of railways in various parts of United States, giving new data as to extent of this trouble; practices followed in removing and cost, and comments as to causes.

JOINT WELDING. Investigation of Seam Welded Rail Joints, R. B. Fehr. Am. Welding Soc. Jl., vol. 3, no. 1, Jan. 1924, pp. 28-60, 17 figs. Results of investigation along following lines: Functions of seam welded rail joints and stresses to which they are subjected; improvements in joint structure and welding processes; development of practical method for making accelerated tests on seam-welded joints; and comparative tests on seam-welded joints in which variations have been made in either mechanical structure or welding process.
Progress Report No. 2 of Committee on Welded Rail Joints. Am. Welding Soc. Jl., vol. 3, no. 2, Feb. 1924, pp. 48-88, 28 figs. Report of committee organized by Am. Elec. Ry. Assn. and Am. Bur. of Welding, to investigate various types of welded rail joints in commercial use. Summary of tests.

WHEEL THRUST ON. Otheograph Records of Steam and Electric Locomotives, P. M. Gillilan. Gen. Elec. Rev., vol. 27, no. 3, Mar. 1924, pp. 179-181, 7 figs. Notes on a device for recording thrust on rails by each separate wheel of a locomotive or motor car; shows by a graphic record amplitude and characteristic of both vertical and transverse thrust of all wheels on each tie. Describes records made.
Otheographic Records of Wheel Effects on Rails. Eng. News-Rec., vol. 92, no. 11, Mar. 13, 1924, pp. 441-442, 5 figs. Tests of electric and steam locomotives; charts show load and lateral thrust imposed by each passing wheel.

RAILWAY MAINTENANCE

EXPENSE ANALYSIS. Analysis of Equipment Maintenance Expenses, J. L. White. Ry. Age, vol. 76, no. 9, Mar. 1, 1924, pp. 507-510. Review information available in accounts and explains methods for its use.

RAILWAY MANAGEMENT

STORE-DEPARTMENT METHODS. Functions of the Store Department, U. K. Hall. New England Railroad Club, Jan. 8, 1924, pp. 214-225 and (discussion) 225-240. Discusses functions, including supply-train service, shop delivery, reclamation, etc.

RAILWAY MOTOR CARS

GASOLINE. Two-Unit Motor Train for Mississippi Central. Ry. Elec. Engr., vol. 15, no. 2, Feb. 1924, pp. 43-45. 3 figs. Description of two-car gasoline-driven train, built by Four Wheel Drive Auto Co., Clintonville, Wis., which will operate from Hattiesburg to Beaumont, Miss.; motor unit provides space for baggage and seats for 12 passengers, and trailer seats 34 passengers; electric lighting circuits patterned after standard automobile practice.

STEAM. The "Sentinel-Cammell" Steam Rail Coach in Service. Ry. Gaz., vol. 40, no. 9, Feb. 29, 1924, pp. 277-279, 7 figs. Results of a demonstration carried out on system of Jersey Rys. & Tramways Co. on Feb. 20, 1924. Economies effected since its introduction.

RAILWAY OPERATION

FUEL ECONOMY. Conservation of Fuel in Railway Operation, W. E. Symons. Ry. & Locomotive Eng., vol. 37, no. 2, Feb. 1924, pp. 41-49, 5 figs. Comparison of statistical items of 30 steam railways; hours of time each day under way earning revenue; locomotive improvements.

TRAIN CONTROL. Automatic Train-Control. Its Development and Status. Eng. News-Rec., vol. 92, no. 10, Mar. 6, 1924, pp. 390-394, 4 figs. Types of automatic apparatus to stop trains or to lower speed being installed by railroads under current order of Interstate Commerce Commission.
Train-Control Company Improves Air Apparatus. Ry. Elec. Engr., vol. 15, no. 3, Mar. 1924, pp. 81-83, 3 figs. Description of functions of the different pieces of pneumatic apparatus in train control system of Indiana Equipment Corp., of Indianapolis, Ind.; develops valves to give graduated reduction of brake pipe pressure.
Train Operation with Automatic Control, C. & O. Ry. Ry. Rev., vol. 74, no. 10, Mar. 8, 1924, pp. 449-461, 25 figs. Describes automatic train control, and signal system, both operated by alternating current; signals are three-indication color light automatic block signals of absolute-permissive type.

RAILWAY REPAIR SHOPS

LONDON UNDERGROUND RAILWAYS. The Acton Works of the Underground Railways. Engineer, vol. 137, no. 3555, Feb. 15, 1924, pp. 172-174, 8 figs. partly on p. 176. Details of central repair shop which will eventually serve for overhauling of rolling stock belonging to Metro. District, London Elec. & City and South and Central London railways. See also Ry. Gaz., vol. 40, no. 7, Feb. 15, 1924, pp. 195-202, 18 figs.; and Engineering. vol. 117, nos. 3033 and 3034, Feb. 15 and 22, 1924, pp. 195-202, and 229-234 and 240, 53 figs. partly on p. 208 and supp. plate.

RAILWAY SIGNALING

AUTOMATIC. Automatic Signals for a Railroad Grade Crossing. Ry. Age, vol. 76, no. 15, Mar. 15, 1924, pp. 735-738, 3 figs. Satisfactory for thin traffic; home and distant signals arranged on "normal danger" plan.

DEVELOPMENT. Development of Railway Signaling, K. E. Kellenberger. Ry. Signaling, vol. 17, no. 2, Feb. 1924, pp. 60-64, 5 figs. Discusses manual block and automatic block systems, interlocking, track circuit, recent developments in signaling, and automatic train control. Paper read before Springfield Engrs. Club.

INTERLOCKING. Operating Features of Electric Interlocking. Ry. Rev., vol. 74, no. 11, Mar. 15, 1924, pp. 510-515, 10 figs. Recent developments of this type mechanism which introduce refinements of detail contributing to operating efficiency.

RAILWAY TIES

COMPARISON OF TYPES. Railway Sleepers, F. H. Clark. Assn. Chinese & Am. Engrs.—Jl., vol. 4, no. 9, Nov. 1923, pp. 6-13. Present conditions in China; efforts made in other countries to secure better or less expensive supply of ties; how experience and research of other countries can be advantageously applied to conditions in China.

REINFORCED-CONCRETE. The Utilization of Reinforced-Concrete Ties (Utilisation de traverses en béton de ciment armé), M. Adam. Revue Générale des Chemins de Fer, vol. 43, no. 2, Feb. 1924, pp. 105-113, 9 figs. Discusses their employment for reducing maintenance expenses of secondary lines; experiences of the Orléans Co. with concrete ties on 21-km. line section between Hautefort and Terrasson.

STEEL, CORROSION OF. The Causes of Premature Failure of Ribbed Ties (Ueber die Ursachen der vorzeitigen Zerstörung von Rippenschwellen), R. Kühnel and G. Marzahn. Stahl u. Eisen, vol. 44, no. 7, Feb. 14, 1924, pp. 175-178, 4 figs. Describes nature of damages occurring in railway ties; chemical investigation; investigation of mechanical properties and of structure; main cause of corrosion is attributed to poor design; protection of ties against corrosion.

RAILWAY TRACK

CURVES. The Cubic Transition Railway Spiral. M. K. Rice-Oxley. Instn. Civ. Engrs.—Sessional Notices, no. 3, Feb. 1924, pp. 73-74. Author derives suitable curve and endeavors to show how it may be set out by rectangular offsets or by theodolite without use of tables or complicated formulas. (Abstract.)

CROSSINGS. Eliminating Grade Crossings by Highway Relocation, M. W. Torkelson. Eng. News-Rec., vol. 92, no. 10, Mar. 6, 1924, pp. 403-405, 1 fig. Wisconsin work in grade-crossing improvement; opposition of railroads; principles of cost apportionment should be established.

GRADE REDUCTION VS. HEAVIER POWER. Grade Reduction or Heavier Power. Ry. Rev., vol. 74, no. 11, Mar. 15, 1924, pp. 509-510. Appendix A. preliminary report of Committee on Economics of Railway Location, Am. Ry. Eng. Assn.

INSPECTION CAR. Track Inspection on the Erie R. R. Ry. Rev., vol. 74, no. 11. Mar. 15, 1924, pp. 503-508, 11 figs. Describes special car designed and built for better track inspection, by reconstructing a passenger car, and fitted with instruments which record all low joints, line and surface, gage and lurches; charts made by car are blueprinted and copies of their respective sections sent to track foremen to locate and correct defects recorded.

MAINTENANCE. How the Illinois Central Uses Labor More Efficiently, G. M. O'Rourke. Ry. Eng. & Maintenance, vol. 20, no. 3, Mar. 1924, pp. 99-100. Detailed programs, concentration on specific tasks, and analysis of methods increase output; how section work was scheduled; another method of making time studies.

SNOW-PROTECTING STRUCTURES. Snow-Protecting Structures for High Altitude Railways (Sneforhygninger paa Höifjeldsbaner), G. R. Lorange. Teknisk Ukeblad, vol. 17, nos. 5 and 6, Feb. 1 and 8, 1924, pp. 45-47 and 56-59, 17 figs. Describes a number of wooden structures designed to keep snow off railway tracks in very effective ways.

TRACK-BOLT SPECIFICATIONS. Specifications for Quenched Carbon Steel and Alloy Steel Track Bolts. Am. Ry. Eng. Assn.—Bul., vol. 25, no. 263, Jan. 1924, pp. 403-405. Specification covering materials, chemical and physical requirements, design and tolerance, manufacture, inspection, and marking.

RAILWAY YARDS

SWITCHING. A Proposed Catapult Switching Yard, F. W. Eagelston. Eng. & Contracting (Railways), vol. 61, no. 2, Feb. 20, 1924, pp. 409-414, 4 figs. Economic necessity of some radical improvement in present methods of switching freight cars. Description of novel process and means devised by author.

RAILWAYS

COMMITTEE REPORTS, A. R. E. A. American Railway Engineering Association Meeting. Eng. News-Rec., vol. 92, no. 12, Mar. 20, 1924, pp. 481-483. Review of reports on economics and standards; rails and joints; track material and maintenance; bridges and trestles; water and fuel supply, stations and buildings. See also Abstracts of Committee Reports, pp. 491-493.

EQUIPMENT DEPRECIATION. Depreciation of Railway Equipment, J. E. Muhlfeld. Ry. & Locomotive Eng., vol. 37, no. 2, Feb. 1924, pp. 41-49, 5 figs. Depreciation accounts; physical condition of composite properties such as locomotives and cars.

VALUATION. Railroad Valuation, A. Brief Survey, Wm. D. Pence. Eng. News-Rec., vol. 92, no. 10, Mar. 6, 1924, pp. 406-408. Outline sketch of origin and growth of valuation movement leading up to Federal Act, what has been achieved to date, and present-day prospects for useful outcome.

WATER PICK-UP SYSTEMS. Water Troughs on the Great Western Railway. Ry. Gaz., vol. 40, no. 6, Feb. 8, 1924, pp. 168-172, 6 figs. Standard permanent way with cross-ties used; troughs shaped with inturned edges at top to reduce splashing when water is being taken up by locomotive.

RAINFALL

RUN-OFF. Precipitation and Runoff Near the Condinental Divide, Rob. E. Horton. Eng. News-Rec., vol. 92, no. 9, Feb. 28, 1924, pp. 355-358, 4 figs. Study of records for basins mostly at elevation 9,000 ft. on both slopes of Colorado Rockies indicate that orientation and snowfall largely account for greatest runoff.

REFRACTORIES

CONDUCTIVITY AND SPECIFIC HEAT. Conductivity and Specific Heat of Refractories at High Temperatures, M. D. Hersey and E. W. Butzler. U. S. Bur. Mines, Reports of Investigations. No. 2564, Jan. 1924, 7 pp. General statement of problem, with results on Georgia firebrick to 1700 deg. fahr.

OPEN-HEARTH-FURNACE LININGS. Compare Steel Refractories, E. C. Kreutzberg. Foundry, vol. 52, no. 5, Mar. 1, 1924, pp. 175-176. Suggestions for improving qualities, methods of construction and maintenance of open-hearth furnace linings; problems of electric-furnace materials. Abstract from discussion at meeting of Am. Ceramic Soc.

REFUSE FIREBRICK, NEW USE FOR. New Use for Refuse Refractory Material, S. F. Walton. Iron Age, vol. 113, no. 11, Mar. 13, 1924, pp. 786-788, 4 figs. Old fireclay brickbats ground up with bond to form highly refractory mortar; cost reported low.

STEEL WORKS. Refractory Materials for Steelworks Chem. Age (Lond.), vol. 10, no. 242, Feb. 2, 1924, pp. 10-12, 4 figs. Their uses and essential properties they should possess in order to insure satisfactory results.

REFRIGERATING MACHINES

ABSORPTION. The Absorption Ice Machine, H. A. Cranford. Southern Engr., vol. 40, no. 6, and vol. 41, no. 1, Feb. and Mar. 1924, pp. 38-42 and 38-40, 9 figs. Pointers on purchasing; the various apparatus comprising the system; handling aqua-ammonia pump; packing, gaskets and supplies.

AIR. The Use of Cold Air as a Refrigerating Agent, M. Leblanc. Refrig. Eng., vol. 10, no. 8, Feb. 1924, pp. 309-313, 3 figs. Application to freezing of ice; decided departure from beaten path described and advantages of such a system enumerated and backed up with figures. From Revue Générale du Froid, Dec. 1922.

ETHYL-CHLORINE. An Ethyl Chloride Refrigerating Compressor, R. G. Reid. Ice & Cold Storage, vol. 27, no. 311, Feb. 1924, pp. 27-30, 3 figs. The ideal refrigerant; pros and cons of ethyl chloride; describes Peter Brotherhood, Ltd., vertical single-cylinder two-stage uniflow machine.

MODERN TYPES. Modern Refrigerating Machines, R. G. Reid. Inst. Mar. Engrs.—Trans., vol. 35, Feb. 1924, pp. 570-601 and (discussion) 601-607, 6 figs. Shows factors which have influenced adoption of high-speed compressor, describes some particular machines, and presents summary of tests taken from such machines on test bed in actual service.

REFRIGERATION

ABSORPTION SYSTEM. The Absorption Refrigerating System, H. J. Macintire. Power, vol. 59, no. 11, Mar. 11, 1924, pp. 399-401. Competition of compression system; refrigeration calculations; heat taken up in absorber.

INTERMITTENT SYSTEM. Intermittent System of Refrigeration, W. F. Schaphorst. Power Plant Eng., vol. 28, no. 6, Mar. 15, 1924, pp. 347-348, 2 figs. Describes refrigerating system which may be operated on off-peak boiler loads.

REFUSE DISPOSAL

INCINERATORS. Wilmington's New Incinerator, H. L. Maier. Pub. Wks., vol. 55, no. 2, Feb. 1924, pp. 56-58, 1 fig. Description of three-unit plant with capacity of 25 tons a day; result of a test run of five weeks, and of twelve months of service operation.

RESEARCH

INDUSTRIAL. Industrial Research as a Factor in Progress, A. W. Mellon. Chem. Age (N. Y.), vol. 32, no. 1, Jan. 1924, pp. 15-16. The role of industrial research in iron and steel, and-by-product coke industry; co-operation of industry witb organized research.

Scientific Work and Research in the Mechanical Industry (Ueber wissenschaftliche Arbeit und Forschung in der Maschinenindustrie), G. Lippart. Zeit. des Vereines deutscher Ingenieure, vol. 68, no. 5, Feb. 27, 1924, pp. 89-93. Discusses field of application of science in industry, and refers to conditions in United States as described by W. Rosenhain; discusses research work in mechanical industry in Germany and suggests ways of improving work of co-ordination between science and industry.

RIVERS

ST. LAWRENCE. The St. Lawrence River Problem, D. W. McLachlan. Eng. Jl., vol. 7, no. 3, Mar. 1924, pp. 119-141 and (discussion) 142-146, 25 figs. Important features of various projects for improvement of St. Lawrence River for power and navigation; international status; ice conditions; statement showing net heads obtainable in winter by various schemes considered; double development projects; possible modification of official plan; modification of plans for geographical system of dividing costs; economy of waterway project; practicability of waterway; calculations of future channel slopes in open season.

RIVETS

CUTTING WITH ELECTRIC ARC. Rivet Cutting with an Electric Arc. Ry. Rev., vol. 74, no. 7, Feb. 16, 1924, pp. 290-292, 6 figs. Describes equipment in use for burning off of rivets on steel cars and locomotive boilers and tender tanks at Huntington, W. Va., shops of Chesapeake & Ohio Ry.

ROADS

BITUMINOUS-SURFACE, MAINTENANCE OF. What is the Correct Method of Maintaining Bituminous Surfaces? E. A. James. Contract Rec. & Eng. Rev., vol. 38, no. 10, Mar. 5, 1924, pp. 246-248. Discusses surface treatment of macadam roads, surface maintenance of penetration roads and surface maintenance of hot-top pavements. See also Can. Engr., vol. 46, no. 10, Mar. 4, 1924, pp. 299-300 and 303, 1 fig.

EARTH, OIL FOR TREATMENT. Experimental Oiled Roads in Illinois, H. F. Clemer and F. L. Sperry. Eng. & Contracting (Roads & Streets), vol. 61, no. 3, Mar. 5, 1924, pp. 497-502, 3 figs. Results of tests in Henry and Christian counties of use of oil for treatment of earth roads.

ROADS, CONCRETE

CURING, CALCIUM CHLORIDE FOR. Cutting Down Curing Period for Concrete Roads, H. F. Clemmer. Eng. & Contracting (Roads & Streets), vol. 61, no. 2, Feb. 6, 1924, pp. 283-290, 5 figs. Results of investigation conducted by Bur. of Materials of Ill. Division of Highways on use of calcium chloride. Paper read before Am. Road Bldrs.' Assn.

SINGLE-TRACK. Advantages of Single Track Concrete Roads, A. M. Jackson. Can. Engr., vol. 46, no. 10, Mar. 4, 1924, pp. 304-305. Principal features of a concrete road built in Brant county, Ont.; one-half concrete and other half being gravel; construction methods; construction and maintenance costs. Paper read at Road Construction Conference. See also Can. Engr., vol. 38, no. 10, Mar. 5, 1924, pp. 241-243.

ROAD MACHINERY

TAMPING AND CONCRETE-BREAKING. Tamping and Concrete Breaking Machine. Engineer, vol. 137, no. 3557, Feb. 29, 1924, p. 236, 2 figs. Small machine intended for trenches up to 2 ft. wide; capable of breaking up 30 ft. run of concrete 2 ft. wide and 9 in. thick per hr.; can be machanically propelled, and can be easily moved forward and operated by one man.

S

SCREW THREADS

STUD FITTING. Modern Practice in Fitting Studs. Am. Mach., vol. 60, no. 9, Feb. 28, 1924, pp. 323-324. Résumé of methods used in securing satisfactory fits for studs in aluminum, bronze, cast iron and steel.

SEWAGE DISPOSAL

ACTIVATED SLUDGE, FILTRATION. The Filtration of Activated Sludge, F. W. Mohlman. Indus. & Eng. Chem., vol. 16, no. 3, Mar. 1924, pp. 225-227. Practical, simple method of treatment of activated sludge before filtration in use at plants and testing stations of Sanitary District of Chicago; procedure in use at each plant is discussed separately.

DIRECT OXIDATION. Direct Oxidation Tests at Toronto, F. A. Dallyn, G. A. Johnson and A. V. Delaporte. Can. Engr., vol. 46, no. 8, Feb. 19, 1924, pp. 243-254, 6 figs. Carried out under direction of Provincial Board of Health of Ontario at Experimental Station, Toronto; description of plant and method of conducting tests; conclusions based on experiments.

DISTRIBUTORS, POWER-DRIEVN SEWAGE. Distributors for Percolating Sewage Purification Beds. Engineer, vol. 138, no. 3556, Feb. 22, 1924, pp. 206-208, 6 figs. Describes latest type of power-driven sewage distributors supplied by Hartley, Sons & Co. for new disposal works at Leeds.

EJECTOR SYSTEM. Ejector System For Seware Disposal, J. J. Taylor. Compressed Air Mag., vol. 29, no. 2, Feb. 1924, pp. 782-786, 5 figs. Advantages of pumping by compressed air in this manner; design and operation.

SEDIMENTATION AND COAGULATING BASINS. New Sedimentation and Coagulating Basins at Toledo, Geo. N. Schoonmaker. Eng. News-Rec., vol. 92, no. 11, Mar. 13, 1924, pp. 443-446, 6 figs. Experience with old basins utilized in design of new structure: non-baffled units with controlled supply.

STANDARDIZATION

METHODS. Contribution to Methods of Standardization (Beschowingen over Normalisatie-methodiek), J. Goudriaan, Jr. Ingenieur, vol. 39, no. 3, Jan. 19, 1924, pp. 33-38, 6 figs. Theoretical investigation of most economical steps between successive sizes in series of standardized units. For practical reasons larger steps may be preferable..

STEAM

HIGH-PRESSURE. Properties and Utilization of High-and Maximum-Pressure Steam (Eigenschaften und Verwertung von Hoch- und Höchstdruckdampf), E. Josse. Zeit. des Vereines deut scher In genieure,vol. 68, no. 4, Jan. 26, 1924, pp. 65-71, 20 figs. Properties of ste am; treatment of maximum-pressure steam in reciprocating engines (Borsig) and steam turbines (de Laval, Brown-Boveri & Cie, Erste Brünner); feedwater heating through tapping steam; utilization of excess flue-gas heat.

MAXIMUM-PRESSURE. The Technical and Economic Prospects of Maximum-Pressure Steam (Die technischen und wirtschaftlichen Aussichten von Höchstdruckdampf), F. Münzinger. Zeit. des Vereines deutscher Ingenieure, vol. 68, no. 7, Feb. 16, 1924, pp. 137-146, 16 figs. Calculation of heating surfaces of boiler, superheater and economizer; generation of maximum-pressure steam; behavior of maximum-pressure boilers in operation; dependence of boiler feedwater on steam pressure; new heat-economic problems.

STEAM ENGINES

HEAT ECONOMY IN. Heat Economy in Reciprocating Steam Engines (Wärmewirtschaft in der Kolbendampfmaschine), A. Christ. Praktischer Maschinen-Konstrukteur, vol. 57, no. 5, Feb. 5, 1924, pp. 31-33, 2 figs. Supplementary to first part of article published in no. 48-49, 1923, further tests and improvements are described.

STEAM POWER PLANTS

AUXILIARY POWER LAYOUTS. Energy Supply for Station Auxiliaries, F. M. Billheimer. Elec. World, vol. 83, no. 8, Feb. 23, 1924, pp. 377-380, 10 figs. Reliable service under all operating conditions sought; effect of heat balance and bleeding on layouts; discussion of systems proposed and used.

DETROIT LUBRICATOR CO. Power Plant of the Detroit Lubricator Company, C. K. Little. Power, vol. 59, no. 9, Feb. 26, 1924, pp. 316-321, 6 figs. New plant has two bent-tube boilers of 2360 sq. ft. of heating surface each wbich are on second floor of building, with inside coal storage directly above stokers; details of cooling-water supply; cost of machinery.

DEVELOPMENTS. A Resumc of Recent Power-Station Developments, J. H. Lawrence. Mech. Eng., vol. 46, no. 3, Mar. 1924, pp. 144-145; Brief review of important developments.

SALT-MANUFACTURING PLANT. Salt Manufacturer Installs 3625 Kw. Power Plant Eng., vol. 28, no. 6, Mar. 15, 1924, pp. 317-322, 12 figs. New power plant of Ruggles & Rademaker for furnishing electricity, high and low pressure steam and compressed air; boilers are set singly; conveyor controls are inter-connected.

STEAM COSTS. Comparative Analysis of Steam Costs, C. J. Mason. Nat. Engr., vol. 28, no. 3, Mar. 1924, pp. 108-109, 1 fig. How to determine whether privately generated or purchased steam is more economical.

STEAM TURBINES

LUBRICATION. Correct Lubrication for the Steam Turbine, C. C. Brown. Power Plant Eng., vol. 28, no. 6, Mar. 15, 1924, pp. 323-325. Operating methods, causes for breaking down of oil and specifications for suitable oils are discussed.

PRESSURE AND VELOCITY. Relation of Pressure and Velociiy in Various Types of Steam Turbines, F. P. Hodgkinson. Power, vol. 59, no. 12, Mar. 18, 1924, pp. 444-445, 3 figs. Describes variation in steam pressures and velocity for various types of turbine stages.

BINARY CYCLES USING MERCURY. The Binary Cycles Using Mercury and Steam, A. M. Greene, Jr. Mech. Eng., vol. 46, no. 3, Mar. 1924, pp. 142-144, 3 figs. It is shown why mercury is a better substance thermodynamically than water at certain points; presents diagrams of temperature and entropy.

STEEL

CHROME NICKEL. *See Chrome Nickel Steel.*

CORROSION, NATURAL WATER. The Natural Water Corrosion of Steel in Contact with Copper, W. G. Whitman and R. P. Russell. Indus. & Eng. Chem., vol. 16, no. 3, Mar. 1924, pp. 276-279, 1 fig. Experiments wherein natural-water corrosion of steel in contact with metal lower in electromotive series has been quantitatively determined; emphasizes importance of these quantitative data in deciding as to mechanism of corrosion of steel from both theoretical and practical viewpoints.

TOOL. *See Tool Steel.*

STEEL CASTINGS

CARBON VANADIUM. Carbon and Carbon-Vanadium Steel Castings — A Comparison, J. M. Lessells. Am. Soc. Steel Treating—Trans., vol. 5, no. 2, Feb. 1924, pp. 144-152 and (discussion) 152-157, 7 figs. Physical properties of carbon and carbon-vanadium steel castings as obtained from coupon test pieces in cast, annealed and normalized conditions; evidence is given to show that addition of vanadium as alloying element greatly improves quality of material.

STEEL, HEAT TREATMENT OF

HARDENING, SELECTIVE. A Shop Talk on Selective Hardening Methods. Can. Machy., vol. 31, no. 9, Feb. 28, 1924, pp. 23 and 36, 2 figs. Discusses methods available, viz., selective quenching, selective heating, and selective surface exposure.

NICKEL-STEEL CARBURIZATION. Heat-treatment of Steel with Special Reference to Production, J. W. Urquhart. Machy, (Lond.), vol. 23, no. 595, Feb. 21, 1924, pp. 681-684, 4 figs. Carburization of nickel steels.

STEEL MANUFACTURE

BASIC STEEL, METAL MIXER PRACTICE FOR. Metal Mixer Practice and Basic Steel Making, T. P. Colclough. Chem. Age (Lond.), vol. 10, no. 246, Mar. 1, 1924, pp. 18-19. Advantages derived from use of mixer. Used as preliminary refining furnaces, limestone, and oxide of iron, in form of iron ore or tap cinder, being charged as required, and in this way a large proportion of impurities is removed; effects of this purification of pig iron on operation of open-hearth furnaces.

High-Quality Steel. Fundamentals Essential to Improved Quality Steel Production, Em. Gathmann. Am. Soc. Steel Treating—Trans., vol. 5, no. 2, Feb. 1924, pp. 158-168, 4 figs. Fundamentals essential to high-quality steel production and certain improved ingot molds and appliances, whereby tonnage production of sound steel has been made possible and practicable; in author's belief, one of fundamentals is use of big-end-up or inverted pyramidal ingot, in combination with other fundamental practice as described in detail.

Open-Hearth-Furnace. Absorption of Sulfur from Producer Gas in Open-hearth Furnaces, J. H. Nead. Am. Inst. Min. & Met. Engrs.—Trans., No. 1298-S. Feb. 1924, 10 pp., 2 figs. Results obtained from two Armco ingot iron heats; absorption occurs during melting-down stage.

Rate of Cooling in Ingot Molds. Effect on Steel of Variations in Rate of Cooling in Ingot Molds, W. J. Priestley. Am. Inst. Min. & Met. Engrs.—Trans., no. 1236-S. Feb. 1924, 56 pp., 49 figs. Shows, by practical experiments, how rate of cooling steel in mold governs ingotism, segregation, formation of dendrites and distribution of intergranular material, and resulting effect these conditions have on physical qualities of steel before annealing, after annealing, and after forging. How structure of steel is effected by design of mold and method of pouring.

STOKERS

Underfeed. How the Modern Underfeed Stoker Works, and Why, Jos. G. Worker. Coal Age, vol. 25, no. 10, Mar. 6, 1924, pp. 347-349, 5 figs. Number of underfeed stokers has increased rapidly; what special features in design have been introduced for burning Western coals; progresses of ash in fire must be given serious consideration. (Abstract.) Paper read before Chicago Section, A.S.M.E.

Underfeed Stokers, J. G. Worker. Refrig. Eng., vol. 10, no. 8, Feb. 1924, pp. 295-304 and (discussion) 304-305 and 309, 21 figs. Description of some types (both multiple and single-retort) now being used in United States; performance and coal conditions; height to set boilers.

STREET RAILWAYS

Carhouses. Carhouse for 100 Cars at Louisville, F. H. Miller. Elec. Ry. Jl., vol. 63, no. 11, Mar. 15. 1924, pp. 403-406, 10 figs. Describes new structure, which replaces carhouse burned last year, of reinforced concrete with full sprinkler equipment; through tracks facilitate car movement; novel type of double skeleton pits and facilities for car washing.

Cars. Brooklyn's "Duplex Car" Placed in Service. Elec. Ry. Jl., vol. 63, no. 7, Feb. 16, 1924, pp. 252-255, 8 figs. Two-unit, three-truck, car, 63 ft. 10 in. overall, built by Brooklyn-Manhattan Transit Corp.; has novel center construction with weather-tight drum to permit free passage between the two sections.

Three-Car Articulated Train. Three-Car Articulated Train for Detroit, A. C. Colby. Elec. Ry. Jl., vol. 63, no. 10, Mar. 8, 1924, pp. 357-362, 12 figs. Articulated construction reduces weight and cost and also gives improved riding qualities; seating capacity is 140 passengers; many unusual features of design.

Track Reconstruction. Reconstructing Track For $7.72 Per Lineal Foot. Elec. Traction, vol. 20, no. 2, Feb. 1924, pp. 85-87, 6 figs. How Oklahoma Ry. Co. reconstructed 3,500 ft. of double track at low cost; modern methods employed.

STRESSES

Distribution in Rotating Gear Pinions. Stress Distribution in Rotating Gear Pinions as Determined by the Photoelastic Method, P. Meumans and A. L. Kimball, Jr. Mech. Eng., vol. 46, no. 3, Mar. 1924, pp. 129-130 and (discussion) 130-132 and 171, 6 figs. Further results of scientific study undertaken by Gen. Elec. Co. for development of superior electric-railway motor pinions; continuation of work started and reported upon before A.S.M.E. in preceding year; results from preliminary observations.

STRUCTURAL STEEL

Erecting Cost Estimation. Estimating the Cost of Erecting Structural Steel and Iron Work, C. F. Dingman. Contract Rec. & Eng. Rev., vol. 38, no. 7, Feb. 13, 1924, pp. 155-157. Practical data that will enable contractor to bid intelligently on steel erection; cost of installing and glazing steel sash; method of listing items.

SUBSTATIONS

Automatic. New Features of St. Louis Automatics. Elec. Ry. Jl., vol. 63, no. 7, Feb. 16, 1924, pp. 249-252, 4 figs. Particulars of five substations installed by United Rys. of St. Louis; forced ventilation and duplicate power lines; units chosen for full load operation with provision for exchanging equipment to obtain future increased capacity.

Semi-Automatic. Semi-Automatic Substation at Concord. Elec. Ry. Jl., vol. 63, no. 9, Mar. 1, 1924, pp. 321-323, 7 figs. Describes installation of Concord Elect. Rys., Concord, N. H., an improvement over earlier one of smaller capacity destroyed by fire; hasingting of 500 kw.; needs only to be started in morning.

SUBWAYS

Construction Methods, Rochester, N. Y. Construction Methods on the Rochester Subway. Eng. News Rec., vol. 92, no. 9, Feb. 28, 1924, pp. 350-354, 11 figs. In converting old Erie Canal bed for passenger subway, line drilling was economic substitute for channelling; dry-batch haulage to mixing and chuting plant on car; excavation methods; concrete subway construction.

SUPERPOWER

Isolated Station vs. Superpower vs. Coal Conservation, E. Douglas. Power, vol. 59, no. 12, Mar. 18, 1924, pp. 448-449. Points out that panacea of all troubles does not lie with superpower, nor will isolated plant be best solution in all cases, but a combination of the two with proper consideration given to both power and heating, as well as use of steam for industrial purposes, will be intelligent solution. (Abstract.) Paper read before Wis. Eng. Soc.

Significance of. Super Power, S. Q. Hayes. Indus. Mgt. (N. Y.), vol. 67, no. 3, Mar. 1924, pp. 136-138. What it means and what it will accomplish.

SURVEYING

Aerial Photography. Transmission Line Work Aided by Aerial Survey, F. A. Allner and J. R. Baker. Eng. News-Rec., vol. 92, no. 9, Feb. 28, 1924, pp. 360-363 1 fig. Advantages and limitations of air mapping accuragely evaluated in two high-tension lines in Pennsylvania; aerial survey cost less than $50 per mile.

T

TERMINALS, LOCOMOTIVE

Richmond, Va. Advanced Design in New Engine Terminal. Ry. Age, vol. 76, no. 9, Mar. 1, 1924, pp. 492-499, 17 figs. Layout, outside facilities and buildings of terminal recently completed at Richmond, Va. by R. F. & P.

See also Ry. Rev., vol. 74, no. 10, Mar. 8, 1924, pp. 399-412, 32 figs.

TERMINALS, RAILWAY

Passenger. Progress on the Chicago Union Station. Ry. Rev., vol. 74, no. 10, Mar. 8, 1924, pp. 416-422, 10 figs. Description of important passenger tunnel; will be in service late in 1924 and will be completed in 1925.

Ports. Study of a Large Terminal Develops Basic Data, J. R. Bibbins. Ry. Age, vol. 76, no. 8, Feb. 23, 1924, pp. 463-465, 2 figs. Origin-destination survey made at New Orleans may be applied to other large railway centers.

TESTS AND TESTING

Shop Methods. Test Methods for the Shop, D. A. Hampson. Am. Mach., vol. 60, no. 9, Feb. 28, 1924, pp. 325-328, 7 figs. Usual shop tests; use of revolution counter, spring balance, platform scale and Bourdon gage; checking instruments.

TEXTILE MILLS

Electric Drive. Electricity in Textile Mills. Electrician, vol. 92, no. 2389, Feb. 29, 1924, pp. 252-200, 17 figs. Six articles, discussing advantages of electric drive for textile mills, use of electricity for driving flax spinning mills, selecting motors for cotton mills, replacing steam with electric drive without cessation of production in carpet mill, special points in converting equipment to electric drive in fabric-printing works, and a Swiss spinning mill fitted with Oerlikon drives.

TIRES, RUBBER

Molds and Forms for. How Automobile Tire Molds Are Made, Chas. O. Herb. Machy. (N. Y.), vol. 30, no. 7, Mar. 1924, pp. 497-500, 9 figs. Turning and boring mold and form, and engraving tread design in mold.

TOOL STEEL

Time and Temperature, Effects of. The Effects of Time and Temperature on Certain Special Steels, W. E. Woodward. West of Scotland Iron & Steel Inst. — Jl., vol. 31, part 2, Nov., Session 1923-24, pp. 32-34 and (discussion) 35-39, 23 figs. on supp. plates. Describes work undertaken to see if some modern steels said to be suitable for high-speed steel tools would exhibit some phenomena which might afford clue as to their reputed properties; use of Landon dilato-meter for measuring expansion and contraction of moderately sized specimens.

TOOLS

Cutter Heads. A New Cutter Head for Locomotive Shops (Ein neuer Messerkopf für Lokomotiv-Werkstätten), Trautvetter. Glasers Annalen, vol. 94, no. 2, Jan. 15, 1924, pp. 21-23, 5 figs. Describes new Triplex cutter block for drilling holes in smoke and water tubes.

Pattern Work and Drafting. Tool Engineering, A. A. Dowd. Am. Mach., vol. 60, nos. 11 and 12, Mar. 13 and 20, 1924, pp. 407-409 and 443-445, 8 figs. Mar. 13: Points on pattern work for tool designer; use of cores and loose pieces; importance of fillets. Mar. 20: Organization of tool-drafting department; method of keeping record of drawings.

Stellite. Recent Results Obtained with Stellite Tools (Neue Ergebnisse mit Stellitwerkzeugen), H. Märkle. Maschinenbau, vol. 3, no. 9, Feb. 14, 1924, pp. 235-237. Favorable results of recent tests.

TRANSFORMERS

Large-Capacity. Some High Points on Modern Transformers, A. Palme. Power, vol. 59, no. 11, Mar. 11, 1924, pp. 402-403, 7 figs. Few examples of recently built large-capacity transformers, together with short description of their salient features.

Open-Delta Operation. Open-Delta Transformer Operation, A. Boyajian. Elec. World, vol. 83, no. 9, Mar. 1, 1924, pp. 417-418, 5 figs. Advantages and disadvantages of this connection from operating and commercial stand-points; method for computing regulation and capacity; correction for voltage unbalances.

Telephone. Telephone Transformers, W. L. Casper. Am. Inst. Elec. Engrs. Jl., vol. 43, no. 3, Mar. 1924, pp. 197-209, 22 figs. Discusses frequency range over which telephone transformers must operate efficiently in transferring energy between two circuits and three most common limiting impedance combinations of these circuits; shows mechanical construction of various transformers which are constructed so as to give desired accuracy of speech transmission under their particular circuit conditions.

Testing. Methods for Testing Current Transformers, F. B. Silsbee. Am. Inst. Elec. Engrs. Jl., vol. 43, no. 3, Mar. 1924, pp. 239-249, 6 figs. Critical discussion of various possible methods with data as to advantages and disadvantages of each; eleven distinct methods are described and supplementary suggestions are made concerning various types of detecting instruments, etc.

TELEPHONY

Automatic. Automatic Switching of Toll Traffic, A. B. Smith. West. Soc. Engrs. Jl., vol. 29, no. 2, Feb. 1924, pp. 45-64, 24 figs. Means which are used in setting up toll telephone connections by automatic switches; historical development and present status of this branch of telephony.

TELESCOPES

60-In. Reflecting. A New 60-In. Telescope for Perkins Observatory, Ohio Wesleyan University. Mech. Eng., vol. 46, no. 3, Mar. 1924, pp. 113-117 and 147, 8 figs. Describes reflecting telescope built by Warner & Swasey Co., Cleveland, and gives details of tube, polar axis, declination axis, driving clock and electric control.

TUBES

Heat Dissipation from Surfaces. Heat Dissipation from the Surfaces of Pipes and Cylinders in an Air Current, A. H. Gibson. Lond., Edinburgh, & Dublin Philosophical Mag. & Jl. Sci., vol. 47, no. 278, Feb. 1924, pp. 324-336, 4 figs. Experiments carried out with view of obtaining data as to rate of heat dissipation from tubular metal surfaces adaptable as oil coolers for aircraft.

Secondary Failure. On the Secondary Failure of Thin Tubes of Circular Section subjected to Terminal Couples, M. S. Ahmed. Lond., Edinburgh, & Dublin Philosophical Mag. & Jl. Sci., vol. 47, no. 278, Feb. 1924, pp. 319-323, 3 figs. Investigation to determine under what conditions secondary stresses due to deformation of cross-section into oval shape exceed primary stresses found on ordinary theory of pure bending.

TUNNELS

Arthur's Pass, New Zealand. Arthur's Pass Tunnel in New Zealand Completed, F. W. Furkert. Eng. News-Rec., vol. 92, no. 10, Mar. 6, 1924, pp. 395-396, 3 figs. Tunnel 5.3 mi. long to connect east and west coasts of South Island; 3½-ft. gage; single track.

TUNNELING

Moffat Tunnel, Colo. Progress on the Moffat Tunnel Through the Rockies. Eng. News-Rec., vol. 92, no. 10, Mar. 6, 1924, p. 402, 1 fig. Headings on both pioneer and main bores total 2,920 ft.; daily average 12 ft. per heading; construction plant.

TURBO-GENERATORS

Cooling. The Multiple-Radial System of Cooling Large Turbo-Generators, D. Bratt. Am. Inst. Elec. Engrs. Jl., vol. 43, no. 3, Mar. 1924, pp. 185-193, 7 figs. Discusses theoretical basis of special turbo-generator ventilation system, in which cooling air divides into several branches, and passes through stator core radially in and out; analysis of fundamental questions in regard to flow of air in any ventilation system; numerical example is worked out to show application of derived formulas.

TESTING. The Testing of Turbo-Generating and Turbo-Compressing Plant, W. H. Badger. S. African Inst. Elec. Engrs. — Trans., vol. 14, Pt. 2, Nov. 1923, pp. 200-237, 20 figs. Measurement of head, rate of flow and electrical output; turbines on system and precautions necessary when testing; Willian's line; application of nozzle discharge calculations, vacuum temperature, superheat and pressure corrections; aberration of turbines; supersaturation of steam; turbine maintenance; etc.

V

VALVES

SUPERHEATED-STEAM AND HIGH-PRESSURE. Modern Superheated-Steam and High-Pressure Valves (Neuere Heissdampf- und Hochdruckschieber), G. W. Koehler. Zeit. des Vereines deutscher Ingenieure, vol. 68, no. 5, Feb. 2, 1924, pp. 95-100, 22 figs. Deals, with valves with simple and with two parallel seats and emphasizes advantage of auxiliary valve, which is automatically set in action by tightening of valve stem; deals also with flap valves, and points out their advantages.

VIBRATIONS

MACHINERY, ISOLATION OF. The Isolation of Machinery Vibration and Noise. Machy. Market, no. 1214, Feb. 8, 1924, pp. 23-24, 2 figs. Describes effect of patent anti-vibration devices and "Coresil" foundation plates.

MECHANICAL. The Vibration Problem in Engineering, R. Soderberg. Elec. Jl., vol. 21, nos. 1, 2 and 3, Jan., Feb. and Mar., 1924, pp. 39-43, 53-55 and 89-97, 21 figs. Fundamental facts underlying problem of vibration, its general effects and methods usually employed in preventing and curing vibration troubles; review of theory; mechanical balancing.

VISCOMETERS

CAPILLARY-TUBE. Capillary Tube Viscometers, G. Barr. Jl. of Sci. Instruments, vol. 1, nos. 3 and 4, Dec. 1923 and Jan. 1924, pp. 81-86 and 111-116, 2 figs. Principles underlying construction and use of viscometers in which viscosity of a liquid relative to that of some standard is estimated from resistance offered by a tube to flow of liquid through it.

VENTILATION

STILL-AIR CONDITIONS, TEMPERATURES FOR. Effective Temperatures for Still Air Conditions and Their Application to Mining, F. C. Houghten, C. P. Yaglaglou and R. R. Sayers. U. S. Bur. Mines, Reports of Investigations, No. 2,563, Jan. 1924, 10 pp., 8 figs. on supp. plates. Results of experiments made under carefully controlled conditions to determine relative feeling of warmth experienced by men in atmospheres of various degrees of temperature and humidity.

W

WATER FILTRATION

PLANTS. Mechanical Filtration Plant, Lauzon, Que., H. G. Hunter. Can. Engr., vol. 46, no. 9, Feb. 26, 1924, pp. 279-280, 3 figs. Description of plant having capacity of 1,000,000 gal. per day; comprises low—and high—lift De Laval pumps, coagulating and clear water basins, and mechanical gravity filters; supply from St. Lawrence River.

New Filtration Plant for Border Cities W. Storrie. Can. Engr. vol. 46, No. 12, Mar. 11, 1924, pp. 315-316, 1 fig. Layout of water purification plant now under construction at Ford, Ont., which will serve seven municipalities and will have a capacity of 20,000,000 gal. per day, and notes on reinforced-concrete reservoir.

WATER-POWER

ECONOMIC UTILIZATION, SWITZERLAND. The Consumption of Energy from Hydroelectric Plants in Switzerland and the Utilization of Water-Power Sources (Ueber die Verhältnisse des Energieabsatzes aus den hydroelektrischen Werken in der Schwiez, etc.), W. Wyssling. Schweiz. Elektrotechnischer Verein—Bul., vol. 15, no. 1, Jan. 1924, pp. 1-28, 8 figs. Discusses characteristics of Swiss water powers and investigates variations in power demand according to hour and season, showing by numerous figures and diagrams to what extent it is possible to influence this variation and thus improve possibilities of power utilization; discusses export of surplus energy, and draws conclusions for design of hydro-electric plants.

WATERPROOFING

ASPHALT BLOCKS FOR. Asphalt Blocks Make Satisfactory Protection for Waterproofing, M. Hirschthal. Eng. News-Rec., vol. 92, no. 10, Mar. 6, 1924, p. 397, 1 fig. Lackawanna R. R. uses asphalt blocks in preference to concrete or mastic; can be laid quickly; give better results.

WATER TREATMENT

SOFTENING. Water-Softening by Means of Doucil, T. P. Hilditch, and H. J. Wheaten. Engineering, vol. 117, no. 3035, Feb. 29, 1924, pp. 287-288. Describes comparatively new base-exchange material manufactured under name of doucil. Paper read before joint meeting of Instn. Mech. Engrs. and Soc. Chem. Industry.

WATER PURIFICATION FOR INDUSTRIAL PURPOSES, J. P. O'Callaghan. Engineering, vol. 117, no. 3035, Feb. 29, 1924, pp. 286-287. Sedimentation and filtration of water; softening by lime-soda process, and by permutit-zeolite process. Paper read before joint meeting of Instn. Mech. Engrs. and Soc. Chem. Industry.

PURIFICATION PLANTS. Data on Which Design of a Purification Plant Should be Based, C. A. Brown. Fire & Water Eng., vol. 75, no. 8, Feb. 20, 1924, pp. 349-350 and 374-377. Intelligent design of a purification plant; helpful curves and data suggested.

WATER WORKS

AMERICAN AND BRITISH METHODS. A Comparison of American and British Water Works Methods, G. Mitchell. Fire & Water Eng., vol. 75, no. 7, Feb. 13, 1924, pp. 299-300, 318, 320 and 327-329. Principal differences in practice. From paper read before Instn. Water Engrs.

ELECTRICAL EQUIPMENT. Modernizing Electrical Equipment in Water Plants, F. C. Bolton. Fire & Water Eng., vol. 75, no. 9, Feb. 27, 1924, pp. 399-400, 402-403 and 416-417, 1 fig. Connection between source of power and motors; emergency equipment; elements of cost; motors; etc.

PUMPING PLANTS. Water Works Pumping Plant at Guelph, H. S. Nicklin. Can. Engr., vol. 46, no. 9, Feb. 26, 1924, pp. 267-268, 4 figs. Describes additional pumps installed in plant at Guelph, Ont., in 1920 and 1922; motor-driven Rees Roturbo and Bawden centrifugal pumps, also Sterling engine-driven units; operating costs reduced.

WELDING

CAST IRON. *See Cast Iron, Welding.*

CHEMICAL ASPECTS. Some Chemical Aspects of Welding, J. R. Booer. Engineering, vol. 117, no. 3033. Feb. 15, 1925, pp. 221-223, 2 figs. Theory and practice in ferrous and non-ferrous work; problems in oxidation and reduction. Paper read before Instn. Welding Engrs., See also Chem. Trade Jl. & Chem. Engr., vol. 74, no. 1917, Feb. 15, 1924, pp. 189-191; and Chem. Age (Lond.), vol. 10, no. 244, Feb. 16, 1924, pp. 164-165.

ELECTRIC. *See Electric Welding; Electric Welding, Arc.*

OXY-ACETYLENE. *See Oxy-Acetylene Welding.*

WELDS

WELDED JOINT TESTING. A Cheap, Reliable and Exhaustive Method of Testing Welded Joints, A. Menetrier. Am. Welding Soc. Jl., vol. 3, no. 1, Jan. 1924, pp. 13-17, 6 figs. Results of series of shock bending tests which have proved of great value for investigation of relative strength of mild steel-welded joints performed with three different types of electrodes.

WHARVES

CREOSOTED TIMBER CONSTRUCTION. Creosoted Timber in Wharf Construction, C. M. Taylor. World Ports, vol. 12, no. 4, Feb. 1924, pp. 73-86 and (discussion) 86-89, 8 figs. Reduction of fire risk; protection for concrete structures; comparison with steel construction; creosoted wood block floors; framing timbers before treatment; etc.

WIND

CONDITIONS, STUDY OF. Study of Wind Conditions (Die Erforschung der Windverhältnisse), M. Rosenmüller. Zeit. des Vereines deutscher Ingenieure, vol. 68, no. 8, Feb. 23, 1924, pp. 177-179, 5 figs. Study of constancy of wind based on meteorological data, suggestions for seeking good exposures; choice of favorable site for erection of wind motor and the requisite measuring instruments.

GERMAN STATISTICS. Critical Notes on Wind Statistics in Germany and the Study of Weather from a Technical Standpoint (Kritische Bemerkungen zur Windstatistik in Deutschland und zur Kenntnis vom Wetter bei Technikern), C. Kassner. Zeit. des Vereines deutscher Ingenieure, vol. 68, no. 8, Feb. 23, 1924, pp. 179-180. Deals with numerous relations between meteorology and technology and points out that weather statistics should not be employed without some knowledge of meteorology.

WIND MOTORS

DESIGN. Wind Power (Windkraft), P. v. d. Sterr. Zeit. des Vereines deutscher Ingenieure, vol. 68, no. 5, Feb. 2, 1924, pp. 106-108, 7 figs. Method is suggested of calculating coefficient of variability; attention is called to fact that efficiency of most important parts of wind-motor installation plays an entirely different role than is otherwise the case, and other types of machinery are required.

WIND TUNNELS

TORONTO, CANADA. Aeronautical Research. Can. Engr., vol. 46, no. 8, Feb. 19, 1924, pp. 255-256, 2 figs. Describes wind channel opened in Aerodynamics Laboratory, Univ. of Toronto, for testing airplane models; first plant in Canada.

WIRE ROPE

TESTING. Testing Wires and Wire Ropes, R. G. Batson. Testing, vol. 1, no. 1, Jan. 1924, pp. 7-22, 6 figs. Notes on fatigue testing and fatigue tests on stranded cables, results of which are given in tabular form.

WOOD

TESTING MACHINE FOR. A Universal Static and Kinetic Wood Testing Machine, Developed to Meet the Requirements of the French Aeronautical Standardization Committee, B. C. Anderson. Testing, vol. 1, no. 1, Jan. 1924, pp. 72-79, 7 figs. New machine is used first for static tests of wood in bending, in compression, intension, by splitting and for hardness, and secondly, for carrying out kinetic tests in transverse shock application.

WOODWORKING MACHINES

MORTISING AND BORING MACHINE. Wood-Working Mortising and Boring Machine. Engineering, vol. 117, no. 3035, Feb. 29, 1924, pp. 268-269, 3 figs. Describes combined chain and hollow-chisel machine for mortising which can also be used for boring, made by Wadkin & Co., Leicester, England.

X

X-RAYS

SCATTERING. The Scattering of X-Rays, Wm. Bragg. Engineering, vol. 117, no. 3033, Feb. 15, 1924, pp. 204-205, 4 figs. Deals with controversy between corpuscular and undulatory theories of light. (Abstract.) Address before Roy. Instn.

Z

ZINC METALLURGY

SEPARATION FROM IRON AND ALUMINUM. Simplification of the Separation of Zinc from Iron and Aluminum, E.G.R. Ardagh and G.R. Bongard. Indus. & Eng. Chem., vol. 16, no. 3, Mar. 1924, pp. 297-299. Shows that perfect separation can be made quickly and conveniently with ammonia and ammonium salts, even when relatively large quantities of the two metals are present at same time.

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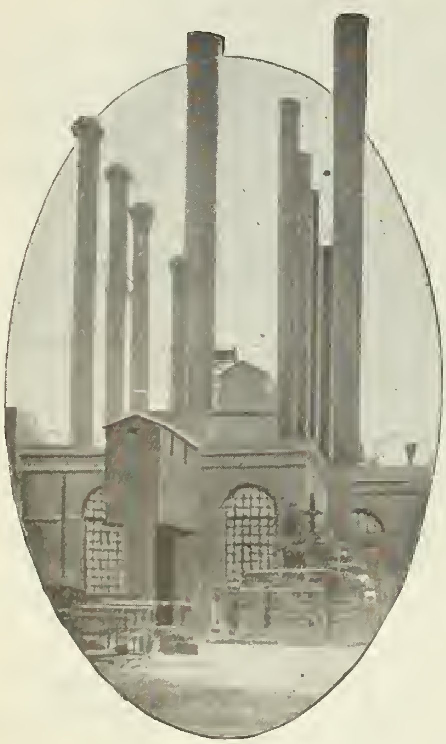

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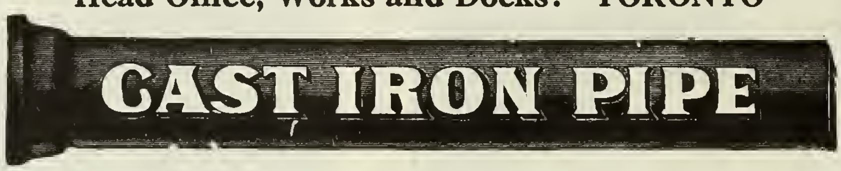

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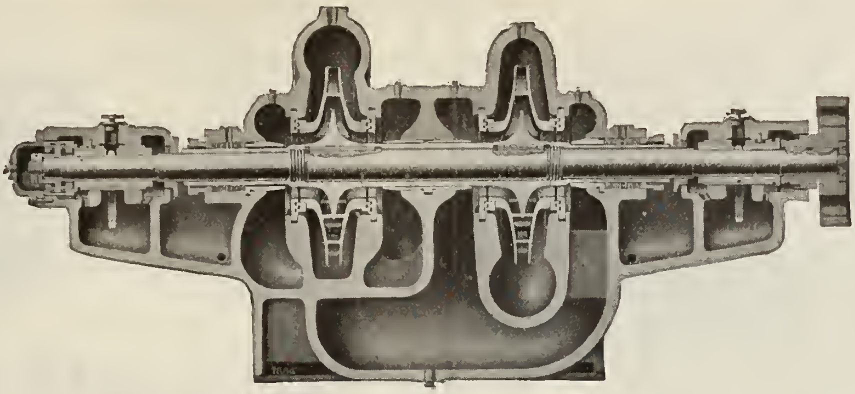

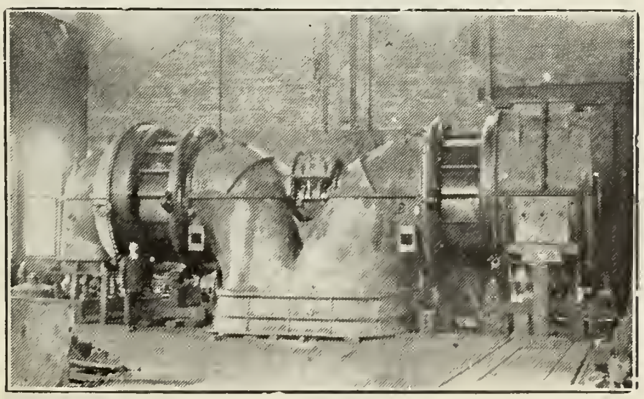

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For Alphabetical List of Advertisers see page 50

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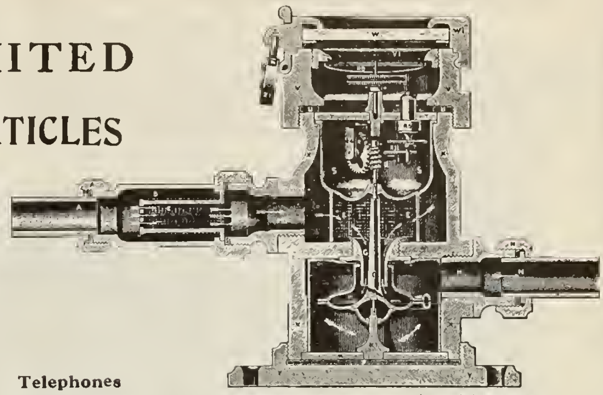

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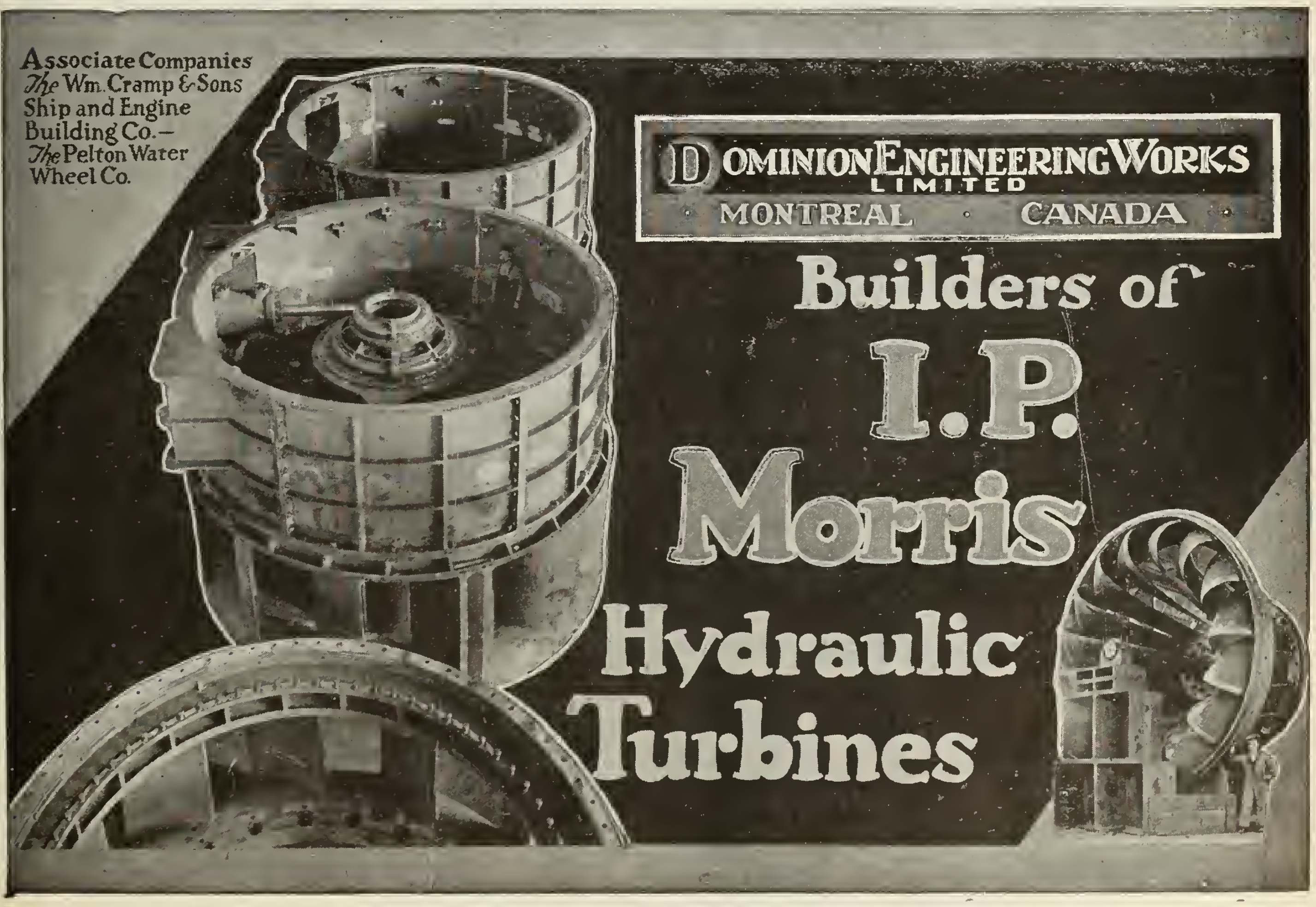

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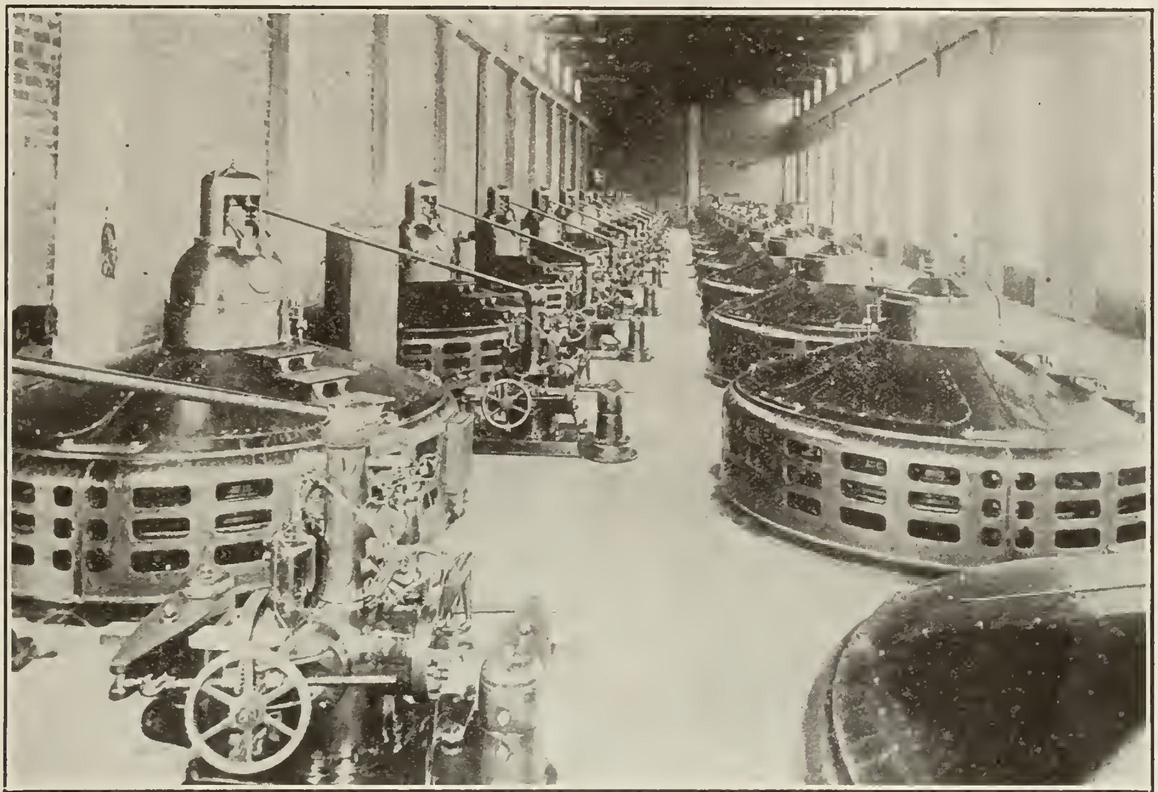

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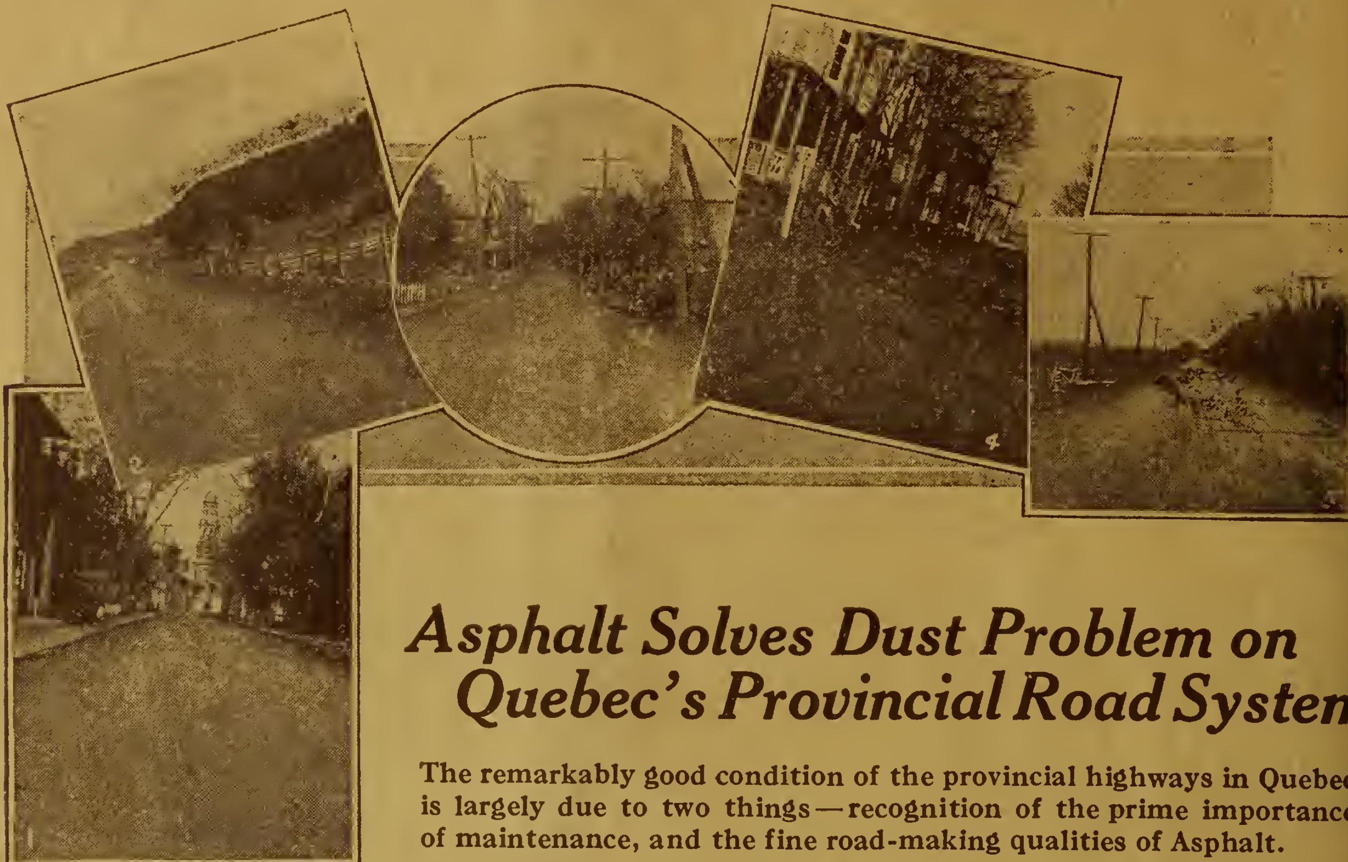


THE

ENGINEERING JOURNAL

THE JOURNAL OF THE ENGINEERING INSTITUTE OF CANADA

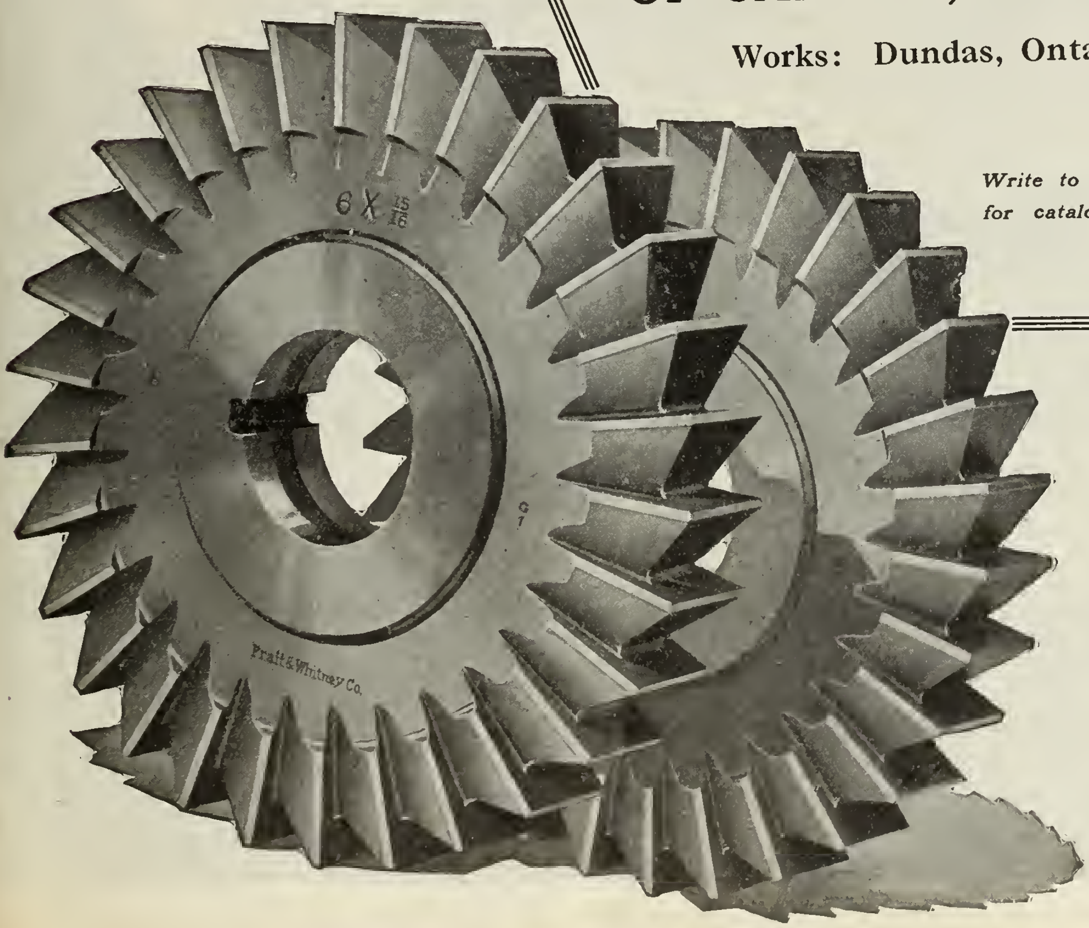
"TO FACILITATE THE ACQUIREMENT AND INTERCHANGE OF PROFESSIONAL KNOWLEDGE AMONG ITS MEMBERS, TO PROMOTE THEIR PROFESSIONAL INTERESTS, TO ENCOURAGE ORIGINAL RESEARCH, TO DEVELOP AND MAINTAIN HIGH STANDARDS IN THE ENGINEERING PROFESSION AND TO ENHANCE THE USEFULNESS OF THE PROFESSION TO THE PUBLIC"

JUNE 1924

PUBLISHED MONTHLY BY THE ENGINEERING INSTITUTE OF CANADA

AT 176 MANSFIELD STREET, MONTREAL

Vol. VII No. 6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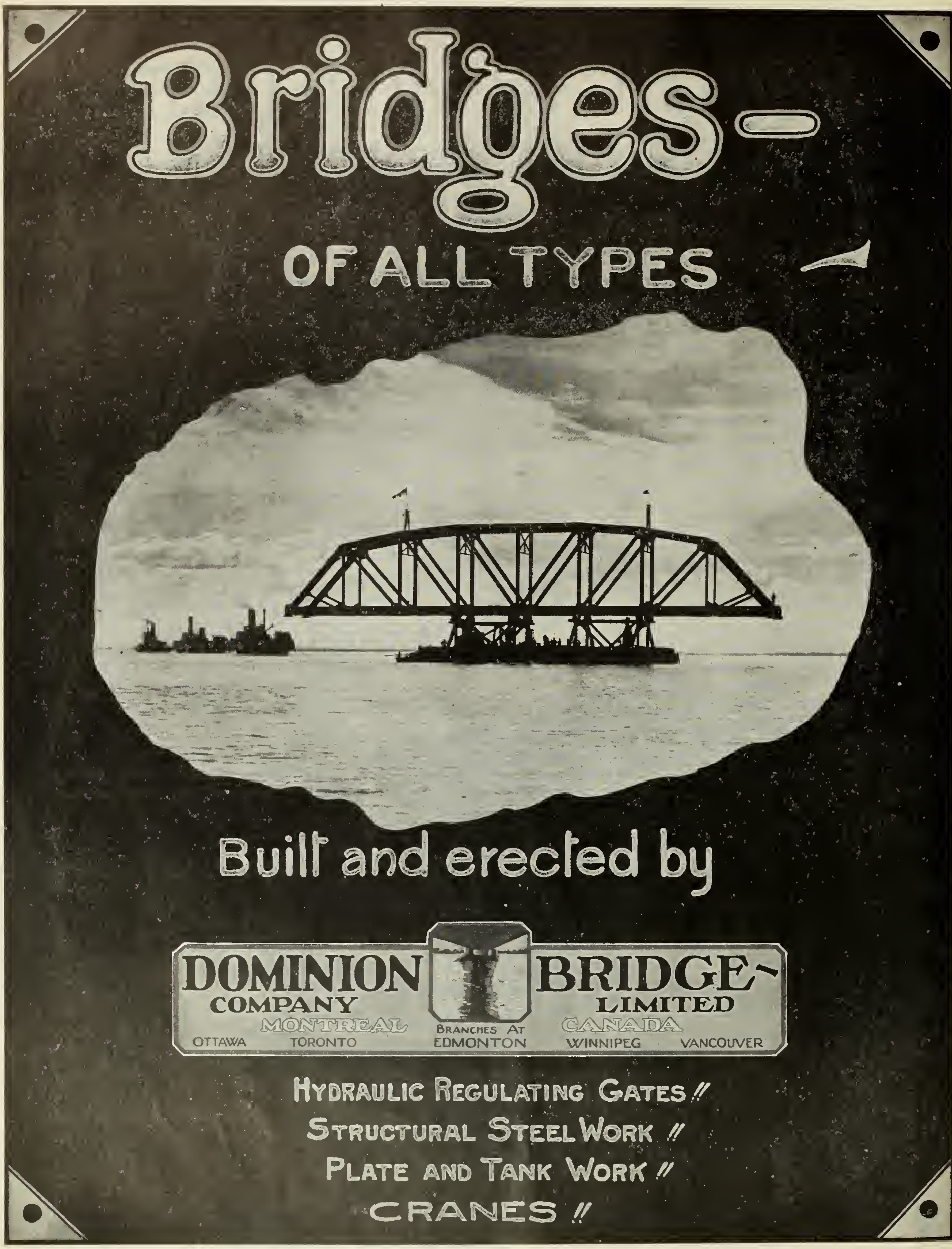
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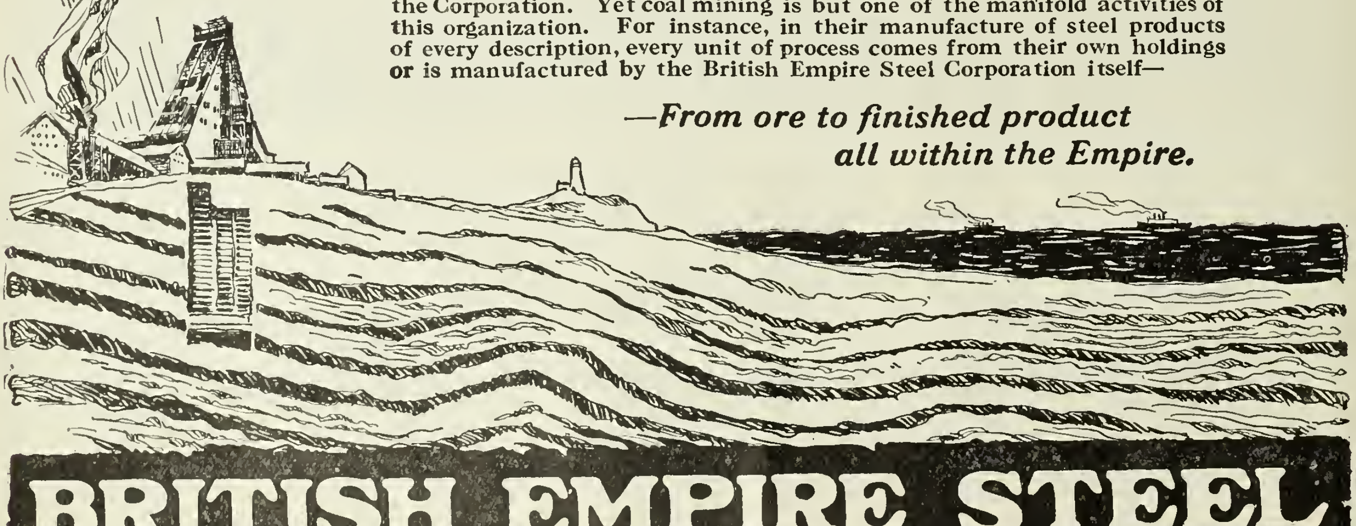

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Ottawa Saves $8,000 on Sewer Pipe

Mr. A. F. Macallum, Commissioner of Works, Ottawa, Ont., replies to published criticism of the action of city council in adopting the Macallum recommendation for concrete pipe as against vitrified clay pipe. (See Ottawa Citizen, April 26th, 1923.) Mr. Macallum's letter to the Board of Control reads:

"It may be taken for granted that there are no acids in comparatively fresh sewage in this city to disintegrate concrete pipe made to our specifications under inspection and properly cured and tested regardless of the absurd statements made by the clay pipe people.

"Concrete pipe was easily made by small plants in a careless manner, and as a consequence engineers have been prejudiced against it until recently, when first class pipe in the smaller sizes has come on the market. For that reason we have not used it in this city for the sizes from 24 inches to 6 inches until recently, giving a monopoly practically to clay pipe.

"It is interesting to note then the difference in prices in 1921 (when there was no concrete pipe tender) with 1923.

CLAY PIPE TENDERS

	1921	1923
6 inch	.32½	.23
9 inch	.59	.41
12 inch	.91	.67
15 inch	1.20	.85
18 inch	1.70	1.27
24 inch	3.10	2.15

"In other words, if we had not allowed tenders from the concrete pipe people we would have had to pay about $25,000 instead of $17,000 for this year's supply of pipe."

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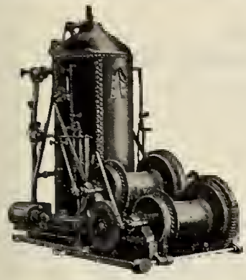
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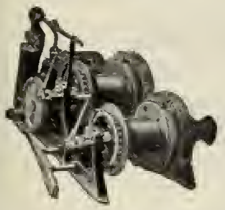
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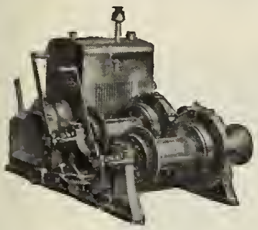
GASOLINE HOIST


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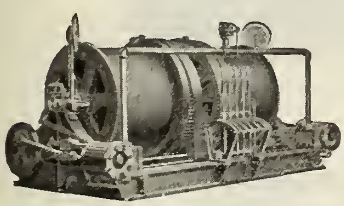
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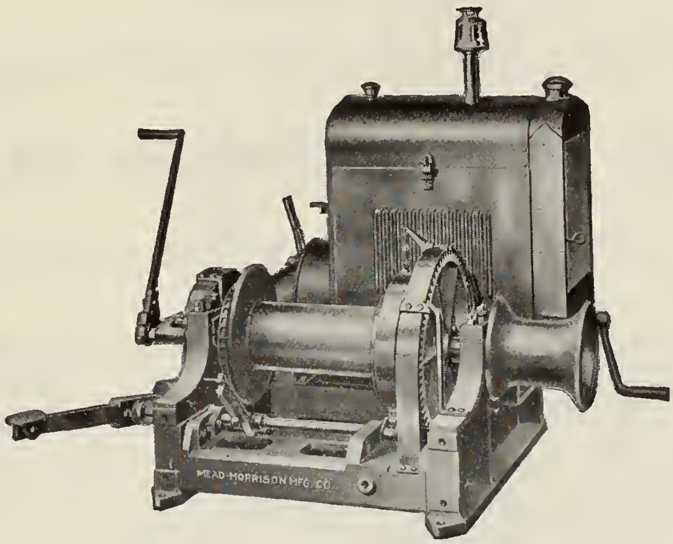
GASOLINE HOIST



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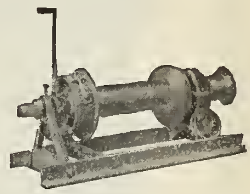
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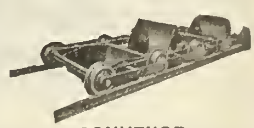
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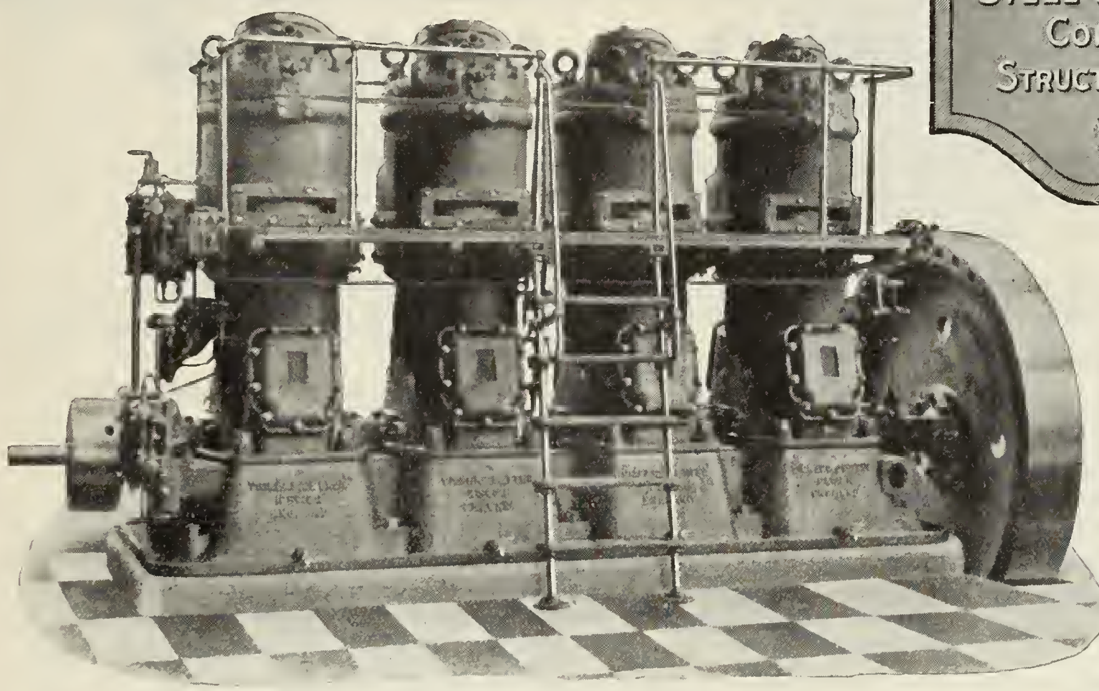

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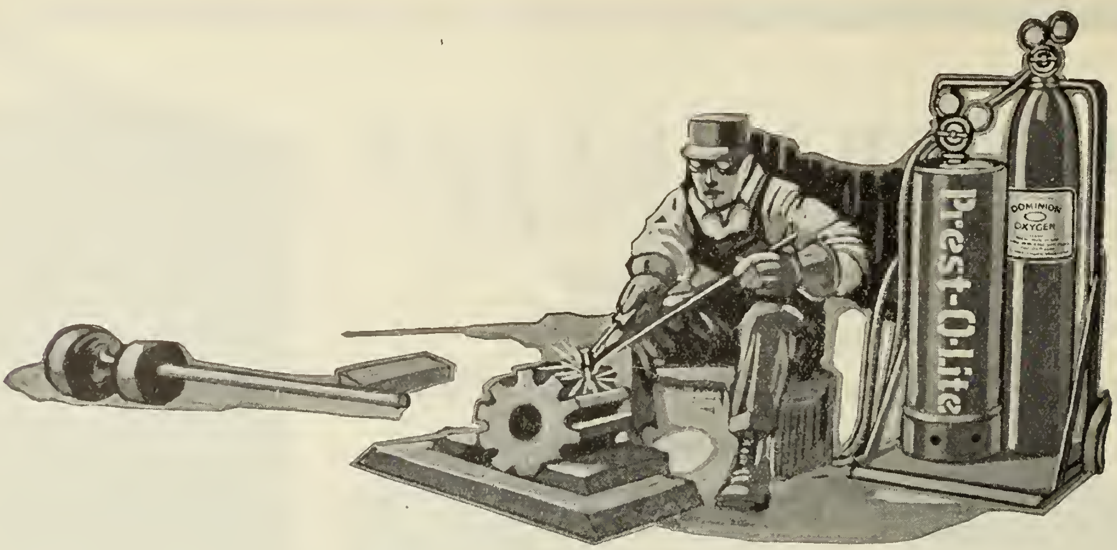

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The St. Lawrence River and Hudson Bay Projects

Discussion on Canada's Water Transportation Problems

Presented before the Winnipeg and Montreal Branches of The Engineering Institute of Canada.

Editor's Note:—Prior to the presentation of the discussions published in this issue, three papers on the subject of Canada's transportation problems were read before meetings of the Institute and subsequently published in The Engineering Journal. These papers are:—Transportation Routes in Canada by F. W. Cowie, M.E.I.C., July 1923 issue, page 313; The St. Lawrence Waterway by E. A. Forward, M.E.I.C., November 1923 issue, page 489; and The St. Lawrence River Problem by D. W. McLachlan, M.E.I.C., March 1924 issue, page 119.

An Economic Examination of the Hudson Bay Railway Project

W. Nelson Smith, M.E., M.E.I.C., F.R.S.A.

Consulting Electrical Engineer, Winnipeg Electric Railway Company, Winnipeg, Man.

***Abstract of paper read before the Winnipeg Branch, The Engineering Institute of Canada, December 6th, 1923**

This investigation is being pursued with an open mind as will be evident further on. It is a search to collect and co-ordinate all the pertinent facts that bear on the economic status of the Hudson Bay project, insofar as that is possible, from an engineering standpoint. All the facts are not yet collected. It is expected to get quite a few not yet uncovered. This talk must be regarded as preliminary only, to show you how my mind works on the question, and to ask your advice as to whether I am on the right track.

So far as any controversy is concerned, I am independent and unattached. I own no real estate in Canada, have no vote myself, do not need any other person's vote, have no newspapers or advertising space to sell, and have not been asked to look for another job. But I am a taxpayer, and as such I appointed myself a committee of one to make an examination of the Hudson Bay Railway project, insofar as it could be examined by a single engineer. It is an examination to see whether the project is economically justifiable. I have not got the whole story yet, but expect to get a good line on it in the course of a few more months, and intend then to place my findings before *The Institute*, for the benefit of the profession and the public

*The speaker took the precaution at the outset to make it entirely clear to all present, (many not being engineers nor members of the branch) that his electric railway corporation connections in Winnipeg had nothing whatever to do with what he was about to say respecting the Hudson Bay Railway project; that no one else knew all of what he was about to present, and that he and no one but himself was personayll responsible for his presentation.

This inquiry has included and will include the following subjects:—

A. The estimated amount of grain that can flow through the Hudson bay outlet per week during the open period of navigation.
B. The possibilities of cattle shipments as to quantity and cost of transportation.
C. Length of open season in the bay and straits, and its effect upon the types of ships and regularity of navigation.
D. Investigation of the best terminal on the shore of the bay.
E. Cost of completing the railway, and of operating it after completed, including the use of rolling stock.
F. Investigation of cost of construction and operation of ships of different sizes and drafts, and of standard and special construction.
G. Cost of completing terminal facilities such as elevators and docks and harbour dredging.
H. Consideration of return cargoes for minimizing ocean freights on outbound grain.
I. Cost of furnishing aids to navigation.
J. Annual cost of maintaining all facilities.
K. Question of providing interest or any other returns on borrowed money by either taxation or freight rates that will pay it. In the British Empire it is customary to pay interest on borrowed money.

L. Question of insurance on cargoes.
M. Effect of the presence of and competition by, existing routes and facilities.
N. Conclusions as to the economic status of the project based upon the facts regarding the foregoing elements in the problem.

The presentation this evening is nothing more than some advance information on some of the foregoing questions, and is altogether subject to correction and advice from any person who has real information pertinent to the subject. I should be glad to receive inquiries and information of any kind from any person who has got some *real facts to contribute.* If facts are not available, an educated guess is the next best thing, but in order to be of any help it has got to rest on some logical basis of scientific deduction from established facts.

The basis of this whole examination is to visualize a set of conditions for the maximum possible grain traffic that can be allocated to the Hudson Bay route by giving it the benefit of every possible doubt, both as to the period of time during which commercial navigation of the straits is possible, and as to the rate at which the countries of northern Europe will import wheat that originates in western Canada.

Commercial Machinery directing Transportation of Grain

As the matter of trading facilities has much to do with the actual cost of the marketing and the transportation of grain from the exporting to the importing countries, it is instructive to take a brief glance at the commercial machinery of the trading facilities which direct the grain along any transportation route, and which themselves help to make up part of the cost of transportation.

A lantern slide was shown of a chart taken from the report of the Grain Elevator Committee of Montreal, of 1922, page 87, and a brief extract was read from the report, pages 85 and 86, illustrating the correspondence between *fifteen* different offices to bring about the movement of a single shipment of grain, and also illustrating the physical movement of this grain shipment in five separate steps between and including the Fort William elevator and the ocean steamship at Montreal. Attention was called to the fact that this mechanism was part of the transportation equipment for exporting grain, that grain would naturally flow along the line of least resistance, that the facilities above pointed out formed a channel that had an actual, though intangible way of determining that resistance, and that only when these resistances, or their reciprocals, the conductivities of several competitive channels, were equal, could the grain be expected to flow equally or proportionately through all of them. This mechanism was exhibited to show that the flow of grain was not due to geographical or physical conditions alone, but was dependent on a chain of trading conditions, which might be classed as intangibles, but which never-the-less were important in influencing the actual cost of transportation of grain.

Besides the conditions here illustrated, there were also the other competitive trade conditions of ocean liners and tramp steamships on existing routes, the supply and demand of shipping and storage space, which are already established in various places along the route; and this whole mechanism of export trading facilities would have to be transplanted for the time being to the Hudson Bay route in order to place it on terms of equality with existing routes, in order that a flow of traffic could be calculated for the Hudson Bay route on a geographical basis.

The speaker called attention to the practical impossibility of figuring out the actual effect of the intangibles in determining the amount of grain to be moved by any one route, as well as their effect on the cost of moving it. However, in dealing with any such problem, one had to *assume something* in order to get started, and the speaker therefore began on an assumed geographical basis, also assuming that the effect of the intangibles on the grain flow would be equal by all routes; with the understanding, however, that whatever result might be arrived at, would inevitably be affected by these same intangible influences due to the existing scheme of trading facilities, competition between various types of ships, routes, and the general law of supply and demand, all of which conditions are inseparable from the ocean carrying trade on the north Atlantic, or on any other trade route.

Transportation Routes to the Seaboard

A railroad map was then exhibited, showing the Dominion of Canada and its various outlets to the ocean, via Vancouver, Hudson bay and Montreal, and also via Buffalo, through which latter port a very large proportion of Canadian grain is exported to Europe via a choice of several United States Atlantic ports. As far as concerns western Canada, the export of grain was considered by three outlets only, namely Fort William, Hudson bay and Vancouver.

Any estimate of what would be the flow of export grain through each of the three outlets must rest upon two premises: — First, the amount of Canadian grain that is actually taken by northern Europe during the open season of navigation of Hudson straits, and secondly, the general assumption that the ultimate export of grain to Europe out of any one district of western Canada, is proportional to the grain production in that district.

In order to get the geographical distribution of production throughout the three prairie provinces, the speaker had secured from the agricultural departments of the three provinces, their official tables of grain production segregated by grains and by certain subdivisions that had been arbitrarily selected by the said agricultural departments. Alberta was thus divided into six production districts, Saskatchewan into nine, and Manitoba into fourteen. The production of each particular grain from each district was thus obtained for each province, except that while Saskatchewan and Manitoba had complete data on all three principal grains, wheat, oats, and barley, Alberta only had data on wheat and oats. Consequently the assumption had to be made for Alberta, that the proportion of the province's total production of barley in each district, was the same for barley as for oats.

The map was divided into districts as designated by the official information from the several provinces, and a label was fixed upon each district, giving the percentages of the total provincial crop of wheat, oats and barley, which that district produced. These districts were then segregated into three groups, one for each of the outlets, east, west and north. The western and northern districts of Alberta were naturally assigned to the Pacific outlet, through which during the past two years, there has been an enormous increase in grain traffic.

To the Hudson bay outlet were assigned the two eastern districts of Alberta, comprising nearly half of the cultivated part of that province, and all of the province of Saskatchewan lying north of the South Saskatchewan river, and half of the three agricultural districts to the south of the said river; also those five of the fourteen districts of Manitoba that are situated in the north western section of the cultivated portion of Manitoba, directly west of lake Manitoba, but not extending south of it.

To the eastern outlet were allocated the southeast corner district of Saskatchewan, and all the other nine districts of Manitoba lying to the south and east of lake Manitoba. The division in Saskatchewan and Manitoba was, after very careful consideration, decided upon after giving due consideration to the geographical grain of the railroad lines as at present built. On the 1922 railroad map there are shown only two railroad lines running north from Regina to Saskatoon and Prince Albert, and one northeast from Regina via Melville, Sturgis and Swan river, while in Southern Saskatchewan and in Southern Manitoba there are several parallel east and west railroad lines, which in Saskatchewan have no north and south connection west of Moose Jaw. Consequently, it seems fair to assume, in view of the present railroad facilities, and the undoubted competition of all existing trading facilities already contributing to the eastern outlet, that not more than half of the grain in the south central and south western part of Saskatchewan would go to the northern outlet, and that all of it in south-eastern Saskatchewan and southern Manitoba would go east.

Export of Grain to United Kingdom and Northern Europe

Tables were then exhibited by lantern slides showing first the flow of northern grain to the United Kingdom in the months of August, September and October, as compiled from the British customs statistics, and the estimate of Canadian grain at 60 per cent of this. Then a similar estimate of wheat imports by other countries of northern Europe convenient to Great Britain, which were followed by statistics on oats and barley to the United Kingdom, and finally by oats and barley in northern Europe, all during the same months of the year. While it was admitted that absolute accuracy in determining actual exports from Canada to all those countries was impossible because of the continual interchange of export traffic between United States and Canadian ports, and because of the crediting of imports at European custom houses to countries where the grain was loaded into the ships, and not to the countries of ultimate origin, it was shown that inevitable inaccuracy in statistics would not materially affect the final result. This worked out at a total export from Canada to the United Kingdom and northern Europe for the months of August, September and October, at 2,179,462 bushels of wheat, 251,823 bushels of oats, and 279,000 bushels of barley per week. The statistical authorities used were British government statistics, and W. Sanford Evans' "Canadian Grain Trade Year Book", also the Dominion Bureau of Statistics reports.

Exports to the United Kingdom and northern Europe, i.e. Scandinavian countries, Germany, Netherlands, Belgium and France, were alone considered as affecting the flow through the Hudson Bay route. The United Kingdom comes first because it takes more Canadian wheat than all the others put together, and the other above named countries are included because they are near enough to the United Kingdom to enable ships that bring Canadian grain east, to conveniently take British coal west. Coal is the most plentiful and available bulk return cargo out of Great Britain that can be loaded and unloaded as cheaply as grain, and for which there is such a demand the world over that it has contributed more than any other one commodity towards the supremacy of British trade. It was therefore regarded as the most dependable return cargo. It must be conceded by everyone that a return cargo is absolutely necessary to keep freight rates to a minimum, which is the one great object of the Hudson Bay route; and there would certainly be a market for British coal in western Canada, particularly the district tributary to the Hudson Bay outlet, so much of which is penalized at present by having a longer haul for coal from either Fort William or Alberta than any other section of western Canada.

Thus was determined the amount of grain that would be taken by western Europe from Canada, during the months of August, September and October, per week, this quantity being regulated absolutely by the demands of the European buyers, who will never take more than they think they need, and take that amount with a fair degree of regularity, as is well known by all who have studied statistics of the world movement of grain.

Probable Flow of Grain through Each Outlet

The speaker next developed a set of percentage tables, grouping the districts by outlets, adding up for each outlet the percentages contributed by each district to the total crop of the province in which the district is situated. The district percentages so added, for each outlet, represented the percentage of each provincial crop that will go out by any particular outlet. The sum of these percentages was then multiplied by the percentage that each provincial crop was of the total Western Canadian crop of the three prairie provinces, in order to get the portion of the entire Western Canada export crop that would flow out through the particular outlet, that was contributed to by the above mentioned group of districts.

For example, the Hudson Bay route would, on the assumed geographical distribution basis, by district production, carry out 74 per cent of all the wheat exported from Saskatchewan to Europe. Saskatchewan contributes 63 per cent of the total Western Canada wheat crop, so the total percentage of the western Canada wheat crop exported from Saskatchewan to Europe via Hudson bay, would be 63 per cent of 74 per cent, or 46.6 per cent of the total western Canada wheat exported to Europe per week, or any other unit of time. The total percentages of all three grains, wheat, oats and barley, by the three outlets, were thus computed on the foregoing proportional basis, and the percentages thus allocated to the Hudson Bay outlet worked out at 62 per cent of the wheat, 61 per cent of the oats, and 42 per cent of the barley, taken from western Canada by northern Europe. From what was stated at the outset, respecting trade facilities, it must be borne in mind that the above percentages refer only to that part of the western Canada grain crop that is exported overseas to the United Kingdom and northern Europe, and can be imagined to apply *only when all trading, storing and shipping facilities are equal and simultaneously available by each outlet, and when ships can ply both ways with clock work regularity.*

Exports to Mediterranean ports and other ports of the world that could be shipped out via Hudson bay were not considered because of their irregularity as to time, and because of the impossibility of estimating on a constantly available commodity as a return cargo, for which there would be a demand in western Canada.

Applying these percentages to the exports of grain that could possibly flow out by the Hudson Bay route during the open season of navigation, it developed that the shipments via Hudson bay would not exceed 1,351,000 bushels of wheat, 153,000 bushels of oats and 117,000 bushels of barley, or a total of 1,621,800 bushels of grain per week, that being just about 60 per cent of all the grain that the United Kingdom and northern Europe can possibly take per week from western Canada at the season of the year at which their imports from North America are a maximum.

Season of Open Navigation

A recently published report by the Natural Resources Branch, Department of the Interior, Canada, on the Hudson Bay Railway belt, contains an average of twenty-seven opinions of professional navigators and others as to the length of season of open navigation of the straits. This average is stated to be fifteen weeks, and as it coincided with a previous estimate made by the speaker, it was accepted as the time basis of estimate for the total quantity of grain exports by the Hudson Bay route. The route is assumed to be open to cargo steamers of standard construction, which is the only type of ship that can carry grain at minimum cost, beginning August 1st and closing November 14th. In the absence of a concensus of opinion in favour of the longer navigation season, the speaker considered 15 weeks to represent a fair maximum length of season for the purpose of estimating. A minimum length of season was assumed to last ten weeks beginning August 15th and closing October 24th, as available navigation records show that ice, impassable by merchant ships, may be met with in the straits at dates that might easily make it impossible for them to reach the Hudson Bay Railway terminus earlier than August 15th, or to get safely out of the bay and straits with a full cargo after October 24th. In a ten weeks' season only 16,218,000 bushels of grain would go out by this route; in fifteen weeks, 24,327,000.

Percentage of Export Grain by Each Outlet

	East Ft. W. & Pt. A.	West Vancouver	North H. B. Rly.
Wheat	30%	8%	62%
Oats	25	14	61
Barley	47	11	42

Total Bushels of Canadian Grain Imported by United Kingdom and Northern Europe per week in August, September and October.

	Wheat	Oats	Barley	Total bushels Grain
Bushels exportable per week	2,179,462	251,823	279,000	2,710,285
Max. possible percentages by Hudson Bay	62%	61%	42%	59.8%
Bushels per week by H.B. Ry. during Aug., Sept. and Oct.	1,351,800	153,000	117,000	1,621,800

Movement for 10 Weeks' Season Aug. 15 — Oct. 24

Movement for 10 weeks' season —

Bushels	13,518,000	1,530,000	1,170,000	16,218,000
Carloads	10,400	765	780	11,945
Shiploads at 243,000 bushels	55.7	6.3	4.8	67

Movement for 15 Weeks' Season Aug. 1 — Nov. 14

Bushels	20,277,000	2,295,000	1,755,000	24,327,000
Carloads	15,600	1,148	1,170	17,918
Shiploads at 243,000 bushels	83.5	9.4	7.2	100

The opinion of Mr. Harold Parker, late lieutenant R.N.R., an experienced deep water sailor, who has made several voyages through the straits, is that a fifteen weeks' season might be possible once in seven years for ordinary cargo steamships of standard construction.

To start grain ship traffic August 1st, would require two weeks advance work with two lighthouse tenders to place keepers at lighthouses before that date. Starting grain traffic would depend on how early and how quickly they could do this.

The possible movement of all grains is 1,621,800 bushels per week. As the new crop cannot arrive at the bay before the middle of September, say September 12th, there must be a supply stored available for the ships that are assumed to begin departures commencing August 1st, to September 12th, at the rate of about one per day. A six weeks' supply for the ships is 9,730,000 bushels. Let this be accumulated gradually at the bay for six months, being taken there at the rate of 374,261 bushels per week, for twenty-six weeks. If the shipping season begins twenty weeks after this gradual movement starts, there must be stored 7,485,220 bushels, so that at least 7,500,000 bushels of elevator capacity must be provided at the bay. This grain movement from March 12th to September 12th, will transport 240 cars of wheat, 18 of oats, and 18 of barley per week, or 46 cars per day, six days of the week, which is one train per day each way.

When the fall rush starts September 12th, to move the 1,621,800 bushels will take 1,040 cars for wheat, 77 for oats, and 78 for barley, or 1,195 cars per week, or 171 cars per day, which is three trains of 57 cars, each way per day, for the nine weeks to November 14th. In the foregoing, 1,300 bushels of wheat, 2,000 bushels of oats and 1,500 of barley, make one carload. It is believed that actual grain trade conditions would render the above geographical estimate unattainable in practice.

Geography of Hudson Bay and Straits

The geography of Hudson bay and straits was next taken up, and the official government chart of those waters was shown on the screen, whereon were indicated the proposed locations for about fifteen lighthouses, and the four proposed locations for wireless stations that have been proposed by the Dominion government. The Port Nelson terminal was then discussed, also from the government chart, and from a large map which had been secured from the Department of Railways and Canals, drawn to a scale of 2,000 feet to the inch, which was on large enough scale to show the soundings of the channel and to enable a rough estimate to be made of the amount of dredging involved. It was shown how the outer section of the Port Nelson channel for about 9 miles, has an average depth of about 23.4 feet; inside of this is what is called the "deep hole" about 4 miles long, averaging 30 to 40 feet in depth and needing no dredging. This is succeeded by an inner channel about 7 miles long, the average present depth of which is about 18.6 feet, leading nearly up to the so-called artificial island, where at low tide there is now practically no water at all.

To connect the channel with the docks on the proposed island, and along the docks themselves, a channel or turning basin would have to be dredged to accommodate the most economical ship which draws 24 feet. The safe employment of any ship requires that there must always be water enough to keep her afloat. It would be impossible to get ships to go there if they had to rest on the bottom while loading. Persons unfamiliar with ships do not realize that they are very sensitive structures. Both the sides and the bottom are flat surfaces of thin steel plates, with no reinforcement except the ribs and deck beams. Any unusual stress, such as is easily brought about by contact of the ship itself with the bottom of the harbour, or by impact with any heavy and immovable object, resulting either from the momentum of the ship itself or by collision from another object, is instantly destructive to these aforesaid flat surfaces, which are then as easily ruptured as tissue paper.

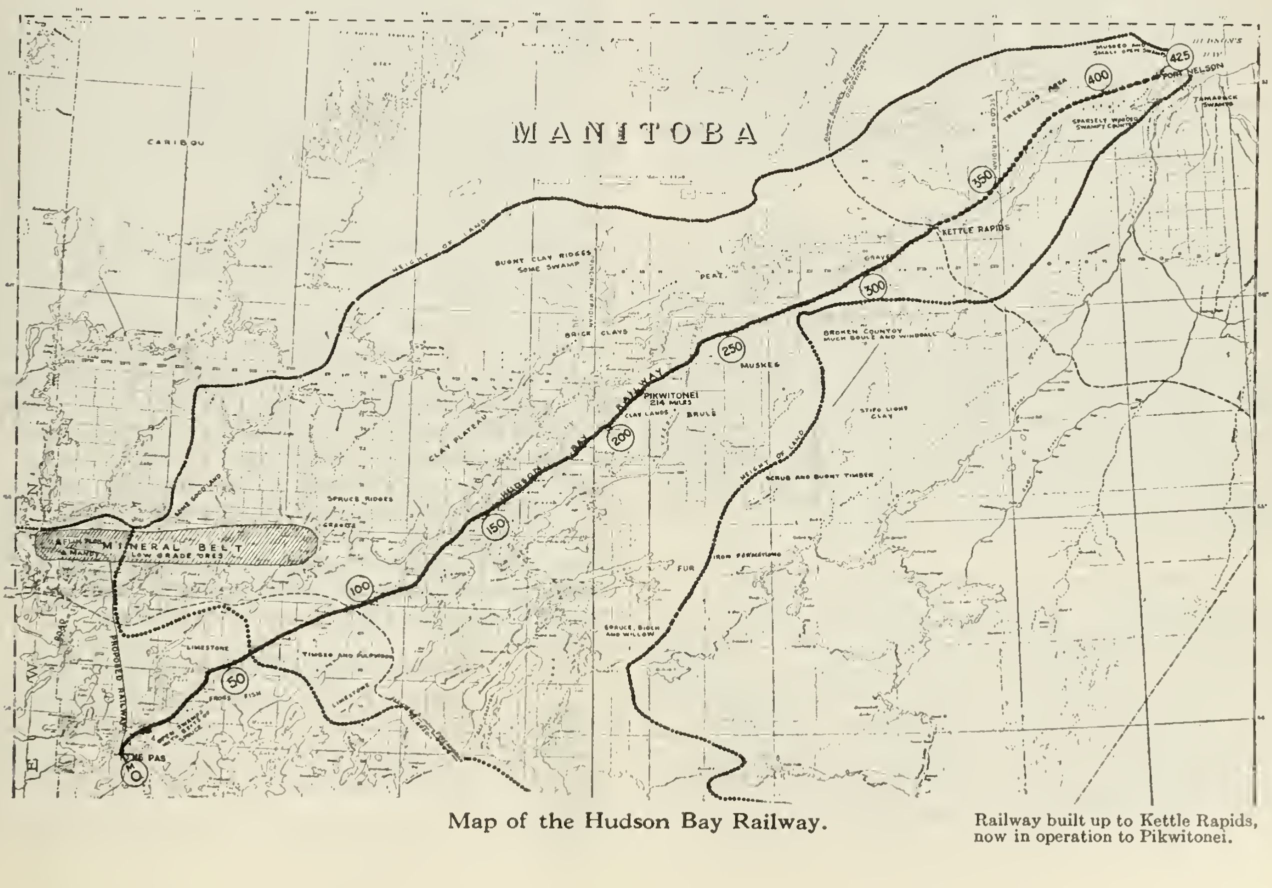
A docking and turning basin with connection to the ship channel, 30 feet deep, would require at least 3,400,000 cubic yards of dredging, even if no dredging was done between the head of the present channel and its outer end at the bar, about 20 miles distant. This would make the harbour a tidal one, with the outer end of the outer bar about 20 miles from the turning basin. This 20-mile channel would have to be traversed by a ship in two jumps, one of 9 miles and one of 7 miles at high tide only, if she were of 24-foot draft, as required for minimum ocean freight rates. A ship might make both these jumps in one tide if everything favoured, otherwise she would take two tides, anchoring in the deep hole between them, requiring 24 hours to cover the 20 miles from the outer bar to the dock. Uncertainty as to time of docking is detrimental to a grain transportation route where time is "of the essence of the contract", and conditions that make for irregularity of ship movement, will not help to keep down freight rates. If a channel 200 yards wide were dredged for the whole 16 miles of shallow water, to give 30 feet of water at low tide for a ship of 24-foot draft, it would amount to 19,500,000 cubic yards of dredging. This is a stupendous quantity but it would be necessary in order to admit a ship drawing 24 feet of water at all times, and in all weathers, and might save anywhere from one to two days time for each ship both in and out, on a route where the time is so inherently short, being limited by natural causes entirely beyond human control. If this amount of dredging were actually undertaken, it would probably take 20 dredges about 4 years to do it, at the maximum rate possible under Nelson conditions. This dredging would cost so much that the speaker has been compelled to assume that only the minimum amount of dredging for the dock, turning basin and connection to channel, would be undertaken, amounting to 3,400,000 cubic yards, and that the ships would have to take their chances of sacrificing valuable time in arriving at and leaving the terminal.

In a fifteen-week season there would be about one hundred ships required of 24-foot draft. If lighter draft ships carried the grain, there would be about 230 required if they were of 3,500 deadweight tons cargo capacity each, drawing 20 feet of water; or about 320 ships, or more than 3 per day, if they were of 2,000 deadweight tons capacity and drew only 16 feet of water.

The 3,500 ton ships are of a kind that the Canadian Government Merchant Marine is now trying to get rid of, as not being a commercial proposition in comparison with the 7,500 ton ships of 24-foot draft, while the small ship of only 2,000 tons deadweight capacity would have to charge a freight rate double that charged by the 7,500 ton, 24-foot draft ship, in order to live on the trade route from Port Nelson to the United Kingdom. These small ships are not able to live on the present grain rates in the north Atlantic trade.

Port Churchill

Turning now to Port Churchill, the government chart of the harbour was exhibited, showing the limited amount of anchorage space, which does not admit of more than three ships anchoring without risk of fouling each other, but the speaker showed how by constructing quays or wharves along both the east and west shore lines, it would be possible to berth seventeen ships end-to-end, seven on the west side of the harbour without any dredging to speak of, and ten on the east side, where only about 750,000 cubic yards of dredging would be needed, by reason of the present depth now being 24.2 feet at low water, requiring dredging of only 5.8 feet for a minimum channel width of 200 yards, over a distance of about one mile.



Map of the Hudson Bay Railway.

Railway built up to Kettle Rapids, now in operation to Pikwitonei.

This dredged channel would be along the east shore of the harbour, which is where the terminals would have to be anyway, to prevent the expense of a railroad bridge over the Churchill river. In other words, Churchill harbour could be treated like a river with levees or quays on both banks, the same as at New Orleans, for example, on the Mississippi, at which port anywhere from 50 to 100 ships are easily accommodated on a long continuous levee or wharf upon the river bank, and do not anchor in the river, although it is a mile wide.

There would thus be room at Churchill for as many ships as the European grain trade from this port would ever require. Probably not more than 10 grain ships would have to be in port at once, this estimate being based upon one ship per day, and ten days in port for unloading coal and loading grain, which ought to be ample enough, even with ocean steamers, if modern coal and grain handling equipment were provided. The port has deeper water than Nelson with no bar at the entrance, which is only about 1,000 feet wide, and where the scour of swift tides has kept a bar from forming. The presence of rock at or near the surface of the land makes the foundation conditions for elevators and docks far better than at Nelson, where the depth of bed rock below the surface does not appear to be known. Altogether, the only obstacle to the easy development of Churchill, other than its remoteness, is apparently 750,000 cubic yards of dredging, (mostly of sand according to the charts), in contrast to at least 3,400,000 cubic yards of stiff blue clay at Port Nelson, and in further contrast to the absence of good foundation conditions for heavy building structures. The port is a natural harbour, the only one on the bay, easy for entering mariners to pick up, and it is altogether possible that the reduced cost of constructing and maintaining terminal structures and harbour facilities at Churchill would, as an economic proposition, outweigh the disadvantages of requiring 90 to 100 miles of extra railway construction and possibly 8 to 12 hours of freight train operating time, as compared with Port Nelson, where the natural obstacles to be overcome are so great and the cost of overcoming them is so difficult to estimate. The speaker's opinion is that this matter of choice of terminals should be re-opened on an economic basis, in case the Hudson Bay route should be seriously considered as worth developing.

Attention was called to a statement in some engineering testimony published in the Senate Committee Report of 1920, page 53, as follows: — "The expenditure on the Hudson Bay system is not for the purpose of furnishing protection for vessels but to get the grain overseas as cheaply as possible". This statement prompts the speaker to ask the question, if vessels are not protected, how can it be expected that their owners would ever consent to employ them on terms that would result in getting grain overseas as cheaply as possible? The statement above quoted is a fair example of the method of treatment of the economics of this whole project, by the Senate Committee.

Minimum Cost of Completing Project

The speaker then gave some rough estimating figures on the cost of completing the entire project, including the finishing of the railway, providing terminal facilities at Port Nelson, and also providing aids to navigation through the straits, all of which must absolutely be considered as necessary to any development of the project as a competing grain route to Europe, which has been its *raison d'être* from the very beginning.

Completion of railway including various contingencies as per estimate from reliable engineering source	$ 5,000,000
7,500,000 bushel grain elevator and foundations	5,750,000
Coal unloading docks	500,000
6 beacons on stone cribs along channel	300,000
3 harbour tugs	300,000
15 lighthouses in straits	960,000
3 additional wireless stations	110,000
Aeroplanes, stations and facilities	1,000,000
2 lighthouse tenders	600,000
Floating drydock	3,000,000
Buoys, ship cables, spare parts, floating equipment	200,000
3,400,000 cubic yards dredging at $1.00	3,400,000
7 dredges at 200,000	1,400,000
Total minimum new expenditure necessary	$22,520,000
Previously expended	20,500,000
Total minimum cost of project	$43,020,000

The foregoing is simply a preliminary estimate intended only to give an idea of the possible cost of the various things that are absolutely essential to any consideration of regular navigation of the straits, and for harbour and terminal facilities. In fact, the foregoing estimate is more likely to be low than high, as the speaker is not at the moment familiar with what more must be done to the present artificial island at Port Nelson in order to make it a suitable site for docks and elevators. This estimate is therefore submitted as being subject to revision, but it is believed to represent a minimum rather than a maximum.

Dredging is assumed at $1.00 per cubic yard. Testimony was given to the Senate Committee that dredging would cost at least two and a half times as much as is usual in ordinary operations. Dredging at Fort William and at Vancouver, from the reports of the Department of Public Works, seems to have cost around 25 cents per cubic yard under those special harbour conditions. At Vancouver dredging can be done practically all the year round; at Fort William it can be done for seven to eight months continuously, but at Port Nelson with the short season, floating ice at the beginning and the end of it, powerful tidal and river currents, hard blue clay to dig with occasional boulders, and the unknown amount of lost time removing the dredged material, together with the possibilities of caving and silting; with all these possibilities $1.00 a yard looks to be as reasonable as any other figure for a rough shot at an estimate.

The floating drydock is regarded as an absolute necessity for assistance to ordinary cargo ships that may meet with difficult ice conditions when entering or trying to leave Hudson bay. During the building operations at Port Nelson, the "Allette", one of the supply ships, in attempting to leave the bay, had her bows so badly stove in by ice encountered off the north end of Mansel island on October 10th, 1913, that she was barely able to get back to Nelson Roads in time to be beached on the edge of the channel about four miles below the port terminal. Had a drydock been available, the ship could probably have been salvaged, but although her cargo was saved, the ship still lies where she was stranded to save her cargo. This might happen to any cargo ship of the same type, and a floating drydock would probably save enormous sums in insurance, if it were provided.

Main Elements of Annual Cost

The speaker next considered the main elements of annual cost of operating the railway and maintaining the harbour and navigation facilities, and submitted the following tentative estimate, assuming Port Nelson conditions:—

Up-keep of two dredges at $50,000 a year	$100,000
Annual cost of keeping harbour dredged, fuel and labour	50,000
Cost of maintaining and operating 2 lighthouse tenders at $35,000	70,000
Cost of maintaining and operating 3 harbour tugs at $12,000	36,000
Cost of maintaining and operating 15 lighthouses	90,000
Cost of maintaining and operating 4 wireless stations at $8,000	32,000
Maintenance gang, elevators, docks and wharves, 20 men at $2,000 average	40,000
Cost of repairs materials, docks, lighthouses, beacons, etc	100,000
Cost of maintaining and operating aeroplanes in straits	100,000
Supervision and engineering staff for harbours, docks, elevators, etc	50,000
Civil administration of port and town	25,000
Total	$693,000

Other items equally necessary may occur to other engineers. The required total may be roughly placed at $700,000 per year.

The amount already spent on the project is $20,500, 000. The statement has been made in parliament that no debt has been incurred for the Hudson Bay Railway, but on the contrary the $20,500,000 has been amply reimbursed by the amounts of money received for certain lands, homesteads and preemptions.

Reference to Hansard for March 12, 1923, page 1,117, discloses a statement by the Hon. Mr. Stewart in reply to a question by Mr. N. N. Campbell of Mackenzie, that the Dominion Land Act of 1908 have no specific authority for sale of land for Hudson Bay Railway construction. But his questioner contended that this was nevertheless the purpose of the act.

If the past expenditures for the Hudson Bay Railway have not been absorbed into the funded debt of the Dominion, there is no interest on the $20,500,000 to be considered, and in order to make the item of interest on money borrowed for this obligation as small as possible, we will say good-by to any return on the $20,500,000 and consider that henceforth interest would only have to be paid on the $22,500,000 that is still needed to make the whole project operative.

Basis of Estimating Cost of Railway Operation

The cost of operating the railway has been estimated on the following basis. In the Canadian Railway statistics for the year 1921, a railway was selected that traversed the same sort of country as the Hudson Bay Railway and just paid its operating expenses with a small margin to spare. This was the Algoma Central and Hudson Bay Railway, about three-quarters the length of the Hudson Bay Railway to Port Nelson. Upon the above railway the cost of conducting transportation, the traffic department and the maintenance of equipment, together totalled about $2.75 per train mile. The maintenance of way and the general expense totalled about $2,161.00 per track mile. These figures were used in estimating the operating expense of the Hudson Bay Railway.

To the schedule of freight trains previously shown, was added one mixed train traversing the line each way three times per week, between November 14th, and March 12th, and one passenger train each way was added during the 15 weeks navigation season. The 6 months' freight service of one train per day each way was also assumed to carry passenger accommodation, so that a continual passenger, mail and express service would be included in the train movement the year round.

On this basis the total train miles per year, including 10 per cent non-revenue train miles, totalled 467,332.

Cost of running operations per train mile at $2.75	$1,285,163
Cost of maintenance-of-way and general expense for 424 miles of road at $2,161	916,264
	$2,201,377
Less passenger train receipts at $1.03 per train mile for 89,040 train miles	91,711
Total expense chargeable to freight operations per year	$2,109,666
For even figures, call it	$2,110,000

Passenger traffic is here assumed to be conducted on a basis that will make it pay for itself independently of freight operations.

Tons grain assumed to move north in a 15 weeks' season	689,445
Tons coal assumed moved south in 15 weeks' season	454,000
Proportion that each of the foregoing is of the total freight movement is 60 per cent grain, 40 per cent coal.	

In order to charge the grain with only its proper proportion of the total operating expense, let it carry only 60 per cent of all annual charges, and let the remaining 40 per cent be charged to the return tonnage of coal that makes ocean transportation possible at minimum cost, whatever that cost may be.

No capital charges have been included for railway rolling stock in the foregoing estimates, to be purchased for the Hudson Bay Railway. It is assumed that equipment would be loaned by the Canadian National Railways and used for the necessary period, and then returned. Instead of interest on the cost of this rolling stock, the cost of use of it s substituted, to be added to the railway operating expenses. It is assumed that a fair charge would be 10 per cent per year on the average use of one million dollars worth of locomotive and service equipment, passenger, express, mail, flat, derrick and ballast cars, and snow plows, etc. This would amount to $100,000 per year and is thought reasonable. Also, as the grain movement has been shown to require almost 18,000 box cars per season, an allowance of $1.00 per day per car for 5 days use from The Pas to Port Nelson and return, is estimated. This is on the same basis of use of borrowed cars as now exists between Winnipeg and Fort William and return, and would amount for one year to $90,000. These two items are therefore added to the railway operating expense.

Recapitulating the foregoing items, an approximate estimate of the total annual cost of fixed charges and operating expenses of the railway, harbour and navigation facilities without any taxes, insurance or depreciation whatever, is therefore as follows:—

Interest on money borrowed to complete the project via Port Nelson — $22,520,000 at 4½ per cent	$1,013,000
Cost of Hudson Bay Railway freight operation, the Pas to Port Nelson	2,110,000
Use of $1,000,000 worth of locomotives, passenger cars and service equipment at 10 per cent	100,000
Use of 18,000 box cars 5 days each at $1.00 per day	90,000
Cost of maintaining all terminal harbour and navigation facilities	700,000
Total minimum annual expense for 15 weeks' navigation	$4,013,000

If only 60 per cent of this be charged against the grain movement, making the coal take care of itself, the cost of the grain movement per year then becomes $2,407, 800, which is required to manipulate 24,327,000 bushels of grain per season from The Pas to Port Nelson, providing the means of transferring it into ships, and further providing the navigation facilities that must exist in order to get the ships out of and into the Atlantic ocean, with the maximum amount of safety that human ingenuity can devise to overcome the risks to ships and cargoes that are known to exist between the railroad terminal and the Atlantic ocean.

The above figure is about 9.9 cents per bushel of grain, bare cost, with no insurance, taxes, depreciation allowance or profit either to the railway or to the Government, and without elevator charges.

Besides the foregoing, the grain will of course have to pay for the use of the elevators and for ocean transportation to Europe, besides the marine insurance on ships and cargoes, which last item cannot even be predicted. It is possible that some arrangement might be made whereby the Dominion government would stand sponsor for loss or damage to ship and cargo, on a basis of actual cost of administering an insurance department, in order to prevent the grain from being penalized too heavily by insurance rates.

With respect to elevator charges, it has been shown that some of the grain would have to be stored at the terminal for some months. Assuming an average of three months storage for the 7,500,000 bushels at one cent per month per bushel, this comes to $225,000.00, which, if averaged for the entire movement of 24,327,000 bushels per season, is 0.93 cent per bushel.

It is obvious that if the navigation season were as short as ten weeks, which is evidently likely to happen in some years, if the naval service department reports can be believed, the total cost of operating the railroad and other facilities would not be reduced in proportion to the reduced grain and shipping movement, on account of the tremendous overhead expense. Instead of 9.9 cents, the above operation and maintenance costs other than grain storage would be at least 14.6 cents per bushel against the grain before it was loaded into the ships, to which would have to be added the storage, insurance and ocean freight charges.

Assuming Saskatoon as an average interior point of departure for a grain shipment to Europe, a rate of 24 cents per 100 pounds from Saskatoon to Fort William is 14.4 cents per bushel. On a ton mileage basis at the same rate, the cost would be about 4.63 cents per bushel from Saskatoon to The Pas.

Cost of Ocean Transportation

After a careful investigation of the cost of ocean transportation in cargo tramp steamships across the Atlantic, including the time spent in turning around at both ends, and loading and unloading cargoes, the lowest possible estimate that the speaker has so far been able to compile, is that the ocean freight rate from Port Nelson to the United Kingdom could not possibly be less than 9 to 10 cents per bushel, plus insurance, for a 7,500 ton ship carrying a cargo of 243,000 bushels, also assuming no demurrage on account of being held up in ice in Hudson Straits. For a 3,500 ton ship the bare cost would not be less than 13 cents and in a small 2,000 ton ship, not less than 16 cents to 18 cents, plus insurance.

Adding up the above bare costs:—

Saskatoon to The Pas..............	4.63 cents	
The Pas to Port Nelson............	9.9	
Average elevator storage at Port Nelson.......................	.93	
Minimum possible ocean freight in largest steamer without insurance and without profit.............	9.00	(More likely 10 cents)
	24.46 cents	

Plus insurance, for a 15 weeks' season,

For a ten weeks' season the cost would be at least 4.6 cents additional, or 29.06 cents. The cost per bushel for a shorter season would inevitably be greater, and somebody would inevitably have to pay this extra cost.

The present rate from Saskatoon to Liverpool has been variously estimated at from 34½ cents to 37 or 38 cents, according to route, 34½ cents being a recent rate via Montreal. I believe these rates are substantially the same as those just quoted by Commissioner Campbell. The foregoing demonstration shows how the barest minimum cost without insurance cannot possibly be less than 24½ cents, which indicates a possible transportation saving, disregarding insurance, of about 10 cents per bushel. This saving also seems to agree with the estimate just suggested by Commissioner Campbell.

The total saving could thus not possibly be greater, and would probably be less than 10 cents per bushel on 24,327,000 bushels per season, which has been demonstrated to be a maximum movement, probably unattainable in practice, by reason of the effect of the various intangible elements entering into the total cost of grain transportation.

Assuming the above figures, however, the total saving per year would be less than $2,500,000, which is less by 97½ per cent than the $100,000,000 saving per year recently promised to the western Canada farmers if the Hudson Bay project should be completed; presumably this promise was based upon an exportation of 400,000,000 bushels at a saving of 25 cents per bushel.

Observed Conditions of Weather and Ice

The speaker showed five lantern slides of Canadian hydrographic survey ship track charts through Hudson bay and straits in 1911, 1912 and 1913, reproduced from official reports of the Department of Naval Service, on which the observed ice conditions has also been plotted from the ship's log by Captain Anderson. These showed variations in the distribution of ice, both outside Cape Chidley, and at various parts of the straits, even in the southwest portion of Hudson bay directly in the track of steamships, and at dates within the limits above set for the beginning and end of the navigation season. It was stated that the ice conditions as shown were necessarily those seen from that particular ship at the particular spots indicated, and that no one would know how other parts of the Bay and Straits were affected by ice at the same time. Aeroplane service would make such observation more possible, but on this very subject Captain Anderson has stated in his report included in the Department of Naval Service Report for the year ended March 31st, 1915, page 94, that, "Frequent snowstorms and heavy winds might hamper the operation of these machines" and "Fogs caused by the sun on ice fields would certainly be a drawback".

Finally, three photographs were shown of ice conditions, two pictures of the Hydrographic Survey Steamer "Acadia" fast in the ice near the entrance to Hudson straits in July 1914, and a picture taken by Mr. Harold Parker, late Lieutenant R.N.R., when on the S. S. "Thetis", carrying the Chesterfield Inlet exploring expedition, on August 1st, 1920, in the middle of Hudson straits, about halfway between Cape Hope's Advance and Big island, when the ship was unable to move for twenty-four hours. This photograph shows mooring lines holding the ship to one location in the ice, while waiting for a lead to open. The ice was anywhere up to 25 feet thick and constantly moving. In his opinion "nothing but a wooden ship could have stood this", a ship with hull so shaped as to be automatically pinched up out of the ice.

Attention was called to the fact that as compared with other trade routes, Hudson straits combined four of the worst menaces to shipping, namely, bad weather, fog, ice, and a lee shore, all of which in the estimation of a responsible sailor, effectively prevent such a route from being classed as a *good road*.

As ships have been entering and leaving Hudson bay on various commercial ventures for the past 250 years, it is foolish to say that the Hudson Bay route is not feasible for a few ships per year, when they are not operated on a time schedule, but can come and go at their own pleasure. This is particularly true when they have a shape of hull that can lift out of the ice when caught in the pack, this being the way in which government survey steamers, sealing steamers, whalers and the Hudson's Bay Company's ships are constructed. But even after listening to the account from navigators who have sailed in and out of the bay and straits, always under the foregoing special conditions of ship construction, and always able to take their time in dodging ice packs or waiting for them to break up, it is equally foolish to jump to the conclusion that such a route is commercially feasible for cargo steamships of standard build, that must operate with certainty and regularity, on a competitive basis.

For instance, the Hudson's Bay Company has run one and sometimes two ships per year in and out of the bay, specially constructed to withstand ice packs, and they invariably wait for the most favourable ice conditions to enter and leave the bay on this schedule of one or two ships a year. Contrast this with the frail construction of the most economic type of freight carrying steamship, of which there must be operated at least one per day in order to transport to northern Europe the possible maximum of 16,000,000 to 24,000,000 bushels of grain that the open season will permit to be carried through this route. Such cargo ships will not run anywhere unless they can make a profit for their owners, and they cannot compete with existing grain routes unless they can ply to and fro with the certainty and regularity that enables them to make profitable voyages from existing Atlantic ports and maintain competition in Trans-Atlantic grain rates. The conclusion that navigation conditions through the straits will permit a profit to the owners of standard cargo ships, and a material reduction in grain rates that will inure to the benefit of the western Canadian farmer, is not yet warranted by any issued statements of fact that I have yet been able to discover. This particular route to the Atlantic does not have the characteristics of *a good road.*

As far as mere feasibility is concerned, it is said to be *feasible* to build a railway tunnel under the English Channel, and it is also *feasible* to provide a deep waterway for economical ocean ships between tide water and Fort William or Duluth or Chicago. It was possible to enlarge the Erie canal from the Hudson river to lake Erie, but it has cost somewhere between $130,000,000 and $150,000,000 during the past twenty years, and in 1922 the Erie canal transported less than 1,500,000 tons of freight, which included only 19,600,000 bushels of grain. But the question that has still to be answered for each of the foregoing projects is, is it worth while? And while I am looking at it from the geographical, physical and engineering standpoints, I, as an engineer, must stop and consider whether the outlay is likely to be justified by a general cheapening of transportation between western Canada and Europe, either temporarily during the navigation season, or permanently the year round, in the face of the existing competition from large liners able to set the pace for cheap grain rates to Europe all the year round, from existing Atlantic and Pacific ports.

We can *light up* this route with lighthouses, wireless and even aeroplanes, but after it is lit up ships can still do nothing but take their chances in dodging the packs of heavy Arctic ice, even if they are warned about them in time. All the aeroplanes or wireless in the world will not help any ship of any build or shape to work its way through a field of ice masses 25 feet or more in thickness, which it may find in its path, warning or no warning. The ship will simply *have to wait somewhere* until the obstruction breaks up and opens a lane wide enough for safe passage, however wide that may be, and however long it may take. This cannot but affect regularity of movement and tend to make the cost of steamship charters on any basis, higher than it would be if this uncertainty about hold-ups along the route did not exist. In trying to evade the gamble on rates due to variation of supply and demand, you are substituting a *gamble with time.*

The question of reinforced ships is still to be examined from a technical standpoint. I intend to get plans and specifications and costs of such ships, and data with respect to cargo carrying capacity and cost of operation per ton of cargo carried. Hitherto on this particular subject there has been nothing in the literature but a lot of loose, disconnected talk from men who either do not know, or do not tell all they do know, about the technicalities of ship reinforcement and the cost of providing it, and its effect upon cargo space and freight rates for bulk cargoes. The cheapest ocean transportation, which is what is most desired in this connection, can only be furnished by the most economical type of ship; and if such a ship has to be altered or strengthened or have her cargo carrying capacity reduced, she cannot earn a return upon her cost during the months when she cannot be employed in Hudson Bay traffic. All these variations, these ifs, ands and buts, cost money that must be added to the freight rate. Either standard ships must be employed to get minimum rates, ships that can work in other parts of the world, as soon as they are through with the one or two Hudson bay trips per year that they could possibly make and at rates that include a gamble against time, or else a special fleet of ships must be provided, which can only make one or two round trips per season between Europe and Hudson bay, and the rest of the time must either not be operated at all, or be operated under conditions where they cannot commercially compete with other vessels of the same size. Under these circumstances, which cannot be disputed by anyone having a knowledge of the facts, if the country puts up the money to buy the Hudson Bay Railway project, is *it a good road* that the country would be paying for? Cheap ocean freight rates are absolutely *not compatible* with unusual risks or anything that can add to the uncertainties of a sea voyage.

A Scotch marine engineer, Mr. Wm. MacFee, recently broke into the literary world with some very successful novels based upon experience at sea, and one of the best things in a book of his entitled "Casuals of the Sea", in fact one of the best sayings, I have come across for a long time, is this: — "The world belongs to the enthusiast who *keeps cool*". There have been, and are still a great many persons in various walks of life who wax enthusiastic over the Hudson Bay Railway project, chiefly because there seems to be an ocean highway all ready to use within 500 to 600 miles of the western Canada grain belt. I, myself, have felt the contagion of enthusiasm over this project ever since I began studying it; but when, as an *engineer* and *economist*, whose business it is to keep his clients from making expensive mistakes, insofar as he is able to do so; when I look over the physical conditions for shipping brought about by the seasons and the harbour conditions, and the various trade conditions established by practice on regular routes, I am constrained to *keep cool* until all these conditions have been subjected to the most searching analysis.

Final Analysis can only be Made by Technical Experts

I have got far enough in my study to convince me that such a final analysis can only be made by *conscientious,* *incorruptible* and *non-political* technical experts in the various lines of *railroading, harbour construction, marine construction and ship operation,* and in the *grain business,* men who are known to be capable of coordinating *all* the facts, and of reaching a final conclusion on the economic justification of the project that will have to be accepted by non-technical persons from one end of the country to the other. Such a commission should have on it, *only,* men who can *add to* the subject by their own expert knowledge in some one department of it. The railroad, the grain, and the shipping experts can be watched, by a non-political committee of real "dirt" farmers included in the personnel of the commission which would have the double effect of posting the farmers on the technical conditions with which they are ordinarily unacquainted, and of satisfying them that their interests are not being neglected. Such a commission should be presided over by a chairman selected for having a *highly developed sense of proportion in economic matters.*

It is suggested that the commission should be composed of one each of the following experts:—

Chairman and chief engineer.
Railroad construction engineer.
Railroad operating superintendent.
Harbour engineer.
Naval architect.
Shipbuilder.
Sea captain.
Ice pilot.
Air service expert.
Grain elevator engineer.
Grain merchant.
Steamship operator.
Statistician.
1 first class business man of affairs like a banker or a manufacturer.
Also, *three* farmers, who are not politicians or office holders, one to keep in touch with each of the railroad, steamship and grain interests in particular.

Such a commission could safely be intrusted with the task of ascertaining the *facts, all* the facts, and *nothing but the facts,* and reporting on them to the Government and people as a whole.

The past history of the project shows that committees of parliaments and legislative assemblies and even senators, have so far got nowhere. They have not the training to get them anywhere so I take the liberty of proposing that the next and final study be made by trained experts without political bias.

Analogies to the Hudson Straits Conditions

An analogy to the Hudson straits can be found in the problem of safeguarding steam railroad traffic in the Pacific coast mountain ranges. Snow slides come down across tracks without warning, and the trains are held up for several *hours* to several *days* at a time; traffic is physically impossible until the rotary plow and men with shovels have cleared the track. The answer to this is snowsheds wherever slides are inevitable. Where there are *not* snowsheds, the *traffic is delayed* until the track is cleared. Hudson straits is exactly such a route, but nothing equivalent to a snowshed is physically possible in any part of it. Steamship traffic has to wait until *wind and tide,* either or both, play the part of the railroad rotary plow, and disintegrate the ice field so a steamer can get through it.

Or, the situation is analogous to an ordinary smooth automobile highway, able to carry ordinary civilian peace time truck traffic, but upon which some paramount interest, like that of military supply trains in war time, not only has absolute priority of right of way for the full width of the road, but also may even run without lights, and may not be obliged to warn civilian traffic of its coming, or the speed at which it travels, or whereabouts on the road it is to be expected or met by other traffic. No matter how smooth or well lighted such a road might be, would an owner of motor trucks consider it a good road for making profits out of freight hauling at so much per hundred pounds?

If you were asked to haul a motor truckload of civilian freight for 100 miles over a perfect concrete road under such conditions as that, would you offer to perform the service? Would it be at so much per ton or at so much per hour? But the proposition that is put up to the ship owner who is offered a chance to carry a shipload of grain through Hudson straits to Europe, has so far been invariably on a tonnage or a bushel basis. On a cost per *ton* or per *bushel* basis, is Hudson straits a *good road*?

It seems to me that a long study of the facts, and facts alone, by technical experts only, must be made before any conclusion can be arrived at, as to what basis of compensation would be fair enough, both to pay for the railway service, and to attract competitive ocean freight service; and whether any savings that might be made possible, would show that the cost of completing the Hudson Bay Railway project would be economically justified.

The Hudson Bay Railway and Port Nelson

A General Review of Conditions in the Vicinity of Port Nelson

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The Hudson Bay Railway has been, for many years, a political football, and different opinions are held as to the success or failure of the scheme, dependent to a large extent on the occupation of the persons concerned. A glance at the map of Canada will show immediately what a benefit such a road would be to western Canada, if only it were located in southern latitudes and if the harbours on the Hudson bay were capable of being used for all the year or even for eight or nine months. Unfortunately for the scheme, however, the only way out of Hudson bay at present is via Hudson straits, which are located very close to the Arctic regions, and, as it is the navigability of these straits which will determine the success or failure of such a scheme, the chances of its success at present do not seem very bright. The railway itself was a fairly easy proposition to build and has very little curvature and very low grades. Regarding operating expenses, there does not seem to be any great difficulty, but it must be borne in mind that the road was built purely as a grain outlet, and, unless it can pay its way by revenue from that and incoming cargoes from the bay, it has not any very bright prospects of revenue from the country which it traverses. In order to support this latter statement perhaps more space will be devoted to a description of the country than would appear necessary, but the supporters of the Hudson Bay Railway point to vast natural resources and a description might perhaps prove of interest.

Agricultural Possibilities at the Port

For about 250 years the fur companies have been engaged in trading in the bay and, as a result, the coastal regions are fairly well known, as are conditions in the bay itself. Regarding the inland territory, the only sources of information were the Indians and occasional surveyors and explorers and these are none too reliable. Previous to beginning construction of the road, some investigations were made by the government, but the reports published as a result of these seemed very superlative when the country was visited for the first time, nor, in the writer's case, did a further acquaintance with the country change this opinion. From The Pas to Port Nelson the railway traverses practically continuous muskeg and the size of the timber, not very remarkable at the south end, diminishes to about 6 inches diameter in the vicinity of Port Nelson, in fact most of the trees are smaller than that. These trees are mostly spruce and tamarack but an occasional jackpine ridge is encountered. The muskeg, a sort of peat formed by the growth and death of a low form of plant life, varies greatly in depth; in some places being only a foot or so, in others seven or eight. Below there is found a layer of soft clay and then hardpan.

As will be seen from the general plan of Port Nelson, about 50 per cent of the ground is frozen the year round to a depth of 25 feet, while the rest thaws out in summer. During construction at Port Nelson, a shovel cut was located in one of the wet spots and it was drained and the muskeg coating removed. For the first season the shovel operated with a fair amount of ease but, after a winter exposed to the frost, it was necessary to blast ahead of the shovel. In July 1917 a member of the staff died at Port Nelson and was buried temporarily in a dry section; in September the coffin was uncovered for shipment to Halifax via boat and it was found to be frozen solid.

Regarding the possibilities of cultivation along the railroad, grain has been grown as far north as mile 82 and a few garden products are raised at York Factory on the bay, but these latter are in specially prepared soil. During the summer months some of the men tried to grow potatoes at Port Nelson but the plants were twice cut down by frost and the only result was a potato about the size of a marble. Radishes and lettuce were raised by the men, but under glass and in a soil made up of equal parts of sand, muskeg and clay. Excellent swamp grass can be found in many places, especially along the low lying parts of the coast. As far as the clay is concerned, it does not seem very fertile, for no grass or vegetation of any sort appeared on clay which had been exposed at Port Nelson for five years, with the exception of a very little of that low plant life which forms muskeg.

Animal Life

The animal kingdom is the main attraction of people in the Hudson Bay district and this of course is very much disturbed by such a thing as a railway. Fur bearing animals are fairly plentiful and the skins are generally of a high quality, commanding a good price. The staple fur is the white fox, and on the scarcity or otherwise of white foxes depends the prosperity of the native. White foxes, like most Arctic and Sub-Arctic animals, travel in runs and when a run is on they can be caught very easily by any one at all. During a run in the Spring of 1918, a boiler, which was used for boring holes through the ice, was the attraction for foxes crossing the river and the snow in its vicinity had the appearance of having been trodden down by a flock of sheep. A pile of ashes or an empty coal sack or any black object would bring them and on one occasion the writer had one within three feet of him in broad daylight and, only for an unfortunate sneeze, might have caught it alive.

Polar bears and wolves are seen occasionally but are not numerous. A she bear and cub were shot in the summer of 1918 swimming across the river. As an experiment the cub was cooked but the results did not measure up to expectations. The flesh has a pronounced fishy taste and this combined with a large amount of oily fat proved too much for even a gang of men living on barrelled beef. Moose are fairly plentiful along the Hudson Bay Railway as far as Kettle rapids, mile 331, but beyond that only a few stragglers are seen. Caribou can be found north of Port Nelson but in the vicinity of the port itself there is apparently nothing in the line of big game, because it happens to be located at about the boundary between the feeding grounds of the moose and barren land caribou. A little animal which caused quite a lot of damage to stores, etc., was the field mouse.

During the dry summer of 1921 it was almost impossible to put one foot in front of the other without disturbing a mouse. Cats were imported to try and keep them out of the warehouses but the dogs soon killed the cats and finally weazels were coaxed into the warehouses, and they met with better success. It is very trying to find a nest of field mice in the coat pocket of the only suit fit to wear in civilization and it is equally annoying to have field mice as bed companions. While on the subject of animals, a reference must be made to the husky dog. This product of necessity has a range of food including such delicacies as corn brooms, rubbers, mitts, boots, etc., and its vocal accomplishments must be heard to be appreciated. The rations for the government dogs at Port Nelson was 2 pounds of cornmeal and ¼ pound of tallow per dog per day. Water is boiled with the cornmeal until a mush is obtained, the tallow is added and then the whole is allowed to cool and is served in a semi-solid state. Beef tallow must be used as lard has a disastrous effect on dogs when used in large quantities. The usual way of harnessing was six dogs in tandem and such a team could easily handle 400 pounds on a toboggan. The population of Port Nelson consists of about 40 Indians, 2 or 3 mounted policemen and such men as are sent in by the Department of Railways and Canals. One or two white trappers might be included but these do not stay long.

Regarding fish, it cannot be said that the Hudson Bay is a prospective fishing centre to judge from observations at Port Nelson and the reports of people who visited other sections of the bay. Seals and white whales are abundant at Port Nelson itself and whitefish, suckers and trout are caught. The seals are not the fur bearing variety nor are the whales valuable for anything but their oils. At one time the larger whales were caught in the bay but they were soon extinct and the whaling stations are now abandoned. The trout come from the tributaries of the Nelson while further up the main river sturgeon can be caught. During 1918 an effort was made to establish a fishing industry in the lakes along the Hudson Bay Railway but it only lasted a year and is now almost defunct.

Among game birds found around the Bay are swans, geese, ducks, plover, snipe, ptarmigan, prairie chickens and spruce partridge. The ptarmigan is the only bird among those listed above to stay the year round and it is adapted to the country, in summer its plumage is brown and in winter white. Owls are plentiful and the Indians set traps for the white Arctic owl and claim it is a great delicacy.

Conditions on the Nelson River

The Nelson river, the third largest in Canada, has cut clay banks ranging from 100 feet to nothing, but averaging somewhere about 70 or 75 feet and its larger tributaries cut down into the clay to a similar extent. Its fall from lake Winnipeg to the sea is 711 feet and this takes place in 350 miles which shows that the river has a pretty rapid flow. Regarding its drainage areas, a glance at the map will show that it extends from the Rockies to the Great Lakes and south of the United States boundary. Its flow is regulated to some extent by the Manitoba lakes system and many good power sites are to be found on it, but as a navigable stream the Nelson is almost out of the question. A shallow draft stern wheeler used to go from Port Nelson to about 12 miles up river but beyond this a boat drawing 3 feet of water was about all that could be used and this could not be used for more than 40 miles upstream. A good idea of the rapidity of the Nelson's current can be gained from the fact that a canoe takes 4½ days to go up the river to Kettle rapids, a distance of about 100 miles and the canoe has to be tracked almost all the way. The journey down. however, can be made in 1½ days including portages. The gasoline dory, which used to go after the mail as far as the head of navigation, was compelled to hug the shore or else it would go downstream instead of up. In winter some remarkable ice jams occur at the various rapids, often rising to sixty feet and sometimes going as high as seventy. This accumulation is formed by large plates of ice coming down the rapids, getting one end in under the existing ice cover and then being forced upwards by the pressure of the water. At the mouth of the Nelson river the ice is usually from 4 to 5 feet thick, extending from shore to shore, and the seaward limit of this ice varies considerably. By New Year's as a rule it is possible to cross the river at Port Nelson but long before this a crossing can be made by going a few miles up the river. Previous to the formation of the ice bridge, the ice flows in and out of the estuary with the tide for some weeks. As to the distance out from shore that the ice cover extends in the bay itself, the writer has no definite figures but it extends for some considerable distance as can be inferred from the shallow nature of the waters adjacent to the coast. The ice for some miles out from shore is very rough and difficult to travel over and while it has been the writer's misfortune to walk four miles out from shore over this, the journey was not undertaken a second time. The ice in the central portion of the river rises and falls with the tide but extending out from either shore is a vast field of rough ice which is grounded. About the end of May to the middle of June the break up occurs and from then on until the middle of October the port is relatively free from ice. Sometimes ice is brought down by the winds from the north and it has been known for ice to come into the estuary in August and of such dimensions as to ground in 20 feet of water. This floating ice in the bay and straits is what constitutes the handicap to the whole project and vessels have been known to be tied up in floating ice for two weeks at a time.

The Nelson estuary is shaped like a funnel but its deepest channel is relatively narrow and fairly straight. A depth of 20 feet at low water is available up to within two miles of the works and 13 feet more can be added for high water. Unfortunately, however, there does not seem to be any place for boats to anchor and swing freely with the tide; in fact some vessels have touched bottom when swinging at low water. In order to get 30 feet at low water it is necessary to go out about 20 miles from the existing works. Fogs are not numerous nor would they constitute an unsurmountable handicap to navigation, but the currents, on the other hand, are such as to compel navigation in and out with the tide. Near the deep hole the current attains a speed of 8 miles per hour on the ebb of a spring tide. The mouth of the Nelson has frequently been referred to as being full of shifting shoals, but from observations made during a summer's sounding in 1918, it would not appear that the shoals are of a shifting nature. Most of them are made up of coarse gravel and large boulders with some sand and clay mixed and certainly do not give any idea of being of a changeable nature.

The question of tides is of great importance when navigation is concerned and the Nelson river estuary presents much the same features as any other tidal estuary. At a point 20 miles or so below Port Nelson, the tide curve is the ordinary 6 hour ebb, 6 hour flow; opposite Port Nelson the curve changes, the tide coming in in 4 hours and taking 8 hours to go out. The tidal effect is felt as far as Seal island, 12 miles up river from the terminals. A normal spring tide has a rise of 14 feet at Port Nelson itself but with a north east gale this has been increased to 20 feet. This fact renders canoe travel along the coast of Hudson bay very dangerous, especially around the period of the autumnal equinox. High water occurs at the mouth of the river from half an hour to an hour earlier than at Port Nelson itself depending on the height of the tide. This feature is of great assistance to incoming vessels as it enables them to arrive at the terminals at high water or perhaps a little before. Low water at Port Nelson is from 2½ to 2¾ hours later than at the mouth of the river. High water at the terminals is 1½ feet higher than high water at the river mouth and low water is from 1 foot to 5 feet higher than low water at the mouth.

Construction Work

Those who were first sent to the Hudson Bay to begin construction were confronted with no mean task. The site of the work was nothing but a swamp covered with small spruce and tamarack while at low water the mud flats extended 500 feet from the shore. The first thing done was to build some sort of dwelling places for the men and warehouses for the stores and during this to build temporary wharves for unloading the stores from the lighters. A drydock, wireless station, machine shop, power house, saw mill, planer and compressor house were among the auxiliary works constructed and a narrow gauge railway with 7 locomotives served the whole job. Among other things must be mentioned the assembling and fitting up of dredges and the construction of dump scows, pile driver scows, derrick scows and other floating plant. As a result of this preliminary work it was not until 1915 that actual construction was well under way but during the three years 1915, 1916, 1917, construction went on fairly rapidly. In order to lessen the amount of dredging it was decided to build the elevators on an artificial island and to connect this with the shore by means of a bridge or an earth fill. The earth fill was rejected on account of the necessity for allowing the tide water to flow and the final plan was a series of bridges of about 110 feet span supported on piles which are protected from the ice by cribwork. Originally this connection from the island to the mainland was to have been located considerably downstream from its present position but after building an earth dump for a short distance out from shore it was found that the erosive action of the current was too great for the soft clay and the new location was adopted. There is a well defined line of demarcation between the hard clay and the softer variety which was located by means of test piles and borings with a keystone drill and the island and the bridge are located inshore from this boundary. The superstructure of the bridge was fabricated by the Dominion Bridge Company, brought in by boat and erected by the Bridge Company's men, being finished in 1916. The Island is essentially a series of timber cribs built into a more or less rectangular shape and with the interior space filled in with dredged material. The elevators were to be constructed on pile foundations within this space. The cribs were built up 8 or 9 courses on ways on shore, most of them being 101 feet by 28 feet, and were towed to a prepared position by tugs on the incoming tide and sunk with the outgoing tide. They were built of 12 by 12 B. C. fir and were practically all solid faced though some native timber fillers were used for the inner faces. Concrete blocks were used to sink the cribs finally and then river gravel was shovelled in from scows moored alongside. This gravel was obtained from the bed of the river between Flamborough Head and Seal island about 10 or 12 miles away. A 1½ yard dredge was kept at this point all the summer season and the scows were towed up and down by gasoline tugs and a stern wheel steamer. This gravel varied from stones 2 or 3 feet across to fairly fine material and constituted a good material for filling though being difficult to handle. After the crib was sunk and filled it was built up between tides to about 20 feet above low water and the upper portion was train filled with clay from a shovel cut on shore. The drills at the launchways on shore were operated by compressed air, those at the island being electrically operated. The interior of the island was supposed to be filled with material excavated by the hydraulic dredge but this expensive piece of plant did not give very satisfactory service and so the filling was behind when the work was closed down. After the island was filled a series of deep water cribs were to have been placed along the outer face constituting a mooring place for vessels.

It will appear to anyone looking at a picture or plan of Port Nelson that the buildings are placed far apart. This was done intentionally as a precaution against fire, while for additional safety a fire guard 100 feet wide was cut around the whole works. With the water drained off from it, the muskeg offers a good fuel for fire and it is remarkable that no serious fires occurred at the Hudson Bay Terminals when the job was in full swing. The dinkies were the chief offenders but train crews had orders to stop and put out fires and in that way they were checked before they had a chance to spread.

The work was stopped in the fall of 1917, and a few men were sent in during 1918 to put everything in order for a long period of closure. During this summer advantage was taken of the necessity of having these men in to undertake a complete hydrographic survey of the Nelson Estuary. A line of levels was run down the coast about 20 miles and by means of a water level transfer at high water, a tide gauge was established on a shoal about five miles out from the shore. During sounding operations simultaneous curves were taken at Port Nelson and at the outer gauge and all soundings were reduced to the sloping surface of low water. The method adopted for taking the soundings was to drift with the current, sounding all the time and then taking simultaneous readings with two sextants on three beacons on shore. The time of each sextant reading was recorded and the line of drift plotted by the three point method. These soundings supplemented those taken every spring through the ice. The method adopted for taking soundings through the ice was to stake out the area, with stakes every 50 or 100 feet as required, then by means of steam supplied by a boiler mounted on runners make a hole about 6 inches diameter in the ice and sound through this hole. The tide gauge was established on a boulder near by by running levels out over the ice from a bench mark on shore, care being taken to see that the level rod always rested on the river bottom. Borings made by the Keystone drill through the ice were controlled the same way and generally located with a sextant by the three-point method, while a block of soundings was in general tied in by a traverse.

The great difficulty encountered in connection with a work located in such an inaccessible place as Port Nelson, is lack of transportation facilities or perhaps it would be better to say the cost of transportation. Previous to the commencement of the Hudson Bay Railway the principal routes to the bay were via boat through the straits or else overland to lake Winnipeg and down the Hayes river. Most of the earlier arrivals at Port Nelson came in by boat as did practically all material and plant for the job. In the early days with very limited warehousing facilities and very poor lightering arrangements the cost of unloading the boats was fairly high but by about 1915 the temporary wharves were completed and cargoes were handled quicker and cheaper. At first special gangs of stevedores were brought in to unload the boats but this practice was soon discontinued owing to the cost and the loss of goods from theft. During the later years work was practically suspended on arrival of a cargo and all hands were put to work unloading. The lightering facilities as finally developed consisted of three wharves equipped with stiff legged derricks and light railway tracks, three steam lighters, one diesel engined lighter, two steam tugs, five gasoline tugs and numerous scows.

When the railway was within 200 miles or so of the bay the men were brought in overland and they generally arrived in April or May before the spring break up. They would come up by rail as far as possible and then walk the rest of the distance. Caches were established about every 15 miles or so, some by the Department of Railways and Canals and others by the sub-contractor who was doing the grading, and an arrangement existed whereby travellers on the trail could secure accommodation at either. Towards the end of September or beginning of October some of the men were laid off and the outgoing boats were always fitted up with bunks and loaded up with men bound for Eastern points. Such men as could not be accommodated on the boats used to make the journey on foot to the end of steel. As can easily be seen from the above routine, transportation charges were very high and in 1917 the experiment was tried of hiring a special train from Ottawa right through to the end of steel and while this reduced expenses some it did not accomplish much.

In order to communicate with civilization more quickly two wireless stations were built; one at The Pas, Man., and the other at Port Nelson. The latter station was also used for communicating with incoming boats and with one of the tugs which did sounding work in the river mouth. It also received the daily time signals and a press bulletin from Arlington, Va., and in this way enabled those at the Bay to keep in touch with the outside world to some extent. During construction a weekly mail service was provided. Mail would be brought by rail as far as possible, then by canoe down the Nelson to head of navigation and thence by gasoline dory to Port Nelson. This was of course the summer service, the winter service was simply a question of dog teams from the end of steel to Port Nelson.

It was the writer's privilege to spend a year in Port Nelson after the work had been subjected to five winters and the damage done was remarkably small. A part of the cribwork of the island which had not been built up sufficiently high was destroyed by the ice but other than this and the loss of some clay filling the cribwork was in excellent shape. The channels under the bridge spans had not eroded to any great extent with the exception of the last two spans and there only a foot or so. Rip rap which had been deposited around the cribs supporting the bridge was flattened out due to ice pressure and there had been some movement of the bridge itself but nothing of a serious nature. The buildings were in very good shape considering that they were founded on frozen ground and were fit for use without any major repairs. All the launchways which projected from the shore had been carried away by the ice and the shore had been eroded from 10 to 15 feet. With regard to the Hudson Bay Railway itself it cannot be said that it weathered the storms as well. A bi-monthly service had been maintained from The Pas to Mile 214 and beyond this traders operated gas cars as far as Kettle rapids. In 1921 while going up the line on a gas car the writer passed the "Muskeg" coming down from Mile 214 and the best description that can be given of its appearance is that of a vessel in a heavy sea. The few men engaged in maintenance of the road had replaced a few ties, broken rails, etc., but the real need was ballast and the money was not forthcoming.

This paper has not been written with the idea of knocking or boosting the project, although the writer is against the scheme and perhaps a little biased on that account. Our western friends, or at least those in the vicinity of The Pas, when the subject is brought up, immediately raise the question that Eastern ports and maritime interests are against the scheme because it will hurt their business. If they are against the scheme so much the better, for the principal traffic on the Hudson Bay Railway, so far, has been and apparently continues to be, votes.

While the useless expenditure of 20 million dollars must be deplored, this much can be said, that the works constructed at Port Nelson are standing and were not injured to any great extent after five years of exposure in an unfinished state to very adverse weather conditions, a good tribute to the judgment of the men responsible for their construction.

The Hudson Bay Railway

An Economic Study of the Proposed Hudson Bay Route

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Present Conditions

The study of any proposed transportation route from an economic standpoint first involves a study of the factors controlling the movement of the principal commodities to be handled over the proposed route. In the case of the Hudson Bay Railway and the creation of a port on the Hudson bay the general expression of its proponents is that grain will be the principal commodity, although some state that even if the handling of grain does not prove feasible, the tapping of the vast natural resources along the route will enable the railway to pay its own way. The latter proposition, however, could hardly be expected to pay for the establishment of a large port, and in any event there would have to be far more conclusive evidence of the existence of such valuable traffic producers along the route of the Hudson Bay Railway than has so far been produced. There is no question, however, that the principal demand for the railway is being made on the grounds that it will provide an outlet for the western grain crop.

Canada's Grain Crop

Before being able to study the relationship of the Hudson bay route to the handling of the grain crop it is necessary to have a knowledge of existing conditions regarding the production of grain, its marketing and routing for export. (Domestic consumption is not directly relevant owing to the fact that the Hudson Bay route is essentially an export route.) A complete study of this subject would fill volumes. The writer proposes only to outline the leading factors involved in the problem.

Grain production in Canada has steadily increased, and table No. 1 gives the production of grain in Canada since 1910. In view of the fact, however, that in relation to the Hudson Bay route it is only exports that are of interest, the yearly exports are also included.

An examination of this table immediately makes it apparent that wheat is the only grain exported in sufficient quantity to become a serious factor.

Export of Wheat

This naturally leads us to a study of the export of Canadian wheat. One of the first questions that arise is what will be the future tendency? This in turn leads to a study of the maeket to which the wheat is delivered. The principal customers for our Canadian wheat arr European countries, which indeed form the principal importers of the world. Canada does not have a monopoly of this market, but competes with the United States, Argentine, India and Australia, and in normal times with the Balkans and Russia. In table No. 2, there is given for a period of years the amount of the exports from the principal countries and also the world's total exports; in other words this table indicates how the world's market is supplied. The most striking point is that for many years the world consumption has remained comparatively constant, or at any rate has only slightly increased, but on the other hand Canada's share in the supply has recently increased out of all proportion. In looking for the reason for this condition one immediately notes that Russia and the Balkans have ceased exporting. Canada and the United States have largely filled this gap. There is little

Table No. 1, — Production and Export of Various Grains (Canada)

(Thousands of Bushels)

Year	Wheat		Corn		Oats		Barley		Rye		Total grain	
	Crop	Export	Crop	Export	Crop	Export	Crop	Export	Crop	Export	Crop	Export
1910	149,990	46,426	18,718	...	323,449	5,846	45,148	1,639	1,544	56	538,849	53,967
1911	215,918	60,474	18,773	...	348,586	8,357	40,631	1,274	2,669	80	626,577	70,185
1912	199,236	84,958	16,570	...	361,733	9,660	44,014	4,788	2,594	...	624,147	99,406
1913	231,717	129,950	16,773	...	404,669	31,736	48,319	13,906	2,300	127	703,778	175,719
1914	161,280	70,302	13,924	...	313,078	19,287	36,201	6,838	2,017	146	526,500	96,573
1915	376,304	151,900	14,368	...	520,103	7,871	53,331	4,665	2,394	500	966,500	164,936
1916	220,367	191,218	6,271	...	351,174	70,938	41,318	9,905	2,896	989	622,026	273,050
1917	233,743	146,874	7,763	...	403,010	59,791	55,058	7,218	3,859	833	703,431	214,716
1918	189,075	55,054	14,205	...	426,312	24,024	77,287	4,566	8,504	798	715,383	84,442
1919	196,361	69,057	16,940	9	411,136	16,346	58,366	13,172	11,003	1,897	693,776	100,472
1920	263,189	123,060	14,335	37	530,710	14,807	63,311	9,460	11,306	2,999	882,851	150,326
1921	300,858	146,871	14,220	17	426,233	33,183	64,253	12,304	25,800	3,816	831,364	196,174

doubt but that Russia will eventually return to the world market as a wheat exporter and this will seriously affect the Canadian market. Russia can deliver wheat to consumers at freight charges about the same as Canada, and can produce wheat as cheaply. It is certain that Canada's exports will not continue to increase at the recent rate, and it may well be that they will decrease in the future.

Having examined the magnitude of Canada's wheat crop and exports, the next point of interest is the distribution of production, and its relation to the proposed route. This is given in table No. 3, which shows the wheat crop, province by province. From this table it will be seen that Saskatchewan leads the production with an average of 48.9 per cent of the total production, and that the eastern provinces are almost negligible in importance.

Marketing of Wheat

How is the crop marketed? By far the greater part is delivered by rail to the terminal elevators at Fort William and Port Arthur as rapidly as possible after the harvest, although a small percentage is held over in the western country elevators, and some of the crop is retained or milled for domestic consumption. The most recent development is the exporting of a part of the crop by way of Vancouver. From Fort William and Port Arthur every effort is made to get as much as possible to the seaboard, or at any rate as far east as possible before the close of navigation. This is in order to take advantage of the lower freight rate by water than by rail. If the open navigation season is missed the grain has to be held four months, bear the expense of rail haul, or not be marketed until the next season.

Table No. 3, — Production of Wheat by Provinces. Average Crop for Years 1916-1920

(Thousands of Bushels)

	Quantity	Per cent
Prince Edward Island	556	0.3
Nova Scotia	464	0.2
New Brunswick	492	0.2
Quebec	3,826	1.7
Ontario	18,631	8.1
Manitoba	39,508	17.4
Saskatchewan	112,368	48.9
Alberta	51,973	22.8
British Columbia	760	0.4
Total	228,578	100.0

The deliveries of grain to the railways by the farmers is given in the table No. 4. It will be noted that the crop first appears on the market late in August, but only reaches its maximum at the end of September. The deliveries are high during October, November and December, and with the approach of the end of the navigation season they drop off rapidly.

Table No. 2, — Annual Wheat Exports from Principal Exporting Countries

(Thousands of Bushels)

Year	Canada	U. S.	Argentine	Hungary Roumania Bulgaria	Russia	India	Autralasia	Grand Total
1900	14,773	215,990	73,496	32,604	74,140	1,632	14,516	427,772
1901	26,117	154,856	33,226	27,229	83,408	13,773	20,260	550,925
1902	34,025	114,181	23,696	43,588	111,977	19,542	9,282	557,209
1903	28,031	73,372	61,778	44,399	153,448	43,016	1,209	407,232
1904	16,618	13,015	84,684	46,510	169,058	75,256	34,115	441,972
1905	28,669	20,738	106,391	63,115	176,852	47,680	25,424	468,163
1906	38,135	62,850	82,599	64,603	132,410	26,488	30,262	437,355
1907	37,503	91,383	98,501	51,835	85,270	37,515	28,784	432,088
1908	52,502	92,779	133,609	34,079	54,050	4,280	15,027	391,281
1909	49,428	48,489	92,377	37,436	189,272	34,712	31,549	467,278
1910	46,426	24,257	69,209	76,375	225,458	40,481	47,762	532,215
1911	60,474	32,669	83,993	64,722	144,779	52,557	55,148	494,851
1912	84,958	61,655	96,600	53,642	96,915	65,598	32,604	494,383
1913	129,950	99,509	103,328	50,477	122,336	30,558	42,923	601,003
1914	70,302	173,862	36,028	19,744	88,609	26,130	52,878	467,702
1915	151,900	205,830	92,281	.....	7,018	26,505	5,617	489,165
1916	191,218	154,050	84,321	.....	9,656	23,896	55,279	517,420
1917	146,874	106,196	34,383	.....	.....	53,872	22,982	364,658
1918	55,054	111,177	110,098	.....	.....	22,352	21,600	322,569
1919	69,057	148,086	111,631	.....	.....	331	80,919	410,024
1920	123,060	218,290	190,051	9	.....	1,940	45,984	580 178
1921	146,871	279,952	60,019	2,781	.....	9,834	102,071	603,055

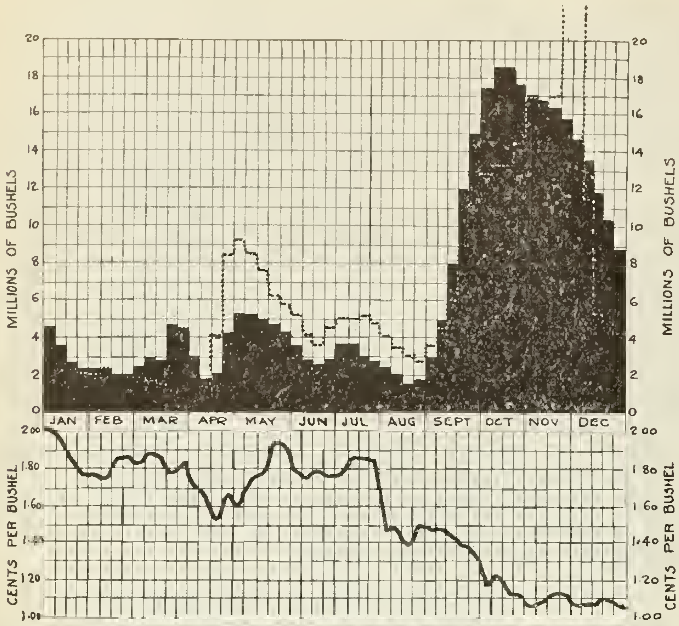


Figure No. 1,—Receipts and Shipments of Wheat from Port Arthur and Fort William for 1922-23.

Solid black—Deliveries of Wheat to Terminal Elevators at Fort William and Port Arthur, by weeks.
Dotted line—Shipment of Wheat from Terminal Elevators.
Full line—Price of No. 1 Northern Wheat at Winnipeg.

The western Canadian farmer disposes of his crop to suit his own convenience and judgment. The purchaser of the farmer's product buys to suit his own convenience and judgment. The convenience of the two parties is not necessarily the same. The farmer has always indicated his desire to get rid of his crop promptly, in fact under present conditions he is obliged to do so, first because the country elevator capacity is insufficient and secondly, the western farmers have not been able to finance on postponed selling. The purchaser, on the other hand, buys to suit the convenience of the ultimate consumer which is uniform from day to day.

In the present case the purchaser represents the European market, and he buys fairly uniformly throughout the year, but he buys from other countries besides Canada. During the early spring he obtains large quantities from the Argentine and from Australia, during the summer from India, and during the fall he buys large quantities from the United States and Canada. There is a limit, however, to the quantity he will buy in any stated period, and if more than this amount is forced on the purchaser it knocks the price down and is to the serious financial disadvantage of the producer. There is probably no product in the world which responds so accurately to the laws of supply and demand.

In other words it must be borne in mind that the Canadian producer must not force the European buyer to take more wheat than he is willing to buy at any one period. Exception can be made to this statement if it is assumed that the producer would be willing to sell at a lower price in order to persuade the purchaser to buy in greater quantities than he requires and to provide increased storage facilities. But there is apparently no desire on the part of the westerner to have the price of his crop reduced.

As a matter of fact it is well known that what Canada has been doing for some time past has been offering in the fall a greater quantity of wheat than there is a demand for. This naturally results in knocking the price down. In figure No. 1, the receipts at and shipments, lake and rail, from Fort William and Port Arthur are given for the crop year 1922-23, and the corresponding prices at Winnipeg. This diagram illustrates the condition outlined above, and is typical for many years past. Having reduced the price Canada then proceeds to sell the bulk of its wheat at the reduced price. Apart from this undesirable feature, the rush to market the wheat puts a tremendous peak load on the railways, elevators, lake vessels and so forth. The whole operation can only be classed as being extremely unbusinesslike, but it is a condition brought about by the inability of the western farmer to finance for a long period, and also by the lack of storage facilities in the west.

Table No. 4, — Deliveries of Wheat by Farmers to the Railways
(Crop Year 1922-23)

Week	Bushels	Week	Bushels	Week	Bushels
1922		1923		1923	
Sept. 1	2,186,151	Jan. 5	2,069,414	May 11	859,709
" 8	13,578,709	" 12	2,371,640	" 18	700,140
" 15	15,901,970	" 19	2,330,184	" 25	643,257
" 22	27,872,116	" 26	2,139,259	June 1	889,728
" 29	30,716,368	Feb. 2	2,322,741	" 8	1,046,100
Oct. 6	21,839,453	" 9	1,732,177	" 15	1,344,292
" 13	17,681,115	" 16	1,260,272	" 22	1,594,817
" 20	17,096,563	" 23	2,128,042	" 29	1,263,606
" 27	16,562,335	Mar. 2	3,307,423	July 6	820,461
Nov. 3	15,758,279	" 9	2,944,244	" 13	844,261
" 10	12,888,743	" 16	2,706,055	" 20	782,595
" 17	15,056,386	" 23	2,244,265	" 27	553,549
" 24	12,789,893.	" 30	1,747,005	Aug. 3	462,226
Dec. 1	11,023,317	Apr. 6	2,003,489	" 10	320,548
" 8	7,557,239	" 13	1,665,422	" 17	535,893
" 15	4,228,673	" 20	1,347,957	" 24	1,034,918
" 22	3,722,491	" 27	1,100,718	" 31	1,479,246
" 29	3,412,600	May 4	958,713		

At this point one is inclined to ask what effect would the proposed Hudson Bay route have on this situation of the marketing of western wheat? The answer is clear. If it is assumed that the route is capable of handling an appreciable part of the western crop, it would simply provide a means for dumping even more wheat on the European market at a time when it is not desirable so to do and of accentuating the present unfortunate conditions. It is difficult to see any other effect than the lowering of the price of wheat on the Canadian market. As it is to-day the congestion of the routes to the seaboard at least has the advantage of helping to prevent the dumping of wheat on the market, to a point beyond all reason.

This naturally leads to the idea that advantage might accrue to Canada if the money that is required to complete the Hudson Bay route were utilized to help the financing of the western farmers and to provide sufficient storage facilities so that the crop can be retained for a longer period in the west. This, however, is a subject outside of the one now under discussion, and indeed the whole marketing situation is being dealt with by more than one body.

Movement of the Crop to the Seaboard

The movement of the western Canadian wheat crop from the terminal elevators to the seaboard is of great interest. Taking the principal division of the traffic by countries, we have out of 248 million bushels shipped by lake and rail from Fort William and Port Arthur, 120 million bushels went out through American ports. This represents 48½ per cent of the total shipments, or 52½ per cent of the lake shipments.

The routing of export wheat is given in detail in table No. 5, and shown diagrammatically in figure No. 2. Of the quantity arriving by lake and rail at Montreal, about 60 per cent is exported by the St. Lawrence route, and the balance is milled locally or exported by the winter routes, St. John, Halifax and Portland, Me.

Table No. 5, — Routing of Western Canadian Wheat from Terminal Elevators
(Thousands of Bushels)

Percentage represents percentage of total shipments
Total shipments from terminal elevators — lake and rail — 248,241 — 100 per cent.

		Per cent		Per cent
All rail shipments	18,423	7.4		
Lake shipments	229,818	92.6		
Depot Harbour	934	0.4		
Port McNicol	20,887	8.4		
Tiffin	5,492	2.2		
Midland	19,296	7.8		
Collingwood	351	0.1		
Total Georgian Bay ports			46,960	18.9
Goderich	14,673	5.9		
Port Stanley	362	0.1		
Huron	3,665	1.5	18,700	7.5
Total lake and rail to Montreal			65,660	26.4
All water to Montreal	3,627	1.6		
Transhipped at Port Colborne from Montreal	42,921	17.3	46,548	18.9
Total to Montreal			112,208	45.3
Chicago	1,012	0.5		
Detroit	106	0.1		
Buffalo	97,242	39.2		
Toledo	5,149	2.0		
Fairport	2,352	1.0		
Erie	11,100	4.5		
Total American ports			116,961	47.3

During the past year the western route, via Vancouver and the Panama canal, has become quite a factor in handling export wheat, particularly from Alberta and western Saskatchewan. Between 40 and 50 million bushels of grain have been exported in the last year of which about 65 to 70 per cent has been for Europe, the balance going to the Orient. The latter is a market, incidentally, which may become of great importance in the future.

Present Cost of Transportation.

To move a bushel of wheat from the point of delivery to the railway in the wheat country to Liverpool involves both transportation and handling costs. The latter can be assumed to be more or less similar for any route and need not be taken into serious consideration in this comparative study.

The cost of transportation is made up of the movement to the seaboard and the ocean freight charge. The nature of the movement has already been outlined above. The rates for rail routes are all fixed and frequently remain stationary for years. The lake or water rates are always fluctuating from day to day and season to season, and are subject largely to laws of supply and demand. The following table, however, gives the general average rate applying to all eastbound routes from a central point in Saskatchewan, namely, Regina, for export wheat.

		per bushel
Regina to Fort William	rail	12 cents
Fort William to Montreal	rail	20.7 "
Fort William to Montreal	lake and rail	11.5 "
Fort William to Montreal	all water	10 "
Fort William to Buffalo	lake	3 "
Buffalo to New York	rail	9½ "
Montreal to Liverpool	tramp	9 "
New York to Liverpool		8 "

By the westerly route, via Vancouver, the rate from Wainwright, Alta., to Vancouver, is 15 cents per bushel, and from Vancouver to Liverpool the tramp rate is quoted at 19½ cents per bushel.

Summing up the cost of transportation we have the following approximate statement:—

	Total cost per bushel
14,000,000 bushels, all rail via Montreal	41.7 cents
60,000,000 bushels, lake and rail via Montreal	32.5 "
40,000,000 bushels, all water via Montreal	31 "
100,000,000 bushels, lake and rail via Buffalo	32.5 "
30,000,000 bushels, rail and ocean via Vancouver	34.5 "

Finally, introducing the question of distance, the following statement is of interest:—

Route from producer to Liverpool	Approximate distance. Miles	Transporta- cost	Per cent handled
Via all rail and Montreal	4,520	41.7 cents	6
Via lake and rail and Montreal	4,400	32.5 "	25
Via all water and Montreal	5,750	31.0 "	16
Via lake and rail and Buffalo	5,200	32.5 "	41
Via Vancouver and Panama canal	9,500	34.5 "	12

This table makes it apparent that distance is not the prime consideration determining the routing of wheat or indeed, the cost of transportation over a route. Actual costs by various routes indicate that the theory of the proponents of the Hudson Bay Railway that the elimination of "one thousand miles of haul" will correspondingly reduce the cost of transportation is not borne out in fact under existing conditions.

The Proposed Hudson Bay Route

Having studied the present export of wheat, its marketing and transportation, the next question that arises is, what will it cost to transport a bushel of wheat from some point in Saskatchewan to Europe by means of the proposed route?

The cost will be made up of transportation charges from point of production to Port Nelson, elevator charges, ocean freight and marine insurance Port Nelson to Europe. Before any estimate can be made of the cost of transportation over the Hudson Bay route the conditions controlling the cost must be studied. Generally speaking these may be divided into two groups; first, those pertaining to the railway, and second, those pertaining to the ocean.

The cost of transportation over the Hudson Bay Railway can only be determined by taking into consideration the capital cost of the road and the volume of traffic it will handle, in addition to its physical characteristics. It was recently stated in the House of Commons by the Minister of Railways and Canals that to complete the project will necessitate an expenditure, past and future, of $50,000,000. The fixed charges and non-operating expenses on such an investment will be in the neighbourhood of $4,000,000 per annum.

Volume of Traffic

To estimate the volume of traffic is a matter involving the study of a great many factors. First of all, there is the question of the determination of the amount of wheat to be exported, secondly, the determination of the proportion that might travel by this route, and thirdly, the amount of ocean tonnage likely to be available. In addition there are a number of other factors all more or less inter-related and dependent on each other. Unfortunately, however, the determination of any of the foregoing principal factors can only be based on conjecture and guesswork. A more definite means is to establish what is the maximum capacity of the route, and then to assume that the route can be operated at this capacity. This, of course, is a somewhat optimistic assumption.

The capacity of the combined rail-and-water grain route is not determined by any one feature. Taken in chronological order there is first of all the possible rate of delivery to the railway, secondly, the operation of the initial terminal facilities, thirdly, the operation of the railway, fourthly, the operation of the transhipping facilities, and finally the operation and capacity of the ocean carriers.

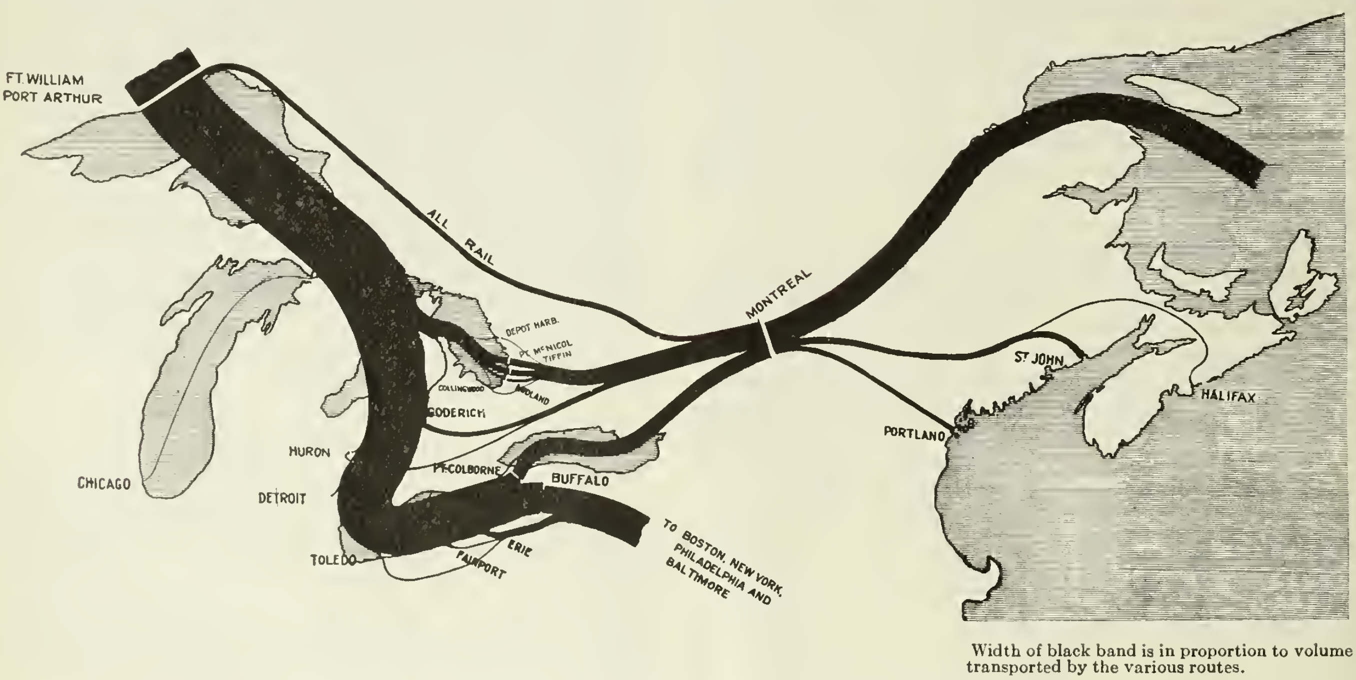
Taking the first point; how fast can the farmers deliver wheat to the railway? Statistics indicate that in September 1922, a year of very large crop, the maximum rate of delivery by the farmers to the railway was 31,000,000 bushels of wheat per week, during the last week of September. The average rate for September was about 3,000,000 bushels per day, and for October 2,600,000 bushels per day. This was the rate at which all the farmers in the three prairie provinces actually delivered wheat to all the railways.

The mileage of all railways in the three western provinces is 15,000, of which 13,600 are in the wheat country. The mileage of railways in the territory which might reasonably be expected to feed the Hudson Bay route does not exceed 800. This represents less than 6 per cent of the total railway mileage in the wheat country. Even if we assume as high a proportion as 10 per cent it gives the maximum rate at which the farmers can deliver wheat to the railways tributary to the Hudson Bay Railway, as 300,000 bushels per day. The relationship of wheat production to the Hudson Bay railway is shown in figure No. 3.

The second, third and fourth features, namely, the terminal, railway and transhipping operations are all more or less dependent on each other, and experience indicates that it would be optimistic to expect to handle even 300,000 bushels per day over a single track railway with the unavoidable delays and surges at each end.

The fifth feature, namely, the capacity of the ocean carrier is not a limiting feature physically. If the assumption is made that suitable handling facilities are provided and that the physical features of Port Nelson are made on a sufficiently generous scale to provide anchorage and berths for the requisite number of vessels, there is no doubt that steamers can carry away wheat as fast as the railway can bring it in. The average vessel carrying full cargoes of grain from Montreal is an 8,000 ton boat with an average capacity of about 200,000 bushels. On the Hudson Bay route it is generally admitted that vessels even as large as 5,000 tons would not be suitable, which means that an average cargo would possibly be about 125,000 bushels. This means that to take away 300,000 bushels per day 2.4 vessels per day would have to be loaded and cleared.

With the daily capacity of the route fixed, the next point is the introduction of the time element, or in other words the navigation season. This is a point of no little controversy, but taking from Dominion government reports the average of twenty-seven opinions from men who have navigated the Hudson straits for many years, a period of fifteen weeks is obtained, commencing at July 7th, and ending October 21st. However, if a period covering from July 4th, to October 25th, i.e. sixteen weeks is adopted for the purpose of analysis it is erring in the optimistic side. Now the records of the harbour of Montreal indicate that on the average for ten years, the first ocean vessel only arrived in Port ten days after the opening of navigation, and the last ocean vessel left seven days before the closing. Considering the distance of Hudson straits, said to be the critical point, from Port Nelson, and of other unfavourable conditions, it is extremely unlikely that the foregoing losses of time could be eliminated from this route. This leaves a net average time extending from July 14th, to October 18th, as the period when cargoes would be taken out of Port Nelson. Naturally after the first vessel arrives it will take some days before sufficient vessels have arrived to operate the route at capacity and, similarly, at the close of navigation



Width of black band is in proportion to volume transported by the various routes.

Figure No. 2,—Routing of Western Canadian Wheat from Terminal Elevators to Seaboard.

the traffic is bound to peter out more or less gradually. It must be noted that any one year's crop is not available for export until the first week in September, and therefore that all wheat handled previous to that date must be obtained from storage. Under present marketing conditions there is only a very little wheat available for export during July and August, and unless the whole economic situation of the west is changed there is not likely to be much available in the future. For the purposes of this study, however, it would be optimistic to assume the availability of 10,000,000 bushels out of storage for shipment during July and August. The volume which could be handled during September and October with the limit of 300,000 bushels per day is 8,500,000 bushels. The total capacity of the route is therefore limited, even with optimistic assumption and application of practical considerations, to 18,500,000 bushels per annum. This quantity would require about 148 vessels of 5,000 tons each. The capacity of the route is shown on figure No. 4.

Cost on the Railway

The determination of the cost of handling 18,500,000 bushels of wheat from The Pas to Port Nelson is made up of two factors, first, the fixed charges, second, the operating and maintenance expense.

On an investment of $50,000,000 the fixed charges and non-operating expense will not be less than $4,000,000. On the assumption that inbound traffic and the natural resources are going to pay not only their own operating expense, but also say 25 per cent of the fixed charges there is still an amount of $3,000,000 to be obtained from the wheat traffic.

Operating and maintenance-of-way expenses are proportionate partly to railway mileage and partly to train or car mileage. As a basis for study the following figures give the cost per unit of the various items making up the total operating expenses on all Canadian railways.

1. Maintenance-of-way.................. $2,000 per mile of railway
2. Maintenance of equipment............ $0.84 per train mile
3. Traffic expense...................... $324 per mile of railway
4. Transportation expense............... $1.70 per train mile
5. General expense...................... $297 per mile of railway

In view of the local conditions, it seems reasonable to assume that the maintenance of way expenses would be higher than the average for all Canada, but on the other hand, regarding traffic expense and some of the other items it is at least within the bounds of possibility that they may be somewhat less than the average. The following units have therefore been adopted in this study.

1. Maintenance-of-way.................. $2,500 per mile of railway
2. Maintenance of equipment............ $0.75 per train mile
3. Traffic expense...................... $200 per mile of railway
4. Transportation expense.............. $1.25 per train mile
5. General expense...................... $250 per mile of railway

Total: $2,950.00 per mile of railway — $2.00 per train mile.

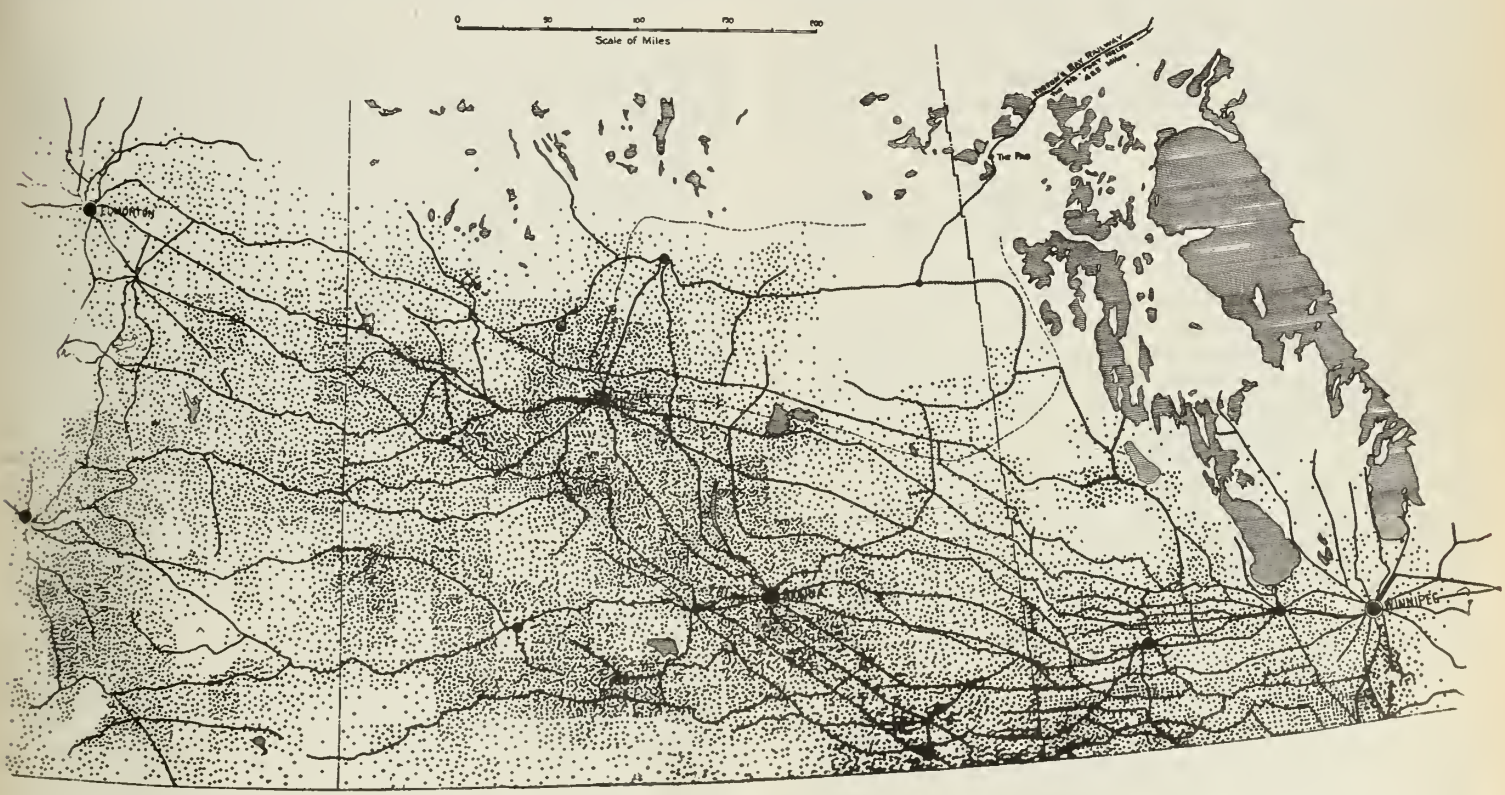
In order to handle 18,500,000 bushels of wheat over the railway it means the operation of somewhat more than 200 trains from The Pas to Port Nelson and return, a distance of 425 miles each way. This is equivalent to 170,000 train miles, exclusive of non-revenue trains, which are very necessary evils, the total train mileage cannot therefore be less than 180,000.

Summing up, the total operation and maintenance expenses will be as follows:—

425 railway miles at $2,950.00........................	$1,253,750.00
180,000 train miles at $2.00..........................	360,000.00
	$1,613,750.00
Fixed charges....................................	3,000,000.00
	$4,613,750.00

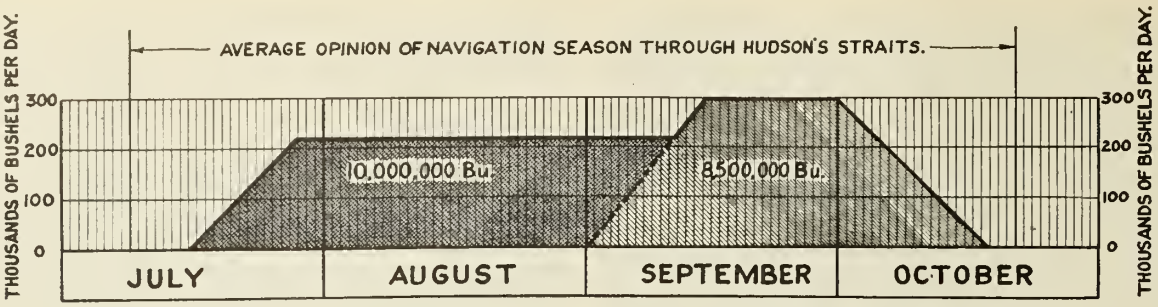
Hence cost per bushel from The Pas to Port Nelson 24.95 cents.

Total cost from center of producing area tributary to Hudson Bay Railway, will therefore be in the neighbourhood of........................ 30 cents per bushel.



Each dot represents 1,000 acres of Wheat under cultivation.

Figure No. 3,—Production of Wheat in Western Canada.



Single Hatched—Current Year's Crop.
Double Hatched—Previous Year's Crop, ex storage.

Figure No. 4,—Capacity of Route.

This is undoubtedly working the problem out backwards, and is obviously impossible because at 30 cents per bushel there would not be any wheat travelling over the route. On the other hand if to start with, a rate of say 10 cents a bushel were assumed, it would be found that it would necessitate the handling of 54,000,000 bushels of wheat, which is the physical impossibility unless extraordinary expenditures were incurred to make it possible, and there again if such expenditures were made the capital cost, hence the fixed charges are increased, and the necessary volume of traffic goes up, and so on.

This, however, does not conclude the comparison with the present cost of transportation, as no reference has been made to the cost on the ocean.

Ocean Freight Rates

Before being able to reach an intelligent conclusion regarding a possible rate from Port Nelson to Europe it is necessary to know something about the conditions which control the making of ocean freight rates. Dealing with the subject on broad lines it is generally true that the first factor controlling a freight rate is distance, the second is the load factor or relationship between inbound and outbound cargoes. In order to reach some idea of what rates from Port Nelson might be when based on considerations of distance and traffic, it is natural to turn to Montreal, as the first of the factors is the same for all practical purposes.

A study of ocean vessels in relation to the grain exports from Montreal first reveals the fact that it is the combination liner which is the prime factor in the traffic. Grain has always been an attractive "fill-in" cargo for the passenger vessels on the eastbound trip and they have always had the first choice of the traffic and have, indeed, been so desirous of obtaining grain cargoes that they have in past years frequently underbid each other to the extent that grain has been carried across the ocean for almost nothing. During war time there was an increase of exports and decrease in ocean tonnage with the result that rates went up enormously and the tramp vessel saw its opportunity of profitably entering the trade. Since the war the exports of grain have remained far greater than the liner capacity with the result that the tramp still remains an important factor and carries the surplus that the liners are unable to take. The rates, however, obtained by tramps are almost invariably higher than these charged by liners.

It cannot be seriously suggested that liners will enter the Hudson Bay route, so that discussion is reduced to the characteristics of the tramp vessel on the Montreal route. It is difficult to obtain exact data subdivided by tramps and liners, but it is interesting to note that the whole ocean export traffic of Montreal amounts to about 4,200,000 tons per season, while the imports are 1,400,000 tons. This would represent a load factor of 3 to 1. In other words every inbound vessel is $\frac{2}{3}$ empty as far as cargo is concerned. On the other hand, it is stated that tramp vessels only occasionally have an inbound cargo, representing a load factor of about 10 to 1.

The principal imports into Montreal are in order of importance, coal, petroleum and oil, in various forms, and sugar, followed by a long list of miscellaneous products in far less quantities, such as dry goods, flax seed (for linseed oil), sand, galvanized iron, and so forth. Of the three principal imports, namely, coal, petroleum and sugar, the last two can be immediately eliminated as far as the Hudson Bay route is concerned as they are all products destined to Eastern manufactories. Coal might be imported by the proposed route, but in view of the vast supplies of cheap coal in the western provinces it is doubtful if coal would be imported in any but small quantities. In other words, the conclusion must be that the load factor in the Hudson Bay route cannot be expected to be more favourable than on the St. Lawrence route as far as the tramp vessel is concerned.

One point, however, in favour of the St. Lawrence route which must not be overlooked is that although the tramp generally comes into Montreal empty, it frequently has a cargo across the Atlantic for New York or some other North American port, whence they have sailed to Montreal to pick up a grain cargo. The distance from New York to Montreal, it might be stated is about 1,500 miles.

While the foregoing remarks cover the prime factors involved in the trade, there are a number of secondary considerations which affect rates on one route as compared with another, such as port delays, port facilities, insurance, and there is also the effect of shipping pools. Under what conditions will the tramp vessel be induced to go to Port Nelson? If the physical conditions of the Hudson Bay route were comparable with the St. Lawrence route, the same cannot be said of trade conditions and the only inducement for a tramp to go to Port Nelson for grain would be the obtaining of a higher rate than from Montreal or the north Atlantic seaboard. From this point of view, alone, it seems reasonable to assume that a tramp vessel would not go to Port Nelson unless it would obtain a rate at least 25 per cent greater than from Montreal.

Certain physical hazards must, however, be admitted. The dangers of navigation, ice risks and even the fact that Port Nelson cannot be considered an ideal port are all conditions which are generally conceded. Taking them into consideration one can only reach the conclusion that the tramp vessel would only proceed to Port Nelson in large numbers if they could obtain a rate 100 per cent greater than from Montreal. At present there is no marine insurance in force for the Hudson Bay route, and it is not conceivable that rates less than the St. Lawrence route enjoys would ever go into effect.

Some of the hazards and difficulties undoubtedly could be overcome in time, and such improvements would tend to reduce the rates. Nevertheless, the cost of such works should be charged up to the traffic over the route, so that as far as the final economic result is concerned little difference would be found. Reference has actually been made to the desirability of operating hydro-planes in conjunction with wireless stations to inform ships of the disposition of ice fields.

On the above basis the rates from Port Nelson to Liverpool would not be less than 12 cents per bushel, and might quite reasonably be expected to reach 20 cents per bushel. It must also be noted that whereas on the railway, the greater the traffic the less the cost, in the case of ocean traffic, the greater the traffic the greater the rates.

Summing up, the total cost of transporting a bushel of wheat from point of production to Liverpool by the Hudson Bay route would be as follows:—

Point of production in Saskatchewan to Port Nelson	30 cents
Port Nelson to Liverpool	12 "
Total	42 cents

In other words under assumptions which are extremely unlikely to be fulfilled, and also under very optimistic estimates of the capacity of the route, it may be possible to lay down western Canadian wheat at Liverpool with transportation charges amounting to 42 cents per bushel, whereas by existing routes the minimum cost from the same point is 31 cents per bushel.

It is absurd to imagine that any wheat at all would travel at the above rate. What condition would have to be obtained to attract wheat? The total cost would undoubtedly have to be equal to or preferably less than by existing routes. If the total rate were equal to other routes, in view of the physical hazards it would not be utilized to any extent, and incidentally even if it were there could be no benefit to anybody. Supposing the route were operated at a loss and at a rate even 10 cents a bushel less than existing rates what would it mean? It would mean that the rail rate would have to be reduced to 10 cents a bushel, and that the loss would be 20 cents a bushel. With the handling of 18,500,000 bushels, the country at large would have to make up the deficit of $3,700,000 per annum. On the other hand, even if the utopian assumption is made that the farmer is going to get the benefit of the full amount of the reduction in rate, it means that the total return to a limited number of farmers would be $1,850,000.

To look at the problem from another angle we have a total production of wheat of about 400,000,000 bushels. If 18,550,000 bushels are sold at a better return of 10 cents a bushel *to the farmer*, it means that on the average there is an additional return of less than ½ cent per bushel to the farmers of the west. As a matter of fact, in view of the whole situation of the marketing of wheat where prices fluctuate 30, 40 or even 50 cents per bushel within short periods, it would be ridiculous to devote any time to a project which could only provide such a minute benefit.

The St. Lawrence River Waterway

Discussion by J. G. Sullivan, M.E.I.C.

In opening the discussion Mr. Sullivan pointed out that had grain been originally shipped down the Mississippi river, a downhill haul instead of going across country, the grain from the prairies would have gone by that route.

It was his opinion that the inland canal, other than short canals connecting open waterways, was no longer a factor in national development on the western hemisphere. Because the obstructions to navigation were concentrated in comparatively short sections, with long stretches between that require very little, if any improvement, by making these short stretches navigable the Great Lakes would be connected with tidewater and since large blocks of power could be developed in conjunction with improvements to navigation, his impression was that the St. Lawrence waterway would, in the course of time, prove to be a work of economy.

Referring to the report of the engineers to the International Joint Commission, submitted on July the first 1921, showing an estimated cost of improvements for navigation to a depth of twenty-five feet as $25,728,000, which included the cost of the development of 1,464,000 h.p., out of a possible potential power of approximately four million one hundred horse power and adding operating maintenance and depreciation of over two and a half million dollars to the interest charged, making an annual charge of over fifty million dollars, he did not think that the benefits to be derived by the improvement of transportation facilities would justify the people of Canada in assuming their share of this cost, especially as the route is only open seven months in the year.

The speaker mentioned the paper by Mr. Forward published in the November, 1923 issue of *The Journal* which stated that the fourteen-foot canal system on the St. Lawrence had so far met all demands upon it and had never been used to one-half of its capacity. He had seen no evidence presented of convincing character to support the statement made that if the saving on the carriage of Canadian grain was only one and one-half cent per bushel it was worth doing.

Discussion by W. Sanford Evans

At the outset Mr. Evans declared that in his opinion an economic case for the proposed development of the St. Lawrence river had not yet been made out. Referring to question IX in the report of the Joint High Commission, "What traffic both incoming and outgoing in kind and quantity is likely to be carried upon the proposed route both at its inception and in the future, consideration to be given not only to present conditions but to probable changes therein resulting from the development of industrial activities due to availability of large quantities of hydraulic power?"

The answer to this question was that it was impossible to give a specific reply in the absence of definite information as to all the factors entering into the problem but that the Commission had so much confidence in the virility and resourcefulness of the people of these two countries that it was convinced that the traffic available for the new waterway would rapidly increase and that the creation of new hydraulic power in connection with the waterway would stimulate growth in manufacture and transportation, and reached the general conclusion that sufficient traffic would seek the new water route to justify its construction. This showed that the commission itself did not carry to a very definite conclusion its investigations into the economic aspects of the case.

Without raising the question of international control, the speaker proposed looking at it as a proposition designed to promote the benefit of the whole traffic watershed of the Great Lakes region of both countries. The first consideration was the question of power. It had been advocated that there was the probability of the sale of hydraulic power yielding sufficient profit to bear all the carrying charges but to his mind there was no inherent justice in making power users pay for development in navigation. The second point he made was that the canals would be open for only seven months in the year. In modern developed communities, business was continued for twelve months in the year, and in the developed region between Winnipeg and the Atlantic coast there was as much business in the five months per month as in the seven months of the open season. Therefore it would not be possible to do without a single railway line in any of the adjoining districts. Only twelve months transportation facilities could possibly meet the requirements of modern developed countries. The building of an elaborate canal system did not lessen the demand for a permanent twelve-months system and represented the building of a duplicate plant.

The speaker then reviewed the situation relating to the grain traffic having in mind the stages by which the grain moved and the business objects of each stage, deducing therefrom that it was the farmer or the farmer's agent who dominated the stage of the movement to the head of the lakes. Another stage was that dominated by the consumer including the baker, the wholesaler or the miller, the movement being dominated by the way the ultimate consumer buys. At some time the interests of the producer and his agent ceases and the balance of the movement is mainly dominated by the interests of the consumer. The railways by providing a great reserve of empty cars, supplemented by the enormous country elevator system, can take care of the primary stage of the grain movement as initiated by the farmer. To take care of the second stage we must fit in with the way the customer takes delivery which is with remarkable regularity. If an attempt were made to ship the grain immediately after production to Europe the demand on ocean shipping would form such a peak that rates would soar and even then it could not all be handled except at the cost of having idle tonnage the rest of the year. It would not be economical to try to provide international exchange for so great a load at one time. Because the world takes evenly of its supply, the bigger the proportion of the worlds supply we aim to provide the more we must come under the law of the market.

This year Canada must sell one bushel for every bushel sold by all other exporting countries together. In view of the fact that the United States would supply a portion of the importing world's requirements from a district tributary to the canal, the importing world would take only sixty per cent of our surplus in the seven months of navigation. To get rid of the other forty per cent it would be necessary for Canada to export every month of the year. It was to Canada's interest to keep the trade abroad supplied regularly with Canada's quality of wheat and flour. Seventy per cent of the crop is usually disposed of up to the close of navigation only part of it goes to the ocean and the balance goes out during the winter months. To compete for the world's markets where should the forty per cent consumed during the period of no inland navigation be placed? To that forty per cent the new canal would be of practically no use. Even if the canal were built there would still be stored at Georgian Bay or Lake Erie ports this forty per cent so that it can be excluded from any direct influence by the canal.

Mr. Evans then went into figures to show that the saving on shipping the remaining sixty per cent of the exportable grain would only be a small sum per bushel, a fraction of five cents. To carry all of Canada's grain by way of Canadian ports would require a much higher ocean rate than if part of it were shipped through the United States, owing to the fact that Canada's freight load to Europe in normal times is at least four tons outbound to every ton brought back while the United States is a little over two tons for every ton brought back. This is the reason our surplus is distributed as it is. The speaker continued his argument to show that if the canal were built that the ratio of outgoing shipment would be very large compared to incoming. He pointed out that although the canals at their present depth had been open for twenty years or more there had never been a direct service to Europe, although there had always been a number of ocean boats that could come up the canals. He believed that even with the twenty-five foot canal ocean vessels would form but an occasional factor in the lakes. He did not believe that the average ocean going vessel, which carried a large percentage of the grain traffic across the ocean, could compete with the efficient lake carriers now used. Even though a slight savings might possibly be made in the carrying of grain by the canal route the cost to the tax payer would remain as a fixed charge. He concluded by emphasizing the point that an economic case had not been made out for the canal in the present state of information and he did not think the two countries would be justified in incurring the expenditure at the present time, in view of its effect upon transportation.

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Investigating Hudson Bay Railway

The question of completing the Hudson Bay Railway has had considerable attention during the past year, both in parliament and out. This is a subject which particularly concerns the engineering profession and it is natural that considerable discussion should be given it by the engineering profession. It is a matter which has been the subject of three meetings of the Montreal branch and two of the Winnipeg branch. The question came to the attention of Council at the last meeting and it is believed that a resolution passed at this meeting crystallizes the engineering sentiment throughout Canada. The resolution reads:

> RESOLVED THAT the Council of *The Engineering Institute of Canada* place itself on record in affirming that the proposed Hudson Bay Railway be thoroughly investigated from the engineering, economic and national viewpoints before any decision is made to construct, complete or operate the said railway.

Copy of this resolution was sent to the Honourable the Prime Minister of Canada, to all members of the federal Cabinet, and to each branch of *The Institute.*

Invitation to Saguenay

A cordial invitation is issued to the members of *The Institute* by the Saguenay branch to be present at their summer meeting which will take place at the Grande Decharge, Lake St. John, on Friday, June sixth, nineteen twenty-four. It is intented to run an excursion from Chicoutimi to Hebertville, at which point arrangements have been made for transporting the members to the Quebec Development Company's Dam at the Grande Decharge. A description of the construction will be given by Mr. F. H. Cothran, vice-president of the company, and the entire site visited. Members will be guests of the company at luncheon. All members desirous of taking advantage of this splendid opportunity of visiting one of the largest engineering undertakings in Canada should advise the secretary-treasurer of the Saguenay branch, Mr. Burroughs Pelletier, A.M.E.I.C., P. O. Box 181, Chicoutimi, Que.

Institution of Municipal and County Engineers

A cordial invitation has been received from the Institution of Municipal and County Engineers to all members of *The Institute* who are in London during June to attend the various meetings and functions of the Institution's annual meeting.

The question of appointing an official delegate was referred by Council to the committee of the World Power Conference and it is anticipated that *The Institute* will be officially represented at this important gathering which is to be held in London.

The meeting will be held on June 25th, 26th, 27th, and 28th, being the fifty-first annual general meeting and conference of the Institution. On the 28th of June a visit will be paid to the British Empire Exhibition at Wembley, where the meeting will be addressed by Mr. E. O. Williams, B.Sc., consulting engineer of the exhibition on the subject of the construction of the buildings.

Any members of *The Institute* in London at the time and desirous of attending the meeting will be supplied with programmes, tickets of admission, and particulars in general from J. W. Dudley Robinson, secretary, 92 Victoria Street, London, S. W. 1.

Kelvin Centenary Celebrations

The Kelvin Centenary, which marks the hundredth anniversary of the late Lord Kelvin, one of the world's great stalwarts in the development of the use of electricity, is to be fittingly observed in London, July tenth and eleventh, nineteen twenty-four.

A committee with Sir Richard Glazebrook as chairman, was established to make arrangements for the centenary celebrations, July tenth and eleventh, and consists of: Dr. F. O. Bower, F.R.S. (The Royal Society of Edinburgh); Mr. W. R. Cooper, (The Physical Society); Sir John Dewrance, (The Institution of Mechanical Engineers); Mr. D. N. Dunlop, (The Institution of Electrical Engineers); Mr. F. Gill, O.B.E., (The Institution of Electrical Engineers); Sir Joseph Larmor, F.R.S. (The Royal Society); Sir Donald MacAlister of Tarbet, Bart., (Vice-Chancellor of Glasgow University); Sir Charles Morgan, (The Institution of Civil Engineers); His Grace, The Duke of Northumberland, (The Institution of Naval Architects); Dr. E. C. Pearce, (Vice-Chancellor of Cambridge University); Dr. Alexander Russell, (The Physical Society); Mr. F. E. Smith, F.R.S. (The Royal Society).

Believing that there are in all lands many who desire to pay their tribute of respect to the memory of one to whose achievements the world is so greatly indebted this committee decided to form a Committee of Honour consisting of representatives of scientific and technical bodies, to whose advancement Lord Kelvin so greatly contributed.

The Engineering Institute has been asked to name a member of this Committee of Honour, and consequently President Arthur Surveyer has been chosen for that office. It affords an opportunity of presenting an address, previously prepared in writing, which will be published afterwards in the Kelvin Memorial Publication. Should Mr. Surveyer not be present on this occasion, Mr. J. B. Challies, has been nominated to present the address.

The programme of the first day will include, at four thirty, the presentation of the Kelvin Medal to Professor Elihu Thomson, and at five o'clock, the presentation of the addresses by delegates from the bodies represented on the Committee of Honour, and the memorial oration by Sir J. J. Thomson, O.M., F.R.S. At nine o'clock there will be the reception of delegates by the President of the Royal Society. On Friday evening the Kelvin dinner will take place at seven fifteen, the Rt. Hon. Earl Balfour O.M., in the chair.

An exhibition of Lord Kelvin's apparatus will be held during the celebrations, and a Memorial volume containing Sir J. J. Thomson's Oration and the addresses will be published later.

Annual Meeting in Montreal

The annual general and general professional meeting for the coming year will be held in Montreal, concerning which arrangements are already being undertaken by the Montreal Branch. The statutory dates for the meeting are the twenty-seventh, twenty-eighth and twenty-ninth of January, and unless there is some good reason for having it otherwise, it is anticipated that the meeting will be held on those dates.

It is the desire of Council and of the Montreal Branch to make this meeting the greatest engineering gathering that has yet been held in this country, and all members are requested to give consideration to being in Montreal on the days mentioned for a pleasant, profitable gathering, and a further opportunity of the social fellowship which is becoming more and more strongly in evidence with every meeting of *The Institute*.

Amendments to By-laws

The amendments to the by-laws suggested by the Legislation and By-laws Committee and presented to the annual meeting, and which were issued to the members for a ballot, all passed by a majority of over ninety-eight per cent.

The following clauses are, therefore, now part of the constitution of *The Institute:*

Section 12. — The officers of *The Institute* shall be a president, five vice-presidents. one councillor from each branch having less than two hundred corporate members, two councillors from each branch having two hundred and less than four hundred corporate members, three councillors from each branch having four hundred corporate members, and an additional councillor from each branch for each two hundred corporate members over four hundred.

Section 13. — The term of office of the president shall be one year, of the vice-presidents two years, and of the councillors one year, except in the case of councillors representing branches entitled to two or more councillors. The term of office for such councillors shall be two years for those representing branches entitled to two councillors, and three years for those representing branches entitled to three or more councillors. At least one councillor shall be elected each year from each branch.

The term of each officer shall begin at the close of the annual general meeting at which such officer is elected, and shall continue for the period above named or until a successor is duly elected or appointed by the council.

A vacancy in the office of president shall be filled by the senior vice-president. Seniority shall be determined by priority of election to the office of vice-president, and, failing that, by priority of admission to corporate membership.

A vacancy in the office of vice-president shall be filled until the following annual election by the senior councillor from the zone in which the vacancy occurs. Seniority shall be determined by priority of election as a councillor and, failing that, by priority of admission to corporate membership.

A vacancy in the office of councillor shall be filled until the following annual election by a corporate member chosen by the council from a list of nominees submitted by the executive of the branch concerned.

Appointment of Secretary, Treasurer and Committees.

Section 18. — The council shall meet within seven days after its election and shall then appoint the secretary, the treasurer, and the following standing committees:—

A finance committee of five members.
A library and house committee of five members.
A papers committee as prescribed in section 21.
A publication committee of five members.
A legislation committee of three members.
An engineering sections committee.

The chairman of each standing committee shall be a member of the council.

Standing committee shall perform their duties under the supervision of the council, and shall report to the council.

The council at any time, may appoint special committees to report upon engineering subjects or upon other matters of interest to *The Institute.* The annual general meeting may recommend to the council the appointment of special committees, and such recommendations shall be considered by the council at the first meeting following the annual general meeting.

Special committees shall perform their duties under the supervision of the council, and shall report to the council.

Papers Committee.

Section 21. — The papers committee shall be composed of representative members selected, as far as possible, from the several branches. The committee shall advise and assist the branches in obtaining papers, especially for the general professional meetings of *The Institute.*

Papers which have been published previously, which specially advocate personal interests, which are prepared carelessly, which controvert established facts or are purely speculative or foreign to the objects of *The Institute*, shall not be accepted.

Publication Committee.

Section 22. — The publication committee shall be composed of members representative of the principal branches of the engineering profession. The committee shall decide whether papers submitted to it, either by the author directly, or through any of the branches, and the discussions thereon, shall be printed for advance circulation or published in the transactions. It shall also assist the secretary in the editing of the transactions of *The Institute.*

An appeal from the decisions of the committee may be made to the council upon the signed application of five corporate members.

The right of prior publication of all papers accepted to be read at a branch or professional meeting is reserved by *The Institute.* Any such paper not accepted for publication shall be returned promptly to the author. No paper shall be considered eligible for any of the prizes of *The Institute*, which has been published elsewhere prior to its publication by *The Institute*, unless published with the consent and approval of the publications committee, officially transmitted by the secretary.

Engineering Sections Committee.

Section 24. — The engineering sections committee shall be composed of a chairman who is a member of council, and a representative from each branch. This committee shall promote the establishment of sections corresponding to any of the recognized branches of the engineering profession, such as chemical, civil, electrical, mechanical, mining, hydraulic, railway, industrial, highway, municipal and structural, in the various branches of *The Institute.*

This committee shall be responsible for the formation and continuation of sections in *The Institute* corresponding to any of the generally recognized branches of the engineering profession by correlating and co-ordinating into *Institute* sections, similar sections of the various branches, with such officers and activities as the council may from time to time approve.

It shall encourage and promote the exchange of papers between similar sections of the various branches, and shall assist the papers committee in securing papers for professional meetings.

Adoption of Specifications.

Section 25. — Specifications of *The Institute* shall be adopted by letter ballot of the corporate members.

Report of special committees on specifications shall be issued to the membership after presentation to the council, and shall be open for discussion by all members for a sufficient period. All discussion thereon shall be forwarded to the special committee by a date fixed by the council, and the committee shall then present a final report to the council, which report shall be issued to the membership, and the council shall determine whether it shall be voted upon for adoption by *The Institute*. If the report be submitted for adoption, the secretary shall issue a letter ballot to corporate members in a form prescribed by the council, and an affirmative vote of two-thirds of all valid ballots shall be necessary for adoption. The ballot shall be canvassed by scrutineers appointed by the council, and the result of the voting shall be announced to the membership.

Consideration of Applications for Admission or for Transfer.

Section 28. — Immediately upon receipt of an application the secretary shall forward copies of all papers and correspondence in connection therewith to the secretary of the branch, if any, to which the applicant belongs. The executive committee of the branch shall thereupon make such inquiries concerning the applicant as it deems to be advisable, and shall recommend to the council the action that it considers should be taken with reference to the application.

At stated periods to be determined by the council there shall be issued to corporate members whose addresses are known, a list of new applicants for admission or for transfer, containing a concise statement of the record of each applicant and the names of his references, with a request that members transmit to the secretary any information in their possession which may affect the classification or eligibility of the applicant.

The council shall consider all the information with reference to the applicants, making further inquiries if deemed expedient, and shall then decide on the class of membership for which each applicant is qualified.

Transfer.

Section 39. — A member when transferred from any one class to any other shall pay the difference between the entrance fee of the two classes.

Compounding of Fees.

Section 40. — At the time of his election a corporate member may compound all future annual fees by a single payment of two hundred and fifty dollars. A corporate member in good standing after ten years of corporate membership may compound his future annual fees by a single payment of one hundred and fifty dollars, and after fifteen years of corporate membership by a single payment of one hundred dollars. The money thus received shall be invested and only the income thereof used for the current expenses of *The Institute*. Should an Associate Member compound his fees, he shall be subject to section 27 as regards transfer, and shall also be required to pay a transfer fee.

By-Laws.

Section 54. — Branches shall adopt by-laws governing the election of officers, the holding of meetings, and other matters of local jurisdiction. As far as possible, there shall be uniformity in the by-laws of all branches of *The Institute*. The draft of the by-laws, and of amendments or additions thereto, shall be submitted to the council for approval, and shall then be submitted by letter ballot to the vote of the corporate members and Juniors of the branch for final adoption.

Election of Nominating Committee.

Section 67. — The nomination of officers of *The Institute* shall be made by a nominating committee. The honorary councillors shall be ex-officio members of this committee. The remaining members, who shall not be officers of *The Institute*, shall be elected annually as follows:—Each branch shall appoint one member, an additional member appointed by the council shall be chairman of the committee. The membership of the committee shall be announced at the annual general meeting.

Vacancies in the nominating committee as announced at the annual general meeting shall be filled by council from the nomination or nominations submitted by the branch in which the vacancies occur.

Nominating Committee to prepare Officers' Ballot.

Section 68. — The nominating committee shall prepare an officers ballot, which shall contain the names of not less than two nominees for each office to be filled, with the exception of that of president, for which only one name may be submitted.

A vice-president shall be elected by vote of the corporate members resident within the zone for which he is a candidate, an election to take place every two years in each zone, except in zone (c) where an election shall take place each year. One vice-president shall be elected from each zone, except zone (c) from which two vice-presidents shall be elected, one of whom must be resident within twenty-five miles of the headquarters of *The Institute*.

A councillor shall be elected by vote of the corporate members resident within the branch district for which he is a candidate.

The officers' ballot shall be forwarded by the nominating committee to reach headquarters not later than the fifteenth day of September, for presentation to council at a meeting to be held not later than the thirtieth day of September, and should be accompanied by a letter of acceptance of nomination from each nominee.

The council shall examine the officers' ballot submitted by the nominating committee. If the council find a nominee ineligible for the office for which he is nominated, or should the consent in writing of a nominee to appear on the officers' ballot not be furnished before the first meeting of council in October, or should any nominee after such consent withdraw his name, such name shall be deleted, and the council shall substitute another name therefor. The words "Proposed by Nominating Committee" and "Proposed by Council" shall be printed conspicuously on the ballot, to indicate the manner of nomination of all nominees.

Nominees for Officers' Ballot sent to Members.

Section 69. — Not later than the seventh day of November, the secretary shall mail to each corporate member of *The Institute* the officers' ballot, as prepared by the nominating committee and the council.

Additional nominations for the officers' ballot signed by ten or more corporate members and accompanied by written acceptances of those nominated, if received by the secretary on or before the first day of December, shall be accepted by the council and shall be placed on the ballot. The words "Special Nomination" shall be printed conspicuously near such names, and the names of the members making such nominations shall be printed on some part of the ballot.

National Advisory Committee Appointed

The national advisory committee appointed by the government to study the St. Lawrence waterways project occupies a position of responsibility fraught with the gravest consequences to Canada, as the outcome of the problem involved in the St. Lawrence waterways involves greater potentialities as affecting the future of the Dominion than any other facing the people of this country at the present time.

The committee appointed consists of the Honourable G. P. Graham, minister of railways and canals, as chairman; Thomas Ahearn, Ottawa; Hon. W. E. Foster,

**Brig.-Gen. C. H. MITCHELL, C.B.,C.M.G.,C.E.,M.E.I.C.
Technical Officer of St. Lawrence Waterways Committee.**

O. O. LEFEBVRE, M.E.I.C.
Technical Officer of St. Lawrence Waterways Committee.

St. John, N.B.; Beaudry Leman, A.M.E.I.C., Montreal; Edward D. Martin, Winnipeg; Dr. W. L. McDougald, Montreal; Hon. Sir Clifford Sifton, K.C., Toronto; Major-General John W. Stewart, Vancouver; and the Hon. Adelard Turgeon, Quebec.

Of great interest to the engineering profession is the personnel of the engineering board which will represent Canada, who, with the three representatives of the United States, form a joint engineering board to study and report on the entire situation. The members are Mr. D. W. McLachlan, M.E.I.C., assistant engineer of the department of railways and canals, Mr. O. O. Lefebvre, M.E.I.C., chief engineer of the Quebec Streams Commission, and Brig.-Gen. C. H. Mitchell, M.E.I.C., the two latter to act as technical officers of the commission. They are all well known members of *The Institute* and it is certain that they will maintain the high ideals and the admirable traditions characteristic of the engineering profession in the Dominion in the past.

Their investigation of the possibilities of carrying out the St. Lawrence waterways project will include such points as whether or not the work would materially affect the level of the St. Lawrence or of any other navigable waters in Canada, whether the cost of the scheme can be kept within reasonsable bounds, and what advantages accruing to either country, including the advantage of export and import traffic and rates, might influence the apportionment of the cost of the undertaking. On the latter point a number of years will be allowed after the completion of the work to settle the question of assessment.

Canadian Engineers Resent Allegations

Under the caption "Whitewashing the Hydro-Electric Power Commission of Ontario", the *Electrical World* of March twenty-ninth carries an editorial of which the general sentiment is quite frankly one of real disappointment that the Hydro-Electric Power Commission was not condemned generally and in detail by the Gregory Commission. This Commission, composed of five members, was in continuous session for twenty-one months and with the assistance of a large corps of engineers and chartered accountants recently submitted a voluminous report, costing over half a million dollars, to the Ontario government. Presumably the *Electrical World's* information in this connection has been derived from various newspaper items, as the report has not been officially published.

One outstanding fact is, however, that the Hydro-Electric Power Commission is looked upon as an economic blessing by over two millions of the population of the province it serves, and against such an overwhelming consensus of opinion the rather undignified pettishness of the *Electrical World* is quite immaterial. Furthermore, the statement that the findings of the engineers of the Gregory Commission agree with the "discoveries" of Mr. W. S. Murray and Mr. H. L. Cooper, in the matter of the cost of the Queenston-Chippawa development, does not agree particularly well with the recent announcement of Sir Adam Beck that the total production cost of Queenston power is now only slightly over fifteen dollars per horse power per annum, with only fifty per cent of the ultimate machine capacity under load.

When the Gregory report is given to the public in its entirety it will be interesting to compare the ultimate annual cost of Queenston power, as estimated by the engineers of the Gregory Commission, with the corresponding figures evolved by Mr. Murray and Mr. Cooper. Until such an opportunity is available, one is not inclined to further discuss this subject editorially, as it is well to have *all* the facts before expressing an opinion.

Under date of April fifth last, the *Electrical World* followed up this editorial by publishing some deductions of its own from a recent report of the Dominion Bureau of Statistics. The figures thus derived are intended to prove a condition which the *Electrical World* is over-anxious to establish, and which would not have been established had the figures in the body of the report in question been used to interpret and modify the grand totals which the *Electrical World* used as the basis for its deductions. For instance — the report in question states that over sixty-five million dollars was included in the

D. W. McLACHLAN, M.E.I.C.
Appointed to Engineering Board on St. Lawrence Waterway Project.

total capital investment on account of the Queenston-Chippawa development, but only one hundred and sixty-five thousand horse power was included in the installed horse power. In deducing the comparative revenue per 1,000 k.w. hours generated, no attention has been paid to the cost of power exchanged between stations, which is stated in the report to be over twenty million dollars. If the cost of power sold by one station to another is allowed for, the revenue per 1,000 k.w. hours received from consumers is seven dollars and four cents in Quebec, and eight dollars and thirty-five cents in Ontario, instead of eight dollars and forty-six cents and twelve dollars and eighty-two cents respectively, as the *Electrical World* would have its readers believe. This difference is fully accounted for by the fact that the rates paid by consumers in Ontario include not only the cost of power but a sinking fund which will make the consumers themselves the sole owners of the system in thirty years, and also to a large extent by the fact that business in Ontario is designedly and essentially for domestic service and for small users of power.

This same report furthermore states that the revenue *to the stations generating the power* was only .538 cent per k.w.hour in Ontario and .640 cent in Quebec thus directly controverting the deduction of the *Electrical World* in this regard.

As regards the comparative number of employees per million k.w.hours generated, the argument of the *Electrical World* is vitiated by the fact that the census figures for Ontario include large numbers of municipal officials doing only part-time work for nominal sums, in the capacity of meter readers, collectors, bill clerks, etc., and having no part whatever in the business of power generation. If a more sensible comparison were made on the basis of employees actually engaged in the generation of power it would show a condition exactly the reverse of the one deduced by the *Electrical World;* namely, the output per employee in Ontario is 1,703,000 k.w.hours as against only 1,242,000 k.w.hours in Quebec, thus destroying altogether the implication that the system of the Hydro-Electric Power Commission is extravagantly over-manned, as compared with the privately owned systems in Quebec.

A rather amusing commentary on this alleged condemnatory evidence, as adduced by the *Electrical World,* is that approximately fifty-two per cent of the total central electric station installation in Ontario is privately owned and operated, and no effort appears to have been made to exempt these organizations from the strictures applied to Ontario stations in general.

The above comparisons contain no implication that the *Electrical World* is guilty of deliberate misrepresentation, but rather as confirming the opinion that the *Electrical World,* in its criticism of the Hydro-Electric Power Commission, is guilty of a bias, and an over-anxiety to discredit this enterprise, which is not compatible with the editorial dignity of a great technical journal.

The editorial referred to should be unreservedly condemned, however, for casting a reflection on the professional integrity of two of Canada's most prominent and highly respected engineers, one of whom was a member of the Gregory Commission and the other the Commission's consulting engineer. Both of these gentlemen are past-presidents of *The Engineering Institute of Canada,* and in accusing them of compromising their professional honour for the purpose of deceiving the public, the *Electrical World* has gratuitously affronted the Canadian profession as a whole.

H. G. Acres, M.E.I.C.

OBITUARIES

Nathaniel Child Mills, M.E.I.C.

In the death of Nathaniel Child Mills, M.E.I.C., which occurred on December 5th, 1923 the profession lost one of its outstanding mechanical and electrical engineers. The late Mr. Mills was born at Boston, Mass., on November 20th, 1872, and received the degrees of B.Sc., C.E., and E.E., from Tufts College, from which he graduated in 1902. He also spent two years at Harvard University and one year at Union University on post graduate work. From 1903 to 1905 he was chief engineer of the Espluts River Lumber and Pulp Company at Newfoundland and during the following four years he was designing engineer with the General Electric Company and later construction engineer for the Stanley Company. In 1909 he became chief designing engineer for the Canadian General Electric Company at Peterborough, Ont., and in this capacity he was in charge of motor works, design, testing and consulting for ten years. Subsequently he entered in the consulting field in Montreal, at the same time occupying the position of vice-president and general manager of the Montreal Armature Works, Limited. Mr. Mills was elected Member of *The Institute* on January 26th, 1920. He was also a member of the American Institute of Electrical Engineers and the American Society of Mechanical Engineers.

Frank M. Young, M.E.I.C.

After a short illness of only a few days, Frank M. Young, M.E.I.C., died suddenly at his home in Dover, Delaware, on May 15th, 1924. Mr. Young was in his sixty-third year and had been actively engaged in his professional work until a few days before his death.

Born at Salmon Falls, N.H., on April 2nd, 1861, and educated at the Hebron Academy in Hebron, Maine, the late Mr. Young commenced his professional career on railway location as rodman with the Chicago, Milwaukee and St. Paul Railway when only in his twentieth year.

F. M. YOUNG, M.E.I.C.

The following year, 1883, he was rodman on the construction of one of the western sections of the Canadian Pacific Railway, and for the next two years continued on construction work for this company, first as leveller and later as resident engineer. In 1886 he was again with the Chicago, Milwaukee and St. Paul Railway as resident engineer on construction. He then spent two years as locating and division engineer in charge of construction on the Duluth South Shore and Atlantic Railway and from 1889 until November 1892 he occupied the same position on construction of the Great Northern Railway in Montana and Washington.

In September 1893, he came to eastern Canada and was resident engineer on the Wiscasset and Quebec Railway; he then returned to the Canadian Pacific Railway and spent seventeen years as locating and assistant engineer with this company. In April 1919, he was appointed resident engineer with the Delaware State Highways Commission in charge of construction of concrete roads for the Commission and he was still occupying this position at the time of his death.

The late Mr. Young was elected Associate Member of *The Engineering Institute of Canada,* (then the Canadian Society of Civil Engineers), on May 15th, 1908, and was transferred to Member on March 21st, 1916. He was also a member of the American Association of Engineers.

Cyrus Carroll, M. E. I. C.

In the death of Cyrus Carroll, at his home in Hamilton, on December 9th, 1923, *The Institute* has lost another of its highly esteemed members. The late Mr. Carroll's connection with *The Institute* dates back to March 1894 when he was elected a Member of the Canadian Society of Civil Engineers. He was born at Zorra in the county of Oxford, Ontario on December 6th, 1834, and after serving his apprenticeship with his uncle, the late Peter Carroll, received his diploma as a Provincial Land Surveyor in January, 1860.

His first work under his own certificate was with the Great Western Railway Company. He later settled at Wroxeter Ont., where he practised his profession and subsequently became county engineer of Bruce with headquarters at Kincardine and later at Walkerton, when that municipality became the county town. In 1877 he moved to Port Elgin where in addition to his professional practice he undertook the duties of clerk of the division court and village treasurer. During that time he spent nearly two years in the Duck Lake district, in Saskatchewan, engaged in surveys for the Dominion government. On returning from Saskatchewan he resided first at Toronto and later at Hamilton. When he retired in 1915 he was in the employ of the provincial government of Saskatchewan with headquarters at Regina, and in the hope that he might return to Saskatchewan his resignation was held in abeyance for a year before it was finally accepted. The late Mr. Carroll was an Anglican, belonged to the Masonic Order, and was a Major in the militia.

R. F. Hayward, M.E.I.C.

The news of the death of Robert Francis Hayward, M.E.I.C., which occurred in London, Eng., on Thursday, April 10th, has been received with the deepest regret by his many friends in the engineering profession, particularly on the Pacific Coast where the influence of his fine personality in the early affairs of the Vancouver Branch will remain for many years. Mr. Hayward was formerly general manager of the Western Canada Power Company and a director in a number of other important British Columbia business organizations.

R. F. HAYWARD, M.E.I.C.

He designed the Stave Falls plant of the Western Power Company and the work was completed under his supervision. This was, however, only one of many engineering works carried on by Mr. Hayward in the course of a long and practical experience with power plants on this continent.

Born at Harrow, England, in 1865, Mr. Hayward received his technical education at the Engineering School, London, and later was a pupil of Compton and Company, Chelmsford, of which firm he became works' manager.

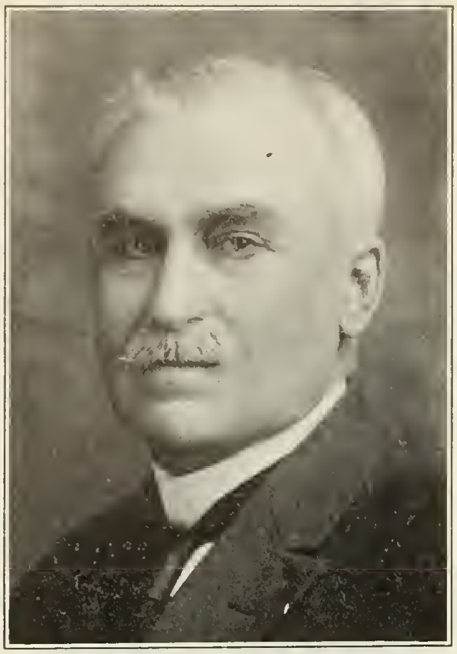
In 1889 he came to America as general manager of the Salt Lake and Ogden Gas and Electric Light Company. This position he filled untill 1894 when he went over to the Utah Light and Railway Company as chief engineer. From 1896 to 1905 he was general manager of the Mexican Light and Power Company, Mexico City, and in this position was engaged in the construction and operation of a 40,000-h.p. hydro-electric power plant, including 175-mile transmission line.

He came to British Columbia in 1909 as general manager of the Western Canada Power Company, to which his exceptional knowledge and grasp of his profession was invaluable during its construction.

Mr. Hayward was elected Member of *The Engineering Institute of Canada,* (then *The Canadian Society of Civil Engineers*) on September 21st, 1914.

Louis Arsène Désy, M.E.I.C.

Sincere regret is expressed at the death of one of *The Institute's* esteemed members, Louis Arsène Désy, M.E.I.C., which occurred at his home in Montreal on May third, 1924, after a short illness. The late Mr. Désy while apparently in good health, has suffered from the severe shock of the news of the death of his son, who was killed overseas during the Great War, and about three weeks before he contracted pneumonia which resulted in his death. Born at St. Cuthbert, Berthier County, Quebec, about sixty miles below Montreal, Mr. Désy received his early education at the Jacques Cartier Normal School, Montreal, and the Joliette College. His



L. A. DESY, M.E.I.C.

first work was in Winnipeg in 1880 where as an architect he was engaged on the design of railway stations between Winnipeg and Vancouver. In 1888 he returned to Montreal where he practised as an architect, until he was appointed mechanical superintendent with the Harbour Commissioners of Montreal in 1894. For four years from September 1901 he was mechanical engineer with the Public Works Department on ship channel dredging between Montreal and Quebec. For the next two years he was engaged in private practice, on the construction of dredges for private parties. In January 1906 and until 1910 he was in the employ of the State of Jammu Kashmir, India, as chief engineer in charge of the erection and operation of electrically driven plants, dredges, derricks, etc. From 1910 to 1911 he was consulting engineer in Montreal and from 1912 to 1914 he was with the G. W. Harris Manufacturing Company, as engineer and designer of steam shovels and excavators. He then entered private practice as contractor in munitions work until 1916, when was engaged on munitions work with Lymburner Limited. At the close of the war he returned to private practice. The late Mr. Désy was elected an Associate Member of the Canadian Society of Civil Engineers, on January 31st, 1899, and transferred to Member on April 17th, 1909. He is survived by his wife and one son, Joseph E. Désy, who is an Associate Member of *The Institute.*

Geodetic Survey of Pacific Coast

One of the main triangulations of the Geodetic Survey is that along the Pacific coast from the International Boundary to the northern limit of that part of Canada. This survey was begun in 1910 and it is expected that it will be finished during the coming season with the connection of Queen Charlotte islands with the main scheme of triangulation. The United States Government has a system of triangulation along its west coast and another in Alaska; by the completion of the British Columbia link there will be a continuous triangulation from southern California to the Arctic ocean stretching across thirty-four degrees of latitude or a distance of about 2,380 miles. This is one of the longest lines of geodetic survey to be found anywhere and lying north-south and approaching the polar region it makes available valuable information.

PERSONALS

W. R. Bunting, S.E.I.C., has accepted a position with the Northern Electric Company, Limited, of Montreal, Que.

A. L. Dobson, S.E.I.C., of New Glasgow, N.S., is now located at Puducah, Kentucky, with the Puducah Electric Company.

Stephen J. H. Waller, A.M.E.I.C., assistant engineer with the Canadian National Railways at Montreal, has been transferred to Champlain Market, Quebec.

Goria Lynch, A.M.E.I.C., formerly of Durham, Ont. is at the present with Walter J. Lehuer, consulting engineer of Mt. Clemens, Michigan, on drainage and municipal work.

Stewart Troop, A.M.E.I.C., of Moncton, N.B., recently returned home after an absence since early last fall in the south western states and Mexico.

C. C. Sutherland, A.M.E.I.C., who has been for many years on the staff of the city engineer's office of Edmonton, Alta., has left to join the technical staff of Warren Brothers Limited, of Portland, Oregon.

Geo. H. Lowry, A.M.E.I.C., formerly of Niagara Falls is at the present time in charge of survey work for the Grand Falls Development, for the N.B. Electric Power Commission, Edmundston, N.B.

Harold S. Wilson, S.E.I.C., is now with the Canadian Inspection and Testing Company in Montreal. Mr. Wilson graduated in electrical engineering from the University of Toronto.

Geoffrey H. Rowat, S.E.I.C., of Toronto, Ont., has accepted a position with the Canadian S.K.F. Company in their Montreal office. Mr. Rowat graduated this year from the University of Toronto.

Bruce B. Shier, S.E.I.C., formerly of Toronto, Ont., has recently accepted a position with the Northern Electric Company Limited, Montreal, in their engineering inspection department.

S. R. Turner, A.M.E.I.C., until recently with the International Paper Company, Piercefield, N.Y., is now with the Department of National Defence at Halifax, N.S. Mr. Turner is a graduate of Queen's University.

C. R. Davis, S.E.I.C., has accepted a position with the St. Regis Paper Company, Matane, Que. Mr. Davis received his B.A.Sc. degree from the University of Toronto this year having taken the mechanical engineering course.

H. Spencer Clark, S.E.I.C., who has graduated with this years' class from the University of Toronto has accepted a position with the Hydro-Electric Power Commission of Ontario and will be located at Queenston, Ont.

John A. Shaw, M.E.I.C., electrical engineer, Canadian Pacific Railway Company, Montreal, was elected first vice-president of the Canadian Railway Club at the 22nd annual meeting of the club, which was held in Montreal, on May 13th, 1924.

D. W. Hays, M.E.I.C., consulting engineer of Calgary, Alberta, has been in Ottawa for some time in the interest of private water users who are dependent upon the works of the Canada Land and Irrigation Company, a concern which has for some time been in financial difficulties.

Major Athol H. Macfarlane, M.C., A.M.E.I.C., executive engineer, irrigation, Hindiyah Barrage Iraq, Mesopotamia, is home on six months leave of absence from his work and is renewing many old acquaintances throughout Canada, making a call at the headquarters office recently where he was a welcome visitor.

Archibald MacPherson, A.M.E.I.C., until recently with the W. H. Yates Construction Company, Limited, of Hamilton, Ont., has resigned to enter into a partnership under the name of A. R. MacPherson Scofield Engineering-Construction Company with offices in the Pacific Finance Building, Los Angeles, California. Mr. MacPherson is a graduate of the University of Toronto of the class of 1913.

E. G. Cameron, A.M.E.I.C., for the past six years chief engineer of the St. John Drydock and Shipbuilding Company at St. John, N. B. removes on June first as assistant to engineer-in-charge Welland ship canal construction at St. Catharines, Ont. Mr. Cameron will be remembered as the author of the paper on "St. John Drydock" read at the Maritime General Professional Meeting at St. John in 1923.

R. H. Stenhouse, A.M.E.I.C., is assistant engineer with the Minneapolis, St. Paul and Sault Ste. Marie Railway being located at Minneapolis, Minn. Since coming to Canada from Scotland in 1909, Mr. Stenhouse's experience has largely been on railway work. He was on active service overseas for three years, and prior to his present appointment he was for three years on the staff of the Reclamation Service in Ottawa.

W. G. Mawhinney, A.M.E.I.C., who has been with Toltz, King and Day, Incorporated, engineers and architects of St. Paul, for the past two years has resigned to accept a position with Consoer, Older and Quinlan, Incorporated, consulting engineers of Chicago, Ill., on sewer, water and pavement improvements in cities just outside of Chicago. Previous to going to the United States, Mr. Mawhinney was with the Manitoba Good Roads Board at Selkirk, Man.

Horace L. Seymour, M.E.I.C., town planning engineer of Toronto, who was recently elected vice-president of the Town Planning Institute of Canada has been retained as consulting engineer to the town of Waterloo. Mr. Seymour has just completed a year's work in Waterloo and presented a town planning report. In appreciation of his services to the Town Planning Commission, the Council decided to name Mr. Seymour as their consulting engineer for future work in the town.

Captain David B. McLay, M.E.I.C., sewerage engineer to the Municipal Commissioners of Singapore, S.S., in a letter received recently, extends his kind regards to friends in Canada, and advises that he had bound all copies of *The Journal*, which he prizes for their associations and as volumes of reference. The Ocean Building in Singapore is a memorial to Captain McLay's skill as an engineer and his perseverance and capacity to overcome difficulties. He is imbued with the spirit of doing useful work for the comfort and convenience of individuals and for the benefit of the health of his community, in which he has the good wishes of his fellow members.

Major F. L. C. Bond, M.E.I.C., chief engineer of the central region of the Canadian National Railways, has been appointed general superintendent of the Montreal district, taking over his new duties on May first. On the same date T. T. Irving, A.M.E.I.C., chief engineer of the lines west of the Detroit and St. Clair rivers took over his new duties of chief regional engineer. On the occasion of these appointments going into effect, a dinner was given in honour of Major Bond and Mr. Irving, which event partook of the nature of a farewell and a welcome. At this function practically every department of the central region of the Canadian National Railways was represented.

Brig. General A. G. L. McNaughton, A.M.E.I.C., has been added to the inter-departmental committee which, under the chairmanship of Colonel O. M. Biggar, K. C., has been advising the government upon the St. Lawrence river navigation improvement scheme. The other members of the committee consist of W. J. Stewart, M.E.I.C., representing the department of marine and fisheries; K. M. Cameron, M.E.I.C., and C. R. Coutlee, M.E.I.C., representing the department of public works; D. W. McLachlan, M.E.I.C., representing the department of railways and canals; J. B. Challies, M.E.I.C., representing the department of the interior; O. Higman, M.E.I.C., representing the department of trade and commerce; and J. A. Russell, representing the department of finance.

Alexander E. MacRae, A.M.E.I.C., Enters Private Practice.

Alexander E. MacRae, A.M.E.I.C., for nine years examiner of the chemical and metallurgical division of the Canadian Patent Office, has announced that he has registered as a patent solicitor, and opened an office in the Trusts building, Sparks Street, Ottawa. Mr. MacRae is a graduate of Queen's University with the degree of Bachelor of Science in chemical and metallurgical engineering. He is a Fellow of the Canadian Institute of Chemistry, as well as an Associate Member of *The Engineering Institute of Canada*. Prior to entering the Federal Government service in 1914 he had considerable practical experience with the Mond Nickel Company at Coniston, and with the Canadian Copper Company at Copper Cliff, Ontario. Mr. MacRae is secretary of the Ottawa section of the Society of Chemical Industry. He will have associated with him a prominent Ottawa legal firm which will attend to that end of his work.

Col. F. W.W. Doane, M.E.I.C. resigns as City Engineer of Halifax

Colonel F. W. W. Doane, M.E.I.C., city engineer of Halifax, Nova Scotia, resigned on April 30th, of this year and will continue in private practice. He has held the position of city engineer for thirty-three years, and

COLONEL F. W. W. DOANE, M.E.I.C.

previously to this was for eight years assistant to Dr. Martin Murphy, at the time, provincial engineer of Nova Scotia.

In the activities of the profession, Colonel Doane has always taken a prominent part, being one of the early members of the old Canadian Society of Civil Engineers. He was chiefly instrumental in forming the Nova Scotia Society of Civil Engineers, which started the movement for the present legislation respecting professional engineers in Nova Scotia. He is also a past-president and life member of the Nova Scotia Institute of Science and was one of the founders of the Union of Nova Scotia Municipalities. It is to a large extent, due to his efforts that the interest in this union has been kept so active.

Colonel Doane has been a member of the Militia for many years, at present being in command of the 63rd Regiment Halifax Rifles. At the outbreak of war he was ordered on outpost duty at Halifax, but desiring to go overseas, applied for an appointment in the C. E. F., and served with one of the battalions of the Highland Brigade until the spring of 1918.

On his retirement the officials, of not only his own department, but of the whole city, presented him with an address and a handsome gold watch, as a mark of their esteem and appreciation of the attitude he has always assumed towards furthering the interests of all officials.

Colonel Doane has acted in a consulting capacity for numerous cities and towns throughout Canada and the United States, and during his service in Halifax, the city has advanced until in some respects it is acknowledged to be second to none. As a result of his resignation, Halifax is losing a most efficient city engineer.

Manager of Good Roads Association in Brazil

Don L. Derrom, M.E.I.C., has left Kentville, N.S., for Brazil to take over the management of O Associacâs de Estradas de Rodagem do Estado de Sao Paulo, which being translated is the Good Roads Association of the State of Sao Paulo.

Mr. Derrom graduated from McGill University in 1910 and was for the following two years with the Grand Trunk Railway in charge of locomotive terminals at Depot Harbour and Belleville, Ont. For the next two years he was with the Canadian Venezuelan Ore Company, first as mechanical and electrical engineer, then as superintendent of construction and later as manager. From 1915 to 1917 he was with the Canada Cement Company and subsequently was engaged on munition work with the Winslow Bros. Company, Chicago, Ill.

As a native of South America, born at Caracas, Venezuela, Mr. Derrom speaks the language (Portuguese) and understands the people. In his new position he is returning to a work in which he was keenly interested before he left Brazil in 1921 and he will have with him many of his former associates.

Awarded Doctors' Degrees

The engineering profession in Canada will receive with considerable satisfaction the news that at the Convocation of the University of Toronto on Friday, May thirtieth, degrees of Doctor of Science were conferred upon F. A. Gaby, M.E.I.C., chief engineer of the Ontario Hydro-Electric Power Commission, and upon H. G. Acres, M.E.I.C., chief hydraulic engineer for the Commission.

F. A. GABY, D.Sc., M.E.I C.

H. G. ACRES, D.Sc., M.E.I.C.

T. H. HOGG, M.E.I.C.

Mr. Acres has just retired from the active working staff of the Commission and will engage in private practice, continuing to act as consultant for the Commission. He is succeeded in the office of chief hydraulic engineer by T. H. Hogg, M.E.I.C., who has been assistant hydraulic engineer in the carrying out of the noted Chippawa undertaking.

The National Research Council of United States has been requested to undertake investigations in Heat Transmission, the results of which will provide the designing, operating, and research engineer with more reliable information.

Recent Graduates in Engineering

Congratulations are in order to the following Students of *The Institute* who have recently completed their courses at the various universities.

University of Alberta

Degree of B.Sc.

Fraser. Arthur Archibald, B.Sc., (Ci.), Edmonton, Alta.

University of British Columbia

Degree of B.A.Sc.

Coffin, Fred. W., B.A.Sc., (Ci.), Vancouver, B.C.
Gwyther, Valentine M. W., B.A.Sc., (Ci.), Vancouver, B.C.
Norman, George H. C., B.A.Sc., (El.), Trail, B.C.
Stacey, Leonard B., B.A.Sc., (El.), Vancouver, B.C.
Stroyan, Philip B., B.A.Sc., (Ci.), Vancouver, B.C.
Wolverton, Jasper M., B.A.Sc., (Me.), Vancouver, B.C.

University of Manitoba

Gold Medallist

William F. Riddell, Winnipeg, Man.: Joseph Doupe, Gold Medal for highest aggregate in third and fourth years of civil engineering and University Gold Medal.

Degree of B.Sc.

Finch, Gordon H., B.Sc., (El.), Winnipeg, Man.
Long, George Freeman, B.Sc., (Ci.), Winnipeg, Man.
Marion, Joseph A.P., B.Sc., (Ci.), St. Boniface, Man.
Mauer, Rudolph William, B.Sc., (Ci.), Winnipeg, Man.
Mitchell, James Ian, B.Sc., (El.), Selkirk, Man.
Riddell, William F., B.Sc., (Ci.), Winnipeg, Man.

Degree of B.Arch.

Pybus, Ralph Carr, B.Arch., Jr.E.I.C., (Ci.), Winnipeg, Man.

University of New Brunswick

Degree of B.Sc. (with honours)

McNally, James Osborne, B.Sc., (El.), Fredericton, N.B.

Degree of B.Sc.

Barbour, Ronald Granville, B.Sc., (El.), Fredericton, N.B.
MacRae, Donald Alexander Gregory, B.Sc., (El.), Fredericton, N.B.
Secord, Ralph Edmund, B.Sc., (El.), Fredericton, N.B.

Nova Scotia Technical College

John Albert Rogers, Halifax, N.S., Governor-General's Medal.

Degree of B.Sc.

Gilbert, Richard Reginald, B.Sc., (Ci.), Rothesay, N.B.
Lowe, Mark Curry, B.Sc., (El.), Halifax, N.S.
MacDonald, Ervin Douglas, B.Sc., (Me.), Halifax, N.S.
Rogers, John Albert, B.Sc., Halifax, N.S.
Schurman, Hulbert Hartt, B.Sc., (El.), Halifax, N.S.
Sterns, Laurence, B.Sc., (Ci.), Dartmouth, N.S.

Queen's University

Degree of B.Sc. (with honours)

Campbell, A. J. G., B.Sc., Trenton, Ont.
Hanna, H. B., B.Sc., Prescott, Ont.
Harvey, W. M., B.Sc., New Liskeard, Ont.
Osborne, H. R., B.Sc., Kingston, Ont.
Roberts, F. M., B.Sc., Kingston, Ont.

Degree of B.Sc.

Allan, I. C., B.Sc., Kingston, Ont.
Appleyard, C. E., B.Sc., Kingston, Ont.
Ballard, B. G., B.Sc., Kingston, Ont.
Boyd, I. W., B.Sc., Kingston, Ont.
Cockburn, J. M., B.Sc., Kingston, Ont.
Edwards, H. J., B.Sc., Kingston, Ont.
Gilpin, J. J., B.Sc., Collingwood, Ont.
Heard, C. A., B.Sc., Kingston, Ont.
Henderson, D. A., B.Sc., St. Blenheim, Ont.
Holmes, E. I., B.Sc., Ottawa, Ont.
Lewis, David J., B.Sc., Kingston, Ont.
Lockett, L. W., B.Sc., Kingston, Ont.
Lyons, G. S., B.Sc., Kingston, Ont.
Macpherson, D. C., B.Sc., Kingston, Ont.
Peal, E. J., B.Sc., Guelph, Ont.
Robertson, D. G., B.Sc., Kingston, Ont.
Thompson, M. L., B.Sc., Kingston, Ont.

McGill University

Honours in the Graduating Class, Medals, Certificates and Prizes

William Howard Barnes, Montreal, Undergraduates Society Third Year prize for Summer Essay. Honours in Chemical Engineering.

John Albert Becking, Montreal, British Association Medal; Sir William Dawson Fellowship in Mining; McCall prize for Summer Essay. Honours in Mining Engineering.

Alexander Campbell, Montreal, British Association Medal; Honours in Civil Engineering.

Abraham Benjamin, Montreal, Electrical Club prize for Summer Essay.

George McKinstry Dick, Montreal, British Association Medal; Honours in Mechanical Engineering. Crosby Steam Gage and Valve Company prize for summer Essay.

Frederick Stanley Howes, Montreal, Honours in Electrical Engineering.

George Laurence Matheson, Montreal, British Association Medal; Honours in Chemical Engineering.

Allan Kenneth Muir, Montreal, James Douglas Fellowship in Mining. Honours in Mining Engineering.

Roderick Macdougald Richardson, Montreal, British Association Medal; Montreal Light Heat & Power Consolidated 1st Prize. Honours in Electrical Engineering.

Gerald Edison Shaw, Montreal, Undergraduate Society's 1st Prize for Summer Essay; Departmental Prize for Summer Essay.

Harold Stockdale Wilson, Montreal, Honours in Geology.

Robert W. Wood, Montreal, Honours in Electrical Engineering.

Degree of B.Sc.

Andrews, Donald Cochrane, B.Sc., (Ci.), Montreal, Que.
Barnes, William Howard, B.Sc., (Chem.), Montreal, Que.
Becking, John Albert, B.Sc., (Mi.), Sault Ste. Marie, Ont.
Benjamin, Abraham, B.Sc., (El.), Montreal, Que.
Borden, Douglas Clare, B.Sc., (El.), Pugwash, N.S. (aegrotat).
Bostock, Hugh Samuel, B.Sc., (Mi.), Ducks, B.C.
Buzzell, Henry Walter, B.Sc., (Ci.), Abbotsford, Que.
Campbell, Alexander, B.Sc., (Ci.), Winnipeg, Man.
Campbell, Frank Robinson, B.Sc., (Ci.), New Denver, B.C.
Cave, Allister Edward, B.Sc., (Mi.), St. John's, Nfld.
Cleveland, Henry Roland, B.Sc., (El.), Danville, Que.
Cossitt, Lawrence Sulis, B.Sc., (Me.), Joggin Bridge, N.S.
Darling, Arthur Balfour, B.Sc., (Ci.), Montreal, Que.
Dick, George McKinstry, B.Sc., (Me.), Sherbrooke, Que.
Evans, Charles Durward, B.Sc., (Me.), Quebec, Que.
Fairbairn, John Macfarlane, B.Sc., (Me.), Montreal, Que.
Farmer, Eric Westover, B.Sc., (El.), St. Therese, Que.
Findlay, William Fraser, B.Sc., (Me.), Carleton Place, Ont.
Finlayson, Archie Wallace, B.Sc., (Ci.), Montreal, Que.
Forbes, Robert Clarence, B.Sc., (Ci.), Montreal, Que.
Furness, George Winston, B.Sc., (El.), Vernon, P.E.I.
Horsey, Richard Mountstephen, B.Sc., (El.), Montreal, Que.
Howes, Fred Stanley, B.Sc., (El.), Windsor, Ont.
James, Arthur Lorne, B.Sc., (Ci.), Montreal, Que.
Kent, Kenneth MacIvar, B.Sc., (Me.), Montreal, Que.
Lanctot, Raymond, B.Sc., (Me.), Montreal, Que.
MacDonald, John, B.Sc., (Chem.), Sydney Mines, N.S.
Macnutt, Erskine Keir, B.Sc., (Ci.), Malpeque, P.E.I.
Matheson, George Laurence, B.Sc., (Chem.), Ottawa, Ont.
Maxwell, Edward Gerrard, B.Sc., (Ci.), Halifax, N.S.
Mitchell, Wallace Murray, B.Sc., (Ci.), Montreal, Que.
Muir, Allan Kenneth, B.Sc., (Mi.), Burford, Ont.
McCall, Allan Drummond, B.Sc., (Mech.), Montreal, Que.
Plow, Gordon-Locklin, B.Sc., (Ci.), Montreal, Que.
Pringle, John Buchanan, B.Sc., (El.), Montreal, Que.
Reaper, Clarence Paul, B.Sc., (Ci.), Montreal, Que.
Richardson, Roderick McDougald, B.Sc., (El.), Westville, N.S.
Ridout, Andrew Maurice, B.Sc., (Chem.), Montreal, Que.
Shaw, Gerald Edison, B.Sc., (Ci.), Windsor, Ont.
Spriggs, Robert Hayward, B.Sc., (Ci.), St. Anne de Bellevue, Que.
Stewart, Donald Laughlin, B.Sc., (Me.), Dunvegan, Ont.
Snyder, Earle, B.Sc., (Mi.), St. Jacobs, Ont.
Stirling, Laurie Brodie, B.Sc., (El.), Shawinigan Falls, Que.
Trenholme, Henry George, B.Sc., (Me.), Montreal, Que.
Watson, William, B.Sc., (El.), St. John's, Nfld.
Wickwire, James Leander, B.Sc., (Ci.), Kentville, N.S.
Williams, Sydney Waldron, B.Sc., (Chem.), Quebec.
Wilson, Harold Stockdale, B.Sc., (Mi.), Indian Head, Sask.
Wood, Robert, B.Sc., (El.), Montreal, Que.
Wyse, James Wilson, B.Sc., (Ci.), Moncton, N.B.

University of Toronto

Degree of B.A.Sc.(with honours)

Chambers, Harold Joseph Ashbridge, B.A.Sc., (Civ.), Toronto, Ont.
Emerson, Theodore Roosevelt, B.A.Sc., (Civ.), Toronto, Ont.
Forward, Frank Arthur, B.A.Sc., (Chem.), Ottawa, Ont.
Grabill, Dayton Leslie, B.A.Sc., (Mi.), Toronto, Ont.
Hendershot, Rolphe Webb, B.A.Sc., (Ci.), Toronto, Ont.
Keefler, Ralph Holley, B.A.Sc., (Me.), Toronto, Ont.
Matson, Bruce Cook, B.A.Sc., (Ci.), Toronto, Ont.
Muirhead, Stuart Robert, B.A.Sc., (El.), Regina, Sask.
Pedder, James Frederick, B.A.Sc., (El.), Trout Creek, Ont.
Simpson, Walter LaVern, B.A.Sc., (El.), Toronto, Ont.
Thomson, John Morton, B.A.Sc., (El.), St. Catharines, Ont.

Degree of B.A.Sc.

Adams, Henry Carlton, B.A.Sc., (Me.), Toronto, Ont.
Archibald, Thomas Arthur, B.A.Sc., (El.), Toronto, Ont.
Beattie, John, B.A.Sc., (Mi.), Galt, Ont.
Beecroft, George William, B.A.Sc., (Ci.), Toronto, Ont.
Campbell, William Henry, B.A.Sc., (Ci.), Toronto, Ont.
Carp, Max. B.A.Sc., (Ci.), Toronto, Ont.
Chadwick, Austin, Ralph, B.A.Sc., (Ci.), Toronto, Ont.
Clark, Herbert Spencer, B.A.Sc., (El.), Toronto, Ont.
Collison, Lloyd Seth, B.A.Sc., (Ci.), Leamington, Ont.
Coulter, Stanley Lytton, B.A.Sc., (El.), Toronto, Ont.
Cowan, William Rae, B.A.Sc., (Me.), Toronto, Ont.
Davis, Cecil Reginald, B.A.Sc., (Me.), Toronto, Ont.
Elliott, William Kennedy, B.A.Sc., (El.), St. Thomas, Ont.
Franks, Selwyn Thomson, B.A.Sc., (El.), Weston, Ont.
Good, Earl Franklin, B.A.Sc., (Ci.), Blair, Ont.
Greenwood, Arthur Harold, B.A.Sc., (Me.), Palmerston, Ont.
Grenzebach, Sylvester Leslie, B.A.Sc., (El.), Toronto, Ont.
Griesbach, Robert James, B.A.Sc., (Ci.), Toronto, Ont.
Hardcastle, Sydney, B.A.Sc., (Ci.), Toronto, Ont.
Harlow, George Hammond, B.A.Sc., Toronto, Ont.
Harman, William John, B.A.Sc., (Ci.), Zephyr, Ont.
Heyland, Kenneth Vaughan, B.A.Sc., (Ci.), Toronto, Ont.
Joy, Clyde Barber, B.A.Sc., (Ci.), Toronto, Ont.
Keith, William Hargrave, B.A.Sc., (Ci.), Newmarket, Ont.
Langlois, William Lawrence, B.A.Sc., (Ci.), Toronto, Ont.
McDowell, William Ogle, B.A.Sc., (Ci.), Toronto, Ont.
MacQuarrie, Edison Malcolm, B.A.Sc., (Ci.), Toronto, Ont.
MacQuarrie, John Douglas, B.A.Sc., (Ci.), Toronto, Ont.
Miller, William Harold, B.A.Sc., (El.), Galt, Ont.
Moon, Almer Martin, B.A.Sc., (El.), Toronto, Ont.
Mueller, Emil Karl, B.A.Sc., (Ci.), Hamilton, Ont.
Nettleton, Cecil Arthur, B.A.Sc., (Ci.), Toronto, Ont.
Patience, Alfred Melbourne, B.A.Sc., (El.), Toronto, Ont.
Reid, William Joseph Walter, B.A.Sc., (El.), Toronto, Ont.
Robinson, Frank Harold, B.A.Sc., (El.), Toronto, Ont.
Rowat, Geoffrey Holms, B.A.Sc., (Me.), Toronto, Ont.
Shields, Stanley, B.A.Sc., (El.), Toronto, Ont.
Siddall, Kenneth Cave, B.A.Sc., Islington, Ont.
Take, Percival Horace, B.A.Sc., (Me.), Toronto, Ont.
Welsh, Dean Thomas, B.A.Sc., (Ci.), Hamilton, Ont.
Wilson, Frank Elvyn, B.A.Sc., (Ci.), Toronto, Ont.

International Mathematical Congress

An International Mathematical Congress will be held in Toronto from Monday, August 11th, to Saturday, August 16th, 1924, under the auspices of the University of Toronto and the Royal Canadian Institute.

The Congress will be conducted in conformity with the regulations of the International Research Council. The Congress will meet in the following sections:

Section I: Algebra, Theory of Numbers, Analysis.
Section II: Geometry.
Section III: (a) Mechanics, Mathematical Physics.
(b) Astronomy, Geophysics.
Section IV: (a) Electrical, Mechanical, Civil and Mining Engineering.
(b) Aeronautics, Naval Architecture, Ballistics, Radiotelegraphy.
Section V: Statistics, Actuarial Science, Economics.
Section VI: History, Philosophy, Didactics.

The above arrangement of sections is designed to afford, in the sphere of Applied Mathematics, full opportunity for consideration not only of those questions whose interest is purely scientific, but also of practical problems of engineering whose solutions contribute directly to the cause of material progress.

Activities in Lethbridge, Alta. District

Irrigation Projects in Operation

Operation and maintenance work is now in full swing on the various irrigation projects. On the C. P. R. project adjacent to Lethbridge, water was turned into the main ditch on April 26th, and into the distributaries on May 3rd.

Last season, 54,571 acres were irrigated with a production result valued at just under a million and a half dollars. The staff on this project consists of Sam G. Porter, M.E.I.C., superintendent of operation and maintenance; Chas. Raley, A.M.E.I.C., office engineer; Geo. S. Brown, A.M.E.I.C., assistant engineer; M. F. R. Lloyd, A.M.E.I.C., construction superintendent; R. S. Lawrence A.M.E.I.C., watermaster and H. W. Rowley A.M.E.I.C., watermaster.

The Lethbridge Northern Irrigation District turned water into their system on April 10th. This is really the first year of complete operation for this system as water was only available last season late in the fall. There are 105,000 acres in the district, which is managed by the farmers themselves through a board of three trustees. P. M. Sauder, M.E.I.C., is district manager with an operating staff consisting of Messrs Dodge, Hilliard, Branch, Clendenning, Brookes, Watermasters and Alex Thompson, hydrographer, all being members of the Lethbridge Branch of *The Institute*. The work of cleaning and priming the ditches progressed smoothly. To practically all the farmers served by the Lethbridge Northern, irrigation is new and a great deal of work will devolve upon the staff in assisting individual farmers with their private distributary problems. In all this irrigation work, the engineer must be not only an operating and maintenance expert but also something of an agricultural advisor, and able to answer practically any question that the farmer may ask concerning the water requirements of various crops, the proper time to irrigate, etc. He must be a diplomat as well, and master of every situation that may arise in emergency.

Municipal Electric System being Changed

Under the supervision of M. Freeman, A.M.E.I.C., commissioner of public utilities, the entire electrical system of the city of Lethbridge is being changed over from two-phaze to three-phaze. The complete change, switchboard equipment, lines, transformers etc., is being accomplished without any shut-down of service. The work will be completed by the end of August.

Concrete Paving in Lethbridge

Under the supervision of H. W. Meech, A.M.E.I.C., as city engineer, concrete paving is being laid on 13th street, the cost of which will approximate $4,500. The work is about half through and consists of paving two sides of the street, there being a double car track down the centre. The portion of the street passing through the C. P. R. subway is being paved its full width. The Crown Paving and Contracting Company has the contract.

Experiments in Sanding Bathing Beach

Mr. Meech is also conducting a series of experiments in sanding the beach at Henderson lake, the Lethbridge municipal playground. The experiments are being made in an endeavor to ascertain how best to treat the edge of the lake, and convert what is now a mud bottom into a sand floor for bathing purposes. One experiment consists of a series of steps, each step being about 12 by 25 feet with a board bottom covered with a five inch layer of sand. The other experiment is a 50 by 25 foot area with a board bottom following the contour of the lake bed with a cover of six inches of gravel and six inches of sand on top. The experimental work is being paid for by the Lethbridge Rotary Club jointly with the municipality on a fifty-fifty basis.

American Water Works Association Convention

The forty-fourth annual convention of the American Water Works Association was held at the hotel Astor, New York City, May 19th to 23rd, and following the announcement of the election of officers for the year 1924-25, and the presentation of the reports of committees, the Hon. Grover A. Whalen, commissioner of plant and structures, New York City entended a welcome to the visiting delegates.

In addition to the reports of the various committees, which indicated the progress made in extensive investigations into various importance subjects, a large number of extremely interesting papers were presented. Among the important subjects dealt with in these papers were the follows:—Allocation of Water Supply Derived from watersheds of Interstate Streams; Iodine Treatment of the Rochester Water Supply; The Method of Making Flow Tests and their Value to the Water Works Engineer; The Relation of Fire Protection Requirements to the Distribution System of Small Towns; The Economic Significance of the Fire Waste; A defect in Permanent Colour Standards Due in Variation in Cobalt Chloride; Colour Transmittency Curve of Some of the Colormetric Standards Including Cobalt Chlorides; Micro Dissolved Oxygen Apparatus; Note on the use of Dykes in Agar Media; Use of Gentian Violet Broth; a Note on the Voges Proskauer; Development and Manufacture of Engineering and Surveying Instruments; Progress in the Chemistry of Precipitation and Coagulation; The Development and Manufacture of the Modern Cement-Lined Service Pipe; Observations on the Chlorination of Small Water Supplies; Large Water Supply Mains; Early History of Zeolites; Operating Experiences and Economy of a Diesel Engine Driven Pumping Station; Proper Zeolites for Water Softening; Keeping an Antiquated Plant in Tune; A New Well System at Holland; Weather Bureau Data at Pumping Stations.

Sewerage (*9th edition*)

By A. P. Folwell

Reviewed by R. O. Wynne-Roberts, M.E.I.C., Consulting Engineer, Toronto, Ontario.

The first edition of this book was published about 1898, since when the art of designing and constructing sewers and sewage disposal works has changed considerably.

In the matter of combined sewers the method of computing storm water has been changed during recent years, thanks to initiative of the late Mr. Kuichling of Rochester. Some engineers, however, still adhere to old rules which have been proved to be inadequate. Prof. Folwell discusses this matter in detail, although some phases of the problem are omitted. The author treats on the questions of rainfall intensity, run-off, time of concentration and so on. The synthetic method, — but generally called the rational method, — of designing is one which different engineers apply according to various conceptions. Mr. Folwell has adopted a method which the student would do well to study although it is recommended that such study should be extended.

The chapter on sewer design is good and has reference to many types of construction with their many accessories.

A copy of the specifications and contract issued by the American Society of Municipal Improvements are included and will be found useful as guides. A later and revised specification has been issued since this book was in the hands of the printer.

The writer deemed it desirable to have Mr. A. V. De Laporte, M.E.I.C., a Canadian authority to review the second part of this volume which deals with the problems of sewage disposal and the following is an extract from his letter:

"The task of reviewing Prof. Folwell's book has been most pleasant. The book is valuable as a reference but is more valuable to a student than to an engineer practising in Canada. It gives very complete descriptions of the older methods of sewage treatment. It is a matter for regret that Prof. Folwell did not give more information about the newer methods and plants, one would almost suspect that he had not the intimate knowledge of the later processes that he displays in his descriptions of contact beds and sprinkling and intermittent filters."

This volume will be useful to indicate the progress in the art of sewer design and sewage disposal, but when the engineer desires to have fuller and more complete dissertation on any special work in which he may be interested, he should also consult other authorities.

It is somewhat unfortunate that some of the statistics and records in this volume are not up-to-date and prices are generally those of a pre-war period. Of course some records do not change much in the course of time. The Canadian student must bear in mind when making comparisons, that United States gallons and prices are quoted.

The book is published by John Wiley & Sons, Incorporated, New York, represented in Canada by Renouf Publishing Company, Montreal.

Canadian Good Roads Association Annual Convention

Final arrangements are being made for the eleventh annual convention of the Canadian Good Roads Convention which will be held this year at the Algonquin hotel, St. Andrews-by-the-Sea, N. B., from Tuesday to Friday, June 24th, to 27th, inclusive. The programme which has been arranged for the business sessions of the convention provides for the grouping of papers and discussions under general heads, so that subjects which are connected or inter-related will be taken up consecutively. One session will be devoted to finances in connection with road building; another to administration methods; while others will include construction problems, traffic regulations, maintenance methods, and other important divisions of the general policy of the association and the needs of its members. The usual interprovincial conference of highway ministers, deputy ministers, departemental heads and engineers will be held, at which their special road problems, such as uniformity of motor vehicle laws and interchange of traffic, will be discussed. Of great importance will be the discussion of federal aid for the highways of Canada. A special invitation has been issued by the Hon. P. J. Veniot, the Prime Minister of New Brunswick, to all motorists of Canada to take advantage of this occasion to motor to the convention by way of the all-Canadian highway between Montreal and St. Andrew's.

Tests of Impure Water for Mixing Concrete*

Professor Duff A. Abrams, M.E.I.C.

Summary and Conclusions

Strength tests of portland cement concrete were made at ages of 3 days to 2⅓ years using mixing waters of a wide range of types, many of which were thought to be unsuitable for use in concrete. Sixty-eight samples of water were tested in two different investigations; 52 samples were collected from different sections of the country; 14 were from the Chicago district. Among the waters tested were sea and alkali waters, bog waters, mine and mineral waters, waters containing sewage and industrial wastes, and solutions of common salt. Tests of fresh waters (including distilled) were made for purpose of comparison. About 6,000 tests are included in this report. Reference is made to a number of other investigations on related subjects.

Series 137: 50 samples of water were used in 1-4 concrete of relative consistency 1.10 and tested after curing under the following conditions:

(a) Moist room tested at ages of 3 days to 2⅓ years.
(b) Moist room 28 days, then in air of laboratory, tested at 3 months to 2⅓ years.

Series 138: 18 samples including sewage and trade wastes from the Chicago district were used in concrete cured in moist room as follows:

(a) 1–7, 1–5, 1–4, 1–3 and 1–2 mixtures; relative consistency 1.00, tested at 28 days.
(b) 1–4 concrete mix, relative consistency 0.90, 1.00, 1.10, 1.25, and 1.50, tested at 28 days.
(c) 1–4 concrete mix; relative consistency 1.00, tested at 3, 7, and 28 days, 3 months, 1 and 2⅓ years.
(d) 1–3 standard sand mortar, tension tests of briquets and compression tests of 2 by 4-in. cylinders at ages given in (c).

Concrete and mortar tests were made in accordance with standard methods. In general, 5 to 10 concrete specimens, and 5 mortar specimens were made in a set on different days.

Time of setting and soundness tests of cement were made with each sample of mixing water.

The principal conclusions from these tests are:

(1) In spite of the wide variation in the origin and type of the waters used, and contrary to accepted opinion, most of the samples gave good results in concrete. This result seems to be due to the fact that the quantity of injurious impurities present is quite small. The following samples gave concrete strengths below the strength-ratio of 85 per cent which was considered the lower limit for acceptable mixing waters: Acid waters, lime soak from tannery, refuse from paint factory, mineral water from Colorado, and waters containing over 5 per cent of common salt.

(2) The quality of a mixing water is best measured by the ratio of its 28-day concrete or mortar strength to that of similar mixes with fresh water. While the lowest permissible strength-ratio is a matter of judgment, waters giving strength-ratios which in general fall below 85 per cent should be considered unsatisfactory; if only isolated tests are made, 80 per cent should be the limiting value. The time-of-setting test appears to be an unsafe guide as to the suitability of a water for mixing concrete.

(3) Neither odor or color are any indication of quality of water for mixing concrete. Waters which were most unpromising in appearance, gave good results. It may safely be said, however, that any natural water which is suitable for drinking can be used without question for mixing concrete.

(4) Distilled water gave concrete strengths essentially the same as other fresh waters.

(5) Bog waters which were thought to be unsuitable for mixing concrete generally contained only small quantities of foreign materials and gave good results. The strength-ratios for the individual samples were seldom below 90 per cent.

(6) Sulphate waters produced little or no ill effects until an SO_4 concentration of about 1 per cent was reached. For a concentration of 0.5 per cent the average reduction in strength was about 4 per cent; a concentration of 1 per cent was required to produce a reduction in strength of more than 10 per cent.

(7) Concrete mixed with sea water (about 3.5 per cent salts, mostly sodium chloride) cured in the moist room gave higher strengths than fresh-water concrete at ages of 3 and 7 days; at 28 days and over, the strength-ratios for sea water ranged from 80 to 88 per cent. Air-cured concrete mixed with sea water was lower in strength than similar

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fresh-water concrete at 3 months, but showed a recovery in strength at later ages and gave strengths equal to that obtained with fresh water. (In spite of the satisfactory strength results, it seems unwise to use sea water in reinforced concrete construction, particularly in the tropics on account of danger of corrosion of reinforcement).

(8) Synthetic sea water gave concrete and mortar strengths similar to natural sea water.

(9) Concrete mixed with water from the Great Salt lake (about 20 per cent sodium chloride) gave strength-ratios from 65 to 77 per cent at ages of 28 days and over. This water is not satisfactory for mixing concrete, unless allowance is made for about 30 per cent reduction in the assumed strength.

(10) Water from Devil's Lake, North Dakota, (0.15 per cent sodium sulphate and 0.15 per cent sodium chloride) gave normal concrete strengths and showed no ill effects.

(11) Water from Medicine Lake, South Dakota, (3.5 per cent solution of sulphates, largely magnesium; SO_4 concentration 2.8 per cent) gave strengths similar to that obtained with sea water. The lower strength-ratio was 84 per cent.

(12) Waters from drains and small streams in sulphate districts gave satisfactory strengths at ages up to 2⅓ years. The lowest strength-ratios were about 90 per cent.

(13) Concrete made with solutions of common salt and cured until test in a moist room showed a slight increase in strength at 3 days for solutions of 10 per cent and less. Solutions of low concentration (1 and 2 per cent) also showed a slight increase in strength at 7 days; after 7 days, however, all concentrations gave material reductions in strength. Strength-ratios as low as 60 per cent were found for a 20 per cent solution at early ages and for 10 per cent and 15 per cent solutions at the later ages.

Concrete made with salt solutions and cured in the moist room for 28 days then in air, gave results at 3 months almost identical with that obtained for moist-room curing. For this curing condition, the addition of salt reduced the streng that one year about 12 per cent; at 2⅓ years there was no reduction in strength. The apparently conflicting results for moist-room and air-curing have not been explained.

(14) The use of common salt for the purpose of lowering the freezing point of the mixing water during cold weather should not be permitted; 5 per cent of salt lowers the freezing point of water about 6°F., but reduces the strength of concrete about 30 per cent.

(15) Mine and mineral waters gave good results in concrete, with the exception of a carbonated mineral water from Colorado which gave strength-ratios as low as 80 per cent. Pumpage waters from coal and gypsum mines also gave good results in concrete.

(16) Water containing sanitary sewage gave essentially the same concrete strengths as fresh water. Water from the Illinois River, which carries sewage from Chicago, gave strength-ratios at 28 days and 3 months of 83 and 85 per cent for moist-room curing; for air-curing strength-ratios ranged from 92 to 102 per cent.

(17) Waters containing refuse from oil refineries gave erratic strengths. These samples generally gave strengths near normal, but in some cases material reductions in strength were found. Setting time of cement with one water sample was, initial 10 hour, final 42 hour.

(18) "Bubbly Creek" water, which is highly polluted with wastes from the Chicago Stockyards and gave off an offensive odor showed strength-ratios of about 100 per cent for all ages, mixes and consistencies.

(19) Tannery wastes generally gave reductions in concrete strength; the lowest strength-ratios were about 80 per cent (lime soak water).

(20) Brewery and soap works wastes gave concrete strengths essentially the same as that of fresh water.

(21) Waste from a gas plant and a corn products factory gave good results; the strength-ratios ranged from 90 to 100 per cent.

(22) Paint factory waste water gave strength-ratios ranging from 80 to 90 per cent.

(23) A spent plating bath containing sulphuric acid, after dilution to 10 and 20 per cent of its original concentration, gave strength-ratios as low as 85 per cent for the 10 per cent solution and 74 per cent for the 20 per cent solution. For different consistencies both solutions gave about the same strength-ratios which ranged frcm 88 per cent to 106 per cent. Lower strength-ratios were obtained with the rich concretes than with the lean.

(24) The strength of concrete mixed with all samples of impure waters showed normal increase at 28 days with additional quantities of cement. The impure waters gave about the same strength-ratios regardless of the mix used in the concrete tests. For the usual range in mixtures (1–5 to 1–4) the strength increased about one per cent for each one per cent additional cement.

(25) There was a marked reduction in strength of concrete with increase in quantity of mixing water both for fresh and impure water. Increasing the quantity of mixing water one per cent reduced the strength of concrete about the same amount as if the quantity of cement were *reduced* one per cent. A comparatively slight increase in *quantity* of mixing water produced a greater reduction in concrete strength than that caused by the use of the *most polluted* mixing water that is ordinarily encountered. These tests show the importance of the water-ratio strength relation in concrete which has been pointed out in numerous other reports from this Laboratory.

(26) The effect of impure waters was in general independent of the consistency of the concrete. Acid waters from a spent plating bath gave somewhat higher strength-ratios in the wetter concrete.

(27) The strength of concrete cured in a damp condition at normal temperatures increased with age for both fresh and impure waters. The strength was approximately proportional to the logarithm of the age at test.

(28) The effect of impure mixing waters on the tensile and compressive strength of 1–3 standard sand mortar at ages of 3 days to 2⅓ years was generally similar to that on the compressive strength of concrete. In the mortar tests a few waters gave somewhat higher strength-ratios and one water gave a somewhat lower strength-ratio than was obtained in concrete.

(29) The percentage of water required for normal consistency of cement when mixed with the impure waters was, with few exceptions, about the same as for fresh waters. Water from Great Salt Lake, solutions of 5 to 20 per cent of common salt, refuse from an oil refinery, Medicine Lake water, and acid water from a spent plating bath, required somewhat higher percentages for normal consistency than fresh water.

(30) The time of setting of portland cement mixed with the impure waters was about the same as for fresh waters, however, there were some notable exceptions. In most instances the samples giving low concrete strength-ratios were slow setting. On the whole the tests show that time of setting is not a satisfactory test for suitability of a water for mixing concrete.

(31) None of the impure waters caused unsoundness of the portland cement when subjected to the standard test over boiling water.

(32) Most specifications for water for mixing concrete are so worded that they would, if strictly enforced, exclude nearly all but rain water and distilled water; these tests have shown that almost any impurity may be present without *necessarily* producing ill effects. The important point is not whether impurities are present, but do the impurities occur in *injurious* quantities?

(33) The effect of sugar and similar compounds were not studied; earlier tests have shown that these compounds are most detrimental and must be avoided.

Tallest Building in British Empire

There will shortly be added to the list of Toronto's skyscrapers one which will claim the position of the tallest building in the British Empire. This building will be situated at the southwest corner of Adelaide and Victoria Streets, Toronto, Ontario. It will occupy a lot 54.6 feet by 150.9 feet. The building will be twenty-one storeys high, and the plans call for the use of stone for the first two storeys facing the streets, and pressed brick with stone cornices. The contract for the building was awarded to the Geo. A. Fuller Company of New York early last month, at which time Hugh White, president of the company and John T. McPherson, Canadian manager, were in Toronto conferring with James J. O'Neil, owner of the building, as to the details of the contract.

Abstracts of Papers read before the Branches

Canada's Mineral Resources

Professor H. W. McKiel, B.A., B.Sc., M.E.I.C., Moncton Branch, April 25th, 1924.

Professor McKiel began his lecture with a short description of the various types of ores and mineral deposits, classifying them according to their genesis; that is, of sedimentary origin or the result of igneous phenomena. Dealing with the latter class he briefly showed how the various types, such as those of magmatic segregation, contact and vein deposits, developed, bringing out in each case their relation to magmatic intrusions. Pointing out that some idea of the evolution of the Canada as we know it, from the original shield around Hudson bay, would be of assistance in appreciating the origin and reasons for the location of the ores. A brief sketch of the geological history of Canada followed. From this, as a starting point, the five main geological provinces were outlined, namely, the Acadian or Appalachian, the Laurentian, the St. Lawrence Valley, the Interior Plains and the Cordilleran.

Dealing with the Appalachian province, its main resource, coal, was first taken up. The boundaries of the carboniferous formation were traced, the deposits located and their known reserves estimated. Possible developments of new fields were then discussed and it was shown that, in the light of our present information such a contingency seemed improbable. Passing on, the asbestos deposits of eastern Quebec were dealt with, and then the recently discovered salt formation at Malagash, N.S. The less important minerals of the region, such as lead, zinc, manganese, tungsten, copper, gold, iron, etc., came under discussion, the two latter more fully than the others. Under present conditions a great development of any one of these seemed to be very improbable. Leaving the metals, reference was made to oil and oil shale possibilities, but not with an optimistic outlook for the immediate future, though the shale industry may at some distant time be of considerable importance. The gypsum and plaster possibilities were then considered, and discussion of the Appalachian province concluded with a few remarks on the stone formations suitable for abrasives and for building purposes, and the clays and shales adapted to the production of brick, tile, etc.

Taking up next the St. Lawrence valley, and Niagara-Sarnia peninsula, the absence of igneous intrusions was shown, and hence the improbability of anything but sedimentary deposits being found. The oil and gas fields of western Ontario were dealt with, also the accompanying salt and gypsum. This with the clay, shale, cement rock and limestone pretty well exhausted the district.

Turning to the Laurentian plateau, reference was made to its history and development, and also to the fact that it was almost unexplored. The occurrence of the Animikian formation containing the Michigan-Minnesota iron deposits, and the Keweenawan, in which is found the nickel, copper, gold and silver of new Ontario, was mentioned, and the known occurrences of these same formations in widely scattered locations throughout the plateau, formed the basis of a suggestion that systematic prospecting would reveal considerable quantities of mineral wealth, not yet discovered. The known occurrences of the precious metals and copper were located, ranging from Sudbury, Cobalt and Porcupine, through The Pas to Coppermine river and the northwest. The lesser metals such as zinc, lead, arsenic and iron were next dealt with. In connection with the latter the speaker offered some encouragement, in spite of the present poor showing of the Ontario industry, basing his optimism upon a recent report of the Advisory Council for Industrial Research, in which the Belcher's Islands deposits of James bay were compared favourably with the famous Mesabi range of Minnesota. Taking up the non-metallics such as mica, corundum, apatite, feldspar, talc, etc., various occurrences were noted and mention was made that Ontario was now the largest producer of feldspar in America. Discussing the possibility of coal occurring in this province, the absence of all the coal bearing formations, and hence the improbability of any coal being found was pointed out. Some lignite deposits on the James bay slope were considered, however, and attention called to the vast quantities of hydro-power available in this region. In summing up the resources of the Laurentian district, stress was laid on the fact that most of our present great developments were of accidental discovery and hence future prospects should be excellent.

The resources of the interior plain proved to be altogether of sedimentary origin, and to consist mostly of coal and lignites, which were present in great quantities; of gas and oil in comparatively large, though diminishing quantities, the former supplying, with the gas of Albert county, N.B., the only known sources of helium in the British Empire. A curious clay, Bentonite, which possesses the property of swelling enormously when saturated with water, and also of becoming very greasy or soapy, was touched on, as many and varied uses for it have been discovered. Alkalies were being recovered in commercial quantities from the so called alkali lakes of the west, and in addition to the well established brick and tile industries, advances are being made in the manufacture of pottery and ceramics in general from the clays of the region.

Coming to the Cordilleran region, the intense igneous development and the resulting opportunity for mineralization was shown. The past history of the gold, silver-lead, and copper industries was briefly sketched, and mention made of the apparent present trend of development, away from the boundary district to the north coast, Portland canal and Howe Sound regions. The production of electrolytic zinc at Trail was touched on and the possibilities of a small iron industry in the islands along the coast discussed. The enormous coal resources, including Canada's only anthracite, and taken with that of Alberta amounting to some 17 per cent of the resources of the world, was commented upon. Attention was once again directed to the almost unexplored condition of the great part of the province and the favourable outlook for the future, in view of the great discoveries of the past.

The lecture was concluded with the advice to remember that our resources, great as they are, are not unlimited, and that metal once extracted cannot be replaced; that we should make haste slowly in consuming resources which required millions of years in the making.

The Future Importance of Canada's Tremendous Mineral Resources

Dr. R. C. Wallace, M.A., Ph.D., D.Sc., Ottawa Branch, May 1st, 1924.

Dr. Wallace made it perfectly clear that he looked to the mining industry to maintain the prosperity of Canada in the future, and that the coal production was one of the Dominion's greatest assets He maintained that in Winnipeg it was possible to get a better idea of the solution to the mining problems of the Dominion than in the east; and he strongly championed the Hudson's Bay Railway. He maintained that it was an asset to Canada, not merely because it had opened up one of the richest mining countries in the Dominion, but because of the outlet it provided for Canadian grain direct to the Old country.

Dr. Wallace maintained that the reason why two-thirds of the Dominion was unpopulated was because the settlers sought agricultural land first. Two-thirds of the Dominion was mining land and the fact that this was unpopulated, or sparsely settled, provided the reason, mainly a geographical reason, for the misunderstanding that undoubtedly existed between east and west.

"Mining does not to-day produce what forestry does," acknowledged Dr. Wallace, "but mining will in future be the guiding influence over the distribution of population, and the consequent prosperity of the Dominion. It is perfectly clear that Canada is not going to continue indefinitely as a wheat growing country only. We realize fully that agriculture, represented by two million people in the west, has produced more than mining, fishing and forestry all put together. We realize also that agriculture will continue to attract settlers on our land. But we know full well, and the country must realize the fact soon, that the one solution of the future development and settlement of the country rests with the mining industry. The key to national unity and prosperity lies in the heart of the mining lands of the Dominion. One of the most important branches of this industry is the production of coal, and in future the coal area will be the center of industrial Canada."

Referring to the struggle in which western Canada was attempting to compete with the coalfields of the United States, Dr. Wallace discussed, for a few minutes, the pre-Cambrian shield. This belt of land, he said, embraced 90 per cent of Quebec, 70 per cent of Ontario, 60 per cent of Manitoba, 20 per cent of Saskatchewan, 2,000 square miles in Alberta, and the whole of the Northwest Territories; in all about two-thirds of the Dominion. Into this area last year was imported, mainly for domestic purposes, about 750,000 tons of western Canadian coal. In the same period 2½ million tons of coal was imported from the United States.

"The Winnipeg market has been almost entirely captured for western Canadian domestic coal, but in the field of steam coal western producers have not as yet secured the market in western territory that is rightfully theirs."

Dr. Wallace considered this the most important problem that was facing western Canada directly and, through the west, would influence to a very large extent the future development of the east also.

"Winnipeg reached its limit as an agricultural center long ago," he said. "Its future growth depends almost entirely upon the mining industry, and what is true of Winnipeg, applies also to the rest of western Canada. There is a period of expansion coming when the utilizing of all the natural resources of the Dominion will be the key note to development, and the mining industry will play a very prominent part in this."

Mechanical Stokers and the Use of Pulverized Coal

John T. Farmer, M.E.I.C.,
Halifax Branch, April 3rd, 1924.

In opening his remarks, Mr. Farmer stated that he considered the functions of an ideal stoker to be three-fold, to feed coal to the grate, to distribute it adequately over and regulate its depth on the grate, and to dispose of the non-combustible material. Under the heading of essential features he placed reliability first, efficiency second, and capacity third, but explained that reliability must be considered in connection with the cost of obtaining it and that efficiency quite often is displaced from its second position by the necessity for increased capacity in existing equipment or available space. References to mechanical stokers appear in literature of combustion as long as seventy-five years ago and many of the improvements being made to the stoker to-day were anticipated in the forgotten patents and installations of the past fifty years. He divided present day stokers into three main classes; the overfeed type which imitates the handfired system, the underfeed which was the first to take into consideration the composition of bituminous coal, and the travelling grate. The first type of grate operates on natural draft, the second forced draft, and the third in its earlier types on natural draft and in the later types, (compartment), on forced draft. He explained that the extra expense for machinery and power to supply forced draft was compensated for by better mixture of air with the combustible gases and increased combustion per unit of grate area.

The stoker problem is not simple. It is full of complexity and variations which make it very fascinating to study. Coal itself is a very complex compound commonly considered as a mixture of carbon, hydro-carbon which will burn, and an ash which will not burn. Because the hydro-carbons are changed into gases and vapours before they ignite they may escape from the combustion chamber before they are oxidized. Because the ash is of variable composition, the temperature at which it will fuse and become clinker varies between wide limits. The performance of a stoker depends on how adequately it can maintain a high rate of combustion per unit area of grate without permitting the escape of unburnt gases and without the formation of large bodies of clinker. This performance is partly built into the stoker and partly due to operation.

Concerning Nova Scotia coals it was the opinion of Mr. Farmer that nature had been careless in laying down the beds because in most cases, particularly in mainland fields, the content of ash was comparatively high. With coals which clinker badly, that is, contain low fusing point ash, underfeed stokers are undesirable and the travelling grate is better. Where the rate of combustion is very high the linings of the furnace may melt and run.

Mr. Farmer said then that the use of pulverized fuel was not new. He spoke of installations which had been made in Nova Scotia twelve or fifteen years ago. But only in the last four or five years has the question of its use been satisfactorily solved. In general the use of pulverized coal requires more machinery but not in a hot place. The coal requires crushing before pulverizing and sometimes drying. Pulverizers are elaborate and costly. Several fans are necessary to move the powdered coal from one point to another and finally to place it and the necessary air in the combustion chamber. In the combustion chamber the oxidation depends on the distance that the particles travel. In some cases this distance is from 45 to 50 feet from the point of ejection from the feeder until contact with the boiler tubes is obtained. In this connection the speaker related the interesting fact that a particle of carbon requires 16,000 times its own volume of air to burn it. This illustrates the difficulty of getting a proper mixture of pulverized coal and air for the particles must be injected to spread and separate by distances of twenty-five times their diameter. Usually the furnaces are larger than the boilers and the fuel is injected downwards. It seems to be the best practice to put in 25 per cent of the air with the fuel and to draw the rest through the walls of the furnace at right angles to the direction of flow.

Pulverizing the fuel does not get rid of the ash. It is left behind in a fused state due to the high temperature. Formerly this presented a great difficulty which is now overcome by providing a cold chamber at the bottom of the furnace into which the small particles of clinker fall like hail. The cold chamber is sometimes accentuated by a water screen of tubes in conjunction with the circulation in the boiler. The efficiency and reliability of pulverized coal installations has been proven at Milwaukee where an efficiency of about 85 per cent was obtained on a 24-hour run every day for a month, and the plant was kept running for a period of seven months without shutting down. Capacities of 250 to 300 per cent were maintained. In the opinion of the speaker this type of combustion could be considered in connection with the use of coals from the Joggins, Inverness and Minto fields.

He considered the problem of the domestic furnace to be diametrically opposed to power plant practice. Industrially the efficiency of combustion is determined by a rapid rate: domestically the desire is for a slow rate of combustion. In other words to get maximum efficiency from the use of soft coal in a house-heating furnace, the distillation of the gas from the coal should be controlled to such a rate that it can be consumed as formed. If the slowest rate obtainable gives more heat than is desired the excess is wasted. Furnaces designed for hard coal usually have insufficient volume in their combustion chambers for the efficient and smokeless combustion of soft coal.

Discussion

In the discussion which followed D. L. Derron, M.E.I.C., chief mechanical engineer of the Dominion Atlantic Railway told of the success of the fuel conservation programme to date. Through co-operation between the traffic and mechanical departments and the men on the road the yearly bill will probably be reduced by about 20 per cent.

He emphasized the desirability of providing adequate combustion space above the fire and the importance of having ratio existing between grate area and load. In one case he had reduced the grate surface by one-half, in another one-third. In each case very much better results were obtained. The ratio to which he was working was the one which was recommended by the U. S. Bureau of Mines. When resetting some stationary boilers at Kentville he had placed them six feet above the grates. If he had the job to do again he would raise them four feet more and expect to get smokeless combustion when the right amount of air was admitted above the grate. In his opinion 50 per cent of the air necessary for combustion should be admitted above the fire and he had had very much more efficiency from both locomotive and stationary boilers when this was done under proper control. To get better control on stationary boilers he had equipped them with Franklyn automatic doors such as are used on locomotives. In the case of the locomotives he had cut additional openings into the fire box when it was not possible to get sufficient air into it as it was.

Concerning the use of soft coal, he did not hesitate to recommend it for domestic use. If it is clearly understood it can be burned to dollars and cents advantage. He advocated the methods described in "Coal Truth". Summing up the advantages of hard coal he said "hard coal needs less trouble to waste it".

The Engineer in the Nation

Sir Arthur Currie, G.C.M.G., K.C.B.,
Montreal Branch, April 24th, 1924.

In a short address Sir Arthur Currie spoke of what civilization owed to the engineer. North America everywhere showed his footsteps and it was almost true that the engineer had constructed the North American continent from the very foundation. In Canada no man had done more for the development of the country and the comfort of the Canadian people than the engineer, but his task was as yet far from done. He would be expected to undertake still more in the management of affairs and he must be prepared for his function.

Economic progress followed in the trail marked by the engineer. Yet, in the last twenty years, a great change had left its mark on the profession. Standardization had come to the fore. A great idea was born and was spread all over the world for other engineers to copy. In great modern undertakings such as the railroad and the shipyard, to which no man had contributed more than the engineer, work had become standardized. There was a danger that the engineer would become absorbed in routine, become an efficiency planner, a craftsman rather than a creator. To offset dangers arising from the process of standardization, Sir Arthur advocated more engineering research.

The profession operated under several disabilities, Sir Arthur concluded. It was the only profession on which fortunes were staked. Engineers did not appear to have the esprit de corps which marked other professions, and there appeared to be lack of organization. Other profession set forth the necessary qualifications of their membership but there were more poorly qualified men attempting to practice in the engineering profession than in any other, he believed.

Considerations on a Project of Town Planning for the Island of Montreal

S. J. Fortin, M.E.I.C.,
Montreal Branch, April 17th, 1924.

Mr. Fortin outlined in detail a possible scheme of procedure and organization for a practical solution of the problem of town planning in Montreal. He advocated the appointment of a town planning commission, having jurisdiction over the whole island of Montreal, which embraced a large proportion of the population of the province. This, he suggested, could best be done by a town planning commission, appointed with suitable personnel by the Montreal city council, and then through the provincial legislature, so as to get island-wide authority and provision for assessments on the various municipalities, because without power and money such a commission could do nothing. Such a commission should include a prominent engineer and architect, and should have an efficient secretariat and engineering staff.

Montreal, he said, occupied relatively the same position to Canada that New York does to the United States, while both cities have similar destinies. For purposes of comparison he described the comprehensive town planning scheme outlined for Greater New York by the Russell

Sage Foundation, for a commission working in co-operation with the various public authorities of the district. He doubted if outside New York there was a city on the continent that offered such opportunities for town planning as Montreal. It was time for Montreal to cease regarding itself as an overgrown country town, and realize its destiny as a metropolis.

Their first work would be to prepare a general plan, with maps, according to the instructions of the executive body, always acting in accord with local authorities, especially with regard to trunk highways, sewers, parks, etc., while such plans should then be published for public consideration, their reports eventually to be approved by the legislature. Mr. Fortin described in detail the working of such an organization, which is estimated to cost about $200,000, while its works would continue almost indefinitely, and be directed rather to avoiding future errors than correcting those of the past.

Mayor P. W. McLagan of Westmount, who is a member of the Metropolitan Commission, agreed that the appointment of a town planning commission was a matter of immediate and great importance to the city and island of Montreal, both of which are suffering to-day from the lack of such co-ordinated effort to direct development in the past. However, he did not altogether agree with Mr. Fortin's plan, because it seemed to ignore the outlying municipalities too much. Since they would have to pay their share they should be represented on such a commission. He preferred the borough system, with a central body to carry out the recommendations of such a commission, and provide the funds. Such a central body might be developed out of the Metropolitan Commission, until it became a central body representing the various boroughs, along the lines of the London County Council, which he considered an excellent model for the island of Montreal.

London's Street Railway Situation

A. E. K. Bunnell, A.M.E.I.C.,
London Branch, April 23rd, 1924.

In enlarging on his London street railway report, Mr. Bunnell after declaring that in his opinion the street railway should be owned by the city, reminded his hearers of the importance of the clause in the original franchise on which the valuation of the assets of the company were to be based by the arbitrators. This clause, he pointed out, says emphatically that only the tangible assets of the company are to be considered and that nothing is to be allowed for goodwill. It also statee that the assets are to be estimated at the current value they may havs to the city at the time of arbitration and that the earning power of the company shall have no bearing on the question of valuation.

Mr. Bunnell, in stressing this phase of the question, declared he was wholeheartedly in favour of arbitration and that he thought a contract was a contract in any circumstances, and that it should be adhered to by all parties. He said that in the event of arbitration being agreed upon, it was imperative the city should take care to make its case in respect of the basis of valuation in the courts before proceeding to the actual process of arbitration. He added also in the event of the city taking over the road it was either a question of using two-man cars and paying increased fares, or using one-man cars with the same or perhaps a lower fare.

On the subject of paving allowance he stated that all over the country street car companies were seeking to be relieved from this charge on the ground that by running a regular every day service they were supplying service for emergency days as well, and that the track allowance should be a service charge on the community, and not an operating expense to the company. He upheld this view, adding that the man who used a car only on a wet day or when his motor was out of action, should in fairness pay more than the man who used a car every day, so as to help pay for the daily service for general use. He stated that as in most cities 90 per cent of all traffic ran on the track built by the street car company, it was not fair to the company to burden it with this charge.

In comparing the bus and the street car in operation he observed that if busses were operating on the streets and were not charged for the upkeep of the streets why should a street car company have to face such a charge? The accident hazzard was not greater, but rather less, with the one-man cars as far as available statistics showed.

Discussion

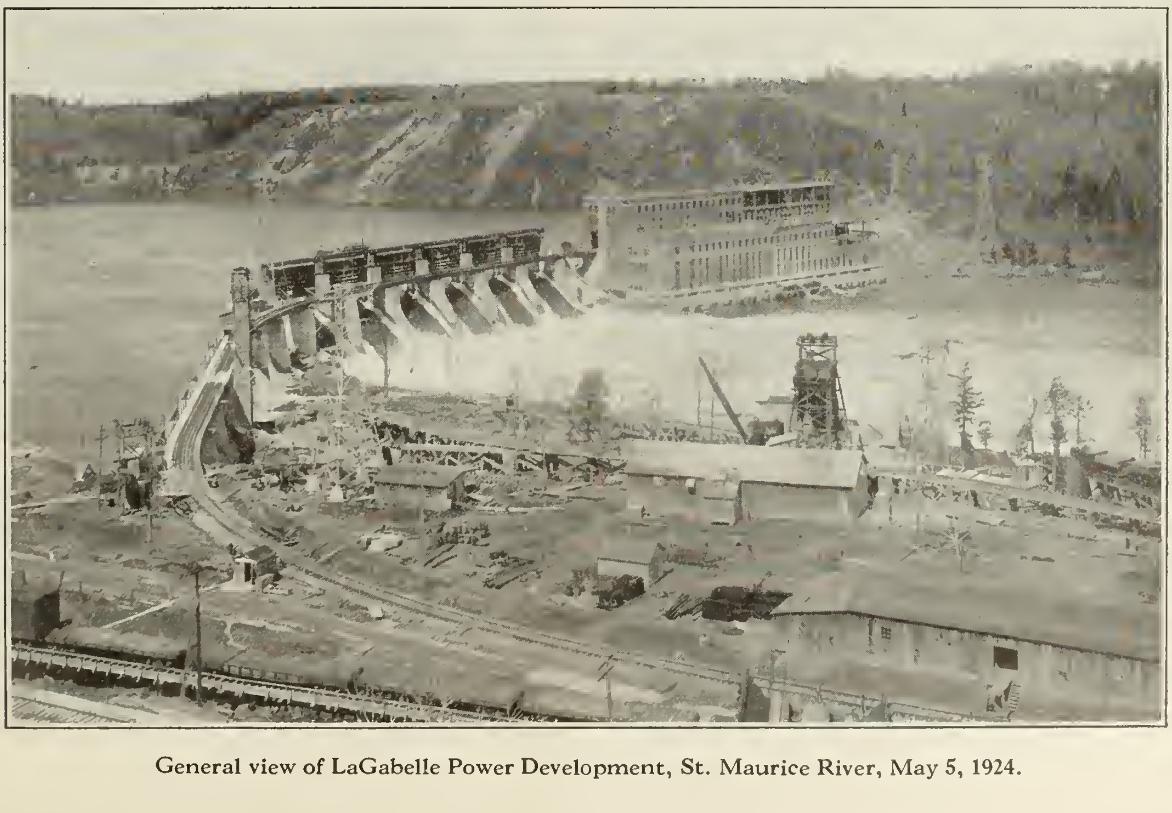
Philip Pocock, ex-chairman of the public utilities commission, expressed himself as being in favour of arbitration in settling the matter, but differed with Mr. Bunnell on the advisibility of adhering to the clause on valuation as stated in the original franchise on the ground that it was not natural for any man to base valuation solely on the assets and ignoring the earning power of the company altogether.

W. P. Near, M.E.I.C., took issue with Mr. Bunnell on the case of the track allowance. He saw no reason why it should be recognized as a service charge. He believed the actual users of the cars should pay all operating expenses, and that the community in general should not pay the track allowance.

Mr. Bunnell and Mr. Pocock took different sides when the question of the taxation of public utilities was discussed, the dean of the commission declaring that as the profits of any public utility were the property of the real estate owners of a city that it was absurb to assets the utility which made that profit Mr. Bunnell, however, stood firm in behalf of the taxatiou of a public utility.

Standard General Specification for Galvanized Steel Wire Strand

A Standard General Specification for Galvanized Steel Wire Strand has been issued by the Canadian Engineering Standards Association being publication under No. B 12-1924. This publication deals with the manufacture of galvanizing physical properties and tests for wire; galvanizing properties and tests for strand; standard grades and sizes; workmanship and finish; packing and marking; and inspection and rejection. In addition there is an appendix on chemical test to be applied to zinc coating of wire. Copies of this specification may be secured from Captain R. J. Durley, M.E.I.C., Secretary of the Canadian Engineering Standards Association, Ottawa, Ont., or from the headquarters of *The Engineering Institute of Canada.*



General view of LaGabelle Power Development, St. Maurice River, May 5, 1924.

BRANCH NEWS

Moncton Branch

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

At a supper meeting of the Moncton Branch, held April 25th, Professor McKiel, B.A., B.Sc., M.E.I.C., of Mount Allison University, Sackville, delivered a lecture on "Canada's Mineral Resources".

This is the second very excellent lecture that Professor McKiel has given the Moncton Branch.

F. A. Bowman, B.A., B.E., M.E.I.C., assistant superintendent, Maritime Telephone and Telegraph Company, Halifax, and a vice president of *The Institute*, was the guest of the Moncton Branch on this occasion, and was welcomed by the chairman, C. S. G. Rogers, A.M.E.I.C. Mr. Bowman in addressing the members discussed various items of interest, including the proposed holding of a meeting each year at one of the branch headquarters; of the four branches in the maritime provinces St. John has already held a largely attended and very successful meeting. This year Halifax expects to entertain, next year very likely Moncton will be the scene of a large gathering and Sydney the following year. He also paid a tribute to our late president, Walter J. Francis, remarking that we could never fully realize the great amount of work he did for *The Institute*.

L. McKendrick of the C.N.R. legal department entertained the gathering with several solos and a reading from Henry Drummond, Professor Wright was accompanist.

London Branch

E. A. Gray, Jr.E.I.C., Secretary-Treasurer.
R. I. Olmsted, A.M.E.I.C., Branch News Editor.

The final spring meeting of the London Branch, at which there was an attendance of about twenty, was held in the Public Utilities Board Room on April 23rd, at which E. V. Buchanan, M.E.I.C., presided.

The speaker of the evening, A. E. K. Bunnell, A.M.E.I.C., explained to the local members London's Street Railway Situation and following his address a lively discussion on various phases of the subject took place.

Ottawa Branch

F. C. C. Lynch, A.M.E.I.C., Secretary-Treasurer.

On his way to attend the British Empire Exhibition at Wembley, Dr. R. C. Wallace, M.A., Ph.D., D.Sc., professor of geology of the University of Manitoba, and president of the Canadian Institute of Mining and Metallurgy, stayed long enough in Ottawa to address the Ottawa Branch of *The Engineering Institute of Canada* at their luncheon held May 1st, at the Chateau Laurier.

His address was followed with the closest attention by one of the largest and most representative gatherings of engineers that have ever assembled under the auspices of the local Institute.

Dr. Charles Camsell, M.E.I.C., deputy minister of mines, was in the chair at the luncheon, which was held under the joint auspices of *The Engineering Institute of Canada* and of the Canadian Institute of Mining and Metallurgy. He was supported by Hon. Charles Stewart, and among the guests at the head table were Hon. R. J. Manion, Hon. C. B. White, Hon. R. Dandurand, Hon. J. L. Côté, A.M.E.I.C., Hon. Andrew Haydon, Robert Forke, M.P., E. A. Lapierre, M.P., J. F. Fafard, M.P., George Black, M.P., and Dr. Morley Wilson.

Dr. Camsell introduced the guest of the day and referred to Dr. Wallace as the spokesman for the whole of Canada in matters that were of vital interest. For the past fifteen years Dr. Wallace had been identified with the mining industry in Canada, and for three years he was Commissioner of Northern Manitoba, during which time he was largely instrumental in bringing the mineral possibilities of the north country before the public.

In expressing his appreciation of Dr. Wallace's address, the Hon. Mr. Stewart said, "I have been profoundly influenced by Dr. Wallace's words. He has given a very valuable hint as to the future means of developing the country. Just now the conservation of the forest lands is attracting, and rightly so, a great deal of attention. Side by side with that I would like to see propaganda for the development of the mineral wealth of the Dominion. I have always been convinced, and since hearing Dr. Wallace, I am the more certain that the whole of Canada, from the coast of Labrador to the Pacific ocean, is teeming with vast mineral wealth that awaits the touch of skilled hands to become one of the greatest assets of our country. The department of mines is turning out the men who will make this possible. Such controversies as that around church union and the tariffs are of secondary importance to this question of the fullest possible development of the natural resources of the Dominion."

In paying a tribute to the sentiments expressed by the minister, J. L. Rannie, M.E.I.C., expressed the hope that members of both Institutes would have, ere long, the opportunity of reading in Hansard something that, during the discussion of the estimates, would reflect the ideas and opinions expressed by Mr. Stewart.

During the luncheon a vocal solo rendered by Mr. Harry Underwood was greatly enjoyed. There was a splendid turnout of members and the function was voted one of the most successful ever held by either of the Institutes.

Calgary Branch

G. P. F. Boese, A.M.E.I.C., Secretary-Treasurer.
W. St. J. Miller, A.M.E.I.C., Branch News Editor.

On April 25th a general meeting, probably the last indoor meeting of the season, was held at which some fifty members were present to listen to papers read by three Juniors of *The Institute*. This was the outcome of an offer made last year by W. J. Dick, M.E.I.C., of a prize of the value of $25.00, for the best paper read by a Junior, with the proviso that at least three members take part in the competition. The following papers were presented:—

Evaporation from reservoirs and open water surfaces by H. J. McLean, Jr.E.I.C.

Preparation of maximum strength concrete by C. M. Moore, Jr.E.I.C.

Seepage and alkali investigations by W. Crook, Jr.E.I.C.

The prize committee appointed to judge the papers consists of B. Russell, A.M.E.I.C., (chairman), D. W. Hays, M.E.I.C., and Lt.-Col. W. S. Fetherstonhaugh, M.E.I.C., who, it is predicted, will have no easy task before them when making the final selection. Owing to Mr. Hays' absence from the city the committee have not been able to meet as a whole, but it is hoped an announcement will be made very shortly, and that the winning paper at least may be published in *The Journal*.

The papers were well illustrated by the aid of wall graphs and blueprints.

Mr. McLean dealt with points of very vital interest to the irrigation engineer in particular, emphasizing the importance and need of re-determining the evaporation co-efficients that are in common use to-day in the Prairie Provinces. Some discussion was evoked following his reference to evaporation pans, particularly as to whether the results obtained could be satisfactorily applied to large water surfaces such as reservoirs. An especially interesting remark was the fact that recorded evaporation in a certain lake was 2½ to 5 times as great as the precipitation during the growing season.

Mr. Moore's paper was instructive to those directly connected with cement and concrete operations and proved very interesting to all present. His efforts were evidently the results of careful personally conducted laboratory tests and experiments.

Important points were brought out in Mr. Crook's paper especially regarding the effects of seepage and alkali on farm lands, and investigations of subsoil conditions. The speaker emphasized the advantages of tile drains over open drains when reclaiming water-logged land, and also referred to the possibility of over-leaching of the soil, thereby carrying away an excessive quantity of the soluble organic matter so necessary as a plant food.

J. H. Ross, A.M.E.I.C., moved a vote of thanks to Mr. Dick, with regrets at his absence, and also to the three speakers of the evening. In his remarks he stated that within his recollection the three papers delivered were the equal of any he had heard at branch meetings. He strongly advocated their publication, and referred to the great amount of work and study that their preparation must have entailed. In seconding the motion C. C. Richards, M.E.I.C., aptly expressed his appreciation of the papers and highly complimented the writers, stating that their efforts were evidently the results of years of experience.

Quebec Branch

Eugène Roy, A.M.E.I.C., Secretary-Treasurer.

At the annual meeting of the Quebec Branch, held on Wednesday April 30th, 1924, the following officers were elected for the coming year:—

Chairman	A. R. Décary, M.E.I.C.
Vice-Chairman	A. B. Normandin, A.M.E.I.C.
Secretary-Treasurer	Eugène Roy, A.M.E.I.C.
Executive	P. Joncas, A.M.E.I.C.
	T. E. Rousseau, A.M.E.I.C.
	S. L. deCarteret, A.M.E.I.C.
	Hector Cimon, A.M.E.I.C.
Ex-Officio	J. E. Gibault., A.M.E.I.C.

Hamilton Branch

H. B. Stuart, A.M.E.I.C., Secretary-Treasurer.

The annual meeting of the branch, with an attendance of sixty, was held in the Royal Connaught hotel at 8 p.m., Thursday, May 15th, 1924, with J. W. Tyrrell, M.E.I.C., in the chair.

The secretary-treasurer read his report, as follows:—

Secretary's Report

During the year seven branch meetings have been held including this annual meeting. All these are reported in the branch news of *The Journal.*

The following are the dates, speakers and attendance:—

	Attendance
Nov. 1—Annual dinner; the late Walter J. Francis; *The Institute*	47
Dec. 14—Mr. Bradley; *Asbestos*	40
Jan. 18—At Brantford; Peter Gillespie; *Engineering in Canada*	70
Feb. 14—G. P. Graham; *Asphalt*	75
Feb. 27—American Waterworks Association, G. W. Fuller	15
Mar. 28—Joint meeting with A.I.E.E.; J. F. Peters; *Klydonograph*	150
May 15—Annual meeting; W. H. Breithaupt; *Grand River*	60

Your executive committee held eight meetings with an average attendance of five out of nine members on the executive.

The following table shows changes of membership during the year:

CLASS	June 1st, 1923	Resigned or Transferred	New Members Joined	Transferred	Total May 31st, 1924
Members (resident)	21	2	–	1	20
(non res.)	—	–	–	4	4
Ass. Members (resident)	57	5	–	1	53
(non res.)	—	–	–	16	16
Juniors (resident)	9	1	3	2	13
(non res.)	–	1	–	2	1
Students (resident)	26	9	–	15	32
(non res.)	—	2	1	19	18
Branch Affiliates	43	11	1	—	33
Total	156	32	5	61	190

We regret to report the death of Cyrus Carroll, M.E.I.C., on December 9th, 1923, of pneumonia, aged 89 years.

Our increase in membership from 156 to 191 is chiefly due to our branch territory being extended to include Wentworth, Norfolk, Brant, Haldimand, Waterloo, Wellington and part of Halton Counties instead of the 25 mile radius from Hamilton. We have taken on no new corporate members and only 3 Juniors and 1 Student. We have however a large migration of Students to Hamilton to take positions in our factories, chiefly the Westinghouse and Steel Co.

A special honour is being done one of our members this month by the conferring of the degree of D.Sc. on H. B. Dwight by McGill University.

Our finances are in excellent shape as shown by the financial statement. Under the revised constitution we get 30 per cent rebate on membership fees instead of 25 per cent. On the other hand our news items produce about 22½ per cent less on account of the smaller type used.

It will be noted that:

Receipts	$424.47
Expenses	266.82
Excess receipts over expenses	157.65
Last year's balance	238.03
Cash in bank	$395.68

The business of the branch has involved the writing of about 150 letters, mailing 250 cards for each meeting, writing up news items, calling and attending executive meetings, depositing funds and drawing 30 cheques.

I might say in closing that we are accummulating a library and I hope the day will come when we will have a place to keep our books. Each year headquarters sends us a bound volume of *The Journal.* I have 1921 to 1923 volumes, I don't know where the others are. We also get reports from the Canadian Engineering Standards Association, the Geodetic Survey of Canada, the Department of Labour and the Research Council. The Ingersoll Rand Company send us their "Compressed Air Magazine" and the H. Mueller Company of Sarnia send us their magazine, the "Bronze Crafter".

The work is full of interest and has great possibilities, which I am sure will be well taken care of by your new secretary.

W. F. McLaren, M.E.I.C.

Financial Statement

Receipts

Brought forward		$238.03
Rebates:—Apr. to Aug.	$ 67.62	
Sept. to Dec.	24.00	
Jan. to Mar.	128.70	
	220.32	
Less discount	.45	219.87
Branch news:—May 1923 to April 1924		$ 41.59
Affiliates fees 1923-24: — 32 at $3.00	96.00	
Less bank discount	.15	
	95.85	
Arrears: — 4 at $3.00	12.00	107.85
Journal subscriptions: — 4 at $2.00		8.00
Annual dinner		39.50
Brantford party		7.66
		$662.50

Expenses

Meetings:—		
Nov. 1—Annual dinner	$ 82.52	
Dec. 14—Bradley	7.16	
Jan. 18—Brantford	19.07	
Feb. 14—G. P. Graham	26.48	
Feb. 27—Water Works Association	11.50	
Mar. 28—Peters, A.I.E.E.	7.26	
May 15—Annual	16.83	
Ballots	10.50	
		181.32
Postage and telegrams		13.25
Journal subscriptions		8.00
Miscellaneous:—		
50 song sheets	1.75	
flowers	10.50	
library hall, Jan. 1923	2.00	14.25
Stenographer		50.00
Balance		395.68
		$662.50

The chairman read the report of the scrutineers, Messrs. Dwight and Dunbar, the following being the new executive:—

Chairman — J. J. Mackay, M.E.I.C.
Vice-Chairman — C. H. Marrs, M.E.I.C.
Secretary-Treasurer — H. B. Stuart, A.M.E.I.C.
Executive Committee — F. P. Adams, A.M.E.I.C., (1 yr.); C. J. Nicholson, A.M.E.I.C., (1 yr.); W. L. McFaul, A.M.E.I.C., (2 yrs.); L. W. Gill, M.E.I.C., (2 yrs.).
Members emeriti — J. W. Tyrrell, M.E.I.C., past chairman; W. F. McLaren, M.E.I.C., past secretary-treasurer.
Ex-officio — R. K. Palmer, M.E.I.C, councillor.

The chairman presented the secretary-treasurer with a Member's badge in appreciation of his three years of service, for which the secretary thanked the members.

The chairman then called upon William H. Breithaupt, M.E.I.C., to address the meeting on "Grand River Conservation and Power Development".

Grand River Conservation and Power Development

Mr. Breithaupt referred to the spring floods on the Grand river which will eventually necessitate some action being taken. Periodically they are very serious as in 1912 and 1913. In addition to protecting life and property by means of storage reservoirs, regulating the flow, there are wonderful possibilities for the development of power by running a waterway to the escarpment above Dundas. A maximum head of 600 feet could be obtained and with a constant flow of 400 c.f.s., 24,000 h.p. could be developed at an estimated cost of $3,000,000 or about $125 per horse power.

Montreal Branch

E. A. Ryan, A.M.E.I.C., Secretary-Treasurer.
W. H. Abbott, A.M.E.I.C., Branch News Editor.

S. J. Fortin, M.E.I.C., addressed the regular weekly meeting of the branch on April 17th, on "Considerations on a Project of Town Planning for the Island of Montreal". The meeting was presided over by O. O. Lefebvre, M.E.I.C., chairman of the branch and was well attended and several members and representatives of adjoining municipalities took part in the discussion following the paper.

A resolution of condolence on the recent death of W. F. Gronau, an honoured Member of *The Institute*, was adopted in silence, on motion of J. T. Farmer, M.E.I.C., seconded by J. L. Busfield, M.E.I.C.

On April 24th, the branch had the privilege of hearing Sir Arthur Currie, G.C.M.G., K.C.B., etc., principal and vice-chancellor of McGill University on "The Engineer in the Nation".

Mechanical Section Meeting

A special meeting of the Mechanical Section of the Montreal Branch to which members of recognized Mechanical Engineering Societies in Montreal were invited was held on Monday, April 28th. John T. Farmer, M.E.I.C., occupied the chair and explained briefly that the object in calling the meeting was to strengthen the mechanical section of the Montreal Branch.

Mr. Farmer said that the meetings of the branch have been of too general a character and that the time had arrived to develop sectional activities. He was not desirous of forming a local section of the American Society of Mechanical Engineers but rather to arrange affiliation of the members of the A.S.M.E., and kindred societies who were residents of the district the whole to form the mechanical section of the Montreal Branch of *The Engineering Institute of Canada* which could be affiliated with the American Society of Mechanical Engineers at a later date. Mr. Farmer thought that resident members of the British societies, the Institute of Mechanical Engineers and others should be taken in on the same basis as Montreal members of the A.S.M.E.

Geo. E. Newill, M.E.I.C., said that if the local section became affiliated with the A.S.M.E. arrangements might be made for a portion of the fees of the Montreal members to be refunded to the Treasurer of the local organization.

Fraser Keith, M.E.I.C., as general secretary of *The Institute* said that the closest co-operation now existed between the E.I.C. and A.S.M.E. By a definite co-ordination of the two bodies members of the E.I.C. would extend to the A.S.M.E. full courtesies of the branch.

Mr. Farmer proposed that a committee of three be appointed to act in conjunction with J. D. Alder, M.E.I.C., chairman, and J. A. McCrory, A.M.E.I.C., vice-chairman, of the Mechanical Section. The following were nominated and elected: G. E. Newill, M.E.I.C., M. Brooks and E. T. Spidy, A.M.E.I.C.

The following resolution moved by F. A. Combe, M.E.I.C., and seconded by A. C. Tagge, M.E.I.C., was carried.

> WHEREAS it is considered desirable by the mechanical section of *The Engineering Institute of Canada* to increase its usefulness and extend its scope,
>
> BE IT RESOLVED by this meeting of the mechanical section of the Montreal Branch of *The Engineering Institute of Canada* (to which has been invited all local members of the A.S.M.E.),
>
> THAT the Council of *The Engineering Institute of Canada* be asked to approve of the suggestion that all members of the A.S.M.E., and all members of other recognized mechanical engineering societies, resident in Montreal district, be affiliated with the present mechanical section as a courtesy to fellow mechanical engineers, without additional expense to them.

H. J. G. McLean, A.M.E.I.C., was appointed secretary of the Mechanical Section of the branch.

Practical Issues in Canadian Progress

Dr. R. C. Wallace, Professor of Geology, University of Manitoba and President of the Canadian Institute of Mining and Metallurgy addressed the branch on May 1st. Dr. Wallace's address was on "Practical Issues in Canadian Progress" and he also touched on the Hudson Bay project. Dr. Wallace considered that a greater degree of understanding between the west and the east would come when the present aparsely populated strip between the two was developed and the mining industry combined with water power developments was the only hope for this district. The west needed industries as the present situation was not healthy, and Winnipeg had reached the limit of its growth as a purely middleman's town. The industrialization of the west would also lead to a better understanding with the east, and the development of the mining regions between central Canada and the Hudson bay would ensure the future prosperity of a United Canada.

In Speaking of the Hudson Bay scheme, Dr. Wallace said that if one looked at a globe of the world one saw that the north of England pointed directly to western Canada through Hudson bay. The building of the line was feasible and there remained only the question of the passage of the straits. All he would say was that in 250 years 750 vessels had entered through the straits and only two had been lost. Dr. Wallace said that it was a national question and not a sectional one, and that the line had to stand or fall on its merits as a grain carrying proposition apart from any mining or natural resources which might be developed owing to its construction.

J. E. Hardman, M.E.I.C., moved a vote of thanks to the speaker and congratulated him on his faith in the Pre-cambrian field which was the subject of divergent views.

After the meeting Dr. Wallace was given the results of the economic investigation into the Hudson's Bay line which forms the subject of a paper in this issue of *The Journal.*

Papers and Meetings Committee

A meeting of this committee under the chairmanship of W. C. Adams, M.E.I.C., was held on May 13th, at the University Club. Reports of the chairmen and vice-chairmen of the different sections of the branch were read and the suggested papers for the forthcoming session considered. A discussion on the resolution of the Mechanical section of the Branch which was passed at the special meeting held on April 28th, took place, and it was thought that full consideration of what it would entail should be given to the plan before it was finally adopted.

An effort will be made next season to have the Montreal Branch connected by wire to another branch and loud speakers installed at each end, in order that the members of both branches could listen to speeches from each end on this occasion. Representative speakers would be obtained and the speeches also broadcasted.

The chairmen of the various sections are requested to send in to the secretary of the Montreal Branch a list of the papers for the next session, together with the names of the authors, the chairman for the meeting and those who will lead the discussion, in order that a programme may be drafted.

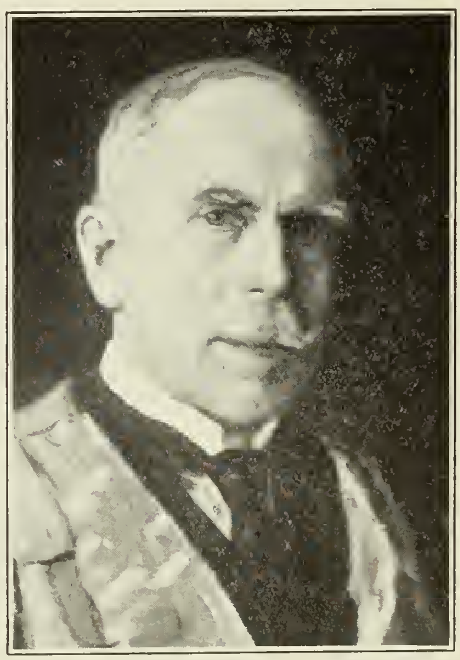
The next meeting of the Papers and Meetings Committee will not be held until August as the progress made in planning the activities for the next session of the Branch has been very satisfactory.

Special Meeting

A special meeting of the Branch was held on May 8th, under the chairmanship of O. O. Lefebvre, M.E.I.C., to discuss the Hudson's Bay Railway and Port Nelson project.

The meeting was very well attended the hall being filled to capacity. In addition to the regular members there were some 56 visitors present and an interesting discussion took place after the papers had been presented.

The speakers of the evening were L. C. Nesham, A.M.E.I.C., on the Physical Aspects of Port Nelson, J. L. Busfield, M.E.I.C., on the Economic Aspects of the Hudson Bay Railway, and H. R. McClelland, M.E.I.C., who dealt with the navigation side of the subject. These papers are published in this issue of *The Journal.*



Doctor FRANK D. ADAMS, Hon. M.E.I.C., who, on the occasion of his retiring from the position of dean of the faculty of applied science and vice-principal of McGill University, was presented with an oil painting of himself and other evidences of the esteem in which he is held.

Niagara Peninsula Branch

R. W. Downie, A.M.E.I.C., Secretary-Treasurer.

The annual meeting of the Niagara Peninsula Branch, held at St. Catharines, on May twentieth, closed one of the most successful years of the branch's history. The results of the election of officers were announced at this meeting as follows:—

Chairman	E. P. Johnson, A.M.E.I.C.
Vice-Chairman	H. L. Bucke, M.E.I.C.
Secretary-Treasurer	R. W. Downie, A.M.E.I.C.
Executive	J. R. Bond, A.M.E.I.C.
	A. W. L. Butler, A.M.E.I.C.
	J. B. McAndrew, A.M.E.I.C.
	T. V. McCarthy, A.M.E.I.C.
Ex-Officio	F. W. Clark, A.M.E.I.C.
	S. R. Frost., A.M.E.I.C.

The financial statement submitted by the secretary-treasurer showed a balance of $143.53 to the credit of the branch. This is slightly in excess of the balance of the previous year, the complete statement is as follows:—

Financial Statement

May 29th, 1923, to May 20th, 1924

Receipts

Balance from May 29th, 1923	$132.89
Affiliate fees	21.00
Rebates on members fees, branch news and advertising *Journal*	310.68
Proceeds of monthly meeting June, Sept. and Oct. 1923, Jan., Feb., 1924	36.05
Proceeds of picnic	27.50
Proceeds of dance	13.02
	$541.14

Disbursements

Printing	$123.53
Stenography	10.87
Postage, telegrams, telephone, express and exchange on check	38.82
Expenses for annual meeting 1923	4.39
Expenses for October meeting	5.00
Expenses for January meeting 1924	12.00
Annual picnic, prizes and gratuities	41.00
Grant to dance committee	55.00
Gratuities at monthly meetings	7.00
Secretary's honorarium	100.00
Balance in bank May 20th, 1924	143.53
	$541.14

We the undersigned have checked the books and accounts of the Niagara Peninsula Branch of *The Engineering Institute of Canada* with the vouchers and found same correct.

S. Bowen, A.M.E.I.C.,
C. W. West, A.M.E.I.C.,
Auditors.

St. John Branch

W. J. Johnston, A.M.E.I.C., Secretary-Treasurer.

Annual Meeting

The members of the St. John Branch believe in mixing pleasure with business and immediately preceding their annual meeting on May 16th, enjoyed a dinner at the Union Club, St. John. Guests at dinner were Mayor F. L. Potts, O. J. Fraser of the New Brunswick Telephone Company, S. E. Elkin of the Maritime Nail Company, S. R. Cann of Philadelphia, and J. H. Byrne, A.M.E.I.C., of Ottawa.

Mayor Potts in a witty after-dinner speech made several humorous references to the recent election in which hydro was one of the issues. The Mayor spoke of his term some years ago as commissioner of public works in the city of St. John and of his contact at that time with some of the members of the St. John Branch.

S. E. Elkin spoke of his interest in the work of engineers and in particular mentioned the work which remained to be done in the conservation of the country's natural resources. Referring to the Maritimes the speaker instanced the past unnecessary waste in timber coal and other raw products, and declared such as remained must be conserved. As one interested in the proposed establishment of a coke plant in St. John, it was hoped this plant would prove a reality, another industry be added to the city, coke and gas be provided for all citizens, and in general a fuller utilization made of all the energy which under present conditions is wasted up the chimney in the burning of coal in St. John.

S. R. Cann spoke briefly on the process of making coke from coal, of the gas and other valuable by-products obtained, and of the prospects for such an industry in St. John. A coke plant would utilize New Brunswick and Nova Scotia coals and its products and in time probably largely displace the local importations of American anthracite. In general the speaker declared the development of some process whereby all the latent resources of coal may be utilized as one of the greatest possible feats of present-day engineering.

O. J. Fraser mentioned his association with several members of the St. John Branch in the employ of the New Brunswick Telephone Company and briefly mentioned the difficulties of the telephone service in catering to the public. The speaker spoke of the pleasure it afforded the New Brunswick Telephone Company in making available the assembly hall in its building for the meetings of the branch.

J. H. Byrne, A.M.E.I.C., as a member of The Institute of the Ottawa Branch, spoke of his recent attendance at the annual meeting of the Ottawa Branch, and by his attendance at the local meeting of the opportunity afforded by membership in *The Engineering Institute of Canada* of meeting engineers throughout the country.

The business meeting followed the dinner at which reports of the executive and various committees were read. The reports showed the activities of the branch during the past year to have been satisfactorily maintained.

Various suggestions were advanced by members present for making the work of the branch of more value to its members. It was the concensus of opinion that Institute members resident in Fredericton and vicinity should receive more benefit from the work of the St. John Branch and the incoming executive were charged to investigate this matter.

A vote of thanks was moved to the New Brunswick Telephone Company for courtesy extended the branch in allowing its assembly hall to be used for branch meetings during the past year.

The election of officers for 1924-25 resulted as follows:—

Chairman	G. G. Hare, M.E.I.C.
Vice-Chairman	C. McN. Steeves, M.E.I.C.
Executive	E. G. Cameron, A.M.E.I.C.
	W. R. Pearce, M.E.I.C.
	F. P. Vaughan, M.E.I.C.
	Geoffrey Stead, M.E.I.C.
	G. N. Hatfield, A.M.E.I.C.
Secretary-Treasurer	W. J. Johnston, A.M.E.I.C.

The new branch officers are Messrs. Hare, Steeves and Stead.

G. N. Hatfield, A.M.E.I.C., the retiring chairman, presided. The toast to the King was observed with musical honours, and to *The Engineering Institute of Canada* was replied to by C. McN. Steeves, M.E.I.C., and G. G. Murdoch, M.E.I.C.

Executive Committee Annual Report

Herewith is submitted the report of the executive for the year ending April 30, 1924.

Eleven meetings of the executive have been held during the year.

Seven regular branch meetings have been held in St. John, also three dinners in St. John, and a meeting in Fredericton. In chronological order the past year's events occurred as follows:—

1923

May 19—Paper by Col. H. C. Boyden on "Concrete Highway Investigations and Specifications".

June 2—Dinner at Royal Hotel in honour of the late W. J. Francis, M.E.I.C., then President of The Institute; U. Valiquet, M.E.I.C., C. R. Coutlee, M.E.I.C., and S. J. Chapleau, M.E.I.C., of Ottawa; H. G. Acres, M.E.I.C., Niagara Falls.

Sept. 26-27—Maritime General Professional Meeting.

Oct. 19—Paper on "Coal Testing and its Significance", by A. F. Blake, Manager, Atlantic Sugar Refinery.

Nov. 22—Paper on "Telephone Transmission", by A. A. Turnbull, Jr.E.I.C.

Dec. 20—Paper on "The Development and Scope of Forest Engineering", by Prof. B. E. Claridge, Ph.B., M.F.

1924

Jan. 17—Paper on "Breakwater Construction at Malta", by J. A. Grant, A.M.E.I.C.

Jan. 30—Dinner at Union Club with the Association of Professional Engineers of the Province of New Brunswick.

Feb. 12—Illustrated lecture "Ice Formation and Prevention", by Dr. Howard T. Barnes, F.R.S., of McGill University.

Mar. 12—Paper on "A Few Electric Transmission Economics and their Relation to Rate Fixation", by Budleigh Faraday, Commercial Manager, N.B. Power Co.

Mar. 27—Joint Meeting with the Engineering Society of the University of New Brunswick at Fredericton. Speakers were: F. A. Bowman, M.E.I.C., vice-president of The Institute, on "The Engineer's Attitude toward Accountancy"; K. H. Smith, M.E.I.C., on "Engineering Education not Taught in Colleges"; J. A. Grant, A.M.E.I.C., "Breakwater Construction at Malta".

Apr. 18—Paper on "Concrete in Sea Water", by A. G. Tapley, A.M.E.I.C.

The branch meetings have been well attended by Institute members and the policy of the Executive in having all branch meetings open to the general public has resulted in a good attendance by the public at the several meetings. A high standard in addresses delivered has been maintained throughout the year.

Outstanding over all events of the past year was the Maritime General Professional Meeting held at St. John, Sept. 26th, and 27th, 1923. At this meeting four papers were read, visits paid to two engineering works, three luncheons and a banquet attended. The total registration was 150. The general committee in charge consisted of F. G. Goodspeed, M.E.I.C., chairman, and Alex. Gray, M.E.I.C., G. G. Hare, M.E.I.C., C. C. Kirby, M.E.I.C., S. R. Weston, A.M.E.I.C., W. R. Pearce, M.E.I.C., F. P. Vaughan, M.E.I.C., G. G. Murdoch, M.E.I.C., and D. L. Hutchinson. For courtesies extended at this time we wish to repeat our appreciation of services rendered by the St. John Drydock and Shipbuilding Company, the New Brunswick Power Company, the New Brunswick Telephone Company, the New Brunswick Contracting and Building Company, the St. John Board of Trade, and the press of St. John.

The following have been officers of the branch for the past year:—

Chairman................H. F. Bennett, A.M.E.I.C.
Vice-Chairman............G. N. Hatfield, A.M.E.I.C.
Members of the Executive..C. C. Kirby, M.E.I.C.,
A. G. Tapley, A.M.E.I.C.,
F. G. Goodspeed, M.E.I.C.,
E. G. Cameron, A.M.E.I.C.,
W. R. Pearce, M.E.I.C.
Secretary-Treasurer.......W. J. Johnston, A.M.E.I.C.

In March H. F. Bennett resigned as chairman owing to removal to Halifax and vacancies were filled as follows:—

Chairman................G. N. Hatfield, A.M.E.I.C.
Vice-Chairman............F. G. Goodspeed, M.E.I.C.
Member of Executive......A. R. Crookshank, M.E.I.C.

The chairmen of the various committees were as follows:—

Papers and Meetings.......G. N. Hatfield, A.M.E.I.C.
Entertainment............W. R. Pearce, M.E.I.C.
Salaries..................C. C. Kirby, M.E.I.C.
Employment..............J. A. W. Waring, A.M.E.I.C.
Publicity.................A. A. Turnbull, Jr.E.I.C.
Civic Building and By-Laws.J. N. Flood, A.M.E.I.C.
Fuel.....................G. G. Hare, M.E.I.C.
Auditors: A. R. Crookshank, M.E.I.C., and J. A. W. Waring, A.M.E.I.C.
Representative on Nominating Committee: S. C. Webb, A.M.E.I.C.

Prior to this year the branch members included all Institute members living within a radius of twenty-five miles of the city of St. John. On the decision of Council at Institute Headquarters to make all Institute members as members of a branch, the St. John Branch district was designated as the counties of Madawaska, Victoria, Carleton, York, Sunbury, Queens, Kings, St. John and Charlotte. This change was effected by Council on July 9, 1923.

It may be pointed out that at Fredericton, within the territory of the St. John Branch district, fourteen members of the Institute reside. There is also located here a university at which engineering courses are given; it is the expressed wish of Council that any branch of The Institute having within its territory a college giving engineering instruction, take an especial interest in the students and work being carried on at such an institution. The visit paid by members of this branch to Fredericton during the past year, when a joint meeting was held with the Engineering Society of the University of New Brunswick, has been an effective means of showing the interest of this branch in the engineering students and has also enabled Institute members residing in Fredericton and vicinity to attend a branch meeting.

The following is the list of members of the branch on April 30, 1924:

Grade	Resident	Branch District	Total
Members	12	10	22
Associate Members	28	11	39
Juniors	11	5	16
Students	8	5	13
Affiliates	2	0	2
	61	31	92
Branch Affiliates	3	0	3
Grand Total			95
Grand total, April 30th, 1923			68
Gain			27

Respectfully submitted,

G. N. HATFIELD, A.M.E.I.C., Chairman.
W. J. JOHNSTON, A.M.E.I.C., Secretary-Treasurer.

EMPLOYMENT BUREAU AND MEMBERS' EXCHANGE

Situation Wanted

Industrial Engineer

Practical shop production engineer, age 36, wishes to connect with live manufacturing concern. Fifteen years Canadian experience in executive positions with machine shop and foundries. Specialty shop cost reduction methods. Apply box No. 147-W.

Situations Vacant

University of Manitoba
Appointment in Civil Engineering

The Board of Governors will proceed shortly to appoint an Assistant Professor of Civil Engineering, having regard especially to his qualifications in Surveying, Geodesy, Railroad Engineering and Hydraulics. Initial salary, $2,800. The successful applicant will be expected to enter upon his duties on or about September 1st, 1924. Letter of application and testimonials should be in the hands of the Board of Governors on or before June 20th, 1924.

THE SECRETARY,
BOARD OF GOVERNORS,
University of Manitoba,
Winnipeg, Canada.

Hydro-Electric Engineer

A well known firm of contractors desire to get in touch with an engineer who has had extensive experience on the design and construction of hydro-electric power plants. Applicant must be capable of taking entire charge of such work. Complete statement of experience must accompany applications. Apply box No. 106-V.

Sales Engineers

There are openings for two recent graduates in a Montreal office to demonstrate gear compounds with a view to joining the sales staff of the Company. Apply box No. 107-V.

Sales Engineers

There are a number of openings with a well known firm supplying mechanical engineering equipment. This firm is prepared to provide the successful applicants with six or eight months training at their shops, and will possibly place these men in their foreign offices for a short time. The complete training will lead to good sales or executive positions. These positions are open to civil, mechanical or mining graduates. Apply box No. 108-V.

Members' Exchange

Technical Periodicals

Subscribers offers for immediate sale sets of technical periodicals, including:—

(1) Engineering News, N.Y. 1883-1918.
(2) Canadian Engineer, Volume 1 to 31 inclusive.
(3) Transactions—American Society of Civil Engineers 1888-1923.
(4) Transactions—Canadian Society of Civil Engineers 1887-1918.
(5) American Water Works Association 1887-1923, part bound.
(6) Van Nostrand's Engineering Magazine, 1881-1886, bound.
(7) Some rare books and reports.
(8) Van Nostrand's Electric Engineering Magazine 1869-1880, bound.
(9) Popular Science Monthly, Nov. 1876—April 1882, bound.
(10) Scientific American, Volumes 15 to 25; 30 to 37; 46 to 59.

Above can be seen at the office of Chipman & Power, Mail Bldg., Toronto, Ont.

The Effect of Storage of Cement

The Structural Materials Research Laboratory of the Lewis Institute of Chicago, have issued the second edition of the report on the effect of storage of cement. In this edition the text has been entirely re-written and the tables revised to include tests for the 2- and 5-year storage periods. No important changes in the original conclusions have been made necessary by the additions of the later tests. The principal conclusions from a preliminary study of the data from an investigation of bin-stored cements are included, as is also a comprehensive bibliography on storage of cement.

OTHER SOCIETIES NEWS

American Society of Mechanical Engineers and American Society for Testing Materials Hold Joint Meeting.

A joint meeting of the American Society of Mechanical Engineers and the American Society for Testing Materials was held at Cleveland on May twenty-ninth, at which a symposium on "The effect of temperature upon the properties of metals" was held. This symposium formed one of the sessions of the American Society of Mechanical Engineers' Spring Meeting which was held at the Cleveland hotel, Cleveland, Ohio, May 26th-29th.

The subject covered by the symposium is one of great importance. The use in central station and power plant installations, in oil refineries and elsewhere, of considerably higher temperatures, and pressures than were prevalent even a few years ago, has emphasized very forcibly the importance of more exact knowledge regarding the behaviour of metals at these elevated temperatures. The properties at very low temperatures also require consideration. The four papers that introduced the symposium are:

Industrial Applications of Metals at Various Temperatures.

Methods of Testing Metals at Various Temperatures and Their Limitations.

Available data on the Properties of Irons and Steels at Various Temperatures.

Available Data on the Properties of Non-Ferrous Metals and Alloys at Various Temperatures.

With the last three papers are given bibliographies that include references to practically all the important tests that have been made.

American Society for Testing Materials

The twenty-seventh annual meeting of the American Society of Testing Materials will be held at the Chalfonte-Haddon Hall, Atlantic City, N.J., from June 24th to 27th inclusive.

The programme provides for parallel sessions to be held practically throughout the meeting, beginning Tuesday afternoon, June twenty-fourth.

The first session will be devoted to a symposium on corrosion-resistant, heat-resistant, and electric-resistance alloys; the second session to coal, timber, rubber and textiles; the third to a continuation of the first session; the fourth to paints, petroleum products, insulating materials and thermometers; the fifth to non-ferrous metals, corrosion and metallography, and the sixth to lime, gypsum and ceramics. Other sessions will deal with steel, road and paving materials and waterproofing, methods of testing and nomenclature, magnetic analysis and fatigue of metals, wrought and cast iron and cast-iron pipe, cement and concrete and reinforced concrete.

Quebec Professional Engineers Annual Meeting

At the annual meeting of the Corporation of Professional Engineers of the Province of Quebec, which was held in Montreal on Wednesday March 27th, the following members of the Provincial Council were elected:—Montreal district, K. B. Thornton, M.E.I.C., Frederick B. Brown, M.E.I.C.; district of Quebec, A. R. Décary, M.E.I.C., A. B. Normandin, A.M.E.I.C.

At the close of the general meeting the new Council held its first meeting, when the following officers were elected for the ensuing year: president, A. R. Décary, M.E.I.C., Quebec; vice-president, K. B. Thornton, M.E.I.C., Montreal; hon. secretary-treasurer, Frederick B. Brown, M.E.I.C., Montreal. The members of Council remaining in office are: J. M. Robertson, M.E.I.C., Lt.-Col. C. N. Monsarrat, M.E.I.C., O. O. Lefebvre, M.E.I.C., A. B. Normandin, A.M.E.I.C., J. E. Gibault, A.M.E.I.C. A. Mailhiot, was re-engaged as registrar of the corporation.

The total membership of the corporation was, at December 31st, 1923, nine hundred and sixty-one.

The treasurer's report which was read by Frederick B. Brown, M.E.I.C., showed an excess of revenue over expenditure for the year 1923, of $3,137.62.

University of Louvain

The March Bulletin published by the Commissioner General of Louvain acknowledges the receipt of fifty-two volumes of the transactions of *The Institute* presented by the Council for the purpose of restoring the University of Louvain.

CORRESPONDENCE

Insulation and Heating Possibilities for Buildings

Editor, *Engineering Journal*, Montreal, Que. Toronto, May 20th, 1924.

Dear Sir:—

Referring to my article "Insulating and Heating Possibilities for Buildings" published in the May Journal, would you be good enough to publish herewith the original list of plates together with the notes attached thereto which were submitted for publication as follows:—

PLATE I — Cabot's "Shocking" Advertisement.

PLATE II — Using puffed gypsum insulation on top of old shingles to make habitable an upper storey apartment abandoned because of the heat in summer.

PLATE III — The application of Balsam-Wool shewn above is typical of a great many insulating materials of the felt or sheet type. The increased comfort in summer must be considered along with the fuel saving factors in determining the added value which such insulation gives to an occupied roof space.

PLATE IV — Celotex is one example of an insulating material with structural value in addition to insulating value. It can be used in place of lath for the direct application of plaster and laboratory tests show that its resistance to racking in a frame building is greater than that of lumber in commercial widths. In the above illustration note that only one thickness of Celotex is used.

PLATE V — In this illustration the manufacturers of Celotex suggest using two layers of their material for roof insulation.

PLATE VI — Removing temporary screeds from poured in place roof Insulex. After filling the screed spaces the roof would require to be finished on top with a commercial waterproof roof covering.

PLATE VII — Pre-casting fireproof Insulex slabs and placing them between furring strips of required thickness for wall insulation.

PLATE VIII — Experiments at University of Toronto with Insulex (puffed gypsum) indicate the possibility of using such an insulating material for roof and floor slabs without any supporting concrete or wood sheathing, thus considerably reducing the dead load (as compared with concrete).

It is just possible that owing to the fact that three of the plates were omitted without my knowledge a wrong impression may have been given as to my attitude regarding the merits of the various insulating materials on the market.

Yours very truly,
JAMES GOVAN, R.A.I.C.

EDITORIAL NOTE—

The plates omitted from Mr. Govan's article were three that would have been difficult to reproduce satisfactorily and there was not sufficient time to secure additional copies. The complete notes mentioned above were not included in full owing to a desire to economize space. It would be unfortunate indeed if any wrong impression were attributed to Mr. Govan's attitude to various insulating materials as his article is absolutely fair and unbiassed and reflects no small credit on the ability of the author who is an authority on the subject.

The Tensile Reinforcement of Concrete Dams

A discussion of an article on the subject by J. B. Macphail, A.M.E.I.C., published in The Engineering Journal, *April 1924, page 200.*

Montreal, May 16th, 1924.

The Editor,
The Engineering Journal.

Dear Sir,

Mr. J. B. Macphail contributed to the April issue of *The Journal*, an interesting article on "The Tensile Reinforcement of Concrete Dams", first drawing attention to a somewhat crude method which has been used in estimating the amount of steel reinforcement needed on the upstream face to enable the dam to resist the effect of large ice pressures. Taking the amount of steel found by the process criticized, Mr. Macphail proceeded to a rational analysis of the structure, neglecting tension on the concrete, and found that the stress in the steel would be 4,030 lbs. per square inch. He then showed how a rational analysis might be made on the basis of given working stresses, the general trend of his conclusions being that less steel might be used with safety, than the amount called for by the method under criticism.

A gravity dam is proportioned by the middle-third rule, so that no tension shall exist on the upstream face. The overturning effect of the water entering cracks under pressure corresponding to the head, is thus avoided. As, however, tension is permitted on the upstream face in the case in question, it occurred to me that it might be of interest to examine the effect of water pressure in the cracks. Such cracks as would be likely to develop at ordinary working stresses would be small, and the questions as to the extent to which water could enter and exert an upward reaction on the front portion of the wall, and as to the possible effect of such water on the reinforcing steel, must remain matters of judgment. Large ice pressures such as those considered would not act for long periods, and this fact alone must influence one's opinion in considering the results of analysis.

Setting aside all such considerations, analysis showed the following results:—

Case (*a*) Concrete cracked, and unable to take any tension. Water pressure corresponding to full head acting over base of wall to the point where compression begins.

Tensile stress in steel	6,270 lbs. per sq. in.
Compression in concrete	185 lbs. per sq. in.

Case (*b*) Concrete uncracked, and able to take tension.

Tensile stress in concrete	48 lbs. per sq. in.
Tensile stress in steel	652 lbs. per sq. in.
Compression in concrete	103 lbs. per sq. in.

Mr. Macphail found that, neglecting the effect of water pressure in the cracks, and assuming that the concrete carries no tension, the tensile stress in the steel was 4,030 lbs. per square inch, and the compressive stress in the concrete 163 lbs. per square inch. The steel stress in Case (*a*) exceeds this by about 50%. Judging by observation of reinforced concrete beams under test, it does not seem likely that this higher stress would produce much cracking, and some tension would then exist on the concrete. The condition would be between cases (*a*) and (*b*). But as construction joints would probably be needed, so that tensile strength in the concrete could not be counted on, Case (*b*) would represent the most unfavourable condition. When there is little or no ice pressure, there would be considerable compression at the water face.

Evidently there are many conditions in such a problem affording room for diversity of opinion, but the extreme cases have been examined and there appears to be ground for criticism. Some might feel that in view of all the conditions the computed stresses are high enough. Mr. Macphail's position, as I understand it from reading his article, is that a structure which can be analyzed by rational methods should be so analyzed. The engineer can use his judgment, when the probable values of the stresses are known. In the case in question, the stress intensity assumed in estimating the amount of steel required, is far in excess of the highest stress which is computed for the worst condition of loading.

In closing may I express my appreciation of Mr. Macphail's interesting article.

Yours truly,

McGill University, Montreal. E. Brown, M.E.I.C.

Investigation of Tidal Power Projects

During recent weeks engineers of some of the Dominion departments have been forced to give serious consideration to certain tidal power projects in the Bay of Fundy. One of these, a purely Canadian project, involves the harnessing of the Fundy tides up near Moncton. The other, and probably the most interesting one, is of an international character and involves the construction of dams in Passamaquoddy bay, near Eastport, Maine. The latter project is understood to be receiving official consideration from the Federal Power Commission in Washington. It will probably have to be investigated internationally and by the International Joint Commission. If tidal power development is a feasible proposition anywhere in the world it should be found attractive where the rise and the fall of sea level has such a high range as in the Bay of Fundy.

East Calgary Oil Refinery

Production at the East Calgary plant of the Imperial Oil Refinery, Ltd., has exceeded all former estimates, having reached and maintained a total of 5,500 barrels a day. The grade of oil produced is the highest of any refining plant in Canada, and surpasses the great majority of large United States refineries. The output is being distributed all over western Canada, while the crude oil is being received from Montana and Wyoming fields. R. L. Dunsmore, A.M.E.I.C., whose election to Associate Membership in *The Institute* has recently been announced, is engineer for the oil refinery.

Engineering Science

By Arthur G. Robson.

Reviewed by Professor C. M. McKergow, M.Sc., M.E.I.C., Professor of Mechanical Engineering, McGill University.

The first ten chapters deal with what is generally known as "Applied Mathematics" which includes the use of vectors, moments, work and power, force and acceleration, transformations of energy, bending and torsion and vibrations. The last chapter deals, in an elementary way, with "Heat Engines".

The book itself is well printed, the type is large and clear, making the book easy and pleasant to read. It has been carefully written and edited. The subject matter is clearly presented and illustrated with descriptive experiments and problems, which together with the exercises at the end of each chapter, covers the subject quite enough for the purpose of the book.

The book should prove a valuable asset for those young men leaving High School, who go into engineering work and hope to rise in their chosen profession through the shops and night schools.

The book is published by Chapman and Hall, Limited.

Montreal Building Code

H. A. Terrault, A.M.E.I.C., chief engineer of Montreal, is chairman of the newly appointed consulting committee to examine into and decide on the definite test of the long-deferred building code for the city of Montreal. The announcement of the appointment of the committee was made on May twenty-second last, and it is expected that the code will come before the city council for adoption during the current year. The committee will be composed of representatives of *The Engineering Institute of Canada*, the Architect's Association, the Proprietor's League, and the Trades and Labour Council.

Timber Research Yields Valuable Information

Within the past year new knowledge regarding the effect of rate of growth on the strength of Canadian woods has been reached at the Forest Products Laboratories of Canada (Dominion Forestry Branch), Montreal.

The fact that rate of growth exercises an important influence on the mechanical properties of timber had been brought to light by previous research. It was known that in softwoods, such as pine and spruce, slowly grown material tended to be stronger than that of very rapid growth and that in the so-called ring-porous hardwoods, such as ash and oak, the reverse was true, slowly grown wood being inferior in strength to that of more rapid growth.

Analysis of the results of many thousands of strength tests, made at the Laboratories, has now enabled the investigators to go a step further and to determine definitely the rates of growth at which maximum strength is developed in a number of the important commercial woods of Canada. This information finds practical application in a large number of uses of wood in which the strength of the material is a primary consideration.

Canada Land and Irrigation Company's Difficulties

It is regrettable that the Canada Land and Irrigation Company has been forced to announce that the supply of water to their irrigation tract in southern Alberta will not be available to farmers. This seems to be the culmination of this corporation's run of bad luck during the last twelve years or so. The reason given for this drastic action is inability to collect the money due on land sale contracts as well as the extremely heavy taxation on the company's property. Sympathy should be extended to those engineers and other employees who have given of their best in the design and construction of this large irrigation project. Misfortune crowded on the company in the early days, and now financial stringency is responsible for this unfortunate climax.

Arrangements have, however, now been effected whereby the Dominion government is to lend assistance to the farmers, and sufficient money will be forthcoming to enable necessary repairs to be carried out at once and main canal to be cleared. D. W. Hays, M.E.I.C., has been the intermedium between the farmers concerned and the officials at Ottawa, he having spent some time in the capital on this account.

Preliminary Notice

of Applications for Admission and for Transfer

May 20th, 1924.

The By-laws now provide that the Council of the Institute shall approve, classify and elect candidates to membership and transfer from one grade of membership to a higher.

It is also provided that there shall be issued to all corporate members a list of the new applicants for admission and for transfer, containing a concise statement of the record of each applicant and the names of his references.

In order that the Council may determine justly the eligibility of each candidate, every member is asked to read carefully the list submitted herewith and to report promptly to the Secretary any facts which may affect the classification and election of any of the candidates. In cases where the professional career of an applicant is known to any member, such member is specially invited to make a definite recommendation as to the proper classification of the candidate.*

If to your knowledge facts exist which are derogatory to the personal reputation of any applicant, should be promptly communicated.

Communications relating to applicants are considered by the Council as strictly confidential.

The Council will consider the applications herein described in June, 1924.

FRASER S. KEITH, Secretary.

*The professional requirements are as follows:—

Member shall be at least thirty-five years of age, and shall have been engaged in some branch of engineering for at least twelve years, which period may include apprenticeship or pupilage in a qualified engineer's office, or a term of instruction in a school of engineering recognized by the council. The term of twelve years may, at the discretion of the council, be reduced to ten years in the case of a candidate for election who has graduated from a school of engineering recognized by the council. In every case the candidate shall have held a position in which he had responsible charge for at least five years as an engineer qualified to design, direct or report on engineering projects. The occupancy of a chair as a professor in a faculty of applied science or engineering, after the candidate has attained the age of thirty years, shall be considered as responsible charge.

An Associate Member shall be at least twenty-seven years of age, and shall have been engaged in some branch of engineering for at least six years, which period may include apprenticeship or pupilage in a qualified engineer's office or a term of instruction in a school of engineering recognized by the council. In every case a candidate for election shall have held a position of professional responsibility, in charge of work as principal or assistant, for at least two years. The occupancy of a chair as an assistant professor or associate professor in a faculty of applied science of engineering, after the candidate has attained the age of twenty-seven years, shall be considered as professional responsibility.

Every candidate who has not graduated from a school of engineering recognized by the council, shall be required to pass an examination before a board of examiners appointed by the council. The candidate shall be examined on the theory and practice of engineering with special reference to the branch of engineering in which he has been engaged. This examination may be waived at the discretion of the council if the candidate has held a position of professional responsibility for five or more years.

A Junior shall be at least twenty-one years of age, and shall have been engaged in some branch of engineering for at least four years. This period may be reduced to one year, at the discretion of the council, if the candidate for election has graduated from a school of engineering recognized by the council. He shall not remain in the class of Junior after he has attained the age of thirty-three years.

Every candidate who has not graduated from a school of engineering recognized by the council, or has not passed the examinations of the first year in such a course, shall be required to pass an examination in the following subjects: geography, history (that of Canada in particular), arithmetic, geometry, euclid (books I, IV and VI), trigonometry, algebra up to and including quadratic equations.

A Student shall be at least seventeen years of age, and shall present a certificate of having passed successfully an examination equivalent to the final examination of a high school or the matriculation of an arts or science course. He shall either be pursuing a course of instruction in a school of engineering recognized by the council, in which case he shall not remain in the class of student for more than two years after graduation; or he shall be receiving a practical training in the profession, in which case he shall pass an examination equal to that prescribed for admission to the grade of Junior in the foregoing section and he shall not remain in the class of Student after he has attained the age of twenty-seven years.

An Affiliate shall be one who is not an engineer by profession but whose pursuits, scientific attainments or practical experience, qualify him to co-operate with engineers in the advancement of professional knowledge.

The fact that candidates give the names of certain members as references does not necessarily mean that their applications are endorsed by such members.

FOR ADMISSION

CHISHOLM—DONALD CAMERON, of Fort William, Ont. Born at Scotland, April 1st, 1882; Educ., B.A.Sc., Univ. of Toronto, 1911; 1905, on location with C.N.R.; 1906-11, rodman, transitman, mtce of way dept., C.P.R. during summer months; 1912 to date, division engineer, C.P.R., with headquarters at Fort William, in charge of constrn. and mtce of tracks, bridges, bldgs., and wharves, reporting to Mr. J. C. Holden, district engr., Winnipeg.

References: J. M. R. Fairbairn, F. Lee, A. C. Mackenzie, J. C. Holden, W. T. Moodie,

COUTURE—ALEX., of 93 St. Peter Street, Quebec, Que. Born at Quebec, July 22nd, 1886; Educ., civil engr. and mining engr., 1910; 1905-08 (summers), T. C. Rly.; 1909 (3 mos.), instr'man. with Mr. Fafard, surveyor,running township lines; 1910, concrete inspr., north pier, Quebec bridge; 1911-12, res. engr., at Murray Bay, Quebec and Saguenay Rly.; 1912-13, res. engr. at Roberval, C.N.R.; 1915-17, asst. chief engr. of sewers, city of Montreal; 1918-22, mech. engr. with Chrs. Page Perin & Stewart Marshall, consltg. engrs., New York; 1917-18, with the Seamless Tube Co., Beaver Falls, Pa., for the Babcocks & Wilcox Co. of Barberton, Ohio; At present consulting civil and mining engr., Quebec, Que.

References: A. R. Decary, H. Cimon, J. P. P. Joncas, T. E. Rousseau, A. B. Normandin, F. X. Ahern.

JONES—MORRIS HERBERT, of 296 Argyle Street, Port Arthur, Ont. Born at Barry, Glamorganshire, Wales, May 24th, 1890; Educ., Full diploma in mech. engrg., Technical College of Cardiff, Wales; 1905-11, ap'ticeship, Barry Rly. & Docks Co., Barry, Wales (locomotive, hydraulic, power plant and marine works; 1911-13, dftsman. with above company; 1913-14, designer, Canadian Car & Foundry Co., arrangements and details of new car bldg. and power plant at Fort William, Ont.; 1914-15, asst. engr. on constrn. of foregoing plant, Fort William; 1915-16, chief dftsman and supt. of constrn. and plant mtce., Swansea National Shell Factory, Swansea, Wales; 1916-17, chief designer, South Wales branch of Tennent & Barrs, consltg. engrs. London, Newcastle & Cardiff; 1917-18, asst. master mechanic and master mechanic, Fort William plant of Canadian Car and Foundry Co. Ltd.; 1918-20, designer, Port Arthur Shipbldg. Co. Ltd., Port Arthur, Ont. (boiler and marine engine works); 1920 to date, asst. engr., pulp and paper machinery dept. of foregoing company—development and design of pulp and paper machinery.

References: A. G. Jeffreys, H. M. Lewis, M. W. Turner, W. H. Souba, J. C. Meader.

NUTTALL—ALBERT, of 146 Hickson Avenue, St. Lambert, Que. Born at Bury, Lancashire, England, Oct. 25th, 1864; Educ., private tuition. Cert., Science and Arts Dept., and City and Guilds of London in mech. drawing, geometry and constrn.; Sanitary Institute, certificate in sanitation. Assoc. Member, Sanitary Institute,London;1year, machine shop; 1 year, drawing, office; 5 years, gen. constrn.; 1889-94, contractors asst. and engr. and instrument work on highway bridge constrn. and on Tragowel Plains irrigation works; Victoria, Australia; 1895, engr. in charge on design and constrn. of cable conveyors, W. J. Stansfield Co., Southport and Manchester; 1895-96, supt. constrn. and instrument work on Gigantic Wheel, Blackpool, England; 1896-97, same work on constrn. of Riesen Rad, Vienna, Austria, and 1898, the same work on constrn. of La Grande Roue de Paris, France, Walter B. Bassett Co.; 1899-1900, res. engr., La Grande Roue de Paris; 1901-02, res. engr., Brighton & Rottingdean Shore Rly., Brighton, England; 1903-05, contractors engr. in charge of constrn. of Widnes and Runcorn Transporter Bridge, England; 1907-21, constrn. supt. on all kinds of bridges, also gen. steel constrn. for Structural Steel Co.,Montreal, Cleveland Bridge Company, Montreal, and Canadian Allis-Chalmers Company, Toronto; 1922-23, res. engr. on extensions to Can. Gen. Elec. plant, Peterborough; At present, asst. engr., City of St. Lambert.

References: J. L. Brower, W. C. Thomson, H. W. Fairlie, G. Sproule, W. G. H. Cam, S. R. Turner, J. A. G. Goulet, J. Stadler, C. R. Lindsey, D. M. Chadwick.

SHECTOR—SIDNEY SAMUEL, of 237 Edward Charles Street, Montrea l,Que. Born at Montreal, July 22nd, 1886; Educ., B.Sc. Univ. of Wisconsin, 1912; 1913, with American Bridge Company on erection of approach to munic. bridge, St. Louis, Mo.; 1914-16, with E. G. M. Cape, asst. to supt. on constrn. of Emp. Wire and Cable Bldg.; 1916-17, dfting, John S. Metcalfe Co.; 1917-18, in charge of constrn., mill at Chambly Canton, for T. Pringle & Son, Ltd.; 1918-19, res. engr. and later supt. in full charge of various works for the Foundation Co. Ltd.; 1919-20, engr. supt. in full charge of works for Raymond Concrete Pile Co.; 1921 to date, engr. supt. in full charge of constrn. of elevators for John S. Metcalfe Co. Ltd., Montreal.

References: H. Rolph, F. W. Cowie, G. M. Wynn, E. G. M. Cape, A. F. Byers.

SWINNERTON—AYLMER ABERFFRAW, of Ottawa, Ont. Born at Hyderabad, India, Oct. 13th, 1893; Educ., B.A.Sc. (Chem. Engrg.), Univ. of Toronto, 1919; 1913-14, rodman, baseline party, D.L.S., Manitoba; 1914 (summer), shopwork, Abitibi Pulp & Paper Co.; 1915-17, overseas; Dec. 1917 to armistice, chemist with British Acetones, Toronto; May 1919, appointed asst. chemist, Dept. of Mines, for oil shale investigations, promoted to chemist in charge oil shale investigations, April 1921, occupying this position at the present time.

References: J. McLeish, B. F. Haanel, G. H. Herriott, E. Stansfield, J. R. Cockburn, T. R. Loudon.

THORNTON—MAJOR GENERAL SIR HENRY WORTH, K.B.E., B.Sc., D.Sc., M. Inst. C.E., Order Leopold of Belgium, Am.D.S.M., Comm. Legion of Honour, of Montreal, Que. Born at Logansport, Indiana, U.S.A., Nov. 6th, 1871; Educ., B.-Sc., Univ. of Pennsylvania, 1894; Dec. 1894, entered service of Penn. R.R. as dftsman in chief engr's. office. Held successively position of asst. engr. of constrn. of the Marietta Divn., Penn. Rd., topog'r. on various surveys, asst. engr. on engr. corps, divn. engr., divn. supt.; 1911, gen. supt., Long Island Railroad; April 1914, called to England as gen. mgr. of the Great Eastern Railway; 1916, deputy director of Inland Water Transportation, with rank of Colonel in the Royal Engrs.; 1917, sent to Paris as asst. director general of movements of the rlys. and in that capacity represented the Director and the Army Council in all negotiations with the French, Italian and American Govts. relating to transportation; Dec. 1917, deputy director general of the movements of the rlys. with rank of Brig.-Gen.; 1918, inspr. general of transportation with rank of Major General. In this capacity had charge of all army transportations on the continent. At present, chairman and president, Canadian National Railways.

References: R. A. C. Henry, C. B. Brown, F. L. C. Bond, F. S. Keith, M. H. Macleod.

FOR TRANSFER FROM CLASS OF ASSOCIATE MEMBER TO THAT OF MEMBER

FISK—HAROLD SELBIN, of St. Adele en Haut, Que. Born at Evesham, Worcestershire, England, July 12th, 1885; Educ., Grammar School and Kings College, London; four years pupil with Baily Grundy and Barrett, elec. and mech. engrs., Cambridge, England; junior elec'l. engr. with Baily Grundy and Barrett; During 1906-07, representing above in east of England for the Electric Construction Company of Wolverhampton, England; 1907-10, with the Shawinigan Water & Power Co. as follows: operator, Montreal terminal station, asst. in chief engr's office, Montreal, constrn. office, Shawinigan Falls; 1910-12, with Mines Power Co. (Now Northern Ontario Light & Power Co.) at Cobalt, Ont. as asst. to gen. supt., Jas. Ruddick, and later supt., generating station at Matabitchouan River development, Constrn. and operating; 1912-13, Shawinigan Water & Power Co. Shawinigan Falls, asst. to elec'l. constrn. supt. Webster and mech. engr. in charge of installation of equipment in No. 2 gatehouse; 1914-16, Kaministiquia Power Co. Ltd., Fort William, Ont. engr. in charge of elec'l. equipment and later asst. to mgr. during publicity campaign to attract industries to the head of the lakes; 1916-21. plant supt. and later divn. supt. with headquarters at Drummondville for Southern Canada Power Co., Montreal; 1921-23, gen. mgr., Walsh Plant and Structural Works, Drummondville, Que.; 1923 to date, managing-director, The Laurentian Hydro-Electric Limited, of Montreal, Que.

References: C. L. Hervey, J. M. Robertson, C. J. Desbaillets, J. Ruddick, F. W. Teele, A. R. Henry, W. Maclachlan, F. T. Kaelin.

MIEVILLE—ARTHUR LEONARD, of Southport, Lancashire, England. Born at Hampstead, London, England, Oct. 31st, 1879; Educ., science and engrn., London University; Experience before the war: 2½ years, shops, millwrighting and paper-making machy., H. Allnutt & Son, Maidstone and Masson Scott & Co., London; 6 mos. shops, 2½ years design, marine engines and boiler fittings, J. S. White & Co., Cowes (Admiralty and Marine work); 1 year, design, steam engines, turbine pumps, etc., W. H. Allen Son & Co., Bedford; 1 year, design, large water turbines, I. P. Morris Co. (Cramps), U.S.A.; 6 mos. telephone survey, Manitoba govt.; 1 year, rly. survey, C.P.R. constrn.; 6 mos. design, structural steel, Manitoba Bridge Co., Winnipeg; 1 year, asst. engr., Winnipeg Hydro Development; 3 years, engr. for Canada, techl. and sales, W. H. Allen Son & Co.; 1 year, associate, Kerry & Chace Ltd., Toronto; 1914-19, overseas, Can. Engrs. Lieut.-Col., D.S.O., M.C.; 1919-20, asst. controller and later deputy, Disposal Board Ministry of Munitions, (Commercial Administration); 1920 to date, gen. mgr., R. Morris & Co., Bolton, Lancashire (Commercial and Technical Administration), and recently appointed as from July 1st, 1924, gen. mgr., Howden-Ljungstrom Preheaters (Land) Ltd., Govan, Scotland.

References: J. G. G. Kerry, W. G. Chace, A. L. Mudge, J. G. Glassco, W. M. Scott, C. W. Allen, R. J. Durley, T. R. Loudon.

RUSSELL-BENJAMIN, of Calgary, Alta. Born at Dartmouth, N.S., April 14th, 1884; Educ., B.Sc. McGill Univ. 1909; Three years, rly. location and constrn., levelman and transitman; (two years Halifax & South Western Rly.; six months, Pincher Creek, Cardston & Montana Rly.; six months Alberta Central Rly.) three mos. rly. mtce. C. P. R. Cranbrook, B.C.); one year hydrographic surveys and breakwater constrn., Dom. Public Works Dept.; one and a half years, municipal work, Glace Bay, C. B., Lethbridge, Alta.; six mos. D.L.S. sub-division work; 1911-12, in charge of survey party, location of irrigation canals and water supply pipe lines; 1913 to date, in responsible charge as chief field inspector and hydraulic engr. of irrigation surveys, design and cost estimates of irrigation projects, Water Power and Reclamation Service, Dept. of the Interior, Calgary.

References: J. S. Tempest, P. J. Jennings, S. G. Porter, V. M. Meek, G. N. Houston, D. W. Hays, C. E. W. Dodwell, W. P. Morrison.

FOR TRANSFER FROM CLASS OF JUNIOR TO HIGHER GRADE

PERRY—LEWIS ALAN, of Longview, Washington, U.S.A. Born at Fort William, Ont. Nov. 20th, 1893; Educ., private study. I.C.S. Canadian Khaki College; 1909-(Feb.-Aug.), rodman, insprn., etc., rly. surveys and constrn., G.T.P. Rly.; 1909-11, elec'l. apprentice; 1911-14, rodman, instr'man., dftsman., acting res.engr. constrn., location and mtce. of way on various rlys. in Ontario; 1914-19, overseas. Cpl. M.M. 1916-18, mil. engrg. with Royal Engrs.; 1919-20, instr'man. and dftsman., rly. constrn. at Firdale, Man. for G.T.P. Rly.; 1920-21, asst. engr., valuation work, Oregan-Washington R.R. and Navigation Co.; May 1921 to date, asst. engr., The Long-Bell Lumber Company, Longview, Wash.

References: E. F. Considine, G. C. Dunn, J. A. Heaman, H. B. R. Craig, G. Murray, C. H. Ellison.

FOR TRANSFER FROM CLASS OF STUDENT TO HIGHER GRADE

DICKSON—WILLIAM LOCHEAD, of 76 Pinewood Avenue, Toronto, Ont. Born at Toronto, Ont. May 18th, 1888; Educ., B.A.Sc. (Honours), Univ. of Toronto, 1915; 1907-11, rodman, topog'r., instr'man., D.L.S. work two years, C.N.R. two years; 1912-13 (summer), instr'man., with O.L.S.; 1914 (summer), dftsman., roadways dept., Toronto; 1915-17, chief examiner, for Canadian Inspection Co. and 1917-18, for Imperial Ministry of Munitions, on component parts, relative to manufacture of 18" shrapnel shells; 1918-19, chief examiner in charge of detail inspection of machine parts, relative to manufacture of Arab 1-A Sunbeam areo engine, for Aeronautical Inspection Directorate of Imperial Ministry of Munitions at Willys-Overland, Toronto; 1919-20, topog'r., rly. dept., H.E.P.C.; 1920-22, engr., rly. dept., H.E.P.C.; 1923 to date, demonstrator in engineering drawing, University of Toronto, Toronto, Ont.

References: P. Gillespie, C. R. Young, J. R. Cockburn, A. G. Young, T. U. Fairlie.

MACDONALD—JOHN ANGUS, of Ottawa, Ont. Born at Sherbrooke, N.S. April 24th, 1892; Educ., B.Sc. (Civil), N.S. Tech. College, 1920; 1909-12 (summers), work in tinsmithing and machine shops; 1913 (summer), recorder on plane table party, Geol. Survey of Can.; 1914 (summer), in charge of plane table party, and 1915(summer), first asst. in charge of a separate camp, Geol. Survey of Can.; 1915-19, overseas, Lieut. C. G. A.; 1919 (May-Aug.), asst. to supt. of highways in Guysboro, N.S.; 1920-21, with Guggenheim Bros. in Bolivia, S.A. in charge of plane table party; 1921 (Mar.-Aug.), with the Cerro de Pasco Copper Corpn., Peru, S.A. as topog'l. engr.; 1922 (Jan.-Apr.), instructor in surveying, N.S. Tech. College; April 1922 to date, junior topog'l. engr., Geol. Survey of Canada, Ottawa, Ont.

References: W. H. Boyd, E. E. Freeland, F. R. Faulkner, R. L. Nixon, J. W. Roland.

MACKENZIE—WILLIAM LANGLANDS, of St. Catharines, Ont. Born at Ottawa, Ont. Nov. 12th, 1895; Educ., B.Sc., McGill Univ., 1917; 1915-16 (summers), assisted hydro-electric engr., Commission of Conservation, Ottawa; 1916-17 (winters), in charge of tutorial classes in physics, McGill Univ.; 1917-18, employed by divn. engr., G.T.R., Montreal; 1919-20, designer on reinforced concrete and steel, John S. Metcalf & Co., Montreal; 1920-21, designer, Riordon Co. Ltd., Mattawa, Ont.; Jan. 1921 to date, senior dftsman., and from April 1923 to date, asst. engr., Welland Ship Canal, St. Catharines, Ont.

References: A. J. Grant, F. E. Sterns, J. B. McAndrew, A. W. L. Butler, W. Walker, H. Rolph, W. H. Sullivan.

SPOTTON—JOHN GREER, of Guelph, Ont. Born at Harriston, Ont., Feb. 24th, 1900; Educ., B.A.Sc. Univ. of Toronto, 1922; 1917 (one year), shop experience, Harriston Furniture Factory, Harriston, Ont.; four mos. tech. experience during vacation periods with each of Messrs. Gilson Manufacturing Co., Guelph, Canadian Westinghouse Co., Hamilton, H.E.P.C. of Ontario (station mtce.); May 1922 to date, with Hepburn and Spotton, Guelph, Ont., as sales engr. and at present manager.

References: R. W. Angus, J. R. Cockburn, P. Gillespie, C. R. Young, H. S. Nicklin, R. A. McLellan.

STEWART—MALCOLM DAVIDSON, of Chicoutimi West, Que. Born at Montreal, Que. Dec. 4th, 1897; Educ., B.A.Sc. Univ. of Toronto, 1922; 1916-19, overseas; 1920 (summer), dftsman., Toronto Steel Constrn. Co.; 1922-23, purchasing agent and estimator, Bremner Norris & Co. Ltd. In charge of constrn. of warehouse for Dom. Cartridge Co. at Brownsburg, Que. Two months concrete inspr. for McVicar & Heriot, Arch'ts. on New Caron Building, Montreal; At present employed in logging divn.; engrg. dept., Price Bros. & Co. Ltd., Chicoutimi West, Que.

References: G. E. Lamothe, J. H. Norris, D. Bremner, R. S. L. Wilson, P. E. M. Rosenorn.

WEST—THOMAS MACDONALD, of Toronto, Ont. Born at Toronto, Ont., August 27th, 1899; Educ., B.A.Sc. Univ. of Toronto, 1921; Previous to graduation, shop work, mechanical, Polson Iron Works, R.A.F., J. J. Taylor Ltd., Toronto; 1921-22, demonstrator in thermodynamics, Univ. of Toronto; Since April 1922, connected with J. & J. Taylor, Ltd., Toronto, Safe Works. First in Factory. Sept. 1923 given temporary charge of Montreal branch office. Dec. 1923, returned to Toronto and attached to head office staff. Since Sept. 1922, junior member of this firm.

References: R. O. Wynne-Roberts, P. Gillespie, C. R. Young, R. W. Angus, W. J. Smither.

WHITE—HAZEL MARGUERITE, of Regina, Sask. Born at Westville, N.S., July 20th, 1899; Educ., B.A. Dalhousie Univ. 1921, Engrg. course given by Dalhousie—has all required subjects except German for B.Sc. degree; 1918 (4 mos), in machine shop of Canada Car Works, Amherst, N.S.; 1920 (4 mos.), in dfting. room, Robb Engrg. Works, Amherst, N.S.; August 1923 to date, asst. plant engr., Dept. of Telephones, Saskatchewan Govt., Regina, Sask.

References: W. R. Warren, S. R. Parker, H. R. MacKenzie, J. N. DeStein, W. P. Copp, H. B. Sherman, R. N. Blackburn, M. Sinclair.

Recent Addition to the Library

Transactions, Proceedings, etc.

Presented by the Societies.

American Institute of Electrical Engineers, Year Book for 1924.
American Society of Mechanical Engineers, Year Book for 1924.
Institution of Mechanical Engineers, Proceedings, June-December 1923. Volume II.

Reports.

Presented by Scientific and Industrial Research Council, Alberta.

Third Annual Report of the Scientific and Industrial Research Council of Alberta, 1922.

Presented by New Brunswick Electrical Power Commission.

Fourth Annual Report of the New Brunswick Electric Power Commission, for year ending October 31, 1923.

Presented by The Lignite Utilization Board of Canada.

First General Report of the Lignite Utilization Board of Canada, covering operations October 1st, 1918, to January 1st, 1924.

Presented by The Swedish Consul General.

Swedish Ports.

Presented by Geological Survey of Ohio, U.S.A.

Geography of Ohio, by Roderick Peattie, Ph.D., Fourth Series, Bulletin No. 27.
Coal Formation Clays, Fourth Series, Bulletin No. 26.

Presented by The Director of Irrigation, Baghdad, 'Iraq (Mesopotamia).

Administration Report of Irrigation Directorate for 1921-1922.

Presented by Department of the Interior, Bureau of Mines, Washington, D.C.

Metal-Mine Accidents in the United States during calendar year 1922, by Wm. W. Adams. Technical Paper No. 354.
Analyses of samples of delivered coal, collected from July 1, 1915, to January 1, 1922, with a chapter on The tidewater pool classifications, by Ned. H. Snyder. Bulletin No. 230.
An investigation of powdered coal as fuel for powerplant boilers, by Henry Kreisinger, John Blizard, C. E. Augustine and B. J. Cross. Bulletin No. 223.
Analytical methods for certain metals, including cerium, thorium, molybdenum, tungsten, radium, uranium, vanadium, titanium and zirconium, by R. B. Moore and S. C. Lind, J. W. Marden, J. P. Bonardi, C. W. Davis and J. E. Conley. Bulletin No. 212.

Presented by Department of the Interior, U. S. Geological Survey.

Summary of Hydrometric data in Washington, 1878-1919, by Glenn L. Parker and Lasley Lee.

Presented by Board of Commissioners of the Port of New Orleans.

Twenty-Seventh Report of the Board of Commissioners of the Port of New Orleans, As of August 31st, 1923.

Technical Books.

Presented by Chapman and Hall, Limited.

Merchant Ship Types, by A. C. Hardy, with a foreword by Professor J. J. Welch.

Engineering Index

This Index is prepared by the American Society of Mechanical Engineers.

In this department will be published from month to month the titles of current engineering papers with the authors and source and a brief extract of the more important. It is designed to give the members of The Institute a survey of all important articles relating to every branch of engineering profession.

PHOTOSTATIC PRINTS

Photostatic copies of the articles listed in this section, or others on engineering subjects, may be obtained from the Engineering Societies Library.

Price of each print (up to 11 by 14 in. size) 25 cents, plus postage. Where possible, two pages, up to 7 by 9 in. size, will be photographed on one print. Larger magazines require a print per page. Bills will be mailed with the prints.

The Library is also prepared to translate articles, to compile lists of references on engineering subjects and render assistance in similar ways. Charges are made, sufficient to cover the cost of this work. Correspondence is invited. Information concerning the charge for any specific service will be given those interested. In asking for information please be definite, so that the investigator may understand clearly what is desired.

The Engineering Societies Library is under the management of the United Engineering Society, which administers it as a public reference library of engineering. It is maintained jointly by the American Society of Civil Engineers; the American Institute of Mining and Metallurgical Engineers; the American Society of Mechanical Engineers and the American Institute of Electrical Engineers. It contains 150,000 volumes on engineering and allied subjects, and receives currently most of the important periodicals in its field.

Orders and correspondence should be addressed to

Harrison W. Craver, Director

Engineering Societies Library,

29 West Thirty-ninth Street. New York, N.Y.

A

AIR COMPRESSORS

IMPURITIES IN INTAKE. Keeping Solid Impurities Out of the Air-Compressor Intake, Wm. V. Fitzgerald. Power, vol. 59, no. 16, Apr. 15, 1924, pp. 599-600, 1 fig. Points out that in analyzing troubles in air-compressor operation, single cause for all is frequently found, namely, impurities in intake air.

PISTON. Chart for Graphic Determination of Main Dimensions and Data of Piston Compressors (Rechentafel zur graphischen Ermittlung der Hauptabmessungen und -daten von Kolbenkompressoren), H. Heinssen. Maschinenbau, vol. 3, no. 11, Mar. 13, 1924, pp. 364-366, 1 fig. Chart for graphic determination of piston strokes and average piston speeds of piston compressors with given suction performance, r.p.m., and cylinder conditions (relation of cylinder diam. to piston stroke).

SEMI-PORTABLE. Semi-Portable Air Compressing and Pumping Sets. Engineering, vol. 117, no. 3040, Apr. 4, 1924, pp. 432-433, 6 figs. Describes self-contained air-compressing unit supplied by Parsons Co., with standard Parsons 3-cylinder engine; and single-cylinder paraffin engine for driving centrifugal pump, whole forming semi-portable pumping unit.

AIR CONDITIONING

THEATERS. Downward-Diffusion Air Conditioning System for a Large Theater. Heat & Vent. Mag., vol. 21, no. 3, Mar. 1924, pp. 57-58, 16 figs. partly on pp. 64-65. How Grauman's Metropolitan Theater, Los Angeles Cal., is heated, humidified and ventilated in winter and cooled in summer.

AIRCRAFT-CONSTRUCTION MATERIALS

FABRICS. Testing Airplane Fabrics, A. Pröll. Nat. Advisory Committee for Aeronautics—Tech. Notes, no. 186, Apr. 1924, 33 pp., 8 figs. Air pressure and tensions in fabric; requirements for fabric; determination of initial tension; interpretation of experiments with stretching frame; curves facilitating calculation of tensions and initial tensions; application of experiments on frames to investigation of wings; calculation for dropped-ball test. Translated from Technische Berichte, vol. 3, no. 7.

AIRPLANE ENGINES

COMPRESSION IGNITION. The Influence of Inlet Air Temperature and Jacket Water Temperature on Initiating Combustion in a High Speed Compression Ignition Engine, R. Matthews and A. W. Gardiner. Nat. Advisory Committee for Aeronautics—Tech. Notes, no. 185, Mar. 1924, 12 pp., 7 figs. Deals with some tests to determine influence on initiating combustion in one-cylinder compression ignition engine of (1) inlet air temperature, and (2) jacket water temperature.

EXISTING, FOR COMMERCIAL AIRPLANES. The Use of Existing Engines on Commercial Planes (L'Utilisation des Moteurs d'Aviation existant sur les appareils civils). Aérophile, vol. 31, nos. 23-24, Dec. 1-15, 1923, pp. 361-365, 4 figs. It is shown that by reducing torque, i. e., mean effective pressure, 10 per cent, life of engine is doubled; it is therefore concluded that existing military engines could be used with profit in commercial planes, provided they are not driven to maximum speeds and torques of which they may be capable. See also abstract in Génie Civil, vol. 84, no. 5, Feb. 2, 1924, p. 119.

STORAGE PREPARATIONS. Comparison Tests of Storage Preparations for Aviation Engine Storage of Less that Six Months, S. A. Christiansen. Air Service Information Circular, vol. 5, no. 451, Mar. 1, 1924, 9 pp., 15 figs. Test to investigate methods and make recommendations.

AIRPLANE PROPELLERS

ADAPTABILITY TO AIRPLANES. A Graphic Method for Determining Adaptability of Propellers to Airplanes (Méthode graphique pour l'adaptation des hélices aux avions), G. Delanghe. Génie Civil, vol. 84, no. 8, Feb. 23, 1924, pp. 185-187, 1 fig. Discusses elements of propellers, and develops method for determining, under given conditions, propeller with which maximum speed can be obtained with given course and altitude.

SLIPSTREAM OBSTRUCTIONS. The Effect of Slipstream Obstructions on Air Propellers, E. P. Lesley and B. M. Woods. Nat. Advisory Committee for Aeronautics—Report, no. 177, 1924, 24 pp., 15 figs. Results of investigation show that combined efficiency of propeller with any obstruction in slipstream is less than that of propeller free and unobstructed.

AIRPLANES

AIRFOILS. Aerodynamic Characteristics of Airfoils. Nat. Advisory Committee for Aeronautics—Report, no. 182, 1924, pp. 145-186, 132 figs. Continuation of reports on airfoil data.

DESIGN. The Construction of Airplanes in France and other Countries (La construction des avions en France et à l'Etranger), P. Grimault. Aéronautique, vol. 5, no. 55, Dec. 1923, pp. 509-516, 11 figs. Policy in France, Great Britain, United States and Germany; commercial planes; high-speed planes; military monoplanes and biplanes; medium and large planes.

FLEXIBLE WINGS. Study of Bird Wings and Flexible Planes (Sur l'étude aérodynamique des ailes d'oiseaux, et des voilures souples), E. Huguenard, A. Magnan and A. Planiol. Académie des Sciences—Comptes Rendus, vol. 178, no. 2, Jan. 7, 1924, pp. 193-196, 2 figs. Describes experimental arrangement used to measure liftdrift ratio, etc., of supple wings. See abstract in Génie Civil, vol. 84, no. 4, Jan. 26, 1924, pp. 91-92, 2 figs.

HIGH-SPEED, DEVELOPMENT OF. The Development of High-Speed Aircraft, R. Mayo. Roy. Aeronautical Soc.—Jl., vol. 28, no. 159, Mar. 1924, pp. 158-182 and (discussion) 183-188, 9 figs. Early development; Gnome engines; French ascendancy and British awakening; British research period; war period; revival of rotary engine; postwar period; beginning of American supremacy; French and British post-war efforts; high-speed seaplanes and flying boats; future prospects; value of speed races.

LONGITUDINAL OSCILLATION. Longitudinal Oscillation of an Airplane, R. Fuchs and L. Hopf. Nat. Advisory Committee for Aeronautics—Tech. Notes, No. 188, Apr. 1924, 45 pp., 10 figs. Problem and method of analysis of longitudinal oscillation. Translated from Technische Berichte, vol. 3, no. 7.

ROLLING MOMENT DUE TO AILERONS. The Induction Factor Used for Computing the Rolling Moment Due to the Ailerons, M. M. Munk. Nat. Advisory Committee for Aeronautics—Tech. Notes, no. 187, Apr. 1924, 5 pp., 1 fig. Induction factor is determined from result of model test, and compared with formula recently developed by author; the two results are found to be in substantial agreement.

ALLOY STEELS

COPPER STEEL. Copper in Modern Steels, G. J. Fertig. Tech. Eng. News, vol. 4, nos. 9 and 10, Mar. and April 1924, pp. 352-353 and 378, and 8-9 and 30, 15 figs. Mar.: Details concerning hardness properties of copper steels. Apr.: Corrosion features of these steels.

ALLOYS

ALUMINUM. *See Aluminum Alloys.*

BEARING METALS. *See Bearing Metals.*

ALUMINUM

CERIUM, INFLUENCE OF. The Influence of Cerium on Aluminum (Der Einfluss des Cers auf Aluminium), K. L. Meissner. Metall u. Erz., vol. 21, no. 3, 1st Feb. issue, 1924, pp. 41-44. Critical discussion of previous investigations, and results of author's own investigations.

ALUMINUM ALLOYS

QUATERNARY. The Aluminum-Rich Mixed-Crystal Range in Quaternary System Aluminum-Magnesium-Silicon-Zinc (Das aluminiumreiche Mischkristallgebiet im Vierstoffsystem Aluminum-Magnesium-Silizium-Zink), W. Sander and K. L. Meissner. Zeit. für Metallkunde, vol. 16, no. 1, Jan. 1924, pp. 12-17, 9 figs. Based on investigations, authors present their views on process of refining in self-refining aluminum alloys and describe refining phenomena observed in certain aluminum alloys.

TREATMENT PROCESS. Investigation of the Z-D Process for Treatment of Light Alloys to Inhibit Corrosion, to Minimize Porosity and to Effect Desired Physical Properties, A. C. Zimmerman and S. Daniels. Air Service information Circular, vol. 5, no. 448, Mar. 1, 1924, 22 pp., 15 figs. Results of investigations show that process prevents corrosion of aluminum and its alloys more effectively and efficiently than any other inorganic coating process, but is not so effective in minimizing porosity as Norton process.

AMMONIA

SYNTHESIS. Manufacture of Synthetic Ammonia at Coke Ovens, E. K. Scott. Gas World, (Coking Section), vol. 80, no. 2067, Mar. 1, 1924, pp. 12-16 and (discussion) 16-17, 6 figs. Methods of fixing atmospheric nitrogen; Haber bomb for 200 atmos.; layout of Claude plant; Claude catalyst bomb; Claude plant at coke ovens; cost figures of Claude plant; uses of ammonia. Paper before Coke Oven Mgrs.' Assn.

ARCHES

Concrete, Rib Design. The Design of Reinforced Concrete Arch Ribs, A. P. Mason. Concrete & Constructional Eng., vol. 19, no. 3, Mar. 1924, pp. 143-150, 5 figs. Describes accurate short-cut method of obtaining a preliminary design.

Thrust, Calculation of. Calculation of Thrust of Arch on its Movable Bearings With or Without Tie Rod (Calcul de la poussée d'un arc sur ses appuis, mobiles avec ou sans tirant), G. Prudon. Génie Civil, vol. 84, no. 9, Mar. 1, 1924, pp. 203-205, 3 figs. Study of influence of instability of bearings on thrust of arch or beam resting upon these bearings, and role of a supplementary stiffening tie rod of bearings.

ARMATURES

Windings. A Contribution to the Theory of Direct Current Armature Winding, H. J. S. Heather. World Power, vol. 1, no. 3, Mar. 1924, pp. 158-163. Author seeks to show that formula for any ordinary winding and criteria as to possible construction can be simply and logically arrived at with help of trigonometrical theorem giving the roots of unity.

AUTOMOBILE ENGINES

Balancing. Practical Methods of Engine-Balancing, L. L. Roberts. Soc. Automotive Engrs.—Jl., vol. 14, no. 4, Apr. 1924, pp. 452-456, 8 figs. Author divides into three major groups units of automobile that require particular attention and treatment to assure smooth-running mechanism and gives details of actual methods employed by Packard Motor Co. to balance parts that constitute each group.

Carburetors. *See Carburetors.*

Cooling Systems. Engine-Cooling Systems and Radiator Operating Characteristics, N. S. Diamant. Soc. Automotive Engrs.—Jl., vol. 14, no. 4, Apr. 1924, pp. 396-406, 14 figs. Quantitative comparison of air, water and oil-cooled cylinders as it relates to subject of heat transfer and temperature drop; comprehensive discussion of radio-condenser type of cooling is given under headings of steam cooling systems and characteristics, cooling capacity of radiators used to condense steam and present state of development; discussion of performance of operating characteristics of radiators from viewpoint of car, truck or tractor designer.

Manifolds, Distribution in. Intake-Manifold Distribution, H. W. Asire. Soc. Automotive Engrs.—Jl., vol. 14, no. 4, Apr. 1924, pp. 387-395, 22 figs. Investigation to determine following questions: (1) how bad is distribution; (2) how do different types of manifold compare; (3) why is liquid distribution in some manifolds poor; (4) how can trouble be corrected.

Radiators, Honey as Anti-Freeze. Honey as Anti-Freeze for Automobile Radiators, T. P. G. Shaw and G. L. Robertson. Can. Chem. & Metallurgy, vol. 8, no. 3, Mar. 1924, pp. 63-64. Discussion from standpoint of viscosity at low temperatures and crystallization-point angles, giving results of experiments.

AUTOMOBILE FUELS

Alcohol-Gasoline Mixtures. Alcohol-Gasoline Mixtures, A. C. Zimmerman. Air Service Information Circular, vol. 5, no. 450, Mar. 1, 1924, 3 pp., 5 figs. Investigation of properties of mixtures of aviation gasoline and 198-proof alcohol which bas been denatured with 1 per cent of aviation gasoline.

AUTOMOBILES

Air Resistance. The Automobile in Air Current (Das Auto im Luftstrom), E. Rumpler. Zeit. für Flugtechnik u. Motorluftschiffahrt, vol. 15, nos. 3-4, Feb. 26, 1924, pp. 22-25, 9 figs. Discusses progress made in recent years in application of airplane theories to automobile design; introduction of streamline automobile developed by author in 1921; results of experiments carried out at Aerodynamic Experimental Station in Göttingen. See also article entitled Air Resistance and High-Speed Automobiles (Luftwiderstand und Schnellkraftwagen), A. Persu, pp. 25-27, 3 figs., discussing future design of streamline automobiles.

Brake-Testing Apparatus. Special Apparatus Tests Rickenbacker Brakes on Assembly Line. Automotive Industries, vol. 50, no. 11, Mar. 13, 1924, pp. 621-623, 2 figs. Rods are adjusted to permanent length which is not altered during road test; equipment involves set of power-operated drums which contact with wheels and elevating mechanism.

Brakes.—Hydraulic Brake Operation. Autocar, vol. 52, no. 1482, Mar. 14, 1924, pp. 465-467, 6 figs. Consideration of a system, remarkable for its simplicity and efficacy, which was first tried over 12 yrs. ago.

New Hydraulic Brake System. Automotive Industries, vol. 50, no. 11, Mar. 13, 1924, p. 615, 1 fig. New 4-wheel hydraulic-brake system worked out by Mattingly Automatic Valve Co. of St. Louis, claimed to possess advantage that if connection to any of four brake cylinders should break or otherwise become seriously defective, remaining three brakes will not be prevented from functioning.

Chassis Lubrication. Chassis Lubrication, F. H. Gleason. Soc. Automotive Engrs.—Jl., vol. 14, no. 4, Apr. 1924, pp. 422-430 and 445, 12 figs. Classification of means generally employed for chassis lubrication; referring to respective characteristics of grease and of oil, those of oil are summarized and preferred; describes centralized oil-lubrication system, composed of central oil reservoir and pump, main-supply line and delivery tubes; advantages of system.

Charcoal-Producer-Gas-Burning. The Burning of Charcoal Producer Gas in Automobile Engines (L'alimentation des moteurs d'automobiles au gaz pauvre), A. Caputo. Technique Moderne, vol. 16, no. 4, Feb. 15, 1924, pp. 116-118, 8 figs. Describes Berliet system of installing charcoal gas producer in rear of car.

Producer-Gas Plants. A Compact Producer Gas Plant. Motor Transport (Lond.), vol. 38, no. 996, Mar. 31, 1924, p. 385, 2 figs. Brief particulars of Berliet-Imbert apparatus with which satisfactory demonstrations have been given before French military and civic authorities; in this case plant was fitted to a 15.9-hp. Berliet touring car; does not use steam in production of gas.

Springs. *See Springs, Automobile.*

Trailers. A Dumping Trailer for Use With a Light Car, G. A. Luers. Am. Blacksmith & Motor Shop, vol. 23, no. 3, Mar. 1924, pp. 19-20, 4 figs. Describes trailer for use with light passenger automobile; capacity approximately 1 cu. yd., which in gravel is about 1,800 lb.

Transmissions. Continuously Variable Transmission Developed in America. Automotive Industries, vol. 50, no. 12, Mar. 20, 1924, pp. 674-675, 2 figs. Weiss invention has driving member in form of hemispherical shell within which is body known as mutor; latter unit is of ring, wheel, or disk form and rotates about its own axis on anti-friction bearing; stops car on hill without use of brakes.

Variable Transmission. Autocar, vol. 52, no. 1485, Apr. 4, 1924, p. 602, 3 figs. Describes device now under test to simplify gear box and back axle of car.

AVIATION

Net-Cost Calculation. The Net Cost of Aerial Transportation. (Le prix de revient des transports aériens), V. Carle. Aéronautique, vol. 6, no. 56, Jan. 1924, pp. 5-12, 8 figs. Method of calculating cost and studying influence of elements of cost, such as depreciation, volume of traffic, speed, etc.

AXLES

Fractures. Axle Fractures and Their Causes (Ueber Achsbrüche und die Erforschung ihrer Ursachen), M. Bermann. Organ für die Fortschritte des Eisenbahnwesens), vol. 78, no. 10, Oct. 15, 1923, pp. 198-202, 1 fig. Deals with fractures in case of uniform and non-uniform steel; fractures caused by steel of unequal chemical composition.

B

BEAMS

Rectangular System. Study of the Continuity in a Rectangular System of Beams and Columns (Etude de la continuité dans un réseau rectangulaire de poutres et de piliers), H. Bordier. Génie Civil, vol. 84, no. 11, Mar. 15, 1924, pp. 248-254, 22 figs. Purpose of study is to show that in a framework of beams and columns, moments on support of loaded trestle can be calculated with the same formulas as those in continuous beams.

T-Beams. Stresses in T-Beams With Compression Steel, J. Rieger. Concrete & Constructional Eng., vol. 19, no. 3, Mar. 1924, pp. 181-187, 5 figs. Describes logarithmic slide rule for calculating reinforced-concrete structures, and explains its use.

BEARING METALS

Hardness. Rate of Cooling Determines Hardness of Alloy. Automotive Industries, vol. 50, no. 13, Mar. 27, 1924, p. 723. Results of researches into structure of ternary bearing-metal alloys by Dr. L. Kaul; it is shown that rate of cooling rather than pouring temperature determines hardness of alloy.

BEARINGS

Paper-Mill Machinery. The Most Efficient Type of Bearing for Paper Machinery, G. H. Spencer. Paper Mill, vol. 48, no. 15, Apr. 12, 1924, pp. 65-66, 68, 70 and 72f, 13 figs. Construction of plain babbitt bearing; functions and operations on paper machines of anti-friction bearing. Paper read at Tech. Assn. Pulp & Paper Industry annual mtg. Apr. 7-10, 1924.

BEARINGS, BALL

Automobile, Manufacture. Making Ball Bearings for Automobiles, H. R. Simonds. Abrasive Industry, vol. 5, no. 4, Apr. 1924, pp. 85-89, 10 figs. Use of angular contact; manufacture of radical bearings at plant of U. S. Ball Bearing Mfg. Co., Chicago, Ill.

Housings. Design of Ball Bearing Closures, T. C. Delaval-Crow. Am. Mach., vol. 60, no. 13, Mar. 27, 1924, pp. 453-457, 39 figs. Description of a variety of ball-bearing housing arrangements to prevent leakage of lubricant and entrance of foreign matter.

Loads. Ball-bearing Loads. Machy. (Lond.), vol. 23, no. 597, Mar. 6, 1924, pp. 738-739, 3 figs. Details of new formula for determining ball-bearing loads in pamphlet issued by Tormo Mfg. Co., London; no actual formula is given, necessary data being supplied by three charts.

BEARINGS THRUST

Pad Type. Thrust Bearings of Pad Construction, F. Johnstone-Taylor. Machy. (N. Y.), vol. 30, no. 8, Apr. 1924, pp. 619-621, 5 figs. Construction of pad thrust collars; pad system applied to thrust washers; thrust washer for vertical shaft; end thrust bearings of pad construction; etc.

BELT DRIVE

Principles. Power Transmission by Belting, J. E. Rhoads. Paper, vol. 33, no. 21, Mar. 13, 1924, pp. 11-12. Some of the principles entering into power transmission by belting.

BLAST FURNACES

Hearth Temperatures. Significance of the Hearth, P. H. Royster, T. L. Joseph and S. P. Kinney. Blast Furnace & Steel Plant, vol. 12, no. 3, Mar. 1924, pp. 154-158, 4 figs. Second series of Bur. of Mines report of data secured from experimental blast furnace, bearing on temperatures attained by slag, metal, and coke, in bottom of furnace.

BOILER EXPLOSIONS

Locomotives. Boiler Explosion Caused by Failure of Crown Sheet. Boiler Maker, vol. 24, no. 3, Mar. 1924, pp. 76-78, 4 figs. Particulars regarding Chicago & North Western locomotive No. 2455 explosion at Belle Plaine, Iowa, July 1923; indicates importance of equipping boilers with water columns to check water level.

BOILERS

Benson High-Pressure. Steam Generation at the Critical Temperature. Chem. & Industry, vol. 43, no. 10, Mar. 7, 1924, pp. 249-250. Describes Benson 3200-lb. pressure boiler.

Crown Stay Angles, Sine Determination. Method of Finding the Sines of the Angles Formed by Crown Stays, E. Hall. Boiler Maker, vol. 24, no. 3, Mar. 1924, pp. 80-81, 1 fig. Shows how sine of each of the different angles which crown stays make with vertical axis of boiler may be found and how to use value so found in formula where term $E \sin a$ is used.

Flue Replacement. Saving Time and Labor on Flue Jobs, C. A. Chincholl. Boiler Maker, vol. 24, no. 3, Mar. 1924, pp. 78-79 and 91-92, 1 fig. Construction and usefulness of three devices necessary wherever boiler flues are replaced in boilers, viz., a flue swaging machine for 2-in. flues, a flue cutter for cutting flues to length and an attachment for an air motor to cut flues in front end.

Excess Air, Effect of. Effect of Excess Air on Flue Temperatures and on Efficiency, A. K. Bak. Power, vol. 59, no. 17, Apr. 22, 1924, pp. 634-636, 8 figs. Variation in air quantity has direct effect upon mass of gas discharged and also gives rise to changes in flue-gas temperature; air quantity thus has important bearing on boiler losses and efficiency. Results of tests made at Connors Creek to establish relation between excess air and stack-gas temperature for particular boiler and setting.

Marine. *See Marine Boilers.*

Testing. Importance of Boiler Plant Test, H. Seymour. Electrician, vol. 92, no. 2392, Mar. 21, 1924, pp 351 and 357. How to conduct a test to find out how well boilers are doing their work.

Water-Circulating Apparatus. Increasing the Efficiency of Boiler Plants (Zur Leistungssteigerung von Dampfkesselanlagen), P. Fessler. Wärme- u. Kälte-Technik, vol. 26, no. 4, Feb. 15, 1924, pp. 23-25, 4 figs. Study of water circulation; it is shown that artificial water circulation through so-called water-circulating apparatus is effective in increasing efficiency of boiler and at same time increasing economy of plant.

BOILERS, WATER-TUBE

Clayton. The Clayton Water-Tube Boiler. Eng. Boiler House Rev., vol. 37, no. 9, Apr. 1924, p. 328, 1 fig. Notes on boiler which is development of Clayton & Shuttelworth, Ltd.; made in two distinct types, straight-tube sectional and curved-tube drum type.

BRAKES

Freight-Train. Hand Brakes on Goods Trains, E. Choquet. Int. Ry. Congress Assn.—Bul., vol. 6, no. 3, Mar. 1924, pp. 220-238, 5 figs. Solution of problem of hand brakes for goods trains which consists in determining, for a train of any composition, weight which must be braked in order that stops may be made from any given speed within a certain distance, gradients of line being taken into consideration.

BRAKING

Regenerative. The Characteristics of a D. C. Series Machine Self-Excited by Rectified Current for Purposes of Regenerative Control, R. D. Archibald. Instn. Elec. Engrs.—Jl., vol. 62, no. 327, Mar. 1924, pp. 233-242, 11 figs. Discusses present position of regenerative control for street cars and describes method of self-exciting field of series motor with low-voltage rectified current transformed from a.c. tappings in armature; calculations for finding conditions of sparkless commutation of rectifier, and tests which corroborate calculations; practical application of device.

BRASS

Extrusion of Rods. The Extrusion and Drawing of Brass Rod. J. Williams. Am. Mach., vol. 66, no. 14, Apr. 3, 1924, pp. 497-498, 3 figs. Process of cold-drawing of brass rods as practised by Bridgeport Brass Co., in production of commercial rods.

Properties, Determination of. Methods of Determining Physical Properties of Brass, A. A. Baldwin. Brass Wld., vol. 20, no. 3, Mar. 1924, pp. 77-79, 9 figs. Physical properties of brass, and tests for each.

BRICK

Porosity Determination. A Simple Brick Porosimeter, E. F. Pressler. Am. Ceramic Soc.—Jl., vol. 7, no. 3, Mar. 1924, pp. 154-159, 1 fig. Describes a brick porosimeter based upon air-expansion principle for determining open pore space, and discusses various considerations of design. Adapted for testing refractory brick. Porosity values obtained by porosimeter and water absorption methods are compared to values calculated from true specific gravity to indicate relative accuracy of methods. (Pub. by permission U. S. Bur. Mines).

BRIDGE DESIGN

Developments and Prospects. Bridge Engineering, Gustav Lindenthal. Eng. News-Rec., vol. 92, no. 16, Apr. 17, 1924, pp. 652-657, 18 figs. Author considers what have been distinctive features in progress of design and construction of bridges in different countries during last 50 years, and prospect for future.

Stresses in Girders. The Interaction in Bridgework of the Deck System on the Main Girders and the Consequent Modification of Stresses Therein, D. H. Remfry. Engineering, vol. 117, no. 3038, Mar. 21, 1924, pp. 380-381. (Abstract.) Paper read before Instn. Civ. Engrs.

BRIDGES, CONCRETE

Development of Design. Development of Reinforced Concrete Bridge Design, A. E. Lindau. Ry. Rev., vol. 74, no. 13, Mar. 29, 1924, pp. 613-617. Historical review showing that invention of reinforced concrete permitted stone and concrete culverts to develop into bridges. Paper read before Am. Concrete Inst.

Design. The Design of Steel and Concrete Bridges, A. C. Hughes. Surveyor & Mun. & County Engr., vol. 65, no. 1678, Mar. 14, 1924, pp. 277-279, 7 figs. Stress calculations.

BRIDGES, HIGHWAY

Concrete. Governor's Bridge at Rosedale, Toronto, F. G. Engholm. Can. Engr., vol. 46, no. 14, Apr. 1, 1924, pp. 389-392, 6 figs. Description of reinforced-concrete bridge recently completed over Belt Line Ravine; construction data; overall length 672 ft., main span 200 ft., width 28 ft. 4 in.; cost about $93,000.

Design. Problems in Highway Bridge Design, E. F. Kelly. Can. Engr., vol. 46, no. 13, Mar. 25, 1924, pp. 374-376. Selection of suitable live loads; need for modern loading specification and uniform practice in design; construction of bridge approaches and floors. Paper read at convention of Am. Road Bldrs.' Assn.

Effect on Local Transit Conditions. The Secondary Effect of Certain Important River Bridges on Local Transit Conditions, J. A. Miller. Am. Soc. Civ. Engrs.—Proc., vol. 50, no. 4, Apr. 1924, pp. 389-400, 6 figs. Study of effect of construction of important vehicular bridges on transit conditions in adjacent communities; consideration of situation created by erection of new Delaware River bridge between Philadelphia and Camden; analysis of traffic movement across East River, N. Y., indicates that existing transportation lines in New Jersey should be extended across new bridge into Philadelphia.

Steel. Specifications for Steel Highway Bridge Superstructure. Am. Soc. Civ. Engrs.—Proc., vol. 50, no. 3, Mar. 1924, pp. 267-290, 6 figs. Final report of special committee on design and construction; deals with loads and streses; details of design; workmanship; full-size eye-bar tests; weighing and shipping; structural steel for bridges; structural nickel steel.

BRIDGES, RAILWAY

Vibrations. The Vibration of Bridges. Ry. Engr., vol. 44, no. 527, Dec. 1923, pp. 462-465. Report by C. W. L. Jones to Indian Ry. Bridge Committee, embodying opinions and experiences of American engineers on impact allowances in railway bridge design.

BRIDGES, SUSPENSION

Concrete Anchorage-Foundations Construction. Constructing Reinforced Concrete Foundations of Delaware River Bridge Anchorages, C. Carswell. Concrete, vol. 24, no. 3, Mar. 1924, pp. 103-110, 16 figs. Details of construction of foundations for anchorages of a two-cable stiffened suspension bridge connecting Philadelphia, Pa., and Camden, N. J. Constructed by means of reinforced-concrete caissons sunk by open dredging to rock 60 to 100 ft. below.

BUILDING CONSTRUCTION

Cost Estimating. Short Cut Methods of Estimating, C. F. Dingham. Contract Rec. & Eng. Rev., vol. 38, no. 14, Apr. 2, 1924, pp. 332-335. How to make preliminary estimates of building costs with a reasonable degree of accuracy.

Metal Lath Reinforcement. Metal Lath in the Construction of Industrial Buildings, E. M. Lurie. Safety Eng., vol. 47, no. 3, Mar. 1924, pp. 124-133, 12 figs. Fire resistive qualities of metal lath in reinforcing cement columns, girders, steel and wooden beams, floor joists, roof trusses, partitions, elevator and stair enclosures.

Wood. Examples of Modern Wood Construction. (Exemples de charpentes modernes en bois), F. Cretin. Génie Civil, vol. 84, no. 11, Mar. 15, 1924, pp. 256-260, 22 figs. Gives examples showing possibilities of permanent or semi-permanent constructions, following usual types, such as straight or parabolic beams, solid-web arches, trussed beams and arches, and triangular systems of large bays.

BUILDING MATERIALS

Hollow Tile. Strength, Absorption and Freezing Resistance of Hollow Building Tile, H. D. Foster. Am. Ceramic Soc.—Jl., vol. 7, no. 3, Mar. 1924, pp. 189-199, 7 figs. Describes test methods and gives summary of compressive strength and absorption determinations of nearly 350 tests of tile selected from 25 representative sources. Preliminary report of resistance to freezing and thawing of tile from 17 representative sources. (Pub. by permission U. S. Bur. Standards).

BUILDINGS

Concrete. Large Concrete Flat Buildings Erected in Thirteen Weeks. Eng. News-Rec., vol. 92, no. 13, Mar. 27, 1924, pp. 531-532, 4 figs. Columns of Emperger type; all members of uniform size; plant and forms; concreting averated two stories daily.

Steel-Frame. Growth of Steel Frame Buildings, H. J. Burt. Eng. News-Rec., vol. 92, no. 16, Apr. 17, 1924, pp. 280-684, 7 figs. Origin and problems of skyscraper.

C

CABLES, ELECTRIC

66-Kv., Installation and Testing. Installation and Testing of 66-Kv. Cable. Elec. World, vol. 83, no. 14, Apr. 5, 1924, pp. 667-669, 6 figs. Two subway circuits laid by Cleveland Co. extend 8¾ mi. across city; detailed description of conductors and method of laying; new joint proves very satisfactory.

Telephone, Balancing of. Trunk Telephone Cables, E. A. Beavis. Electrician, vol. 92, no. 2392, Mar. 21, 1924, pp. 348-350, 6 figs. Method of balancing depending upon systematic reduction of "resultant capacity" differences between wires by means of cross jointing.

CANALS

Lock Chain Fenders. The Panama Canal Lock Chain Fenders, R. Z. Kirkpatrick. Military Engr., vol. 16, no. 85, Jan.-Feb. 1924, pp. 61-62, 3 figs. Description of chain fenders and results of field experiments.

CAR WHEELS

Foundry Practice. Twin Cupolas Melt Wheel Iron, P. Dwyer. Foundry, vol. 52, no. 8, Apr. 15, 1924, pp. 287-293 and 322, 10 figs. Describes new process introduced in Albany plant of Albany Car Wheel Co., consisting in melting iron in twin cupolas, allowing it to collect in central chamber and tapping it therefrom into mixing ladle; to insure continuous operation two pairs of cupolas have been installed.

CARBON MONOXIDE

Detector and Alarm. Notes on a Carbon-Monoxide Detector and Alarm, J. A. Vaughan. S. African Instn. Engrs.—Jl., vol. 22, no. 7, Feb. 1924, pp. 98-103, 2 figs. Describes instrument intended for automatic detection of small traces of CO in atmosphere, so arranged that a bell is caused to ring when small traces, such as one part in two thousand, or even less, are present in atmosphere supplied to instrument.

CARBURETORS

Beach. Beach Carburetor is Constant Vacuum Type. Automotive Industries, vol. 50, no. 12, Mar. 20, 1924, p. 671, 1 fig. Carburetor of variable venturi or constant-vacuum type with wood float located in float chamber concentric with mixing chamber; makes use of float valve consisting of ball of tobin bronze.

Heavy-Oil. The B. M. W. Heavy-Oil Carburetor (Der B. M. W.-Schweröl-Vergaser), B. Katz. Allgemeine Automobil-Zeitung, vol. 25, nos. 7-8 and 9, Feb. 16 and 26, 1924, pp. 28-29 and 31-32, 3 figs. Describes two types of BMW carburetors which have given excellent results when used in trucks, omnibuses and motor boats.

CARS

Dynamometer. Dynamometer Car Used on the Great Western Railway. Ry. Engr., vol. 44, no. 572, Dec. 1923, pp. 466-472, 8 figs. Description of design, equipment and use of car for determining factors in working of locomotives and trains.

New Dynamometer Car, New York Central R. R. Ry. Rev., vol. 74, no. 15, Apr. 12, 1924, pp. 687-691, 6 figs. Special car contains modern devices for recording locomotive performance.

Repairing, Welding and Cutting in. Welding and Cutting in Connection with Car Repairs, H. W. L. Porth, Acetylene Jl., vol. 25, no. 6, Dec. 1923, pp. 286, 288 and 290. Welding of car parts by oxy-acetylene process, and use of cutting torch in car repairing.

Steel, Scrapping. Scrapping Steel Cars by Electric Arc Process, A. M. Candy. Ry. Mech. Engr., vol. 98, no. 4, Apr. 1924, pp. 217-219, 4 figs. Facilities and methods which are applicable where large number of cars are to be handled.

CARS, FREIGHT

Transformer-Transportation. New Transformer Cars for the New York, New Haven & Hartford R. R. Ry. Rev., vol. 74, no. 15, Apr. 12, 1924, pp. 683-685, 2 figs. 70-ton capacity steel underframe transformer cars built by Standard Steel Car Co.; designed to carry load of 150,000 lb. uniformly distributed over length of 24 ft. at center of car.

Truck Frames. Washburn Side Frame for Arch Bar Trucks. Ry. Age, vol. 76, no. 19, Apr. 12, 1924, pp. 937-949, 4 figs. Describes frames of unique design used by Baltimore & Ohio on box and gondola cars.

CARS, PASSENGER

Steel Suburban. Steel Suburban Cars for Missouri Pacific. Ry. Mech. Engr., vol. 98, no. 4, Apr. 1924, pp. 220-222, 7 figs. Unique seating arrangement provides for 117 passengers with weight of 1000 lb. each.

Ventilation. Ventilation and Heating of Railway Passenger Cars, K. F. Nystrom. Can. Ry. Club— Proc., vol. 23, no. 2, Feb. 1924, pp. 24-62 and (discussion) 62-75, 13 figs. Influence of occupants on temperature and humidity; CO_2 content in relation to ventilation; mechanical refinements required for ideal ventilation; factors essential to economical and efficient ventilation; ventilating systems now in use. Heat losses; heat requirements; radiation surface and fuel required for heating.

CARS, TANK

Development and Manufacture. Modern Tank Car is Industry's Bucket that Goes to the Well, A. S. Taylor. Compressed Air Mag., vol. 29, no. 3, Mar. 1924, pp. 813-818, 15 figs. Notes on origin, development, and manufacture.

CASE-HARDENING

Case-Depth Measurement. What Is Case Depth, S. P. Rockwell and F. Downes. Am. Soc. Steel Treating, vol. 5, no. 3, Mar. 1924, pp. 285-295 and (discussion) 295-301, 4 figs. Shows variations which are normally obtained by various methods of measuring carburized case depths, using five standard steels under two different lengths of time, handled according to good hardening shop practice; shows necessity for more accurate specifications as regards case depth.

CAST IRON

DECOMPOSITION BY ACID. Acid Decomposes Cast Iron. Foundry, vol. 52, no. 5, Mar. 15, 1924, pp. 231-232, 3 figs. Chemical and physical peculiarities noted in casting which has been subjected to corrosive influence of dilute sulphuric solution covering long period.

GRAY, GROWTH OF. Studies Growth of Gray Iron, T. E. Hull, Foundry, vol. 52, no. 7, Apr. 1, 1924, pp. 253-254. Experimental work of Moissan with graphite reviewed and theory for growth of cast iron under repeated heating and cooling is evolved; graphite in iron, absorbs gases.

HEAT-TREATMENT EXPERIMENTS. Some Experiments on Cast Iron, J. W. Donaldson. West of Scotland Iron & Steel Inst.—Jl., vol. 31, part 4, Jan. 1924, pp. 54-57 and (discussion) 58-62, 1 fig. Experiments carried out with view to determining what effect low-temperature heat treatment had on good cylinder iron and on irons of similar composition containing small additions of various elements.

TESTS. Physical Tests for Cast Iron, J. Shaw. Foundry Trade Jl., vol. 29, nos. 396 and 397, Mar. 20 and 27, 1924, pp. 226-227 and 262-263, 2 figs. Discusses tests made; present-day specifications; new railway specifications; American conditions; comments on tensile testing; chemical analysis.

CASTING

LEAD ALLOYS. Casting Lead Alloys in Endless Strips. Machy. (N. Y.), vol. 30, no. 8, Apr. 1924, pp. 610-612, 2 figs. Method used by Hazelett Storage Battery Co., Cleveland, Ohio, in manufacture of grids for storage batteries that is applicable in other fields of industry.

CASTINGS

EFFICIENT DESIGN. Efficient Casting Design, F. C. Edwards. Engineering, vol. 117, no. 3040, Apr. 4, 1924, p. 423. Points out that to be really efficient, casting design should tend to reduce operation of molding to its simplest possible terms consistent with ultimate purpose of casting.

PRODUCTION. Some Necessary Adjustments between the Foundry and Drawing Office, E. Ronceray. Foundry Trade Jl., vol. 29, no. 393, Feb. 28, 1924, pp. 180-183 (discussion) 183-184, 11 figs. Discusses points for common interest of both foundryman and engineer; requirements of engineer, internal strains in castings, real object of making castings without feeding heads, defects, strength of cast iron, etc.

CEMENTATION

STUDY OF. Introduction to the Study of Metallic Cementation (Introduction à l'étude de la cimentation métallique), M. H. Weiss. Revue de Métallurgie, vol. 21, no. 1, Jan. 1924, pp. 18-41, 63 figs. Principal apparatus employed; Qualitative study of phenomenon; metal couples which are very slightly miscible in solid state; metal couples forming solid solutions in all proportions. Quantitative study: Influence of temperature; development of phenomena in function of time.

CENTRAL STATIONS

DEVON STATION, CONN. Devon Station Marks Forward Step in Development of New England Superpower. Elec. World, vol. 83, no. 12, Mar. 22, 1924, pp. 562-570, 12 figs. New base-load, high-tension plant of Conn. Light & Power Co. designed for 200,000-kva. rating; mechanical and electrical features.

DISPATCHING BOARD. System Operating and Dispatching Board, A. P. Broadhead. Elec. World, vol. 83, no. 13, Mar. 29, 1924, pp. 627-628, 1 fig. Control board used by N. Y. State Gas & Elec. Corp. to aid dispatchers in checking operations on entire system, and also to give at all times indication of condition of equipment.

MOTOR-TRUCK TRANSPORTATION. "Gas" Trucks in Central-Station Service. Elec. World, vol. 83, no. 15, Apr. 12, 1924, pp. 721-724, 5 figs. Survey of representative practices in all parts of United States; trend toward standardization; data on costs, performances, types and uses.

OUTPUT AND DISTRIBUTION, N. AMERICA. Fourteen Systems with Output of More than a Billion Kilowatt-Hours in 1923. Elec. World, vol. 83, no. 15, Apr. 12, 1924, pp. 715-719. Tabular data, on output and peak load of largest generating and distributing companies in United States and Canada; 1923 detailed output and distribution data for North American Systems.

ST. LOUIS, MO. Cahokia Station, Union Electric Light & Power Company, St. Louis, Mo. Power, vol. 59, no. 14, Apr. 1, 1924, pp. 514-524, 15 figs. Uses pulverized fuel; preparation plant in same building as boilers and flue gases utilized to dry coal; each section of station containing 2 turbo-generators and 8 boilers is independent unit; steam pressure 300 lb., temperature 690 deg., natural draft, no economizers.

SAXTON, PA. Saxton Plant of the Penn Central Light & Power Company, A. Iddles. Power, vol. 59, no. 16, Apr. 15, 1924, pp. 592-599, 11 figs. Minemouth station designed for ultimate capacity of 100,000 kw.; first section 20,000 kw. installed boilers equipped with economizers; house turbine and low-pressure evaporators; load on house turbine automatically controlled by temperature of boiler feedwater; data on principal equipment.

WATER POWER VS. STEAM POWER. Water Power Compared with Steam Power and Their Relation to Rural Service, G. C. Neff. Nat. Elec. Light Assn. Bul., vol. 11, no. 3, Mar. 1924, pp. 152-154. States that only comparatively few of the hydro-electric stations of United States can successfully compete in low cost of generation with large modern well-located steam plants of to-day. Excerpts of address before Agricultural College of Univ. of Wis.

CHARTS

NOMOGRAMS. Applications of a Type of Nomogram with Rectilinear Scales (Quelques applications d'un type de nomogramme à échelles rectilignes), J. Hak. Annales des Ponts & Chaussées, vol. 93, no. 6, Nov.—Dec. 1923, pp. 375-386, 5 figs. Describes methods of application.

COAL

CARBONIZATION. Low Temperature Carbonization, A. McCullogh. Chem. & Industry, vol. 43, no. 11, Mar. 14, 1924, pp. 271-273. Need for smokeless fuel, suitable particularly for domestic purposes; difficulties encountered in producing such fuel from bituminous coal; progress made in this direction, and future of low-carbonization industry.

CHEMICAL CLASSIFICATION. The Chemical Classification of Coal, C. A. Seyler. Fuel, vol. 3, nos. 12, 13 and 3, Jan., Feb. and Mar. 1924, pp. 15-26, 41-49 and 79-83, 4 figs. Author proposes nomenclature which was devised to disturb existing terminology as little as possible.

HEAT, EFFECT ON. Quantity and Nature of Gas Evolved by Solid Fuels under the Action of Heat or of a Vacuum: Coals (Sur la quantité et la nature des gaz dégagés par les combustibles solides sous l'action de la chaleur et du vide: Houilles), P. Lebeau. Académie des Sciences—Comptes Rendus, vol. 178, no. 4, Jan. 21, 1924, pp. 391-393. Study of effect of heat on ten different kinds of coal; gaseous evolution in all cases becomes rapid at 400 deg. (1 to 5 cu. m. per metric ton); most coals give, per metric ton, 15 kg. of hydrogen, anthracite giving 25 kg.

HEATING VALUES. The Calorific Values of Coals, with Special Reference to the Coals of Nottinghamshire and Derbyshire, J. W. Whitaker. Colliery Guardian, vol. 127, no. 3299, Mar. 21, 1924, pp. 734-737, 6 figs. Results of analyses and calorific values of 38 samples of coal. Paper read before Midland Counties Inst. Engrs. See also Iron & Coal Trades Rev., vol. 108, no. 2924, Mar. 14, 1924, pp. 427-428, 1 fig.

COAL HANDLING

LOCOMOTIVE PLANTS. Locomotive Coaling Plant Recently Installed by the Italian State Railway, G. F. Zimmer. Indus. Mgt. (Lond.), vol. 11, no. 5, Mar. 6, 1924, pp. 133-135, 2 figs. Describes installation of stationary type, built entirely of mild steel, erected in duplicate, one at Foggia and one at Rimini, embodying latest developments of its type.

SIZING. The Sizing of Small Coal, Thos. Fraser. Coal Industry, vol. 7, nos. 2 and 3, Feb. and Mar. 1924, pp. 89-91 and 121-124. New conditions in sizing small fuel which have arisen; special shaker screens for small coal and coke; vibrating screens.

COAL MINES

CANADA. Lethbridge Coal Field Developing Rapidly, J. H. Turner. Coal Age, vol. 26, no. 13, Mar. 27, 1924, pp. 459-461, 1 fig. Production of mines of Lethbridge coal field, in Alberta, Can.; analysis of coal; advantages possessed by this field which reduce mining cost.

FIRE PREVENTION. Some Notes on the Problem of Gob Fires in Thick, Highly Inclined Seams, J. B. de Hart. Can. Inst. Min. and Metallurgy — Monthly Bul., no. 142, Feb. 1924, pp. 48-56. Causes and conditions which are inductive of spontaneous heating of coal; study of particular case of thick steeply inclined seams; possibility of ventilating gob; exclusion of air from gob as equally effective method of fire prevention; other possible methods.

COAL MINING

METHODS AND EQUIPMENT. Better Methods and Improved Equipment Increase Production at Beech Bottom Mine, (W. Va.) A. F. Brosky. Coal Age, vol. 25, no. 15, Apr. 10, 1924, pp. 521-527, 8 figs. By locating power plant at mine, cost of power is greatly reduced; means adopted to reduce loss of coal in mining and to save unnecessary handling of slate.

COAL STORAGE

CONCRETE BINS. Concrete Coal Bunkers, F. Dawson. Eng. & Boiler House Rev., vol. 39, no. 9, Apr. 1924, pp. 313-314, 2 figs. Leading features of reinforced-concrete construction. Notes on recent contract placed by Lond. County Council for new coal bunkers at Greenwich.

LOSSES. The Storage of Bituminous Coal, W. Seymour. Eng. Jl., vol. 7, no. 4, Apr. 1924, pp. 183-185, 4 figs. Losses which may occur in storage coal and proposed remedies.

COKE OVENS

BY-PRODUCT. Weirton's New By-Product Plant, C. J. Hunt. Blast Furnace and Steel Plant, vol. 12, nos. 3 and 4, Mar. and Apr., 1924, pp. 166-171 and 193-199. 11 figs. Details of new ovens at by-product coke plant of Weirton Steel Co.; coal and coke handling.

Coke Plant at Troy to Have New Features. Iron Age, vol. 113, no. 15, Apr. 10, 1924, pp. 1075-1076, 1 fig. Elimination of upper horizontal flue and somewhat different layout of heating flues characterize American oven.

Lights 37 New By-Product Ovens, C. H. Hunt. Iron Trade Rev., vol. 74, nos. 15 and 16, Apr. 10 and 17, 1924, pp. 984-989 and 991 and 1053-1057, 9 figs. New type of narrow oven installed by Weirton Steel Co., W. Va.; high-volatile coals coked exclusively; temperature in heating walls lowered without sacrificing coking period; plant has hourly capacity for 570,000 cu. ft. of gas and conversion of over 200 gal. of light oil into pure products; operating data.

COKE PLANTS

BY-PRODUCT. By-Product Coke Oven Plant, Hamilton. Can. Engr., vol. 46, no. 12, Mar. 18, 1924, pp. 359-365, 5 figs. Description of new plant established in Hamilton, Ont., to manufacture gas, coke and by-products; coke to be used as substitute for anthracite, will help solve fuel problem.

CONCRETE

HYDRATED LIME IN. The Use of Hydrated Lime With Portland Cement, J. W. Ramsey. Architectural Forum, vol. 40, no. 3, Mar. 1924, pp. 125-128. Results of tests made on addition of hydrated lime to mortars and concrete. Hydrated lime for waterproofing.

PORTLAND CEMENT. Portland Cement Concrete, W. E. Hart. Armour Engr., vol. 15, no. 3, Mar. 1924, pp. 95-96 and 110-111, 4 figs. Notes on old and newer practice in manufacture of concrete, placing concrete, and curing of concrete after placing.

CONCRETE CONSTRUCTION

NEL-STONE PRECAST MONOLITHIC SYSTEM. More About the Nel-Stone Precast Monolithic System. Concrete Products, vol. 24, no. 3, Mar. 1924, pp. 45-46, and 55, 10 figs. Chief object of this construction system is to eliminate form work in monolithic concrete structures of all kinds, thereby materially reducing construction time and cutting cost nearly in half.

CONCRETE CONSTRUCTION, REINFORCED

FIRE RESISTANCE OF. Reinforced Concrete and Fire-Resistance, J. Singleton-Green. Concrete and Constructional Eng., vol. 19, no. 3, Mar. 1924, pp. 156-161. Conclusions derived from previous articles, and additional data. (Concluded from Apr. 1923).

CONDENSERS, STEAM

TUBES. Manufacture of Condenser Tubes, W. R. Webster. Iron Age, vol. 113, no. 12, Mar. 20, 1924 pp. 871-872. How non-ferrous castings of hollow cylinders are transformed into tubes. Composition and heat treatment. Abstract of paper read before Metropolitan Sec. of A. S. M. E.

UNIT HEAT-TRANSFER DETERMINATION. Condenser Unit Heat Transfer Obtained from Chart, H. O. Michael. Power, vol. 59, no. 13, Mar. 25, 1924, pp. 488-489, 1 fig. Gives chart with which operating engineer may very quickly learn condition of condenser, and explains its use. Based on general principle that all central stations and other well-regulated plants maintain a fairly constant steam pressure and temperature; because of this, B.t.u. rejected to condensers per lb. of steam is nearly constant, varying slightly with vacuum.

CONNECTING RODS

MACHINING. Hollow Connecting Rods in the Making, F. H. Colvin. Am. Mach., vol. 60, nos. 9 and 10, Feb. 28 and Mar. 6, 1924, pp. 311-313 and 351-352, 16 figs. Feb. 28: Operations on connecting rods for Wright airplane engines; fixtures and methods for securing light weight, accuracy and ample strength. Mar. 6: Construction of inner rod and methods by which it is machined.

CONSTRUCTION WORK

Day Labor Construction. Day Labor Construction Does Not Pay, A. S. Bent. Am. Contractor, vol. 45, no. 4, Jan. 26, 1924, pp. 25-27. Tells what is behind the day labor tendency, where method fails, and why it fails; lists a number of typical instances in which costs of construction by this means far exceeded contractors' bids; explains why even the few apparently favorable exceptions would present a different picture were all facts in connection with them made public. Paper read before Associated Gen. Contractors annual mtg.

COOLING TOWERS

Reinforced-Concrete. The Dimensioning of Reinforced-Concrete Cylindrical Cooling Tower Walls (Bemessung von zylinderförmigen Kühlturmwänden aus Eisenbeton), E. Rausch. Deutsche Bauzeitung, vol. 57, no. 102-103, Dec. 22, 1923, pp. 117-120, 3 figs. Influence of wind forces and temperature; combined effect of wind and temperature stresses; practical example.

COST ACCOUNTING

Capital Control. Capital Requirements and Control, J. H. Bliss. Mgt. & Administration, vol. 7, no. 4, Apr. 1924, pp. 405-410. Control of fixed property investments.

Costs and Inventory Records. Combined Record System for Costs and Inventory, Wm. L. Myles. Am. Mach., vol. 60, no. 16, Apr. 17, 1924, pp. 575-578, 6 figs. All records of labor and material kept in visible index; description of forms; how costs are determined; purchasing index and payroll statistics.

Depreciation. A Statistical Theory of Depreciation, Based on Unit Cost, J. S. Taylor. Mass. Inst. Technology—Pub., Dept. of Mathematics, Series 2, no. 71, Feb. 1924, pp. 1010-1023. Discusses methods of treating depreciation, dealing with "useful life" of machine, or number of years property will be used, and how depreciation charges are to be distributed over period of use. Reprinted from Am. Statistical Assn., Dec. 1923.

COUPLINGS

Compression. Making Couplings for Transmission of Power, H. P. Armson. Can. Machy., vol. 31, no. 13, Mar. 27, 1924, pp. 19-21, 3 figs. Shop methods and tools in plant of Bond Eng. Works, Toronto, Can., for machining double tapered sleeves and inner and outer shells for compression couplings.

CRANES

Balance-Weight Determination. Determination of Additional Weight—Ballast and Balance Weight— in Curb-Ring Cranes (Bestimmung des Zusatzgewichtes—Ballast und Gegengewicht—bei Drehscheibenkranen), W. Hilge. Fördertechnik u. Frachtverkehr, vol. 17, no. 3, Feb. 3, 1924, pp. 29-31, 3 figs. Gives simple method for determining additional weight as the only possible minimum; by this means production and freight are rendered cheaper; current supply of slewing motor is reduced, and control of crane is made easier.

Uses. Industrial Cranes and Their Varied Uses, M. W. Potts. Indus. Mgt. (N. Y.), vol. 67, no. 4, Apr. 1924, pp. 216-223, 12 figs. Discusses different ways in which cranes can be of service; classifications for cranes.

CRANKCASES

Aluminum, Molding. Central European Practice, C. Irresberger. Foundry, vol. 52, no. 7, Apr. 1, 1924, pp. 258-262, 15 figs. Aluminum crankcases molded with chills and lugs to neutralize shrinkage effects; molding practice; castings cleaned by sand blast and tested for porosity by brushing with gasoline.

CRANKSHAFTS

Balancing. Practical Balancing of a V-Type Engine Crankshaft, D. E. Anderson. Soc. Automotive Engrs.—Jl., vol. 14, no. 4, Apr. 1924, pp. 409-414, 10 figs. Practical methods devised to accomplish results desired; describes how selection of parts to obtain equal weights is made; combination static and dynamic balancing machine that can be set for either operation is used for balancing crankshaft; method of testing completed work.

Elastic Couplings, Influence of. Influence of Harmonics of Phase Retardation on Arrangement of Cranks in a Multiple-Cylinder Explosion Engine (Influence des harmoniques des retards de phase sur la répartition des manivelles dans un moteur à explosion à cylindres multiples), A. Blondel. Académie des Sciences—Comptes Rendus, vol. 178, no. 4, Jan. 21, 1924, pp. 354-359. Investigation of influence of elastic couplings and damping; it is shown that use of elastic couplings necessitates closer examination of conditions of resonance and damping of multiple crankshafts.

CUPOLAS

Control Records. Records Show Cupola Control, S. J. Pelton. Foundry, vol. 52, no. 7, Apr. 1, 1924, pp. 255-257, 6 figs. Constant personal check must be kept on materials and methods, otherwise records are liable to have little value; scales and weighing methods require particular attention.

Slagging Operations. Slagging Operations in Cupola Practice, H. H. Shepherd. Metal Industry (Lond.), vol. 24, nos. 11 and 12, Mar. 14, and 21 1924, pp. 259-261 and 283-284. Object of slagging; slagging reactions; amounts of flux to use; composition of good limestone for fluxing; sulphur absorption; cupola slags.

CUTTING METALS

City Gas, Use of. Use of City Gas for Cutting Steel, J. H. Gumz. West. Machy. Wld., vol. 15, no. 3, Mar. 1924, pp. 85-87, 9 figs. Results of tests made to determine cost of city gas cutting.

CYLINDERS

Casting. The Cylinder Problem, O. Smalley. Foundry Trade Jl., vol. 29, nos. 392, 393 and 394, Feb. 21, 28 and Mar. 6, 1924, pp. 147-151, 173-177 and 195-197, 26 figs. Cause and elimination of the commoner defects encountered in manufacture of cylinder castings. Paper read before Inst. British Foundrymen and North East Coast Instn. Engrs. and Shipbldrs.

Lubrication. Cylinder Lubrication When Using Saturated and Superheated Steam, J. D. Morgan. Power, vol. 59, no. 16, Apr. 15, 1924, p. 607. Atomization of oil basic requirement in steam-cylinder lubrication; using low flash-point oils; lubrication of special engines.

D

DAMS

Concrete. Laurel Road Dam, F. W. Skinner. Eng. Wld., vol. 24, no. 3, Mar. 1924, pp. 147-151, 9 figs. Construction details of $600,000-dam just completed for Stamford Water Co., across Mill River stream and valley, about 9 miles from Stamford, Conn., to impound about 2¼ billons gallons water in a 285-acre reservoir; is of gravity section.

The Construction of Loch Raven Dam, W. A. Megraw. Am. Water Wks. Assn.—Jl., vol. 11, no. 2, Mar. 1924, pp. 434-445, 6 figs. Description of concrete dam which is being constructed on Gunpowder river, in connection with improvements being made in Baltimore's water supply, to impound 23,000,000,000 gal. water; length 640 ft. overall. Construction details.

Concrete, Tensile Reinforcement. Tensile Reinforcement in Concrete Dams, J. B. Macphail. Eng. Jl., vol. 7, no. 4, Apr. 1924, pp. 200-201, 3 figs. Proposed method for determining amount of reinforcement required.

Multiple-Arch. The Dam of the Vöhrenbach Power Plant (Germany) (Die Staumauer des Kraftwerkes Vöhrenbach), Fritz Maier. Beton u. Eisen, vol. 23, nos. 2 and 3, Jan. 20 and Feb. 5, 1924, pp. 13-18 and 25-28, 31 figs. Dam is of multiple-arch type, consisting of 12 arches with total span of 142-8 m. at crown; built of reinforced concrete; construction details and calculations.

DIESEL ENGINES

Double-Acting. Double-Acting Diesel of Unique Design. Motorship, vol. 9, no. 4, Apr. 1924, pp. 261-263, 5 figs. How North British 200 s.hp. unit differs from all other 2-cycle double-acting marine oil engines.

Power Plants, Use in. Diesel Engines as Economical Power Producers, J. Ander. Power House, vol. 17, no. 6, Mar. 20, 1924, pp. 30-31, 1 fig. Data on Diesel engine plants and operating cost of same under Canadian conditions. Serious competitor of hydro-electric power.

Two-Stroke-Cycle Application. Present-Day Diesel Engines—Application of the Two-Stroke-Cycle Principle, Nagal. Power, vol. 59, no. 14, Apr. 1, 1924, pp. 526-527, 3 figs. Extract of paper read before Verein Deutscher Ingenieure, June 20, 1923, at Berlin.

Valves. Valves of Diesel Engines, F. Johnstone-Taylor. Gas & Oil Power, vol. 19, no. 222, Mar. 6, 1924, pp. 97-98, 3 figs. Practical advice on their care and maintenance.

Water-Works. Oil Engines that Have Seen Long Water-Works Service J. H. Bender. Fire & Water Eng., vol. 75 no. 11, Mar. 12, 1924, pp. 495-496 and 513, 3 figs. Record of three units installed in Clayton, N. M. in 1911, 1912 and 1917 respectively, which have given good satisfaction, demonstrating reliability of this type of motive power.

DOMES

Masonry. Analytical Solution of Masonry Domes, D. C. Coyle. Am. Soc. Civ. Engrs. Proc., vol. 50, no. 4, Apr. 1924, pp. 401-416, 7 figs. Investigation to develop analytical formulas for pyramoidal and conoidal masonry domes, analogous to equations which have been established for spherical and conical shapes; it is shown that conclusions derived from formulas are those which might be expected; deals with stresses in dome of any profile that is symmetrical about vertical axis.

DYNAMOMETERS

Torsion. The Amsler Torsion Dynamometer with Stroboscopic Reading Device (Dynamomètre de torsion, système Amsler, avec dispositif de lecture stroboscopique). Génie Civil, vol. 84, no. 11, Mar. 15, 1924, pp. 260-261, 2 figs. Apparatus for measuring power absorbed by high-speed machines forced to overcome an almost constant resistance.

E

ELECTRIC CIRCUITS, A.C.

Inductive. Inductive Alternating Current Circuits, E.K. McDowell. Power Plant Eng., vol. 28, no. 7, Apr. 1, 1924, pp. 387-388, 3 figs. Explanation of impedance diagram together with rules for its construction.

ELECTRIC FURNACES

Acid. More Electric Steel in South. Foundry, vol. 52, no. 8, Apr. 15, 1924, pp. 312-315, 8 figs. Also Iron Trade Rev., vol. 74, no. 14, Apr. 3, 1924, pp. 913-916, 8 figs. New Orleans company specializing in sugar-mill machinery installs acid electric furnace to make railroad castings; metallurgical control insures uniform quality of metal poured.

Iron-Ore Reduction. Electric Reduction Furnace Iron, R. C. Gosrow. Iron Trade Rev., vol. 74, no. 15, Apr. 10, 1924, pp. 982-983 and 991. States that pig iron made in electric reduction is of high quality and adapted to foundry and steel-making use.

ELECTRIC LOCOMOTIVES

Single-Phase. 2-C-1 Single-Phase Electric Locomotive with Individual Drive. Engineer, vol. 137, no. 3562, Apr. 4, 1924, p. 369-371, 6 figs. partly on p. 362. New locomotives built by Brown, Boveri & Co., in which each of driving axles have independent motors; gearing is fitted on one side of engine and driving wheels on opposite side are free.

ELECTRIC GENERATORS

Assembling Rotors. Assembling Generator Rotors, Ralph Brown. Power, vol. 59, no. 15, Apr. 8, 1924, pp. 566-567, 3 figs. Describes how generators rotors were assembled at Caribou plant of Great West Power Co.

Ventilation. Ventilation of Electrical Generators, M. D. Engle. Elec. Light & Power, vol. 2, no. 4, Apr. 1924, pp. 13-17 and 60, 9 figs. Methods of obtaining cooling air for large generators; specification for a generator air cooler.

65,000-Kv.a. The 65,000-Kv.a. Generator of the Niagara Falls Power Company, W. J. Foster and A. E. Glass. Am. Inst. Elec. Engrs.—Jl., vol. 43, no. 4, Apr. 1924, pp. 365-372, 11 figs. Details of novel features, including stator, stator core, stator winding, rotor spider, poles and field coils, field coils, upper bearing bracket, guide and thrust bearing, oiling system, excitation generators, etc.

ELECTRIC RAILWAYS

Cars, Safety. New Safety Cars for Ontario Hydro-Electric Railways. Ry. Signaling, vol. 17, no. 4, Apr. 1924, pp. 184-185, 2 figs. Details of 400-class cars, which will be equipped for multiple-unit operation.

ELECTRICAL EQUIPMENT

Maintenance. Modern Maintenance of Plant and Equipment, Wm. G. Ziegler. Indus. Mgt. (N. Y.), vol. 67, no. 4, Apr. 1924, pp. 224-229, 5 figs. Maintenance of electric power and heating equipment.

ELECTRICAL MEASUREMENTS

Energy in A.C. Circuits. The Measurement of Electrical Energy in A. C. Circuits, G. W. Stubbings. World Power, vol. 1, no. 3, Mar. 1924, pp. 164-170, 5 figs. Review method of metering energy in high-power circuits, examining more particularly difficulties introduced by use of instrument transformers; considers methods of metering energy in 3-phase circuits.

ELECTRIC TRANSMISSION LINES

Interconnected System, Pacific Coast. Physical Aspects of the Pacific Coast Interconnected System. Jl. Electricity, vol. 52, no. 3. Feb. 1, 1924, pp. 100-101, 1 fig. Survey shows that two small gaps, one in Oregon and other in Washington, remain before complete tie-in of lines serving California, Oregon, Washington and Montana can be effected; with these closed, system that has no parallel in any part of world would then exist.

Power Limit. Experimental Analysis of Stability and Power Limitations, R. D. Evans and R. C. Bergvall. Am. Inst. Elec. Engrs.—Jl., vol. 43, no. 4, Apr. 1924, pp. 329-340, 30 figs. Method of determining power limit of transmission system taking into account characteristics of synchronous condensers and load in conjunction with those of transmission line; tests on voltage stability, hunting and effect of short circuits causing system to pull out of synchronism. (Abridged).

Stability. Transmission Line Stability, C. L. Fortescue. Am. Inst. Elec. Engrs.—Jl., vol. 43, no. 4, Apr. 1924, pp. 373-376. Analytic deduction of condition for stable operation for transmission lines. Supplement to paper by Fortescue and Wayne, entitled Some Theoretical Considerations of Power Transmission.

ELECTRIC WELDING, ARC

Precision. The Electric Arc in Precision Welding, S. W. Mann. Forging-Stamping-Heat Treating, vol. 10, no. 2, Feb. 1924, pp. 68-71, 3 figs. Flexibility of electric arc welding makes it possible to repair a broken shaft or casting to same degree of strength and accuracy as before failure.

Rail Joints. Rail Welding in Connecticut. Elec. Ry. Jl., vol. 63, no. 14, Apr. 5, 1924, pp. 537-539, 2 figs. Improvements in carbon arc welded rail joints adopted by Connecticut Co.; tilted joint plate and base plate adapted to 23 different rail sections; precautions adopted to secure good welds.

ELECTRIC WELDING, RESISTANCE

Seam Welders. Various Types of Electric Seam Welders, J. R. Brueckner. Forging—Stamping—Heat Treating, vol. 10, no. 3, Mar. 1924, pp. 107-109. Discusses development of automatic spot welder, continuous seam welder, roll-step method of seam welding, and seam welding using interrupted current, and merits of each method.

ELEVATORS, ELECTRIC

Winding Machine Manufacture. Building Electric Elevator Winding Machines, H. P. Armson. Can. Machy., vol. 31, no. 12, Mar. 20, 1924, pp. 15-18, 5 figs. Machine shop practice utilized in speeding production at plant of Turnbull Elevator Co.; Toronto, Can., in manufacturing electric geared traction elevator equipment.

EMPLOYEES, TRAINING OF

Co-operative Education. Training the Future Employee Through Co-operative Education, H. H. Bliss. Jl. of Electricity, vol. 52, no. 6, Mar. 15, 1924, pp. 205-206. Describes plan which is being widely adopted in the West, in which firms co-operate with college in training future leaders of industry; includes alternate monthly periods of study and employment, co-ordinated so that work serves practically as laboratory part of a unified course of training.

EMPLOYMENT MANAGEMENT

Promotion Policy. Reducing Labor Turnover by Promotion, K. H. Condit. Am. Mach., vol. 60, no. 15, Apr. 10, 1924, pp. 539-541, 2 figs. Seventh article in Gilbreth series describing personnel policy; doing away with blind-alley jobs; helping employee to reach highest position he can hold.

ENGINEERS

Relation to Finance. The Engineer's Relation to Finance, L. W. Mayer. Min. and Metallurgy, vol. 5, no. 208, Apr. 1924, pp. 163-167. Why engineering profession does not rank higher; confidence in engineer held by banker; points out that there are more failures owing to poor financing than to poor engineering, and that financier underestimates degree of engineer's assistance.

EVAPORATION

Heat of. Heat of Vaporization, A Function of the Temperature, M. W. Green. Am. Chem. Soc.—Jl., vol. 46, no. 3, Mar. 1924, pp. 544-545. Calculation devised to show that if heat of vaporization is assumed to be function of temperature alone, the same function for all substances but differing in constants involved, conclusion is arrived at which indicates approximate limits of accuracy of such relation.

EVAPORATORS

Continuous-Flow. The Continuous Flow Evaporator, M. C. Stuart. Am. Soc. Nav. Engrs.—Jl., vol. 36, no. 1, Feb. 1924, pp. 55-65, 7 figs. Describes new evaporator, design of which embodies novel features directed toward improvement in principal factors of operation, namely, purity, capacity, economy and operation.

F

FABRICS

Wear-Testing Machine. A Machine for Investigating the Resistance of Fabrics to Abrasion ("Wear"), Rob. P. Ethridge. Testing, vol. 1, no. 2, Feb. 1924, pp. 156-159, 2 figs. Principle of design of cloth wear-testing machine.

FANS

Drives. The Argument for the Slow-Speed Direct-Connected D. C. Motor for Ventilating Fan Drive, J. L. McK. Yardley. Heat & Vent. Mag., vol. 21, no. 4, Apr. 1924, pp. 43-46, 10 figs. How motor ratings have increased; limit reached in reductions of speed of a.c. motors; transforming a.c. to d.c.

FLIGHT

Gliding. Difference between the Piloting of Gliders and Motor Airplanes from the Standpoint of the Practical Glider Pilot (Unterschied zwischen der Führung von Segel- und Motorflugzeugen vom Standpunkt des praktischen Segelfliegers), H. Hackmack. Zeit. für Flugtechnik u. Motorluftschiffahrt, vol. 15, nos. 1-2, Jan. 26, 1924, pp. 2-3. Offers practical suggestions for motorless flight.

Gliding Flight against the Wind (Sur le vol à voile contre le vent), A. Rateau. Académie des Sciences—Comptes Rendus, vol. 178, no. 3, Jan. 14, 1924, pp. 280-285, 1 fig. Author demonstrates that Katzmayr effect can be deduced immediately from what is already known of wing characteristics in fixed regular current; formula obtained gives principal laws of Katzmayr effect.

FLUMES

Semi-Circular Wood. Semi-circular Wood Flume with Radius of 6 Ft. Eng. News-Rec., vol. 92, no. 15, Apr. 10, 1924, pp. 612-613, 4 figs. Creosoted staves and section giving minimum leakage make for long life; crew assembles 500 ft. per day in renewal of flume along Deschutes River, Ore.

FORESTRY

Relation to Floods. The Relation of Forests to Destructive Waters in the Light of Scientific Investigations, D. Y. Lin. Assn. Chinese & Am. Engrs.—Jl., vol. 4, no. 10, Dec. 1923, pp. 1-7, 4 figs. Discusses flood problem from a forestry standpoint. Influence of forests on watersheds, and condition they create with regard to surface run-off, soil erosion, absorptive capacity of soil cover, underground seepage, and stream flow.

FORGINGS

Steel. Recent Developments in Steel Forgings, J. L. Cox. Forging—Stamping—Heat Treating, vol. 10, nos. 1 and 2, Jan. and Feb. 1924, pp. 12-16 and 87-89, 23 figs. Review of developments in line of forging exceptionally large machine parts; forgings often employed to advantage in place of steel castings. Paper read before Am. Iron & Steel Inst., Oct. 1923.

FOUNDING

Automobile. Modern Automobile Foundry Practice, P. Pritchard. Foundry Trade Jl., vol. 29, nos. 392, 393, 394 and 395, Feb. 21, 28, Mar. 6 and 13, 1924, pp. 158-161, 169-172, 191-194 and 215-218, 33 figs. Also Automobile Engr., vol. 14, no. 187, Mar. 1924, pp. 84-91, 22 figs. Underlying principles; sand molds; molding machines; aluminum, its melting and molding, and defects which have to be overcome in founding; aluminum die-casting; cast iron, its melting and molding; coremaking; cylinder casting; mild steel castings; non-ferrous foundry practice; etc. Paper read before Instn. Automobile Engrs.

FOUNDRIES

Cost-Distribution System. Distribute Costs on Each Job, E. C. Boehringer. Foundry, vol. 52, no. 6, Mar. 15, 1924, pp. 207-212, 11 figs. Nugent Steel Castings Co., Chicago, Manufacturers of electric-steel castings make detailed tabulation of expenses including minor materials to each job; how work is routed through shop.

Metal Melting, Fuels for. Melting by Natural-Draught Gas and Other Fuels, A. J. Smith. Brass Wld., vol. 20, no. 3, Mar. 1924, pp. 93-94. Results obtained in foundries with different fuels.

Steel, Cost System for. Distributing Costs on Each Job, E. H. Boehringer. Iron Trade Rev., vol. 74, no. 13, Mar. 27, 1924, pp. 853-857, 12 figs. Describes elaborate, yet not burdensome, cost system developed by Nugent Steel Castings Co., Chicago, Ill., whereby it keeps before it at all times a running and complete picture of all its cost factors; is controlling factor through plant from unloading of steel scrap to shipment of finished casting.

FOUNDRY EQUIPMENT

Core and Sand Testing Equipment. Molds, Cores and Molding Sands (Ueber Formen, Kerne und Formsande), L. Treuheit. Giesserei-Zietung, vol. 20, no. 25, Dec. 1, 1923, pp. 483-492, 30 figs. Strength-testing apparatus for molds and cores; a new decanting apparatus for molding sands; evaluation of molding sands.

Flask Design. Principles in Cast Iron Flask Design, H. Cohen. Iron Age, vol. 113, no. 16, Apr. 17, 1924, pp. 1137-1140, 7 figs. Applications to jarring machine work on gray iron; general rules as to bars; core weights and supports; internal strains.

FREIGHT HANDLING

Containers, Demountable. Container Units in Motor Truck Freight Service. Ry. Rev., vol. 74, no. 14, Apr. 5, 1924, pp. 656-658, 4 figs. How Detroit United Ry. has developed new equipment to establish auxiliary motor-truck service, consisting of demountable unit container equipment.

L. C. L. by Motor Truck. Delivering Less-Than-Carload Freight by Motor Truck, R. D. Sangster. Soc. Automotive Engrs.—Jl., vol. 14, no. 4, Apr. 1924, pp. 415-421. Outline of practical working of St. Louis system, demonstrating regard in which it is held by both shipper and carrier; adaptability of system to store-door delivery; advantages of off-track freight stations; Harlan plan for Manhattan Island.

Fuels. *See Coal; Oil Fuel; Pulverized Coal.*

FUEL

Canadian Problem. The Fuel Problem, Chas. Camsell. Eng. Jl., vol. 7, no. 4, Apr. 1924, pp. 186-190. Review of fuel situation in Canada, problems, and progress towards solution; substitutes for anthracite.

FURNACES, GAS

Specific Heat of Combustion Products. Specific Heats of Products of Combustion from Gas Furnaces, L. E. Biemiller. Gas Age-Rec., vol. 53, no. 14, Apr. 5; 1924, pp. 423-425, 1 fig. Determination of specific-heat values; review of previous work on the subject, and calculations.

FURNACES, HEATING

Continuous Pair. Pair Heating, Wm. C. Buell, Jr. Blast Furnace & Steel Plant, vol. 12, nos. 2, 3 and 4, Feb. Mar. and Apr. 1924, pp. 122-123, 159-160 and 180-182, 3 figs. Resume of conditions surrounding present practice in heating sheet bars; describes heating furnace of new design and employing two-stage combustion; analysis of heating costs.

FURNACES, HEAT-TREATING

Recuperative. Heat-Treating Furnaces Using Recuperation, P. J. Nutting. Iron Age, vol. 113, no. 16, Apr. 17, 1924, pp. 1156-1157, 2 figs. Effect of pre-heating air, using coal, oil or other fuels; applications to annealing and carburizing.

FURNACES, HOT-AIR

Gas-Fired. Making Progress with the Hot Air Furnace. Gas Age-Rec., vol. 53, no. 15, Apr. 12, 1924, pp. 473-474, 5 figs. Particulars of furnace developed by Rochester Gas & Elec. Corp., entirely automatic, being equipped with a humidostat as well as a thermostat; heat loss to chimney is low, as gases pass off at 170 deg. fahr. as against 300 to 500 deg. fahr. in coal-fired furnaces.

G

GAGES

Checking System. Systematic Gage-Checking as a Requisite of Precise Measurement, Jos. Lannen. Soc. Automotive Engrs.—Jl., vol. 14, no. 4, Apr. 1924, pp. 407-408. Details of methods employed in creating and maintaining gage-checking system, and statement in reference to equipment used and good results attained.

Pressure. Modern Recording Pressure Gauges. Eng. Progress, vol. 5, no. 2, Feb. 1924, pp. 26-27, 4 figs. Describes design of recording instruments which permit control of constancy of pressure by means of graph produced by apparatus during certain interval of time.

Sine Bar. A Sine-bar Angle Gage for Commutator Work, Wm. Crozier. Machy. (Lond.), vol. 23, no. 598, Mar. 13, 1924, pp. 767-768, 5 figs. Describes sine-bar angle gage designed by author for motor commutators.

Steels for. Research Reveals Properties of Steels Used For Gages. Automotive Industries, vol. 50, no. 14, Apr. 3, 1924, pp. 759-760. Investigations carried on at Bur. of Standards throw light on wear characteristics of different steels, hardened and unhardened; relative changes in size on hardening in oil and water; factors which affect time changes in gages.

GAS PRODUCERS

PRACTICE. Gas Producer Practice, W. Dyrssen. Blast Furnace & Steel Plant, vol. 12, no. 3, Mar. 1924, pp. 161-165. Temperature of gas; blast temperature and steam consumption; use of oxygen in gas producers; influence of rate of gasification; instruments required for controlling and supervising operation of producers; preheating of blast; other cooling mediums than steam in producers.

GASES

EXPLOSIVE GAS-AIR MIXTURES. Investigations of Combustible Gas- and Steam-Air Mixtures (Unter-suchungen an expolsiblen Gas- und Dampf-Luft-Gemischen), E. Berl and H. Fischer. Zeit. für Elektrochemie, vol. 30, no. 1, Jan. 1924, pp. 29-36, 3 figs. Determination according to new method of explosion limits of mixtures of air with carbon monoxide, hydrogen, methane, acetylene, ethylene, alcohol, acetone, ether, benzol and gasoline at atmospheric pressure and room temperature; influence of temperature on explosive range at 100,200 and 300 deg. cent.; influence of subpressure on system carbon monoxide-air. Bibliography.

GEAR CUTTING

QUALITY TESTING. Quality Testing in the Manufacture of Gears (Güteprüfung bei der Zahnradherstellung), Frommer. Werkstattstechnik, vol. 18, no. 6, Mar. 15, 1924, pp. 176-178, 6 figs. Arrangements for investigation of helicoidal cutter of cutting machine and finished wheel; profile-testing machines; testing of pitch and trueness; investigation of condition of cutting machine.

GEARS

CALCULATION. The Calculation of Gears for Machine-Tool Construction (Zahnradberechnung für den Werkzeugmaschinenbau), A. Eberwein. Maschinenbau, vol. 3, no. 11, Mar. 13, 1924, pp. 359-361, 4 figs. Formulas are derived for calculation of machine-tool gears, making use of modulus method.

INVOLUTE. Degree of Irregularity of Involute Spur Gears (Ungleichförmigkeitsgrad von Evolventenstirnrädern), C. Miklósy. Werkstattstechnik, vol. 18, no. 6, Mar. 15, 1924, pp. 173-175, 3 figs. Author traces by calculation the irregular course of involute gears and describes method of determining series of cutters for a given degree of irregularity.

NON-METALLIC. Laboratory Tests of Non-Metallic Gears, H. R. Moyer. Am. Mach., vol. 60, no. 14, Apr. 3, 1924, pp. 505-507, 4 figs. Work done to determine strength and endurance; evolution of testing equipment; tests for vibration and effect of oil; reproducing service conditions.

SPUR. Standardized Roller for Checking Spur Gears, W. H. Folds. Machy. (Lond.), vol. 23, no. 598, Mar. 13, 1924, pp. 765-767, 3 figs. Writer proposed to standardize, to some extent, roller-check method by use of tables of factors, which makes it possible to use any size roller that will form contact on tooth faces or flanks, and from given diameter of roller, overall measurement over roller as it is located in teeth of gear can be calculated.

TOOTH-BEARING CONTROL. Tooth Bearing Control for Spiral Bevel Gears, Chas. H. Logue. Am. Mach., vol. 60, no. 15, Apr. 10, 1924, pp. 549-553, 9 figs. Importance of position of bearing along teeth; measurement of backlash by "pinion inclination"; "pinion intersection"; design and operation of suitable testing machine.

WORM. A New Enveloping Worm Gear. Machy. (Lond.), vol. 23, no. 599, Mar. 20, 1924, pp. 819-820, 4 figs. Describes form of worm gear with very high load-carrying capacity, which is extension of principle of straight-line generation to include its application to production of Hindley-type worm to which term "enveloping" gear has been applied.

Worm Gears and Windlasses, H. S. Howard. Am. Soc. Nav. Engrs.—Jl., vol. 36, no. 1, Feb. 1924, pp. 18-29. Conclusions and decisions as to future heavy-duty worm gears which may be built; worm gear which was investigated was in windlass of battleship Tennessee.

GIRDERS

TRANSVERSE OSCILLATIONS. Theory of Transverse Oscillations in Girders and Its Relation to Live-Load and Impact Allowances, Chas. E. Inglis. Engineering, vol. 117, no. 3038, Mar. 21, 1924, pp. 378-380. Notes on phenomena attending behaviour of girders under influence of dynamical loads. (Abstract). Paper read before Instn. Civ. Engrs.

GRAIN ELEVATORS

MECHANICAL AND PNEUMATIC. Mechanical and Pneumatic Grain Elevators (Mechanische und pneumatische Elevatoren für Getreide), Mangold. Fördertechnik u. Frachtverkehr, vol. 17, no. 4, Feb. 21, 1924, pp. 41-45, 11 figs. Describes different types of both systems and makes suggestions for choice of system.

H

HARDNESS

TESTING MACHINES. Hardness Testing, with Special Regard to Dynamic Hardness Testing Machines (Ueber Härteprüfung, mit besonderer Berücksichtigung des Fallhärteprüfers), M. v. Schwarz. Maschinenbau, vol. 3, no. 10, Feb. 28, 1924, pp. 316-319, 5 figs. Describes new type of hardness testing machine developed by author; results of tests showing its useful applications.

Work-Hardening of Metals and the Herbert Tester. Engineer, vol. 137, no. 3558, Mar. 7, 1924, pp. 248-251, 5 figs. Discusses use of pendulum tester (described in Apr. 13, 1923, issue of same journal) for investigation of scale hardness figures; gives list of work-hardening figures of various materials, as determined by E. G. Herbert, inventor of instrument. See also editorial on pp. 257-258.

HEAT PUMPS

APPLICATIONS. Utilization of the Heat of Low Temperature (Ueber die Nutzbarmachung von Wärme niedriger Temperatur), Ferdinand. Gesundheits-Ingenieur, vol. 47, no. 11, Mar. 15, 1924, pp. 81-82, 9 figs. Describes applications of heat pumps which work on principle of refrigerating machines.

HEAT TRANSMISSION

WATER FLOWING INSIDE PIPES. Heat Transfer for Water Flowing Inside Pipes, W. H. McAdams and T. H. Frost. Refrig. Eng., vol. 10, no. 9, Mar. 1924, pp. 323-332 and (discussion) 332-334, 15 figs. Progress recently made in developing an equation which may be used by designer to predict numerical value of film coefficient of heat transfer between a clean pipe and water which is flowing through it in turbulent motion.

HEATING AND VENTILATING

SCHOOL BUILDINGS. Heating and Ventilating an Up-to-date School Building, T. E. Mason. Plumbers' Trade Jl., vol. 76, no. 6, Mar. 15, 1924, pp. 499, 502 and 504, 2 figs. Describes heating and ventilating system of high-school building now being erected in Saranac Lake, N. Y.; ventilating is of central fan system; vapor heating.

HEATING, ELECTRIC

COMBINATION COOKING AND HEATING OVEN. Recommendation for Utilization of Electric Energy for Cooking and Heating Purposes (Vorschlag zur Verwertung elektrischer Energie für Koch- und Heizzwecke), E. Boder. Schweiz. Elektrotechnischer Verein—Bul., vol. 15, no. 2, Feb. 1924, pp. 67-70, 4 figs. Investigates possibility of utilizing electric energy for calorific purposes in households and suggests scheme for simultaneous heating of kitchen and adjoining room, by means of electric cooking and heat-storage oven.

HEATING, STEAM

CENTRAL-STATION. Central Station Heating Proves Successful, H. A. Woodworth. Power Plant Eng., vol. 28, no. 7, Apr. 1, 1924, pp. 377-380, 3 figs. Discusses factors contributing to successful systems of central-station heating.

UNIT HEATERS. The Trend in the Unit Heater Field, A. H. Greene. Heat & Vent. Mag., vol. 21, no. 3, Mar. 1924, pp. 55-57, 4 figs. Special reference to use of copper and brass radiators as a means of reducing size and weight and increasing efficiency.

HIGHWAYS

STRUCTURAL DESIGN. Researches on the Structural Design of Highways by the United States Bureau of Public Roads, A. T. Goldbeck. Am. Soc. Civ. Engrs.—Proc., vol. 50, no. 4, Apr. 1924, pp. 453-489, 26 figs. Researches on sub-grade; loads on pavements; stresses in concrete pavements; Pittsburg, Cal., test road; studies in materials; miscellaneous investigations.

HIGHWAYS, CONCRETE

DESIGN. Tentative Conclusions on the Design of Concrete Highways. C. Older. Mun. & County Eng., vol. 66, no. 3, Mar. 1924, pp. 103-111, 9 figs. Developments during 1923 in Illinois highway research work, and their probable bearing upon problem of rural pavement design. Paper presented before Am. Assn. State Highway Officials at New Orleans.

HYDRAULIC ACCUMULATORS

SWITZERLAND. Examples of Hydraulic Accumulators and Pumps in Switzerland, Italy and France (Exemples d'installations hydrauliques d'accumulation et de pompage, en Suisse, en Italie et en France). Génie Civil, vol. 84, no. 9, Mar. 1, 1924, pp. 208-210, 5 figs. Describes accumulator plants working principally with Sulzer centrifugal pumps, placed in operation during past few years.

HYDRAULIC DRIVE

SCHNEIDER. The Schneider Gear for the Drive of Machine Tools and Hoists (Das Schneider-Kapsel-getriebe für den Antrieb von Werkzeugmaschinen und Hebezeugen), O. Keller. Schweizerische Bauzeitung, vol. 83, no. 9, Mar. 1, 1924, pp. 100-101, 8 figs. Describes new hydraulic drive patented by H. Schneider, with which any fine adjustment of speed according to material and feed can be made without interfering with operation; advantages of gear, which is a hydraulic change and reversing gear, consisting of two valveless pumps.

HYDRO-ELECTRIC DEVELOPMENTS

AUSTRALIA. Hume Reservoir for Hydro-Electric Development. Indus. Australian & Min. Standard, vol. 71, no. 1836, Feb. 14, 1924, pp. 242-244. Reports of investigations of possibility of utilizing Hume Reservoir (Australia) for hydro-electric development. Conclusion reached was that Hume Reservoir, with capacity as at present proposed, viz., 1,100,000 acre-ft. would have a potential value for development of hydro-electric power and that increasing of capacity of reservoir would add to that potential value.

CANADA. Musquash Hydro-Electric Development, F. B. Casey. Can. Engr., vol. 46, no. 15, Apr. 8, 1924, pp. 405-409, 7 figs. Development in New Brunswick on Musquash River; three Morgan Smith turbines and C. G. E. generators develop 11,000 hp. for transmission to St. John and surrounding district and Moncton.

ECONOMICS OF. The Economics of Hydro-Electric Development, D. W. Mead. Am. Soc. Civ. Engrs.—Proc., vol. 50, no. 4, Apr. 1924, pp. 417-452. 9 figs. Discusses following factors: Acquisition of suitable legal rights; command of satisfactory power market; suitable physical and hydrological conditions; proper design of works involved; economical construction and financing; rapid and economical development of business; management, operation and maintenance; accurate estimates; factors of economic expediency in consideration of proposed hydro-electric developments; capital costs; annual expenses; calculation of net revenue.

WESTERN UNITED STATES. Survey Shows 1924 Will Be Record Year for Hydro-electric Development. Jl. Electricity, vol. 52, no. 3, Feb. 1, 1924, pp. 96-99, 5 figs., 1 map. Survey of hydro-electric projects under way during 1923 or definitely scheduled for 1924.

HYDRO-ELECTRIC PLANTS

STANDARD TESTS FOR. Standard Tests for Hydraulic Power Plants. Engineer, vol. 137, no. 3562, Apr. 4, 1924, pp. 354-356, 3 figs. Discussion of report of Joint Committee appointed by Instns. of Mech. and Civ. Engrs. to draw up set of recommended rules for testing of hydraulic power plants.

I

ICE PLANTS

DESIGN. The Essentials of the Modern Ice Plant, C. T. Baker. Ice and Refrigeration, vol. 66, no. 3, Mar. 1924, pp. 243-245. Type of plant, prime mover, compressors, freezing tank, air agitation system, condensers and piping. Paper read before North Carolina Ice Exchange.

RAW-WATER. Raw Water Ice Plant of Miller Ice Co., Chicago Heights, Ill., V. P. Miller. Ice and Refrigeration, vol. 66, no. 3, Mar. 1924, pp. 239-241, 4 figs. Oil-engine-driven 50-ton ice making plant which has been remodeled and improved several times; description of mechanical equipment; vertical compressors belted to oil engines.

INDICATORS

MANOGRAPH, FOR HIGH-SPEED ENGINES. Indicator-Manograph (Indikator-Manograph Otto Schulze). Motor u. Auto, vol. 21, no. 1, Jan. 10, 1924, pp. 5-7, 8 figs. Describes optical indicator manufactured by Osa Apparate Gesellschaft, Frankfort, Germany, which can be used for speeds up to 8,000 r.p.m.; diagrams are stated to be not only qualitatively but quantitatively correct, so that actual pressure conditions in cylinder can be determined.

INDUSTRIAL MANAGEMENT

ENGINEERING AND OPERATING DEPARTMENTS, RELATION OF. The Relation of the Engineering Department to the Operating Department, F. J. Crolius. Engrs.' Soc. West. Pa.—Proc., vol. 40, no. 2, Mar. 1924, pp. 45-52 and (discussion) 53-55. Relates incidents and results accomplished through co-ordinated engineering investigation; discusses combustion, centrifugal force; etc.

Estimating. Estimating. Engineer, vol. 137, no. 3558, Mar. 7, 1924, pp. 244-246, 5 figs. Deals with requirements of factory employing about 5,000 hands, and manufacturing more than one type of product; personnel of department; preparation of estimate; co-ordination of effort.

Material Purchasing and Control. One Master Form Basis of Material Buying and Control System, W. L. Carver. Automotive Industries, vol. 50, no. 15, Apr. 10, 1924, pp. 806-811, 6 figs. Scheme of material purchasing and control at plant of Chandler Motor Car Co. eliminates bookkeeping from purchasing, stock and production departments.

Pricing Policy. Pricing Policy in Relation to Financial Control, Donaldson Brown. Mgt. and Administration, vol. 7, nos. 2, 3 and 4, Feb., Mar. and Apr., 1924, pp. 195-198, 283-286 and 417-422. Outlines method of price analysis which, though resting, upon theoretical basis, is wholly practical; theory of pricing of Gen. Motors Corp.

Production Control. Maintaining a Profit with Reduced Prices, E. A. Munschauer. Mgt. and Administration, vol. 7, no. 4, Apr. 1924, pp. 401-404, 4 figs. How capacity of plant for manufacturing refrigerators was increased 50 per cent and unit costs lowered.

Production Planning. New Methods of Production Planning That Make Heavy Stocks Unnecessary. Factory, vol. 32, no. 4, Apr. 1924, pp. 480-482 and 528, 1 fig. Methods employed in large machine-tool manufacturing plant, in which standardization is stressed; how production budget aids planning.

Purchasing and Inventories. The Relationship of Purchasing to Inventories, H. N. Stronck. Factory, vol. 32, no. 4, 1924, pp. 501-503, 606 and 608-609. Notes based upon observations made during examination of manufacturing enterprises of large variety of industries, and in all parts of country.

Stores Control. Step by Step Details for Obtaining Equipment and Supplies for Maintenance, J. E. Housley. Indus. Engr., vol. 82, no. 4, Apr. 1924, pp. 169-173, 6 figs. Routine followed in an industrial plant for procuring supplies, with methods of storing and accounting for material.

INDUSTRIAL RELATIONS

Lumber Industry. Industrial Relations in the West Coast Lumber Industry, C. R. Howd. U. S. Bur. Labor Statistics, no. 349, Dec. 1923, 120 pp., 2 charts. Examination of lumber industry, particularly financial conditions and kind of work men do; technology of industry and demands it makes on employees; hours, rates of wages, and working and living conditions; history of organized or articulate protests of employees and reactions of employers.

INSULATION, HEAT

Tests. Insulation, G. A. Young and E. F. Burtono Refrig. Eng., vol. 10, no. 9, Mar. 1924, pp. 345-348. Properties of low-temperature insulating materials; types of insulation; unit of heat flow; facilities for insulation tests at Purdue University; Master Car Bldrs ' Assn. model electric calorimeter; Bur. of Standards model electric calorimeter.

INSULATING MATERIALS, ELECTRIC

Varnishes and Compounds. Insulators and Insulating Materials. World Power, vol. 1, no. 3, Mar. 1924, pp. 181-184, 2 figs. Properties which ideal insulator should possess; Ebonestor insulators; insulating varnishes and compounds; testing enamels and varnishes.

INSULATORS, ELECTRIC

Improvements. Improvements in Insulators, E. Rosenthal. Elec. World, vol. 83, no. 12, Mar. 22, 1924, pp. 575-576, 7 figs. Breakdowns obviated by employing binder which fills all pores and renders cemented joints impervious to moisture.

Testing Instrument. Detecting Defective Insulators, C. E. Bennett. Elec. World, vol. 83, no. 15, Apr. 12, 1924, pp. 714-715, 7 figs. Advantages of instrument called aislometer which is used on live lines for locating bad units; results of tests and operating experiences; description of device used.

INTERNAL-COMBUSTION ENGINES

Factory Power Plants. The Control of Power Production, Chas. L. Hubbard. Factory, vol. 32, no. 4, Apr. 1924, pp. 482-486, 17 figs. Internal-combustion engines as source of factory power.

Technical Aspects. Some Technical Aspects of the Internal-Combustion Turbine. Power Engr., vol. 19, no. 216, Mar. 1924, pp. 107-109, 1 fig. Survey of present knowledge and practice.

Theory of. Contribution to the Theory of Internal-Combustion Engines (Contribution à la théorie des moteurs à combustion interne), M. Brutzkus. Technique Moderne, vol. 16, no. 4, Feb. 15, 1924, pp. 105-112. 7 figs. Rudiments and formulas of theoretical chemistry; combustion in engines and variation of pressure; combustion and variation of temperature; combined action of these three factors; study of fuels employed.

[*See also Airplane Engines; Automobile Engines; Diesel Engines; Oil Engines.*]

INVENTION

Stimulation of Employees. How to Stimulate Invention by Employees, H. A. Toulmin. Jr. Factory vol. 32, no. 4, Apr. 1924, pp. 490-492, 580 and 582, 6 figs. Nine methods from experience of five companies.

IRON AND STEEL

Chemical Specifications, Interpretation of. Interpretation of Chemical Specifications for Iron and Steel in Relation to Analytical Accuracy, C. H. Ridsdale. Iron and Coal Trades Rev., vol. 108, no. 2923, Mar. 7, 1924, pp. 382-383. Abstract of paper read at joint meeting of Cleveland Instn. Engrs., Newcastle Sec. Soc. Chem. Industry, and Inst. of Chemistry.

IRON CASTINGS

Permanent-Mold. Permanent Mold Casting Methods Cut Production Expense, D. H. Meloche. Automotive Industries, vol. 50, no. 13, Mar. 27, 1924, pp. 711-714, 11 figs. Chief problem in developing successful method was to regulate properly cooling rate; results achieved have resulted in better quality and less cost. (Abstract). Paper read before Soc. Automotive Engrs.

Welding. The Influence of Mass Upon Methods of Pre-heating and Welding Large Iron Castings. Acetylene Jl., vol. 25, no. 9, Mar. 1924, pp. 441-443, 4 figs. Typical example of difficulties encountered in repairing massive castings, and correct method of carrying out repair. From Acetylene and Welding Jl., Lond.

IRON METALLURGY

Sponge Iron Production. A Process for the Production of Sponge Iron, C. E. Williams, E. P. Barrett and Bernard M. Larsen. U. S. Bur. Mines, Reports of Investigations, No. 2578, Feb. 1924, 5 pp., 1 fig. on supp. plate. Description of process developed by Northwest Experiment Station of Bur. Mines in co-operation with Univ. Wash., Seattle; cost data; uses of sponge iron.

IRON ORE

Low-Temperature Reduction. Low Temperature Reduction of Iron Ore, J. Kent Smith. Iron Age, vol. 113, no. 14, Apr. 3, 1924, pp. 1003-1006. Direct processes and blast furnace; CO as factor in both; metallurgical, thermal and fuel conditions compared.

IRRIGATION

Northwest Canada. Development of Irrigation in Northwest Canada, P. J. Jennings. Eng. News-Rec., vol. 92, no. 15, Apr. 10, 1924, pp. 616-618, 4 figs. Projects by individuals, companies and groups of farmers; Government supervision.

J

JIGS

Bevel Gear-Testing. Double Helical Bevel Gear-Testing Jig. Machy. (Lond.), vol. 23, no. 596, Feb. 28, 1924, p. 711, 3 figs. Special jig for testing both accuracy and truth of apex in double helical bevel wheels, as used in automobile back-axle drives.

L

LATHES

Chucking Operations. The Machining of Small Components. Machy. (Lond.), vol. 23, no. 599, Mar. 20, 1924, pp. 793-803, 27 figs. Chucking operations on small automatic and capstan machines.

Gear-Box Design. Production Design of a Lathe Feed Gear-box, A. Clegg. Machy. (Lond.), vol. 23, no. 597, Mar. 6, 1924, pp. 735-737, 3 figs. Gives example of expensive design of 3-speed lathe feed-gear box and shows how this can be substituted by cheaper and better design of similar gear box.

LIGHTING

Colored. Colored Lighting, M. Luckiesh and A. H. Taylor. Illuminating Eng. Soc. Trans., vol. 19, no. 2, Feb. 1924, pp. 135-144 and (discussion) 144-149, 7 figs. on supp. plates. Gives spectral limits of the various colors, and relative luminosity of the various portions of spectrum from a 150 or 200-watt gas-filled lamp; characteristics, advantages and disadvantages of various colored media; results of measurement of transmission factors of many samples of such media; describes two examples of recent large installations of colored lighting with connected-load data. Bibliography.

LIGHTNING

Protection Against. Protection Against Lightning, A. M. Schoen. Safety Eng., vol. 47, no. 3, Mar. 1924, pp. 109-117. Nature and characteristics of lightning and lightning discharges; statistics; suggestions for protection.

LOCOMOTIVES

Boosters. The Locomotive Booster, M. H. Roberts. Ry. & Locomotive Eng., vol. 37, no. 4, Apr. 1924, pp. 111-115, 6 figs. Effect of locomotive booster on operation and its efficiency as engine.

Compound. Compound Locomotives. Times Trade and Eng. Supp., vol. 14, no. 297, Mar. 15, 1924, p. 23. Discusses their re-introduction on British railways, giving data on different types.

Condensing. Paris-Orleans Condensing Locomotive, H. Leflot. Ry. Mech. Engr., vol. 98, no. 4, Apr. 1924, pp. 211-212, 3 figs. Means adopted on suburban tank locomotive for condensing exhaust steam while passing through long tunnel.

Design and Construction. Modern Locomotive Engine Design and Construction. Ry. Engr., vol. 45, no. 529, Feb. 1924, pp. 50-53 and 65, 1 fig. Coned helical and volute springs; stresses in locomotive wheels; wheel-boss stresses; stresses in wheel tires.

Mallet. Simple Mallets for the Chesapeake & Ohio. Ry. Age, vol. 76, no. 19, Apr. 12, 1924, pp. 927-929, 4 figs. 2-8-8-2 type designed to meet restricted clearances; rated tractive force 103,500 lb. See also description in Ry. Rev., vol. 74, no. 14, Apr. 5, 1924, pp. 631-640, 13 figs.

Mikado. New Mikado Type Locomotives for the Wabash R. R. Ry. Rev., vol. 74, no. 13, Mar. 29, 1924, pp. 593-599, 6 figs. New 2-8-2-type freight engines somewhat larger than other locomotives of same type in use on this road.

Steam-Turbine. Developments of the Ljungström Locomotive. Ry. Age, vol. 76, no. 17, Mar. 29, 1924, pp. 849-850, 2 figs. Its performance and later developments in design.

Ljungström Steam Locomotive (Ljungströms Locomotiv), I. F. Johansen. Ingeniören, vol. 33, no. 6, Feb. 9, 1924, pp. 61-68, 16 figs. Description of Sweedish locomotive; great economy obtained by this design shown by test data; fuel consumption reduced about 50 per cent as compared to locomotives of usual design.

Superheater. 1 E- (2-10-0) Two-Cylinder Super-heated Goods Train Locomotive for the Polish State Railways. Eng. Progress, vol. 5, no. 2, Feb. 1924, pp. 29-34, 14 figs. Locomotives built partly by Berlin Machine Co. and partly by Belgian works; requirements and characteristics; results of trial trips. See also description in Ry. Gaz., vol. 40, no. 12, Mar. 21, 1924, pp. 416 and 422, 3 figs.

Three-Cylinder. L. V. Tests of Three-Cylinder Locomotive. Ry. Mech. Engr., vol. 98, no. 4, Apr. 1924, pp. 203-206, 9 figs. Fast movement of heavy trains produced with low fuel consumption and high boiler efficiency; results of tests run on Lehigh Valley mountain-type locomotive no. 5,000, for freight service.

LUBRICANTS

Handling and Storage. Good Practice in Handling and Storing Lubricants. Lubrication, vol. 10, no. 1, Jan. 1924, pp. 1-12, 13 figs. Discusses factors involved in storage of lubricants, including construction of oil house or oil room, storage tanks and their accessory equipment for handling products and shipping containers, extent to which semi-solid lubricants are to be used, etc.

LUBRICATING OILS

Automobile-Engine. Lubricating Oils for Automobile Engines (Die Schmieröle für Automobilmotoren), H. Franz. Motorwagen, vol. 27, no. 7, Mar. 10, 1924, pp. 105-108, 5 figs. Study of process of lubrication in automobile engines and properties of lubricating oils in connection therewith.

LUBRICATION

Bearings. Achieving Safety in Lubrication, R. W. A. Brewer. Iron Age, vol. 113, no. 12, Mar. 20, 1924, pp. 857-859, 6 figs. Fundamental principles which underlie art of correct lubrication; results of tests; fatty acids prevent seizure of heavily loaded bearings; normal working friction more important than abnormal conditions.

Journal Bearings. The Mechanism of Lubrication, D. P. Barnard, H. M. Myers and H. O. Forrest. Indus. and Eng. Chem., vol. 16, no. 4, Apr. 1924, pp. 347-350, 8 figs. Effect of oiliness on behavior of journal bearings.

LOCOMOTIVE FLANGES. A Pneumatic Flange Oiler. Ry. Age, vol. 76, no. 17, Mar. 29, 1924, pp. 841-842, 2 figs. Describes Hoofer flange oiler for lubricating locomotive and wheel flanges.

MULTIPLE-FEED HIGH-PRESSURE. Experiences with Multiple Feed, High Pressure Lubrication, L. R. Humpton. Iron & Steel Engr., vol. 1, no. 3, Mar. 1924, pp. 127-129, 3 figs. Describes installation of lubricators in steel works and successful results.

M

MACHINE DESIGN

KINEMATIC STUDY OF MECHANISMS. The Systematic Use of Bright Colors in the Study of Drives and Mechanisms, (Die systematische Anwendung bunter Farben in der Getriebelehre), Hundhausen. Maschinenbau, vol. 3, no. 11, Mar. 13, 1924, pp. 355-356, 13 figs. on supp. plate. Discusses method employed successfully for many years by author, of using bright colors in order to distinguish different parts of a mechanism from one another or the separate groups from an assembled set; includes kinematic instrument sheet, showing use of colors.

MACHINE TOOLS

SPECIAL. "Ten Cookie Cutters per Minute", K. H. Crumrine. Am. Mach., vol. 60, no. 15, Apr. 10, 1924, pp. 535-537, 5 figs. How obstacles in development of special machines for making cookie cutter were overcome; cutting irregular pieces from thin aluminum tubing; mechanism based on ordinary pipe-cutter finally successful.

MACHINING

SHOULDERED WORK. Accuracy in Machining Shouldered Work, A. A. Dowd. Machy. (N. Y.), vol. 30, no. 8, Apr. 1924, pp. 590-591, 3 figs. Method of obtaining accurate shoulder distances with turret lathe. Accurate facing on a drill press.

MANGANESE STEEL

CASTING. Casting Manganese Steel, H. E. Diller Foundry, vol. 52, nos. 7 and 8, Apr. 1 and 15, 1924, pp. 245-249 and 298-302, 14 figs. Apr. 1: Describes openhearth converter and electric-furnace processes; methods of adding manganese to steel; metal softened by heating in oven and quenching. Apr. 15: Heat treatment in electric furnaces; quality of metal determined by bending test piece; details of molding and handling track work.

MARINE BOILERS

TESTS. Tests on a Cylindrical Marine Boiler with and without Preheated Air, W. H. Owen. Mar. Eng., vol. 29, no. 4, Apr. 1924, pp. 244-248, 8 figs. Account of tests undertaken to ascertain what economical results were to be expected from a marine boiler of cylindrical type when air for combustion was preheated, by new form of heater, to a degree much higher than had been possible with type of apparatus hitherto used, and to compare this efficiency with that obtained with natural draft. Abstract of paper read before Instn. Engrs. and Shipbldrs. in Scotland.

MARINE STEAM TURBINES

DE LAVAL. Geared Turbine Drive. Pacific Mar. Rev., vol. 21, no. 4, Apr. 1924, pp. 216-217 and 242, 4 figs. Particulars of De Laval compound steam turbine with double-reduction gear, which is to be installed in Southern Pacific single-screw passenger steamer.

MATERIALS

TESTING. Strength and Material Testing (Festigkeit und Materialprüfung), P. Ludwik. Zeit. des Vereines deutscher Ingenieure, vol. 68, no. 10, Mar. 8, 1924, pp. 212-214, 6 figs. Difference in strength and notch action in static, dynamic and variable stress. Report from Experimental Engineering Inst. of Vienna Technical High School.

MATERIALS HANDLING

EQUIPMENT. Cutting Corners in Material Handling, A. G. J. Rapp. Blast Furnace and Steel Plant, vol. 12, no. 4, Apr. 1924, pp. 12-16, 14 figs. Horizontal conveyors, vertical hoists, tractors, cranes and savings effected by their use.

METAL DRAWING

SHELLS. Drawing Double-walled Steel Shells, R. B. Hickey. Machy. (N. Y.), vol. 30, no. 8, Apr. 1924, pp. 592-594, 4 figs. Describes dies employed in production of steel shells used in connection with an auxiliary mechanism of an a.c. motor and generally known as "spring barrel tubes", and press operations required in blanking, drawing, redrawing and forming shells.

METALLOGRAPHY

SIMULATING NATURAL LIGHT IN. Simulating Natural Light in Metallography, H. S. George. Am. Inst. Min. & Met. Engrs.—Trans., no. 1333-S, Mar. 1914, 15 pp., 16 figs. Method of illuminating that enhances value of microscopic study of opaque materials, as in metallography; example is included of revelation of hitherto invisible microconstituent.

METALS

ELASTIC AND FATIGUE LIMITS. Elastic and Fatigue Limits in Metals, B. P. Haigh. Birmingham Met. Soc.—Jl., vol. 8, no. 9, Feb. 1924, pp. 412-422 and (discussion) 423-424, 8 figs. partly on supp. plate. Proving and research tests; tensile test as a basis of design; safe stress as a fraction of ultimate tension strength; measurement of fatigue limit; different elastic limits for different kinds of stress.

IMPACT RESISTANCE. Elastic Impact Resistance of Metals and Alloys (Schlagelastizität von Metallen und Legierungen), Geo. Welter. Zeit. für Metallkunde, vol. 16, no. 1, Jan. 1924, pp. 6-11, 13 figs. In author's opinion elastic behavior of materials under dynamic stress is of great importance in dimensioning of machine parts and other constructions; describes new method of determining impact elasticity limit of metals and determines according to this method range of permissible permanent stress for alluminum, electrolytic copper, brass, iron and hardened aluminum alloys; influence of notches is taken into consideration.

RESISTANCE TO WEAR. A Universal and Practical Machine for Determining the Resistance of Metals to Wear under the Various Kinds of Friction Encountered in Practice, F. P. Hitchcock. Testing, vol. 1, no. 2, Feb. 1924, pp. 147-155, 5 figs. Describes machine which is also suitable for investigation of efficiency of anti-friction metals and of lubricants.

TEMPERATURE, EFFECTS OF. Summary of the Results obtained from Experiments made during the Years 1918 to 1923 of the Effects of Temperature on the Properties of Metals, A. Mallock. Roy. Soc.—Proc., vol. 105, no. A730, Feb. 1, 1924, pp. 129-134, 6 figs. Study of effects which variations of temperature produce on elasticity and other constants of various metals.

TENSION TESTING. Tension Testing of Thin Plate Metals, N. S. Otey. Iron Age, vol. 113, no. 14, Apr. 3, 1924, pp. 1008-1009, 5 figs. New test grips claimed to insure accurate results on duralumin and alloy-steel sheets.

TESTING. Some Aspects of the Mechanical Testing of Materials, R. T. Rolfe. Birmingham Met. Soc.—Jl., vol. 8, no. 9, Feb. 1924, pp. 385-405 and (discussion) 405-411, 7 figs. partly on supp. plate. Results of investigation carried out on eyebolts; considerations of Izod test in its relation to question of brittleness in mild steel; slag inclusions in forgings and their relation to hardening cracks and failures occurring in service; work-hardening of forgings in service.

MINERAL RESOURCES

NOVA SCOTIA. Nova Scotia's Mineral Resources. Can. Min. Jl., vol. 45, no. 14, Apr. 4, 1924, pp. 328-331. Report by Natural Resources Intelligence Service, Ottawa, Can.

MINES

TIMBER, PRESERVATIVE TREATMENT. Treating Mine Timbers With Preservatives, G. M. Hunt. Min. Congress Jl., vol. 10, no. 2, Feb. 1924, pp. 102-105, 3 figs. This practice making progress; mining companies erecting open tank plants and using hot and cold bath method of treatment. Timber preservatives and specifications; relative durability of different species of wood; service records on mine timbers.

MINE SIGNALLING

T.P.S. METHOD. Underground Signalling for Mines by the Ground-Conduction or "T.P.S." Method, J. J. Jakosky. U. S. Bur. Mines, Reports of Investigations, No. 2576, Feb. 1924, 11 pp., 6 figs. on supp. plates. Description of T.P.S system of underground communication, apparatus used, operation, and results of tests made.

MOLDING MACHINES

HYDRAULIC VS. JARRING Hydraulic vs. Jarring Molding Machine (Hydraulische oder Rüttelformmaschine?), V. Zsàk. Giesserei-Zeitung, vol. 21, no. 1, Jan. 1, 1924, pp. 1-5, 8 figs. Nature of sand packing with molding press and jarring machine; it is shown that for up to 24-in. boxes only hydraulic molding machines can be used; for boxes from 24 to 40 in. both systems are equally good; for boxes over 40 in. only jarring molding machine can be used.

SELECTION AND OPERATION. Why Molding Machines?, C. W. Miller. Metal Industry (N. Y.), vol. 22, no. 4, Apr. 1924, pp. 146-147. Conditions under which it is advisable to use machines in brass foundry, and when it is poor policy to use them; types best suited to different classes of work; methods of handling and operating to get best results; difficulties which may be encountered and how to overcome them; quality of machine-made castings.

TYPES. Molding Machines and Molding Practice, R. R. Clarke. Metal Industry (N. Y.), vol. 22, no. 3, Mar. 1924, pp. 100-103, 2 figs. Principles of machine molding and how to distinguish between different types for different classes of work.

MOLDING METHODS

JOLT-RAMMING. Jolt-Ramming Molding Practice, A. L. Key. Foundry Trade Jl., vol. 29, no. 397, Mar. 27, 1924, pp. 249-251, 8 figs. Describes author's practice. Principles, advantages, types of machines and installations, layout and tackle.

MOLDS

CAST-STEEL. Comparison of Cast Steel and Iron Ingot Molds, Fr. Schivetz. Forging — Stamping — Heat Treating, vol. 10, no. 3, Mar. 1924, pp. 123-125. Account of author's experiments with steel ingot molds, from which he concludes that great distrust toward steel molds is not wholly warranted; with property chosen pouring method and careful observance of all physical properties, favourable economic results can be obtained. Translated from Stahl u. Eisen, Dec. 28, 1922. See reference to original article in Eng. Index 1922, p. 431.

LONG-LIFE. Making Long Life Molds, O. Smalley. Foundry, vol. 52, no. 8, Apr. 15, 1924, pp. 294-297. Details of refractory mixtures which give satisfactory service; record of series of tests under shop conditions; plaster, paper pulp, ganister, carborundum and monazite among materials used.

MONEL METAL

WELDING. Welding Monel Metal and Nickel. Welding Engr., vol. 9, no. 3, Mar. 1924, pp. 25 and 28-29, 8 figs. Correct procedure for welding by oxy-acetylene, metallic-arc, carbon-arc and resistance methods.

MOTOR BUSSES

HYDRAULIC TRANSMISSION. Hydraulic Transmission for Omnibuses. Engineer, vol. 137, no. 3559, Mar. 14, 1924, p. 292, 1 fig. New system of hydraulic transmission gear which is development of mechanism, devised by same inventor for locomotive work, but modified to suit exigencies of chassis on which it has been fitted.

REMOVABLE TOP. New Bus with Removable Top is Installed by Fifth Ave. Coach Co. Automotive Industries, vol. 50, no. 11, Mar. 13, 1924, pp. 614-615, 4 figs. Novel covering protects passengers from rain and snow but can be rolled up in fair weather; front and rear are inclosed in glass panels; capacity increased by lengthening upper deck.

32-VOLT SYSTEMS FOR. Higher Voltage Systems Suggested for Heavy-Duty Motor Buses, A. M. Dudley and W. E. Menzies. Bus Transportation, vol. 3, no. 4, Apr. 1924, pp. 169-171. Arguments advanced in favour of making 32 volts standard for electrical systems on buses capable of carrying 50 to 60 passengers.

MOTOR TRUCKS

LIGHT-DELIVERY. Special Design Features Are Incorporated in Federal Light Delivery Truck. Automotive Industries, vol. 50, no. 15, Apr. 10, 1924, pp. 816-818, 5 figs. Transmission is three-speed-and-reverse sliding pinion type; all four gears on secondary shaft are made in single unit mounted on stationary shaft on flexible roller bearings, equipped with Willys-Knight engine.

PRODUCER-GAS-DRIVEN. The Problem of Producer-Gas-Driven Motor Trucks (Aperçu sur l'état actuel de la question des camions à gazogène), M. Chauvierre. Technique Automobile & Aérienne, vol. 15, no. 124, 1924, pp. 8-16, 10 figs. Describes E. T. I. A. and Renault producers; results of tests employing wood and charcoal as fuel; conclusions.

RENAULT. The 17.9 hp. Renaults. Motor Transport (Lond.), vol. 38, no. 997, Apr. 7, 1924, pp. 425-427, 8 figs. Particulars of two freight-carrying chassis for 30-cwt. and 35-cwt. loads respectively and a 20-passenger coach model fitted with 4-wheel brakes.

O

OIL

PROSPECTING. Some Planetable Methods, W. A. English. Am. Assn. Petroleum Geologists—Bul., vol. 8, no. 1, Jan.-Feb. 1924, pp. 47-54, 3 figs. Use of sighting points offset from planetable stations; preparation of correction table for use with gradienter; use of target rod for stadia measurements.

OIL ENGINES

AIRLESS-INJECTION. Standardizing Airless-Injection Engines. Motorship, vol. 9, no. 4, Apr. 1924, pp. 270-271, 2 figs. Standardization by Vickers, Ltd., of their 600-b.hp. mercantile 4-stroke oil engine.

BETHLEHEM. The Bethlehem Steel Company's New Oil Engine. Shipbldg. & Shipg. Rec., vol. 23, no. 10, Mar. 6, 1924, pp. 275-282, 16 figs. Detailed description of vertical 2-cycle single-acting oil engine, claimed to be first oil engine of all-American design; constructed in units of four, six, or eight cylinders, running at a speed of from 161 r.p.m. for land power and twin-screw marine purpose down to 90 r.p.m. for single-screw marine use. Description of engine as installed on motorship Cubore. See also Mar. Eng. & Shipg. Age, vol. 29, no. 3, Mar. 1924, pp. 161-167, 15 figs.

DEVELOPMENTS. Recent Developments in Oil-Engine Practice, J. T. Godfrey and K. W. Merrylees. Roy. Engrs. Jl., vol. 38, no. 1, Mar. 1924, pp. 28-32, 2 figs. Developments in Diesel and semi-Diesel, or heavy-oil engine.

MARINE. Some Aspects of the Large Marine Oil Engine, C. J. Hawkes. North-East Coast Instn. Engrs. & Shipbldrs., advance paper, no. 2725S, for meeting Apr. 4, 1924, 15 pp., 3 figs. Deals with questions related to cycle temperatures. The Utilization of Waste Heat in Marine Oil Engines. Mar. Engr. & Naval Architect, vol. 47, no. 558, Mar. 1924, pp. 111-114, 6 figs. Theoretical possibilities.

PALMER. The New Palmer Oil Engine. Shipbuilder, vol. 30, no. 164, Apr. 1923, pp. 285-286, 1 fig. Particulars of engine intended for British Tanker Co.'s oil-carrying ship British Aviator; 6-cylinder opposed-piston type working on two-stroke cycle and having a diagonal rod coupling system between top and bottom pistons of adjacent cylinders, giving a double-acting action in reference to each individual crank-pin; 3,000 b.hp. at 90 r.p.m.

OIL FIELDS

ONTARIO. Oil and Gas in Ontario, R. B. Harkness. Can. Inst. Min. & Metallurgy—Monthly Bul., no. 143, Mar. 1924, pp. 148-156, 1 fig. Early gas fields; oil and gas-bearing formations; structure; general geological features; principles of accumulation; probable points of accumulation in Ontario.

OIL FUEL

EQUIPMENT, RULES FOR. New Fuel-Oil Rules for New York City. Heat. & Vent. Mag., vol. 21, no. 3, Mar. 1924, pp. 67-71. Amendments adopted by Board of Standards and Appeals, dealing with construction and installations of oil-burning equipment and storage and use of fuel oil.

OPEN-HEARTH FURNACES

MOLL CROWN. The Moll Crown for Open-Hearth Furnaces (Der Moll-Kopf für Siemens-Martin-Oefen), H. Moll. Stahl u. Eisen, vol. 44, no. 8, Feb. 21, 1924, pp. 193-196 and (discussion) 197-202, 2 figs. Describes furnace designed by author; advantages of Moll furnace crown; practical results.

ORE DRESSING

COPPER AND LEAD. Concentrator Snapshots, E. H. Robie. Eng. & Min. Jl.—Press, vol. 117, no. 15, Apr. 12, 1924, pp. 596-601, 9 figs. Impressions gained on a trip through some of the copper and lead ore-dressing plants of Missouri, Arizona, and Tennessee.

CYLINDRICAL MILLS. Peripheral-Discharge Cylindrical Mills, A. W. Allen. Eng. & Min. Jl.—Press, vol. 117, no. 8, Feb. 23, 1924, pp. 325-328, 8 figs. Exit pulp flow through trunnion has disadvantages. Development shows progress in recent years.

ORE TREATMENT

COMPLEX ORES. Present Trend in Treatment of Complex Ores, G. L. Oldright. Am. Inst. Min. & Met. Engrs.—Trans., no. 1311-M, Mar. 1924, 15 pp. Treatment of low-grade complex ores by smelting; treatment of complex semi-oxidized ores to low-grade to be smelted; treatment of zinc concentrates and of lead-zinc middling products.

OSCILLOGRAPH

CATHODE-RAY. The Cathode Ray Oscillograph, P. B. Findley. Tech. Eng. News, vol. 6, no. 1, Apr. 1924, pp. 14-15 and 28, 5 figs. Describes oscillograph developed by J. B. Johnson, in which disadvantages of Braun tube have been overcome.

OXY-ACETYLENE WELDING

HEAVY PLATE. Fabricating Heavy Plate by Oxy-Acetylene Welding. Boiler Maker, vol. 24, no. 3, Mar. 1924, pp. 63-67, 19 figs. Construction of two 1,000-barrel oil-storage tanks, 125-ft. rotary kiln, and 50,000-cu. ft. has golder.

P

PAINTS

COLLOIDAL REACTION, EFFECT OF. Phenomena in Paints and Varnishes Induced by Colloidal Reactions, H. A. Gardner. Paint Mfrs.' Assn. of U. S.—Sci. Section, no. 200, Mar. 1924, pp. 279-293. Wetting and grinding phenomena; texture of pigments; absorption phenomena; plasticity and yield value; electrical charge on pigments; viscosity and surface-tension effects, etc.

PROTECTIVE PROPERTIES. The Protective Properties of Paint, W. T. Pearce. Chem. & Met. Eng., vol. 30, no. 12, Mar. 24, 1924, pp. 463-467, 10 figs. Scientific investigations at North Dakota Agricultural College; formulation of test paints; factors affecting durability.

PAPER MANUFACTURE

CHROMO PAPER. Special Moistening of Chromo Paper, E. Arnould. Paper Trade Jl., vol. 78, no. 14, Apr. 3, 1924, pp. 79-80. Notes on manufacture of chromo-paper; moistening of paper as it is being reeled. Translated from Revue Universelle de la Papeterie et de l'Imprimerie, Dec. 14-16, 1923.

DRIERS, VACUUM. The Vacuum Paper Machine Dryer, O. Minton. Paper Mill, vol. 48, no. 15, Apr. 12, 1924, pp. 90, 92, 94, 96, 98, 100, 102, 104, 132, 134, 136, 138 and 140. Historical review; mechanical considerations; operation; theoretical considerations; mill data. This method of drying paper is revolutionary improvement in art of paper making, second only to advent of Fourdrinier paper machine.

MINERALS AND CHEMICALS USED. The Non-Metallic Minerals and Chemicals Used in the Pulp and Paper Industry, L. H. Cole. Can. Min. Jl., vol. 45, nos. 7, 10 and 11, Feb. 15, Mar. 7 and 14, 1924, pp. 158-160, 236-239 and 258-261, 2 figs. Indicates where the different minerals and chemicals are being obtained, process of their manufacture, and possibilities of their being procured in commercial quantities in Canada.

SIZING. The Sizing of Paper, L. P. Zbereboff. Paper Trade Jl., vol. 78, no. 13, Mar. 27, 1924, pp. 45-53, 6 figs. Review of latest books on papermaking; results of study on rosin.

WOOD PULP, MEASUREMENT OF. Weight of Wood and Quantity of Pulp, R. Sieber. Paper, vol. 33, no. 21, Mar. 13, 1924, pp. 7-10, 5 figs. Deals with measuring pulpwood by weight instead of volume. Amount of moisture in wood influences yield of pulp, capacity of digester being affected. Results of investigations. Translated from Svensk Pappers-Tidning, 15 and 17, 1923.

PATENTS

CLASSIFICATION AND PROTECTION. Patents, W. G. Carr. Elec. Jl., vol. 21, no. 3, Mar. 1924, pp. 99-102. Requisites of patentable inventions; classes of inventions; essential parts of a patent application; treatment of applications; patent office records; brief comparison of United States and foreign patent laws; extensions, reissues and disclaimers; etc.

INVENTIONS AND. Suggestions on Inventions and Patents, R. F. Hatch. Am. Mach., vol. 60, no. 14, Apr. 3, 1924, pp. 503-504. What to patent; scope of patents and their values; how to obtain inventive ideas and insure their benefits; manufacturer and patent attorney.

PAVEMENTS

STATISTICS. Additional Paving Tables. Pub. Wks., vol. 55, no. 3, Mar. 1924, pp. 96-100. Areas now in use, areas laid during 1923 and cost thereof, of plain or water-bound macadam, gravel, and concrete pavements as reported in February by several hundred cities.

PAVEMENTS, ASPHALT

MIXTURES. Status of Design of Sheet Asphalt Mixtures, M. F. Macnaughton. Can. Engr., vol. 46, no. 15, Apr. 8, 1924, pp. 419-420. Composition of sheet asphalt surface mixtures; relationship between bitumen content and type of aggregate employed; development of Montreal mixture from Richardson's formulas.

PIPE

BENDING. Pipe Bending, Johnstone-Taylor. Boiler Maker, vol. 24, no. 3, Mar. 1924, p. 81, 1 fig. Brief review of Bonn system developed in England and scope of its application.

CONNECTIONS. Various Methods of Making Pipe Connections, R. W. Angus. Can. Engr., vol. 46, no. 14, Apr. 1, 1924, pp. 381-382, 5 figs. Details in construction and operation of water works plants which are not always given sufficient consideration; connection of service pipes to water main; waste pipe design; reservoir connections and drain pipes.

PIPE, CONCRETE

WATER-SUPPLY. Pre-Moulded Reinforced Concrete Pipe, W. G. Chace. Can. Engr., vol. 46, no. 15, Apr. 8, 1924, pp. 416-417, 3 figs. Design of pipe which has recently been offered for water works intake lines and which has received very favourable comment, including its acceptance for use of two New England cities. From paper read before Can. Soc. Am. Water Wks. Assn.

PISTON RINGS

CALCULATION AND PRODUCTION. A New Method of Calculation and Production of Spring Rings (Ein neues Verfahren zur Berechnung und Anfertigung selbstspannender Kolbenringe), O. Pollert. Zeit. des Vereines deutscher Ingenieure, vol. 68, no. 11, Mar. 15, 1924, pp. 253-254, 2 figs. Discusses some well-known methods of making piston rings and describes new method developed in Sweden by R. Bennet, and gives results of tests.

PLATES

DEFORMATIONS AND STRESSES. Deformations and Stresses of Continuous Plates (Die Formänderungen und die Spannungen von durchlaufenden Platten), A. Nádai. Bauingenieur, vol. 5, no. 5, Mar. 15, 1924, pp. 102-107, 5 figs. Calculation of deformation and stress in slabs which have individual loads at regularly arranged points.

PERFORATED, STRESSES IN. On Stresses in a Plate with a Circular Hole, S. Timoshenko. Franklin Inst.—Jl., vol. 197, no. 4, Apr. 1924, pp. 505-516, 6 figs. Method of approximating influence of beads, used to reinforce holes, on local stresses.

POWER FACTOR

MEASUREMENT. Simplified Power-Factor Measurement (Vereinfachte cos u- Messung), L. Schüler. Elektrotechnische Zeit., special spring no., 1924, pp. 13-14, 4 figs. Describes how measurement can be carried out with sufficient accuracy for all practical purposes with unskilled personnel and without installation of a wattmeter.

PRESSES

CLASSIFICATION. Classification of Power Presses, F. R. Daniels. Machy. (N. Y.), vol. 30, no. 8, Apr. 1924, pp. 617-618, 7 figs. Advocates classification by style of frame, because use to which a press may be put and method of moving gate may be varied; describes machines built by Waterbury Farrel Foundry & Machine Co., Waterbury, Conn., the names given them being those applied by this company.

EJECTORS FOR. Ejectors for Punches and Dies, H. M. Groff. Machy. (N. Y.), vol. 30, no. 8, Apr. 1924, pp. 608-609, 3 figs. Describes different devices employed for ejecting parts from punches and dies of power presses.

INCLINABLE. Design of Inclinable Power Presses, P. A. Friedell. Machy. (N. Y.), vol. 30, no. 8, Apr. 1924, pp. 626-628, 1 fig. Calculations for designing gearing, driving shaft, back-shaft bearing, flywheel and pulleys.

PRODUCER GAS

FACTORY POWER AND HEATING. Gas for Power and Heating. Power Engr., vol. 19, no. 216, Mar. 1924, pp. 99-105, 12 figs. Describes Raliegh's Cycle Co.'s power and heating plant; factory uses suction and producer gas for whole of its heat-treatment processes, and as fuel for its prime movers.

PROSPECTING

ELECTRICAL. Electrical Prospecting in Canada, S. F. Kelly. Can. Inst. Min. & Metallurgy—Monthly Bul., no. 143, Mar. 1924, pp. 166-187, 14 figs. Principles underlying Schlumberger's first method of electrical prospecting and later improvements; application to Canadian deposits; prerequisites for success; Conklin's method.

PUBLIC UTILITIES

PROPERTIES VALUATION. Three Recent Decisions of the United States Supreme Court, Upon Valuation, L. Metcalf. Am. Water Wks. Assn.—Jl., vol. 11, No. 1, Jan. 1924, pp. 1-16. Decisions on valuation of public utility properties handed down in Southwestern Bell, Bluefield Water Works, and Georgia Ry. & Power Co. cases.

PULLEYS

PRESSED METAL, MANUFACTURE. Redesigning a Pressed Metal Pulley, E. Panek. Forging—Stamping—Heat Treating, vol. 10, no. 3, Mar. 1924, pp. 129-130, 8 figs. Eight operations eliminated in manufacture of pulley by change of design and addition of one more part; strength and appearance materially improved.

PULVERIZED COAL

BOILER FIRING. Burning Low-Grade Fuels in Pulverized Form, E. K. Scott. Colliery Guardian, vol. 127, no. 3297, Mar. 7, 1924, pp. 607-608 (includes discussion). Particulars of some of the largest boilers in world designed for working with pulverized fuel firing on Lopulco system; particulars of power stations in France and Belgium which are being equipped with boilers to burn pulverized fuel; application to colliery boilers; colliery coal dust as pulverized fuel. Paper read before Coke Oven Mgrs.' Assn.

COMBUSTION. Experimental Investigation of the Combustion of Pulverized Coal (Etude expérimentale de la combustion du charbon pulvérisé), E. Audibert. Revue de l'Industrie Minérale, no. 73, Jan. 1, 1924, pp. 1-32, 16 figs. Points out that primary reason for large combustion chambers is abnormal temperature otherwise reached by brick work; it is suggested that combustion chamber should be in two compartments, viz., an ignition chamber of very refractory bricks, impermeable to heat, and main combustion chamber with walls permeable to heat; heat passing through latter could be recovered by means of water jacket through which passes feedwater.

PUMPS

SPEED OF ABSORPTION. Contributions to the Theory of Pumps and Compressors (Beiträge zur Theorie von Pumpen und Kompressoren), E. Altenkirch. Zeit. für technische Physik, vol. 5, no. 2, 1924, pp. 44-52, 7 figs. Study of phenomenon of absorption of air from spaces in which liquids can penetrate leads to conclusion that velocity of absorption for low suction heads increases with increasing vacuum, with smaller clearance space more rapidly than with larger.

PYROMETERS

OPTICAL. The Optical Pyrometer as a Brightness Photometer, W. E. Forsythe. Franklin Inst.—Jl., vol. 197, no. 4, Apr. 1924, pp. 517-525, 4 figs. Points out that disappearing filament pyrometer, with red-green glass in eyepiece, has been found very satisfactory as photometer for measuring brightness of different surfaces that were difficult to measure by ordinary means.

PYROMETRY

FUNDAMENTAL PRINCIPLES. Non-Technical Discussion on Pyrometry, G. C. McCormick. Forging—Stamping—Heat Treating, vol. 10, nos. 1 and 2, Jan. and Feb., 1924, pp. 38-39 and 72-74. Fundamental principles reduced to terms within understanding of layman; frequent checking of couples and instruments essential.

STEEL WORKS. General Phases of Pyrometry and Temperature Control in the Steel Industry, O. Brewer. Iron & Steel Engr., vol. 1, no. 3, Mar. 1924, pp. 116-123 and (discussion) 123-127, 8 figs. Deals with instruments for indicating, recording and controlling temperatures, and their application to blast furnace, open hearth, soaking pits, rolling mill, etc.

Q

QUARRYING

BLAST HOLE DRILLING. Some Fundamentals of Big Blast Hole Drilling for Quarry Work, M. B. Garber. Concrete, vol. 24, no. 3, Mar. 1924, pp. 37-40. Importance of a properly balanced tool equipment; care of drilling tool taper joints; shape of drill bits; care of drilling cable; handling seams, crevices and crooked holes; etc. Abstract of paper read at Nat. Crushed Stone Convention.

R

RADIATORS

TRAPS. Operating Characteristics of Radiator Traps. Heat. & Vent. Mag., vol. 21, no. 4, Apr. 1924, pp. 57-60, 5 figs. What heating industry should expect of these devices in way of performancy. Symposium based upon recent tests conducted by Nat. Assn. Bldg. Owners and Mgrs.

RADIOTELEGRAPHY

RECEIVING APPARATUS, SCREENING. Some Experiments on the Screening of Radio Receiving Apparatus, R. H. Barfield. Instn. Elec. Engrs.—Jl., vol. 62, no. 327, Mar. 1924, pp. 249-262 and (discussion) 262-264, 13 figs. Investigation to obtain quantitative information on effect of screens, of which dimensions are small compared with wave length of waves they are intended to screen; measurements demonstrate important part played by closed circuits in screening magnetic field of radio waves, and how that effective screen may be constructed of wire netting; effect of screens on electric field of waves is measured; essential points to be observed in design of efficient screens for various purposes.

RADIOTELEPHONY

LOUD SPEAKERS. Discussion on Loud-Speakers for Wireless and Other Purposes. Instn. Elec. Engrs.—Jl., vol. 62, no. 327, Mar. 1924. Contains following papers: General principles Involved in the Accurate Reproduction of Sound by Means of a Loud-Speaker, A. O. Rankine, pp. 265-268; Theory of Loud-Speaker Design: Some Factors Affecting Faithful and Efficient Reproduction, L. C. Pocock, pp. 268-270, 2 figs.; Sources of Distortion in the Amplifier, C. L. Fortescue, pp. 270-273, 8 figs.; Acoustic Problems of the Gramophone, H. L. Porter, pp. 273-274; Relative Importance of Each Frequency Region in the Audible Spectrum — Measurements on Loud-Speakers, E. K. Sandeman, pp. 275-278, 5 figs.; Overtones of the Diaphragm of a Telephone Receiver, J. T. MacGregor-Morris and E. Mallett, pp. 278-280, 2 figs.; Auditorium Acoustics and the Loud-Speakers, G. A. Sutherland, pp. 280-283, 7 figs.; Some Directions of Improvement in the Loud-Speaking Telephone, S. G. Brown, pp. 283-284; Characteristics of a New Type of Loud-Speaker, P. P. Eckersley, p. 284; Discussions, pp. 285-298, 14 figs.

RADIUM

EXTRACTION FROM ORES. Experiments on the Extraction and Recovery of Radium From Typical American Carnotite Ores, Including Contributions to Methods of Measuring Radium, H. H. Barker and H. Schlundt. Univ. of Mo. Bul., vol. 24, no. 26, Eng. Experiment Station Series 23, Sept. 1923, 87 pp., 15 figs. Results of investigation undertaken to compare different methods of treating ores for extraction and recovery of radium, to test applicability of the various methods to different types of ores, to devise new methods of treatment and modifications of existing processes for extraction from virgin ore, to apply and compare different methods for recovery of uranium and vanadium to determine their respective efficiency and quality of product obtained, and to study electrical and analytical methods involved in determining radium in the various products obtained in its commercial production.

RAILS

FAILURES. High Rail Failure Record for 1917 Rollings. Iron Age, vol. 113, no. 12, Mar. 20, 1924, pp. 851-852. Data from records of rail failures made public by rail committee of Am. Ry. Eng. Assn. Electric welding in steel fabrication.

OLD, RE-ROLLING INTO RODS. Re-rolling Old Railroad Rails Into Rods, A. Noell. Iron Age, vol. 113, no. 12, Mar. 20, 1924, pp. 866-869, 10 figs. Methods of operation in rolling with oblique pressure; reduction of sectional area in rolling; influence of steel strength. (Abstract.) Translated from Stahl u. Eisen.

RAILWAY CONSTRUCTION

GRADE ANALYSIS. Analysis of Railroad Grades for Classification, S. Vilar Y. Boy. Am. Soc. Civ. Engrs.—Proc., vol. 50, no. 3, Mar. 1924, pp. 255-263. Author seeks to solve general problem of grade analysis mathematically, giving results to fit any actual condition by simply substituting values in a general formula.

RAILWAY ELECTRIFICATION

FRANCE. Electrification of the French Midi Railway, A. Bachellery. Instn. Elec. Engrs.—Jl., vol. 62, no. 327, Mar. 1924, pp. 213-218 and (discussion) 218-231, 3 figs. Account of extensive electrification work now pursued by Midi Railway in accordance with new standard regulations of French Government, and of first results obtained on electrified lines.

RAILWAY OPERATION

EXPRESS-TRAIN RESISTANCE. The Resistance of Express Trains, C. F. D. Marshall. Ry. Engr., vol. 45, no. 531, Apr. 1924, pp. 133-137, 3 figs. Natural wind; effect of direct wind; effect of wind gusts on frontal pressure; limiting speeds.

FREIGHT ROLLING STOCK DISTRIBUTION AND CONTROL. Increasing the Mobility of Freight Rolling-Stock. Ry. Gas., vol. 40, no. 11, Mar. 14, 1924, pp. 363-374, 19 figs. Lond. & North East. Ry. now control distribution of whole of their freight rolling stock from a central control office at York, working through 24 district superintendents' offices and 120 sub-control stations. Explains means by which economy in wagon movement is effected and mobility of freight rolling stock increased.

FREIGHT-TRAIN DELAYS, COST OF. What Is Cost of Freight Train Delays? Ry. Age, vol. 76, no. 19, Apr. 12, 1924, pp. 925-926. Committee of signal section, Am. Ry. Assn., analyzes charges and fixes average at $21.07 per hour.

LOADED CAR MOVEMENT, DELAYS. Some Causes of Delay to Loaded Car Movement, R. A. Munsch. Ry. Rev., vol. 74, no. 15, Apr. 12, 1924, pp. 681-683. Analyzes delays for which shipper is primarily responsible and for which agent is responsible.

TRAIN CONTROL. Making Brake Tests for Train Control, C. B. Miles. Ry. Signaling, vol. 17, no. 3, Mar. 1924, pp. 98-100, 4 figs. Relation of air brake to signal engineering from standpoint of air-brake engineer. Methods of making tests.

Train Control Test Engine on the U. P. Ry. Signaling, vol. 17, no. 3, Mar. 1924, pp. 102-103, 5 figs. Describes equipment of locomotive fitted by Union Pacific with three types of control equipment to determine device best suited to its conditions; installation made so that locomotive could be operated over adjacent territory on which the three types of road apparatus were installed.

RAILWAY REPAIR SHOPS

LOCOMOTIVE, WELDING STANDARDIZATION. Welding Standardization in Locomotive Shops, J. S. Heaton. Ry. Mech. Engr., vol. 98, nos. 3 and 4, Mar. and Apr. 1924, pp. 176-178 and 231-234, 5 figs. Review of the various methods used on boilers, fireboxes, running gear, cylinders and reclamation work; proper care of equipment.

RAILWAY SHOPS

MACHINE TOOLS, APPLICATION OF MODERN. How Modern Machine Tools Cut Costs. Elec. Ry. Jl., vol. 63, no. 12, Mar. 22, 1924, pp. 444-454, 29 figs. Practices of some shops in application of modern machine tools and methods to electric railway work. How multiple cutting lathes reduce cost of axle machining; improvements in wheel lathes and boring mills; special machines used in bearing work; etc.

RAILWAY SIGNALING

AUTOMATIC, FOR GRADE CROSSING. Automatic Interlocker for a Crossing Ry. Signaling, vol. 17, no 4, Apr.1924, pp. 165-168, 3 figs. Satisfactory for thin traffic; home and distant signals arranged on "normal danger" plan.

AUTOMATIC BLOCK. A. C. Supply with Battery Reserve for Automatic Block Signaling, H. G. Morgan. Ry. Signaling, vol. 17, no. 4, Apr. 1924, pp. 158-160, 1 fig. Discusses use of commercial power for railway signaling with emergency reserve battery; application of floating system on terminals; transmission for systems requiring more power; systems using power for all functions; signals lighted electrically. Paper presented before Signal Section, Am. Ry. Assn.

Report on A. C. Block Signaling. Ry. Signaling, vol. 17, no. 3, Mar. 1924, pp. 126-128. Report of Am. Ry. Assn. committee on necessary modification of a.c. track circuits in detail or in principle to insure reliable protection of motor buses and motor cars, and availability of rectifiers for signal systems.

DIRECT-CURRENT. Report of Committee on D. C. Signaling. Ry. Signaling, vol. 17, no. 3, Mar. 1924, pp. 132-133. Report of Am. Ry. Assn. committee. Instructions for testing resistance of switch circuit controller, shunting circuits and contacts; maximum resistance for switch circuit controllers, shunting circuits and contacts; specification for bonding track circuits.

LIGHT SIGNALS. D. C. and A. C. Power for Light Signals, L. S. Dunham. Ry. Signaling, vol. 17, no. 3, Mar. 1924, pp. 113-115. Reliable, economical operation to be derived by different combinations of primary battery and a. c. supply.

115 Miles of Light Signals on Santa Fe, E. Winans. Ry. Signaling, vol. 17, no. 4, Apr. 1924, pp. 155-157, 8 figs. Electrically lighted switch lamps and pumping-station motor are fed from transmission line. See also Ry. Age, vol. 76, no. 17, Mar. 29, 1924, pp. 843-844, 2 figs.

SINGLE LINES. Economics on Single Lines. Ry. Engr., vol. 45, no. 530, Mar. 1924, pp. 91-94, 6 figs. Single lines are more costly to signal and to man than double lines of equal or slightly higher traffic density, because of necessary stopping places which, generally, have a layout and signaling altogether out of proportion to ordinary traffic demands of locality. Describes how some of this cost may be reduced.

STORAGE-BATTERY MAINTENANCE AND OPERATION. Report of Committee on Instruction. Ry. Sinaling, vol. 17, no. 3, Mar. 1924, pp. 130-131, 1 fig. Report of Am. Ry. Assn. committee giving instructions on installation, maintenance and operation of storage batteries of both lead and nickel alkaline types, and care and installation of insulated wire.

TELEGRAPH AND TELEPHONE PRACTICE. Telegraph and Telephone Practice, Chas. S. Rhoads. Ry. Signaling, vol. 17, no. 4, Apr. 1924, pp. 173-175, 12 figs. West. Elec. Co. developments of selectors, group type, intercalling and time sending.

RAILWAY TIES

PRESERVATIVE TREATMENT. Improving Method of Treating Ties with Zinc Chloride, J. D. MacLean. Ry. Eng. and Maintenance, vol. 20, no. 4, Apr. 1924, pp. 160-162, 4 figs., 3 tables. Experiments show way to improve treatment, reduce fuel consumption and increase plant output.

RAILWAY TRACK

Constituents, Manufacture of. The Production of Iron and Steel for Railway Purposes, C. J. Allen. Ry. Engr., vol. 44, no. 527, Dec. 1923, pp. 453-456 and 465, 9 figs. Manufacture of fishplates, steel sleepers, corrugated sheets, slag bricks and concrete, and miscellaneous equipment, at Cleveland Steelworks of Bolckow, Vaughan & Co. Ltd.

Depression and Elevation, Combination. C. & N. W. Ry. Depresses Busy Main Line at Milwaukee. Eng. News-Rec., vol. 92, no. 14, Apr. 3, 1924, pp. 570-574, 8 figs. Grade-crossing elimination improves operating conditions; new four-track line; one running track maintained during work; three types of monolithic and precast concrete walls.

Crossings. Report on Highway Crossing Protection. Ry. Signaling, vol. 17, no. 3, Mar. 1924, pp. 123-125, 2 figs. Report of Am. Ry. Assn. committee on requisites for automatic signals used for highway crossing protection, transmission values, reflectors, circuits, code on colors for traffic signals.

Renewal. Getting the Maximum Service from Rail, B. M. Cheney. Ry. Eng. and Maintenance, vol. 20, no. 4, Apr. 1924, pp. 145-148. Analysis of various factors that determine when rail must be replaced.

RAILWAYS

Future Traffic Forecast. Forecasting Future Volume of Railway Traffic, L. E. Peabody. Ry. Age, vol. 76, no. 18, Apr. 5, 1924, pp. 899-900. Consideration of Blood's formula is said to lead to estimates that are too large; original article by J. B Blood was printed in same journal (Feb. 9, 1923, p. 369).

Gages. Railway Gauges, L. Wiener. Int. Ry. Congress Assn.—Bul., vol. 6, nos. 1, 2 and 3, Jan., Feb. and Mar. 1924, pp. 35-70, 87-120 and 163-206, 21 figs. Discusses main-line and secondary-line gages, and employment of different gages for railways in same country; comparison of gages; influence of gage on construction and operation of railways; trans-shipment; break of gage; conversion and standardization.

Reclamation Plant. C. B. & O. Builds Modern Reclamation Plant. Ry. Age, vol. 76, no. 19, Apr. 12, pp. 919-923, 9 figs. New facility at Eola, Ill., has large scrap dock with huge gantry cranes to facilitate sorting.

RECLAMATION

Peat Land. The Swedish Peat Society and Its Work in Peat Land Reclamation, With Some Suggestions for Such Work in United States. H. Witte. Am. Peat Soc.—Jl., vol. 17, no. 1, Jan. 1924, pp. 9-14 and (discussion) 14-16. Rational utilization of peat bogs for agricultural purposes.

REDUCTION GEARS

Shock-Absorbing. Shock-Absorbing and Concentric Speed Transformer. Engineering, vol. 117 no. 3038, Mar. 21, 1924, p. 378, 7 figs. Describes system combining speed reduction obtainable with epicyclic gear, with use of shock-absorbing characteristics of helical springs.

REFRACTORIES

Open Hearth, for. Observations on Requirements of Refractories for Open Hearth, F. W. Davis and G. A. Bole. Am. Inst. Min. and Met. Engrs.—Trans., no. 1312-S, Mar. 1924, 10 pp. Deals with certain of necessary requirements of refractories for open-hearth furnace; refractories in common use for different parts are discussed both as to service they are giving and their suitability to withstand existing chemical, thermal and physical requirements: relation between service and allowable cost of refractory; suggestions on these points.

Testing Machine. Testing Machine for Determination of Softening Conditions under Load at High Temperatures (Prüfmaschine zur Bestimmung des Erweichungsverhaltens unter Belastung bei hohen Temperaturen), H. Hecht. Tonindustrie-Zeitung, vol. 48, no. 12, Feb. 9, 1924, pp. 109-110, 1 fig. Describes machine developed for testing softening behavior of refractory raw materials and products under load at high temperatures.

REFRIGERATING MACHINES

Types. Modern Refrigerating Machines, R. G. Reid. Inst. Mar. Engrs., advance paper for meeting Jan. 8, 1924, 11 pp. Factors which have influenced adoption of high-speed compressor; description of some particular machines; summary of tests taken from such machines on test bed and in actual service.

REFRIGERATING PLANTS

Automatic, Electricity in. Electricity in Automatic Refrigeration. W. Deans. Refrig. Eng., vol. 10, no. 9, Mar. 1924, pp. 335-344 and 348-349, 4 figs. Character of load on motor; types, selection, control and protection of motors; description of automatic plant.

Hold-Over Tanks. Heat Transfer in Brine Hold-Over Tanks, Chas. H. Herter. Power, vol. 59, no. 15, Apr. 8, 1924, pp. 563-565. Discusses three types of hold-over tanks; how to calculate size of congealing tank.

REFRIGERATION

Electric. Electro-Mechanical Refrigeration, A. D. Mclay. Nat. Elec. Light Assn. Bul., vol. 11, no. 3, Mar. 1924, pp. 155-158. Temperature observations of cellars and living rooms; summary of refrigerator temperature studies; vapair process; ice-cream cabinets; etc. Abstract of paper read at Great Lakes Division, Nat. Elec. Light Assn.

Oil-Refining Industry. Oil Refinery Refrigeration, C. H. Herter. Refrig. Wld., vol. 59, no. 3, Mar. 1924, pp. 13-16. Data on important applications of refrigeration in various industries treating oils, fats and greases.

REGULATORS

Oil-Pressure. The Working of a Generating Set Provided with an Oil-Pressure Regulator (Fonctionnement d'un groupe electrogène pourvu d'un régulateur à pression d'huile, sous la forme la plus générale), M. Barbillion. Revue de l'Industrie Minérale, no. 75, Feb. 1, 1924 pp. 69-76, 2 figs. Discusses working of a tachymetric oil-pressure regulator; design and calculation.

RELAYS

Differentially-Connected, Testing of. Testing Differentially Connected Relays, C. M. King. Power, vol. 59, no. 14, Apr. 1, 1924, pp. 530-531, 3 figs. Instructions for making suitable tests before generator has been put into service and while generator is in operation, also how to make periodic tests.

RESEARCH

Industrial. The Management of Industrial Research, J. M. Weiss and C. R. Downs. Chem. and Met. Eng., vol. 30, no. 12, 13 and 14, Mar. 24, 31 and Apr. 7, 1924, pp. 475-478, 513-516 and 549-554. Mar. 24: Building of esprit de corps. Mar. 31: Kind of research organization necessary in special industry and relations with other departments of company. Apr. 7: Accounting system for development and argument for its use.

RIVETED JOINTS

Frictional Resistance of. Determination of the Frictional Resistance of Rivet and Bolt Connections (Bestämning av glidmotstandet i nit- och bultförband), W. Weibull. Teknisk Tidskrift, vol. 54, nos. 3 and 7, Jan. 19 and Feb. 16, 1924, pp. 17-21 and 51-54 (Allmänna Avdelningen), 11 figs. Results of measurement of friction between steel plates; calculation of stresses in rivets. Diagrams and tables.

RIVETS

Heat Treating Steel for. Heat Treating Low-Carbon Bars for Rivets, C. B. Langstroth. Iron Age. vol. 113, no. 12, Mar. 20, 1924, pp. 849-850, 3 figs. Advantage derived from heat treating low-carbon steel as shown by some experience with rivets; cold working strains, as cause of broken heads, removed; properties of final product improved.

ROADS

Drainage. Effect of Drainage on Public Safety, C. A. McCubbin. Can. Engr., vol. 46, no. 13, Mar. 25, 1924, pp. 369-371, 1 fig. Responsibility of township and county municipalities with regard to accidents on highways; various court decisions cited. Paper read at 10th annual conference on road construction.

ROADS, CONCRETE

Curing Period. Can the Curing Period for Concrete Roads By Cut Down? H. F. Clemmer. Eng. News-Rec., vol. 92, no. 14, Apr. 3, 1924, pp. 577-580, 10 figs. Thousands of tests of concrete cured with calcium chloride indicate that it cuts normal curing time in two and does not injure strength or soundness. Paper presented to Am. Road Bldrs. and Assn.

Design. New Design Expected to Cut Cost of Concrete Roads. Eng. News-Rec., vol. 92, no. 15, Apr. 10, 1924, pp. 614-615, 1 fig. Edges thickened, edge and joint bars anchored, longitudinal joint doweled, traffic line inlaid and yardage reduced in new design planned by Pa. Highway Dept.

ROCK DRILLS

Production. Efficiency of Present-Day Pneumatic Rock Drill Due to Superior Workmanship, R. G. Skerrett. Compressed Air Mag., vol. 29, no. 3, Mar. 1924, pp. 791-800, 30 figs. Circumstances under which rock drill performs; particulars regarding production.

ROPE, HOISTING

Wire. Wire Hoisting Ropes for Lifts, G. H. Roberts. Mech. Wld., vol. 75, no. 1940, Mar. 7, 1924, pp. 145-146, 3 figs. Discusses features of primary importance for efficient and economical working of lift ropes; rope life, and conditions of a rope's deterioration.

S

SANITATION

Relation to Health. Sanitation—Its Relation to Health and Life, Geo. C. Whipple. Am. Soc. Civ. Engrs.—Proc., vol. 50, no. 4, Apr. 1924, pp. 490-502, 1 fig. Notes on environmental complements to health; nuisances and annoyances; sanitation and its administration; present status of sanitary engineering.

SCREW MACHINES

Five-Spindle. National-Acme Five-spindle Automatic. Machy. (Lond.), vol. 23, no. 597, Mar. 6, 1924, pp. 752-754, 4 figs. Among new features is exclusive use of right-hand tools, telescoping main tool carrier, improved type of spindle carrier, indexing mechanism for spindle carrier, stock feed in either first or fifth spindle, or both, centralized lubrication, etc.

SEWAGE DISPOSAL

Plants, Activated-Sludge. Sewage Disposal Works at Stratford, Ont., A. B. Manson. Can. Engr., vol. 46, no. 12, Mar. 18, 1924, pp. 335-336, 4 figs. Existing Imhoff tank system converted into an activated sludge plant to serve population of 18,000; nearly 2,000,000 gal. sewage per day handled; new feature embodied in construction of plant.

SEWER CONSTRUCTION

Trench Width and Pipe Load. Relation of Sewer Trench Width to Load on Pipe, Geo. C. D. Lenth. Eng. News-Rec., vol. 92, no. 13, Mar. 27, 1924, pp. 533-535, 14 figs. Wide trenches and poor bedding give high loading; definite figures for each condition make rational designs possible.

SEWERS

Velocity of Flow. On the Velocity of Flow in Sewers Partly Full, M. T. M. Ormsby. Surveyor & Mun. & County Engr., vol. 65, no. 1679, Mar. 21, 1924, pp. 297-298, 1 fig. Gives diagram for finding velocity of flow in sewers when discharge is very much less than full capacity of sewer; intended to be read along with a table of usual form, giving discharge and velocity in a given sewer at a given gradient when flowing full. Curve is drawn for circular and egg-shaped sewers for comparison.

SHAFTS

Fastening Drop-Hanger Bearings. The Fastening of Drop-Hanger Bearings (Befestigung von Hängelagern). Praktischer Maschinen-Konstrukteur, vol. 57, nos. 3-4, Jan. 22, 1924, pp. 14-16, 9 figs. Abstract from German Industrial Standards Committee (N. D. I.) report on methods of fastening drop-hanger bearings to concrete beams.

Torsional Strength. Torsional Strength of Keyway-cut Shafts, W. R. Needham. Machy. (Lond.), vol. 23, no. 596, Feb. 28, 1924, pp. 705-706, 2 figs. Discusses method of calculating polar moduli; includes table of torsional strength (polar values) of British standard sunk keyway shafts.

SHEET METAL

Stamping. Widening Applications of Metal Stamping, R. I. Miner. Forging—Stamping—Heat Treating, vol. 10, no. 2, Feb. 1924, pp. 75-78, 6 figs. Describes applications of sheet metal stamping, i. e., work of those industries in which sheet metal is forced to take a desired shape through action of properly designed tools or dies, operated in a mechanical press.

SOOT BLOWERS

Tests. Tests of Diamond Soot Blowers, H. H. Norton. Am. Soc. Nav. Engrs.—Jl., vol. 36, no. 1, Feb. 1924, pp. 42-54, 13 figs. Results of official tests conducted for purpose of determining efficacy of mechanical soot blowers in cleaning water-tube boiler fired with oil fuel, and to ascertain boiler and furnace efficiencies under certain conditions.

SPRINGS

AUTOMOBILE. Making Springs for Motor Vehicles, F. H. Colvin. Am. Mach., vol. 60, no. 14, Apr. 3, 1924, pp. 509-511, 10 figs. Testing steel and finding best heat treatment for it; methods of forming eyes and bending curves; assembling and testing springs for deflection.

STANDARDIZATION

SIMPLIFICATION AND. Simplification and Standardization, R. M. Hudson. Am. Soc. Steel Treating—Trans. vol. 5, no. 3, Mar. 1924, pp. 276-284. Reviews work of Division of Simplified Practice, Dept. of Commerce together with many associations, societies and individual producers, in bringing about standardization of materials produced, as well as effecting reduction in number of types, grades, brands, finishes and sizes; author brings out that much progress has been made in this work.

STANDARDS

EUROPEAN. European Engineering Standards Issued in 1923. Am. Mach., vol. 60, no. 15, Apr. 10, 1924, p. 538. List of standards issued during 1923 by European Standardizing bodies, which have been received by Am. Eng. Standards Committee, copies of which can be furnished or which may be consulted at offices of Committee.

STEAM

HIGH-PRESSURE. The High-Pressure Steam Convention of the Institute of German Engineers. Eng. Progress, vol. 5, no. 2, Feb. 1924, pp. 21-22. Brief account of meeting held in Berlin, Jan. 18-19, and of papers read.

What the Boiler Owner Should Know about High-Pressure Steam (Was soll der Kesselbesitzer über Hochdruckdampf nissev?), Zeit. des Bayerischen Revisions-Vereines, vol. 28, no. 6, Mar. 31, 1924, pp. 41-44, 7 figs. Discusses properties of high-pressure steam up to 100 atmos., and points out that number of auxiliary arrangements are required for its use; difficulties of its generation, complicated design of plants and frequent lack of economic inducements are some of drawbacks counteracting advantages of high-pressure steam.

STEAM ENGINES

POWER PLANTS. Slow-Speed Steam Engines for Industrial Purposes, D. S. Capper. Indian & East. Engr., vol. 54, no. 1, Jan. 1924, pp. 34-36. Discusses chief factors which combine to determine best method of power supply, viz. first cost, working costs, suitability to particular work, liability to stoppage owing to breakdowns and strikes, and insurance risk.

POWER PLANTS, EFFICIENT USE IN. Steam Engine Utility in Modern Power Plants. A. Murphy. Power House, vol. 17, no. 6, Mar. 20, 1924, pp. 21-24 and 46, 6 figs. Plain slide valve, automatic high speed, Corliss and uniflow types still used efficiently in Canadian field despite hydro-electric development; discussion different types and how to secure efficiency.

STOPS, STANDARDIZATION OF. A. I. & S. E. E. General Specifications for Construction and Installation of Automatic Engine Stops. Iron & Steel Engr., vol. 1, no. 3, Mar. 1924, pp. 135-136. Specifications adopted as standard, Sept. 24, 1923, which shall apply to all automatic engine stops of whatever kind or method. See also article, by W. Greenwood, entitled Standardization of Engine Stops, pp. 136-139.

STEAM PIPE

HIGH-PRESSURE. Piping Specifications, H. W. Brooks. Power, vol. 59, no. 13, Mar. 25, 1924, pp. 505-506. Gives specifications on high-pressure steam header for Batavia power house of Chicago, Aurora & Elgin Railroad Co., as an example of specifications prepared from purchaser's viewpoint.

STEAM POWER PLANTS

INTERCONNECTION OF GAS AND. Difficulties Encountered in the Operation of Interconnected Gas and Steam Stations (Quelques Difficultés rencontrées dans l'Exploitation des groupements de Centrales à gaz et à vapeur), F. Courtoy. Assn. des Ingénieurs Electriciens Sortis de l'Institut Electrotechnique Montefiore—Bul., vol. 2, series 7, Jan. 1924, pp. 4-14. Deals with technical, commercial and administrative difficulties.

MEASURING INSTRUMENTS. New Apparatus for Steam Power Plants, Measuring and Recording Instruments (Nouveaux Appareils pour Centrales à Vapeur, Instruments de Mesure et d'Enregistrement des Consommations de Vapeur). Industrie Electrique, vol. 33, no. 760, Feb. 25, 1924, pp. 65-72, 13 figs. Description of apparatus constructed and employed by Gen. Elec. Co. in United States and Compagnie Française Thomson-Houston in France.

PRIME MOVERS, PROGRESS IN. Progress in Prime Movers, Wm. H. Patchell. Engineer, vol. 137, no. 3561, Mar. 28, 1924, pp. 332-334, 3 figs. Review of developments and progress in size of units and pressure; direction in which progress points at present, with mention of some limitations. (Abstract.) Address before Instn. Mech. Engrs.

TESTING, CONTINUOUS. Continuous Power-Plant Testing, T. Maynz. Power, vol. 59, nos. 6, 9 and 12, Feb. 5, 26 and Mar. 18, 1924, pp. 205-208, 324-325 and 450-452, 10 figs. Feb. 5: How efficiency of plant can be found each day; examples of necessary log data together with simple process of making calculations. Feb. 29: Checking performance of turbine room. Mar. 18 :Making power-plant heat balance.

THERMAL EFFICIENCY. Power Plant Simplification, H. D. Fisher. Combustion, vol. 10, no. 4, Apr. 1924, pp. 262-264. Deals with question of how far it is practicable or advisable for an industrial power plant to follow trend of central station to obtain greatest possible thermal efficiency.

STEAM TURBINES

DESIGN AND OPERATION. Modern Large Steam Turbines. Power, vol. 59, no. 14, Apr. 1, 1924, pp. 543-544, 5 figs. Abstract of lecture delivered by L. Helander before Providence Eng. Soc., Jan. 4, 1924, in which he described conditions governing design and operation of large steam turbines.

Water Rates of Geared Turbines, H. E. Brelsford. Mar. Eng. and Shipg. Age, vol. 29, no. 3, Mar. 1924, pp. 171-174, 4 figs. Design and operating factors of impulse, reaction and combined impulse reaction turbines tending to increase economy.

MARINE. *See Marine Steam Turbines.*

NOZZLE REGULATOR. An Automatic Nozzle Regulator for Steam Turbines. Eng. Progress, vol. 5, no. 3, Mar. 1924, pp. 54-55, 3 figs. Consists of number of double-heat drop valves, controlled by one common spindle; each single valve controls steam admission to nozzle, or group of nozzles, of first stage; made by Bergmann Elec. Works, Berlin.

OPERATION. Operating Instructions for Large Turbines. Power. vol. 59, no. 13, Mar. 25, 1924, pp. 490-491. Rules of procedure in starting up and getting turbine under way; taken from instructions of Westinghouse Elec. and Mfg. Co.

PERIODIC EXAMINATION. Periodic Examinations of Steam Turbines. Power, vol. 59, no. 15, Apr. 8, 1924, pp. 562-563. Instructions of Westinghouse Elec. & Mfg. Co. on details which should be critically observed in periodic examinations.

STEEL

ABRASION, RESISTANCE TO. Brinell's Researches on the Resistance of Iron, Steel and Some Other Materials to Wear, H. A. Holz. Testing, vol. 1, no. 2, Feb. 1924, pp. 104-146, 21 figs. Review of researches and test data, largely based upon translation of Brinell's original paper in Sweedish.

ALLOY. *See Alloy Steels.*

BASIC AND ACID, COMPARISON. Comparative Investigation of Basic and Acid Steels. Foundry Trade Jl., vol. 29, no. 394, Mar. 6, 1924, pp. 200-201. Also Iron and Coal Trades Rev., vol. 108, no. 2922, Feb. 29, 1924, p. 352. Abstract of paper by F. Schmitz published in recent issue of Stahl u. Eisen, giving details of tests made by author, using new method of comparing basic and acid steels.

COMPOSITION. Common Elements in Plain Carbon Steel, V. E. Hillman and F. L. Coonan. Forging—Stamping—Heat Treating, vol. 10, no. 2, Feb. 1924, pp. 66-68. A non-technical discussion of properties imparted to steel by common elements entering into its composition; carbon plays most important role.

ELASTIC LIMIT. Determination of the Elastic Limit of Steels (Détermination industrielle de la limite élastique des aciers), J. Durand. Génie Civil, vol. 84, no. 9, Mar. 1, 1924, pp. 205-208, 3 figs. Discusses three methods of determining elastic limit of steel for industrial uses; comparison of results.

HIGH-SULPHUR. Effect of Zirconium on Hot Rolling Properties of High-sulfur Steels and the Occurrence of Zirconium Sulfide, A. L. Field. Am. Inst. Min. and Met. Engrs.—Trans., no. 1306-S, Feb. 1924, 17 pp., 10 figs. Describes hot-rolling properties of series of high-sulphur steels; shows how zirconium reacts with sulphur content of molten steel.

MANGANESE. *See Manganese Steel.*

STAINLESS. Metallurgical Data on Stainless Steels, H. H. Ahram. Chem. and Met. Eng., vol. 30, no. 11, Mar. 17, 1924, pp. 430-431. Results of careful investigation of properties; tells how properties most desired in any particular case may be obtained by means of heat treatment.

TOOL. *See Tool Steel.*

WELDING HEAT, BEHAVIOR AT. The Behavior of Low-Carbon Sheet Iron at Welding Heat (Das Verhalten von Flusseisenblechen in der Schweisshitze), H. Schottky. Kruppsche Monatshefte, vol. 5, Jan. 1924, pp. 1-6, 11 figs. Through tests with series of siliconfree plates, it is shown that bending test at maximum temperatures—1350 to 1450 deg.—gives good idea of resistivity of low-carbon steel at welding heat.

WORK HARDENING OF. Influence of Temperature on the Work-Hardening of Metals, E. G. Herbert. Engineer, vol. 137, no. 3562, Apr. 4, 1924, pp. 356-357, 6 figs. Tests for measuring work-hardening properties of mild steel at succession of temperatures such as might be expected to be generated by action of cutting tool.

STEEL CASTINGS

MANUFACTURE. Liquid Steel for Castings, T. E. Hull. Foundry Trade Jl., vol. 29, no. 396, Mar. 20, 1924, pp. 238-240. Deals with subject of liquid steel as required for sand molds in production of steel castings. Control of slag; slag inclusions; influence of dissolved or occluded gases; shrinkage; liquidity and fluidity of steel; chemical composition.

STEEL, HEAT TREATMENT OF

CARBURIZATION. Heat-Treatment of Steel with Special Reference to Production, J. W. Urquhart. Machy. (Lond.), vol. 23, no. 596, Feb. 28, 1924, pp. 707-711, 4 figs. Carbon concentration and core condition; deep penetration; wasteful carburization; distortion factor; heating for quenching.

QUENCHING. Effect of Repeated Quenching on Hardness, A. Katto. Forging—Stamping—Heat Treating, vol. 10, no. 3, Mar. 1924, pp. 126-129, 6 figs. Points out that many steels that are not sufficiently hardened after first quenching frequently develop cracks if quenching is repeated, due to excessive hardening.

The Quenching Bath. Machy. (Lond.), vol. 23, no. 597, Mar. 6, 1924, pp. 741-742, 1 fig. Facts concerning rate of cooling; effect of specific heat of bath.

STEEL WORKS

BETHLEHEM, PA. Brief Description of the Bethlehem Steel Co.'s Plant. Min. and Metallurgy, vol. 5, no. 208, Apr. 1924, pp. 168-171, 4 figs. Divisions of plant; railroad facilities; power plants; blast-furnace department; open-hearth and bessemer departments; rolling mills, foundries and forge departments; machine shops, etc.; products of plant.

COST AND PRACTICE CHART. The A. I. and S. E. E. Iron and Steel Cost and Practice Chart. Iron and Steel Engr., vol. 1, no. 3, Mar. 1924, supp. loose folder, containing cost data on coke ovens, blast furnaces, open hearth, blooming mill and electric power, compiled by B. R. Shover.

ELECTRIC DRIVE. Inland Steel Electrically Operated, F. J. Crolius. Blast Furnace and Steel Plant, vol. 12, nos. 2 and 3, Feb. and Mar. 1924, pp. 90-93 and 142-147, 8 figs. Feb.: Describes by-product coke plant and replacement of steam-driven units by electrical equipment at Indian Harbor plant of Inland Steel Co. Mar.: Electrical equipment in various departments of the two plants.

STOKERS

ELECTRIC DRIVES FOR. What Type of Stoker Drive Should Be Used? Power Plant Eng., vol. 28, no. 7, Apr. 1, 1924, pp. 374-377, 4 figs. Relative advantages of engine, turbine, a. c. and d. c. motor drives.

STORAGE BATTERIES

ELECTROLYTES. Effect of Certain Impurities in Storage, Battery Electrolytes, G. W. Vinal and F. W. Altrup. Am. Inst. Elec. Engrs.—Jl., vol. 43, no. 4, Apr. 1924, pp. 313-320, 12 figs. Extension of work carried out at Bur. of Standards where new method for measuring rate of sulphation of storage-battery plates was devised, consisting of periodic weighings of plates suspended in electrolyte; results of experiments indicate that reactions of manganese compounds in battery are somewhat different from previously accepted theories.

SUBSTATIONS

RAILWAY. New Automatic Substation for Vancouver. Elec. Traction, vol. 20, no. 3, Mar. 1924, pp. 145-146, 2 figs. Description of Bodwell substation of British Columbia Elec. Ry. Co., installed to improve trolley voltage conditions and to mitigate electrolysis condition.

SUPERPOWER

UNITED STATES. The Significance and Status of Super Power Development in the United States, E. B. Whitman. Mfrs. Rec., vol. 85, no. 13, Mar. 27, 1924, pp. 79-81, 1 fig. Resume of what it is hoped will be eventually accomplished for the entire country.

SURVEYING

PHOTOGRAPHIC, STEREOSCOPIC PLOTTING MACHINES. Stereoscopic Plotting Machines for Use in Photographic Surveying, H. St. J. L. Winterbotham. Roy. Engrs. Jl., vol. 38, no. 1, Mar. 1924, pp. 68-86, 20 figs. partly on supp. plates. Describes camera plastica, Nistri photocartograph, photogoniometer, autocartograph, and stereoplanigraph.

T

TAPS

STANDARD TOLERANCES FOR. Standardizing Tolerances for Taps—Discussion, Chas. C. Winter. Am. Mach., vol. 60, no. 16, Apr. 17, 1924, pp. 593-594. Discussion of article by W. Daley published in same journal, vol. 60, p. 217.

TELEGRAPHY

CARRIER-CURRENT. Telegraph Systems, F. J. Singer. Wis. Engr., vol. 28, no. 6, Mar. 1924, pp. 111-113, 1 fig. Discusses carrier-current systems in general, and describes multiplex carrier-current telegraphy; application of carrier telegraph in Bell system.

TEMPERATURE CONTROL

AUTOMATIC REGULATORS. "Samson" Automatic Temperature Regulators. Power Engr., vol. 19, no. 216, Mar. 1924, pp. 105-106, 3 figs. Device for maintaining constant temperature of atmosphere or of liquids heated by air, hot water or steam.

TERMINAL, LOCOMOTIVE

TURNTABLES. Unusually Quick Installation of Longer Turntable, H. S. Clarke. Ry. Rev., vol. 74, no. 14, Apr. 5, 1924, pp. 644-649, 9 figs. Delaware & Hudson Co. replaces balanced turntable with longer twin span table in remarkable short time.

TERMINALS, RAILWAY

FREIGHT. Pennsylvania Completes New Freight Station. Ry. Age, vol. 76, no. 18, Apr. 5, 1924, pp. 875-878, 10 figs. Capacious two-level structure latest feature of Pennsylvania's entrance into Detroit; building has concrete roof and expansion joints; 25-ton gantry crane for team tracks.

FREIGHT HAULAGE IN. Successful Tractor and Trailor Haulage, J. F. Murphy. Port & Terminal, vol. 4, no. 1, Feb. 1924, pp. 16-19, 6 figs. Intra-city automotive hauling and intra-terminal haulage; off-track versus on-track railway depots; tractor and semi-trailer movement control.

TESTING MACHINES

TENSILE. Inauguration of 100-Ton Tensile Testing Machine at Birmingham. Gas Jl., vol. 165, no. 3173, Mar. 5, 1924, pp. 563-565, 2 figs. Machine is of vertical single-lever type, operated by four straining screws driven through suitable reduction gearing by 15-hp. 440-volt motor; installed at Research Laboratories of Birmingham Gas Dept.

TEXTILE MILLS

OIL-ENGINE DRIVE. The Heavy Oil Engine for Factory Drive. Indus. Australian & Min. Standard, vol. 71, no. 1834, Jan. 31, 1924, pp. 167-168, 5 figs. Results obtained at Coney Lane textile mill, Keighley.

TOOL STEEL

HARDNESS AND CUTTING TRIALS. Hardness and Cutting Trials of a Tool Steel, Dempster Smith and Israel Hey. Engineer, vol. 137, no. 3562, Apr. 4, 1924, pp. 366-368, 8 figs. Hardness observations on tool steel; cutting tests in Herbert tool-steel testing machine; cutting trials with tools held in turret of ordinary lathe; variation in vertical force with speed of cutting; durability trials with hardened tools subjected to different subsequent heat treatments. Paper read before Manchester Assn. Engrs.

TOOLS

DESIGN. Tool Engineering, A. A. Dowd and F. W. Curtis. Am. Mach., vol. 60, no. 13, Mar. 27, 1924, pp. 463-465, 4 figs. Points of importance in making drawings and keeping records of them.

TRACTORS

CROSS-COUNTRY. Traction Across Rough and Roadless Country, L. A. Legros. Engineering, vol. 117, nos. 3035, 3036 and 3037, Feb. 29, Mar. 7 and 14, 1924, pp. 282-286, 316-319 and 347-350, 63 figs. General consideration of problem; examination of qualities that cross-country tractor possess, and general features of such tractors. Paper read before Brit. Section of Société des Ingénieurs Civils de France.

TRANSFORMERS

CONNECTIONS. Transformers Connected for Operation on a Three-Phase Circuit, B. A. Briggs. Power, vol. 59, no. 17, Apr. 22, 1924, pp. 639-641, 6 figs. Describes different connections for three single-phase transformers.

THREE-CIRCUIT. Theory of Three-Circuit Transformers, A. Boyajian. Am. Inst. Elec. Engrs.—Jl., vol. 43, no. 4, Apr. 1924, pp. 345-355, 10 figs. Discusses characteristics of 3-circuit transformers; scope and general aspects of problems; peculiar phenomena of theoretical interest; electrical network equivalent to magnetically interlinked circuits of 3-circuit transformer is developed; formulas for calculation.

TRANSPORTATION

HIGHWAY. Findings and Deductions from Highway Traffic Surveys, J. G. McKay. Engr. News-Rec., vol. 92, no. 13, Mar. 27, 1924, pp. 526-530, 19 figs. Practical uses of transportation surveys enumerated; Connecticut and California surveys summarized in 19 original graphs; economic field of truck transportation.

RIVER. River Transportation, A. F. Crockett. Engrs.' Soc. West. Pa.—Proc., vol. 40, no. 1, Feb. 1924, pp. 1-12 and (discussion) 13-26, 5 figs. Discusses possible future of river transportation, development of waterways and terminals, and designing of barges to carry freight; motive power on rivers.

TUNNELING

PROGRESS IN. Progress in the Art of Tunneling, J. V. Davies. Eng. News-Rec., vol. 92, no. 16, Apr. 17, 1924, pp. 674-679, 14 figs. Review of development in art of tunnel construction during past 50 years.

TURBO-GENERATORS

NIAGARA FALLS. World's Largest Hydro Unit, M. C. Olson and D. B. Plenge. Elec. Wld., vol. 83, no. 4, Jan. 26, 1924, pp. 174-177, 6 figs. Describes Niagara Falls Power Co.'s new turbo-generator, rated at 65,000 kva.; weight is 1,500,000 lb.; driven by a 70,000-hp. hydraulic turbine under an effective head of 213.5 ft.

V

VIBRATIONS

MACHINERY. Vibration and Noise, R. B. Grey. Electrician, vol. 92, no. 2392, Mar. 21, 1924, pp. 354-355, 4 figs. Their isolation as affecting erection of machinery; methods by which it has been successfully accomplished during last few years.

VOCATIONAL TRAINING

VOCATIONAL GUIDANCE AND SELECTION. The Use of Vocational Tests in the Selection of a Vocation, C. S. Myers. Roy. Soc. Arts—Jl., vol. 72, no. 3722, Mar. 21, 1924, pp. 291-298 and (discussion) 298-302. Vocational selection is defined as the process of choosing, by systematic examination of worker's mental and physical condition, those workers best fitted for vacancies in any one occupation. Work being done on the subject; methods of vocational testing.

W

WAGES

STATISTICS. Wages and Hours of Labor. Monthly Labor Rev., U. S. Bur. Labor Statistics, vol. 18, no. 3, Mar. 1924, pp. 65-93. Statistical data on wages and hours of labor in paper and pulp industry in 1923; wage rates in anthracite industry, wages in Ohio coal mines in 1922; wages and hours of labor in Canada in 1921, 1922, and 1923; wages and hours of labor in China; regulation of hours of labor in Germany; and recent Italian legislation on hours of labor.

WASTE HEAT

INDUSTRIAL FURNACES, RECOVERY FROM. Production and Recovery of Waste Heat from Industrial Furnaces (Entstehung und Gewinung der Abhitze von Industrieofen), P. Beck. Gesundheits-Ingenieur, vol. 47, no. 12, Mar. 22, 1924, pp. 90-95. Based on practical experiences important aspects of waste-heat installations are discussed; results of tests on high- and low-pressure waste-heat boilers; suggestions for further developments in design of such boilers.

WATER FILTRATION

PLANT CONTROL. What Accurate Control of an Old Filter Has Accomplished, E. G. McConnell. Fire & Water Eng., vol. 75, no. 13, Mar. 26, 1924, pp. 587-588 and 614-616, 6 figs. Methods adopted to obtain accurate control of dosage and flow of solutions to old filter plant in Charlotte, N.C., which was soon to be superseded by an entirely new unit. Excerpts from paper read before annual convention of North Carolina Sec., Am. Water Wks. Assn.

WATER MAINS

EXTENSIONS, FINANCING OF. Financing Municipal Water Supply Extensions, C. M. Saville. Am. Water Wks. Assn.—Jl., vol. 11, no. 1, Jan. 1924, pp. 38-64 and (discussion) 64-71, 1 fig. Practical method of financing municipal water main extensions. Discusses several methods in use, commenting upon their advantages and drawbacks, giving particular attention to "guarantee" and "assessment" methods; citations from public utility commissions and some legal opinions. Principles of assessment method as employed at Hartford, Conn., and results of its workings.

WATER SOFTENING

BASE EXCHANGE. Water Softening by Base Exchange, G. C. Baker. Am. Water Wks. Assn.—Jl., vol. 11, no. 1, Jan. 1924, pp. 128-149. Nature of reaction of base exchange; history of development of process; advantages and disadvantages of zeolitic treatment over other methods of water softening; describes investigations undertaken to study problems dealing with zeolitic softeners; general properties of zeolitic softeners; tests on solubility of calcium carbonate in 10 per cent salt solution.

WATER WORKS

CONSTRUCTION. The Value of Comprehensive Water Supply Investigations, A. Van Praag, Jr. Am. Water Wks. Assn.—Jl., vol. 11, no. 2, Mar. 1924, pp. 451-457 (includes discussion). Discusses value of a comprehensive and systematic study of community's water resources prior to construction of water works system, insofar as they apply to shallow ground water sources.

WATTMETERS

THREE-PHASE, CONNECTIONS. Three-Phase Wattmeter Connections, Phil. C. Jones. Am. Inst. Elec. Engrs.—Jl., vol. 43, no. 4, Apr. 1924, pp. 356-360, 3 figs. Describes method from which may be determined three possible groups of connections existing in 6 zones from power factor of 0 per cent lagging to 0 per cent leading, and also actual power factor possible within each zone.

WELDING

ELECTRIC. *See Electric Welding, Arc; Electric Welding, Resistance.*

IRON CASTINGS. *See Iron Castings, Welding.*

OXY-ACETYLENE. *See Oxy-Acetylene Welding.*

WELDS

WELDED JOINTS, EFFICIENCY OF. How Efficient Are Welded Joints? E. E. Michaels. Contract Rec. and Eng. Rev., vol. 38, no. 14, Apr. 2, 1924, pp. 327-329, 4 figs. Tests conducted by Chicago Bridge & Iron Works to determine efficiencies of various types of joints; results obtained provide excellent design data.

WIND MOTORS

ELECTRICITY SUPPLY BY. Modern Installations for the Generation of Electricity by Wind Power (Neuere Anlagen zur Erzeugung von Elektrizität durch Windkraft), L. Riefstahl. Praktischer Maschinen-Konstrukteur, vol. 57, no. 6, Feb. 15, 1924, pp. 49-51, 4 figs. Discusses useful field of wind-electric plants and describes AEG (German Gen. Elec.) system and other plants carried according to this system; economic aspects.

WOOD PRESERVATION

MINE TIMBER. Wood Preservation and Reforestation Advances Reviewed by American Mine Institute, Coal Age, vol. 25, no. 14, Apr. 3, 1924, pp. 491-492, 6 figs. Discusses three methods whereby present situation may be at least partially relieved, namely, (1) use of less timber in mining; (2) preservation through chemical treatment of timber used; and (3) employment of various substitutes for timber. Based on round-table discussion at Am. Inst. Min. and Met. Engrs.

WOODWORKING MACHINES

WOOD-PLANING MACHINES. High-Speed Wood Planing Machine. Engineering, vol. 117, no. 3040, Apr. 4, 1924, pp. 445-446, 6 figs. partly on p. 436. Planing machine for production of flooring boards and other repetitive planing work, capable of completely planing timber up to 12 in. by 5 in. in section at rate of 300 ft. per min.

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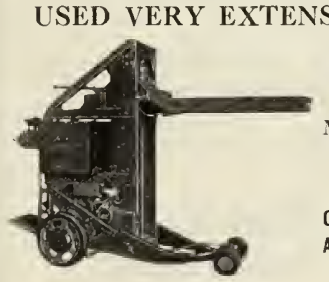

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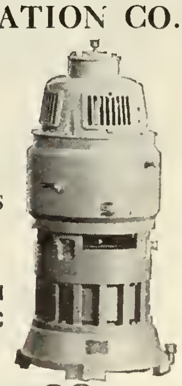

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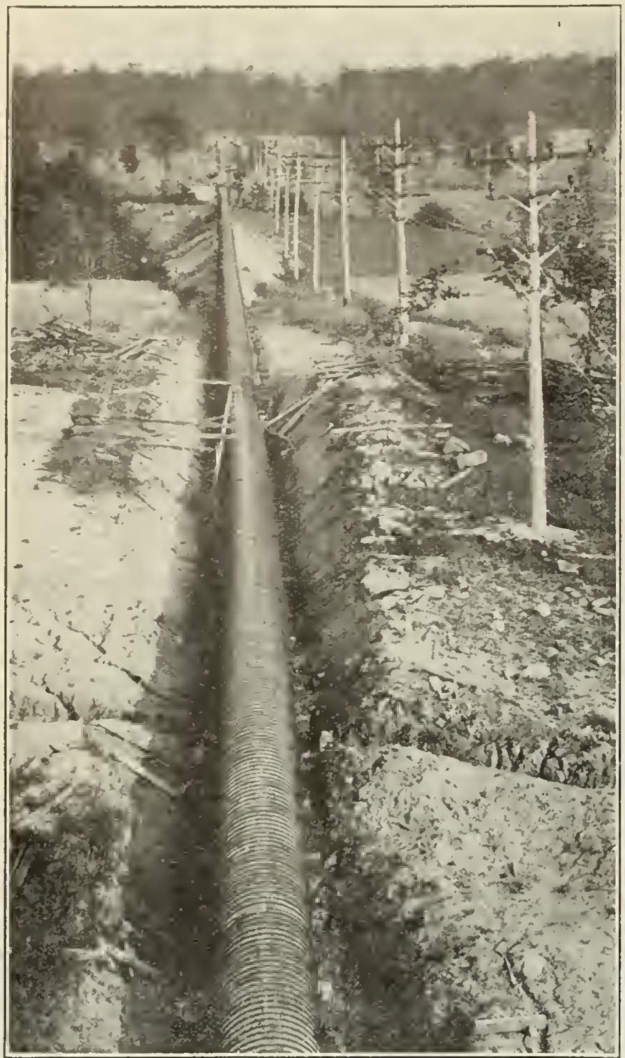


Many Water Powers have been cheaply developed by the use of our

WOOD STAVE PIPE

Many are awaiting development.

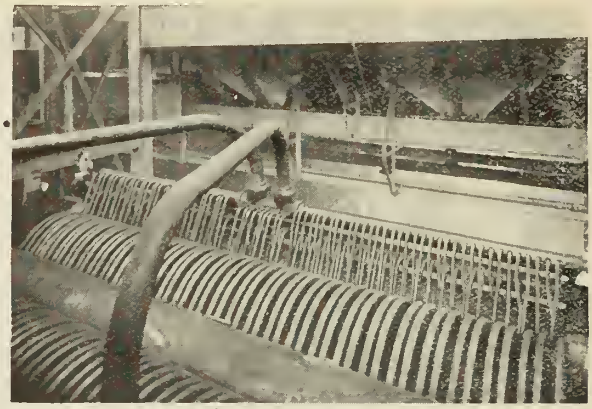
Write us for data on complete installation of our CONTINUOUS WOOD STAVE PIPE made in diameters from 16 inches to 14 ft.

Cheaper than steel pipe Less friction — Long life. Three distinct advantages — and there are others.

Pacific Coast Pipe Co. Ltd.

1551 Granville St., Vancouver, B.C.

ESTABLISHED 20 YEARS 1904 - 1924



View showing top headers of Elesco Superheater installed in 15,000 sq. ft. Heine V-Type Boilers in the Municipal Power Plant of the City of Lansing, Mich. which operates at 200 degrees superheat.

Lansing Municipal Light Plant

Installs

ELESCO Superheaters

The City of Lansing, Mich. is now completing the initial installation of 25,000 kw., in what may be regarded as one of the most efficient municipal power plants in existence. It was designed by J. E. Woodwell, consulting engineer of New York and conforms with the latest large central station practice.

Naturally the importance of superheat as a contributary to high economy received careful consideration. Three 15,000 sq. ft. Heine Boilers of the new V-Type operating at 275 lb. pressure are equipped with Elesco Superheaters. High and uniform velocities through the multiple pass superheater was utilized to assure 200 deg. superheat with the minimum variation under the heavily fluctuating industrial load which the station carries during the day.

SERIES O-T BULLETINS ON REQUEST

The Superheater Co., Limited,

Transportation Bldg. MONTREAL — ELESCO — Works at SHERBROOKE, Que.

Made in CANADA

Purchaser's Classified Directory

A Selected List of Equipment, Apparatus and Supplies

For Alphabetical List of Advertisers see page 54

A

Acids:
Nichols Chemical Co., Ltd
Air Brakes:
Canadian General Electric Co., Ltd.
Air Coolers:
Laurie and Lamb.
Air Filters:
Midwest Canada Limited.
Alumina Sulphate;
Nichols Chemical Co., Ltd.
Ammonia Controlled Water Regulators:
Under-Feed Stoker Co., of Canada, Ltd.
Ammonia Valves and Fittings:
Crane Ltd
Anchorage Equipment:
Midwest Canada, Ltd.
Angles:
Canadian Vickers Ltd.
Dominion Bridge Co., Ltd
Hamilton Bridge Works Co., Ltd.
Arches, Flat:
Combustion Engineering Corp., Ltd.
Asphalt:
Imperial Oil Ltd.
Ash Handling Equipment:
Combustion Engineering Corp Ltd.
Link-Belt Ltd.
Automatic Air Valves:
Jenkins Bros., Ltd.
Automatic Underfeed Stokers:
Combustion Engineering Corp., Ltd.
Taylor Stoker Co., Ltd.

B

Balls, Chromang Grinding:
William Kennedy & Sons, Ltd.
Balls, Steel:
Openshaw & Bennet Ltd.
Barge Cranes:
Industrial Works.
Bars, Reinforcing:
Algoma Steel Corp., Ltd.
British Empire Steel Corp., Ltd.
Burlington Steel Co., Ltd.
Midwest Canada Limited.
Bars, Steel & Iron:
Burlington Steel Co., Ltd.
Steel Co., of Canada Ltd.
Beams:
Canadian Vickers Ltd.
Dominion Bridge Co., Ltd.
Hamilton Bridge Works Co., Ltd.
Bearings, Ball:
Openshaw & Bennett, Ltd.
N. Slater Co., Ltd.
Belting:
General Supply Co., of Canada, Ltd.
Jones and Glassco, Regd
Bending Machines:
John Bertram & Sons Co., Ltd.,
Blowers, Centrifugal:
De Laval Steam Turbine Co.
Blue Print Machinery:
J. Frank Raw Co., Ltd.
Boilers:
Canadian Vickers Ltd.
E. Leonard & Sons, Ltd.
Mussens Limited
Boilers, Electric
Dominion Engineering Works, Ltd.
Boilers, Heating:
Combustion Engineering Corp., Ltd.
E. Leonard & Sons, Ltd.
Taylor Stoker Co., Ltd.
Boilers, Marine:
Canadian Vickers Ltd.
Boilers, Portable:
E. Leonard & Sons, Ltd.
Boilers, Return Tubular:
Babcock-Wilcox & Goldie-McCulloch Ltd.
Bolts:
British Empire Steel Corp., Ltd.
N. Slater Co., Ltd.
Steel Co., of Canada, Ltd.
Bonds, Rail:
Dominion Insulator & Mfg. Co., Ltd.
Boring and Turning Mills:
John Bertram & Sons Co., Ltd.,
Boxes, Cast Iron:
G. & W. Electric Specialty Co.
Boxes, Valve:
Jenkins Bros., Ltd.
Brass, Sheets, Rods, Tubes:
Openshaw & Bhnnet Ltd.
Canadian Vickers Ltd.
Canadian Des Moines Steel Co., Ltd.
Hamilton Bridge Works Co., Ltd.
Canadian Bridge Co., Ltd
Dominion Bridge Co., Ltd.
Hamilton Bridge Works Co., Ltd.
Broadcasting Equipment:
Northern Electric Co., Ltd.
Buckets, Clamshell, Grab:
Industrial Works.
Buckets, Clamshell, Orange-peel:
F. H. Hopkins & Co., Ltd.
Bucket Loaders:
Link-Belt Ltd.
Mussens Ltd
Builders Supplies:
Jno. E. Russell Co., Ltd
Building Papers:
Barrett Co., Ltd
Buildings, Steel:
Canadian Vickers Ltd.
Canadian Bridge Co., Ltd.
Dominion Bridge Co., Ltd.
Hamilton Bridge Works Co., Ltd.
MacKinnon Steel Co., Ltd.

C

Cable End Bells:
G. & W. Electric Specialty Co.
Car Dumpers:
Canadian Mead-Morrison Co., Ltd.
Link-Belt Ltd.
Car Equipment Specialties:
Dominion Insulator & Mfg. Co Ltd.
Car Pullers:
Canadian Mead-Morrison Co., Ltd.
Link-Belt Ltd.
Car Steps, Safety
Irving Iron Works Co.
Car Wheels, Chilled Iron.
Canada Iron Foundries, Ltd.
Cars, Dump:
Canadian Equipment Co., Ltd.
F. H. Hopkins & Co., Ltd.
Hydro Salvage Syndicate.
Mussens Ltd.
Cargo Cranes:
Industrial Works
Casements, Steel:
Trussed Concrete Steel Co., of Canada, Ltd.
Castings:
Babcock-Wilcox & Goldie-McCulloch Ltd.
William Kennedy & Sons, Ltd.
Castings, Brass:
N. Slater Co., Ltd.
Superheater Co., Ltd.
Castings, Car and Locomotive:
Canadian Steel Foundries, Ltd.
Castings; Ferro-Alloy.
Canadian Steel Foundries, Ltd.
Castings, Iron:
Canada Iron Foundries, Ltd.
Dominion Engineering Works, Ltd.
Gartshore-Thomson Pipe and Foundry Co., Ltd.
E. Leonard & Sons, Ltd.
Superheater Co., Ltd.
Castings, Steel:
Canadian Steel Foundries, Ltd.
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N. Slater Co., Ltd.
Cement, Dealers:
Jno. E. Russell Co., Ltd.
Cement Gun:
General Supply Co., of Canada, Ltd.
Cement, Manufacturers:
Canada Cement Co., Ltd.
Chain Grate Stokers:
Babcock-Wilcox & Goldie-McCulloch Co., Ltd.
Chains:
Link-Belt, Ltd.
Chains, Silent:
Jones and Glassco, Regd.
Link-Belt Ltd
Channels:
Dominion Bridge Co., Ltd.
Hamilton Bridge Works Co., Ltd
Chemist, Industrial:
Milton Hersey Co., Ltd.
Chimneys:
Combustion Engineering Corp. Ltd
Circuit Breakers:
Dominion Engineering Agency Ltd
Clamshell Buckets:
Industrial Works.
Coal:
British Empire Steel Corp., Ltd
Coal Handling Equipment:
Canadian Mead-Morrison Co. Ltd.
Combustion Engineering Corp. Ltd.
Dominion Bridge Co., Ltd
Link-Belt, Ltd
Mussens Limited
Coke:
British Empire Steel Corp., Ltd.
Cooling Air Filters:
Midwest Canada, Ltd.
Compressor Filters:
Midwest Canada, Ltd.
Compressors:
Canadian Vickers Ltd.
General Supply Co., of Canada, Ltd.
Babcock-Wilcox & Goldie-McCulloch Co., Ltd.
Compressors, Air:
Canadian Westinghouse, Co., Ltd.
Hydro Salvage Syndicate.
Mussens Limited
Compressors, Ammonia:
Taylor Stoker Co., Ltd.
Compressors, Centrifugal.
De Laval Steam Turbine Co.
Concrete Armouring, Surface:
Irving Iron Works Co.
Concrete Inserts, Continuous:
Midwest Canada, Ltd.
Concrete Mixers:
General Supply Co., of Canada, Ltd.
F. H. Hopkins & Co., Ltd.
Hydro Salvage Syndicate.
Mussens Ltd.
Condensers, Synchronous & Static
Canadian General Electric Co., Ltd.
Construction Material:
Northern Electric Co., Ltd.
N. Slater Co., Ltd.
Contractors:
E. G. M. Cape & Co.
E. O. Leahey & Co., Ltd.
Randolph MacDonald Co., Ltd.
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Canadian Equipment Co., Ltd.
F. H. Hopkins & Co., Ltd.
Mussens Limited
Contractors' Pumps:
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Controllers, Electric:
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Combustion Engineering Corp., Ltd.
Link-Belt Ltd.
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Link-Belt Ltd.
Mussens Ltd.
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Combination Crane Pile Drivers:
Industrial Works.
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Midwest Canada Limited.
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Openshaw & Bennet Ltd.
Cranes:
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Canadian Vickers Ltd.
Cranes, Crawler:
Link-Belt Ltd.
Cranes, Electric:
Industrial Works.
Cranes, Locomotive:
Canadian Equipment Co., Ltd.
F. H. Hopkins & Co., Ltd.
Industrial Works.
Link-Belt, Ltd.
Mussens Ltd.
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Industrial Works.
Cranes, Transfer:
Industrial Works.
Cranes, Travelling:
Dominion Bridge Co., Ltd.
Cranes, Tunnel:
Industrial Works.
Cranes, Wrecking:
Industrial Works.
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Barrett Co., Ltd.
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N. Slater Co., Ltd.
Cross Arm Braces, Steel:
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F. H. Hopkins & Co., Ltd.
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Gartshore-Thomson Pipe and Foundry Co., Ltd.
Jno. E. Russell Co., Ltd.
Cutters, Milling:
Pratt & Whitney Company of Canada, Ltd.
Cutting off Machines:
John Bertram & Sons Co., Ltd.

D

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Derricks:
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Mussens Ltd.
Die Screw Plates:
Pratt & Whitney Company of Canada, Ltd.
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N. Slater Co., Ltd.
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N. Slater Co., Ltd.
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Canadian Vickers Ltd.
Drills:
Pratt & Whitney Company of Canada, Ltd.
Drilling Machines, Metal:
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Dumb Waiters, Electric:
Turnbull Elevator Co., Ltd.

E

Economizers:
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Combustion Engineering Corp., Ltd.
General Supply Co., of Canada Ltd.
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Industrial Works.
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BURLINGTON STEEL COMPANY LIMITED

Hamilton, Canada

Lister Building 138 ft. x 100 ft., Six Storeys, Hamilton, Ont.

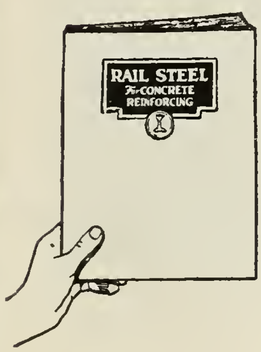
Bernard H. Prack,
Architect.

Pigott-Healy Construction Co.,
Contractors.

Service Counts

Reinforced Concrete Work on above building was completed in 37½ actual working days. This could only have been accomplished by the prompt and satisfactory service given by the Burlington Steel Company who furnished 225 tons RAIL STEEL BARS for this construction. Pigott-Healy state in their circular entitled "Speed in Reinforced Concrete Construction" which is a description of the Lister Building:-

"To the Burlington Steel Company who so arranged their material for us that they were on the job each week with column steel Tuesdays, beam steel Wednesdays, and the slab steel Thursdays, perfectly bundled, without delay, we are very much indebted."



Send for This Valuable Book—FREE

The first and only authoritative and comprehensive treatise on concrete Reinforcing Bars and containing most important information on the manufacture, qualities and use of Rail Steel Bars.

Specify your reinforcing steel to meet ASTM Specification A-16-14 or Canadian Engineering Standards Association A-9-1923-B

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Turnbull Elevator Co., Ltd.
Elevators, Push Botton:
Turnbull Elevator Co., Ltd.
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Dominion Paint Works. Ltd.
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Babcock-Wilcox & Goldie-McCulloch Ltd.
Laurie and Lamb.
E. Leonard & Sons. Ltd.
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Canadian Equipment Co., Ltd.
Mussens Limited
Excavators, Dragline:
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Exhaust Steam Injectors. Locomotive:
Superheater Co., Ltd.

F

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Jenkins Bros., Ltd.
Files, Valve:
Jenkins Bros., Ltd.
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Irving Iron Works Co.
Flooring, Open Steel:
Irving Iron Works Co.
Flooring, Steel:
Irving Iron Works Co.
Flooring, Non-Slipping:
Irving Iron Works Co.
Flooring, Ventilating:
Irving Iron Works Co.
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N. Slater Co., Ltd.
Friction Clutches:
Dodge Manufacturing Co., Ltd.
Link-Belt Ltd.
Fuel, Oil:
Imperial Oil, Ltd.
Furnaces, Automatic:
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G

Galvanizing, Hot Dip:
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Hamilton Gear & Machine Co.
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H

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Taylor Stoker Co., Ltd.
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Taylor Stoker Co., Ltd.

I

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Dominion Engineering Agency, Ltd.
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Dominion Insulator & Mfg., Co. Ltd.

J

Joints, Filler Paving:
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K

Kerosene:
Imperial Oil Ltd.

L

Ladder Steps, Steel:
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Lathes:
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Mussens Ltd.
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Canadian Westinghouse Co., Ltd.
Hydro Salvage Syndicate.
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M

Machine Tools:
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Mussens Limited
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Canadian Westinghouse Co. Ltd.
Lincoln Electric Co., of Canada, Ltd.
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N

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O

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De Laval Steam Turbine Co.

P

Paints, Metal Protectives:
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Dart Union Co., Ltd.
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Pulpwood Machinery:
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Canadian Vickers Ltd.
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Members are urged to consult The Journal's advertising pages.

Purchaser's Classified Directory

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Mussens Limited

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Babcock-Wilcox & Goldie-McCulloch Ltd.

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Dominion Engineering Worbs, Ltd.
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Pumps, Hydraulic:
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Pumps Oil,
Taylor Stoker Co., Ltd.

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Punches and Shears:
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R

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S

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Mussens Limited

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Horton Steel Works, Ltd.

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Under-Feed Stoker Co., of Canada, Ltd.

Stokers, Side-feed:
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Under-Feed Stoker Co., of Canada, Ltd.

Stokers, Under-feed:
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Taylor Stoker Co., Ltd.
Under-Feed Stoker Co., of Canada, Ltd.

Stone Crushers:
General Supply Co., of Canada, Ltd.
Mussens Limited

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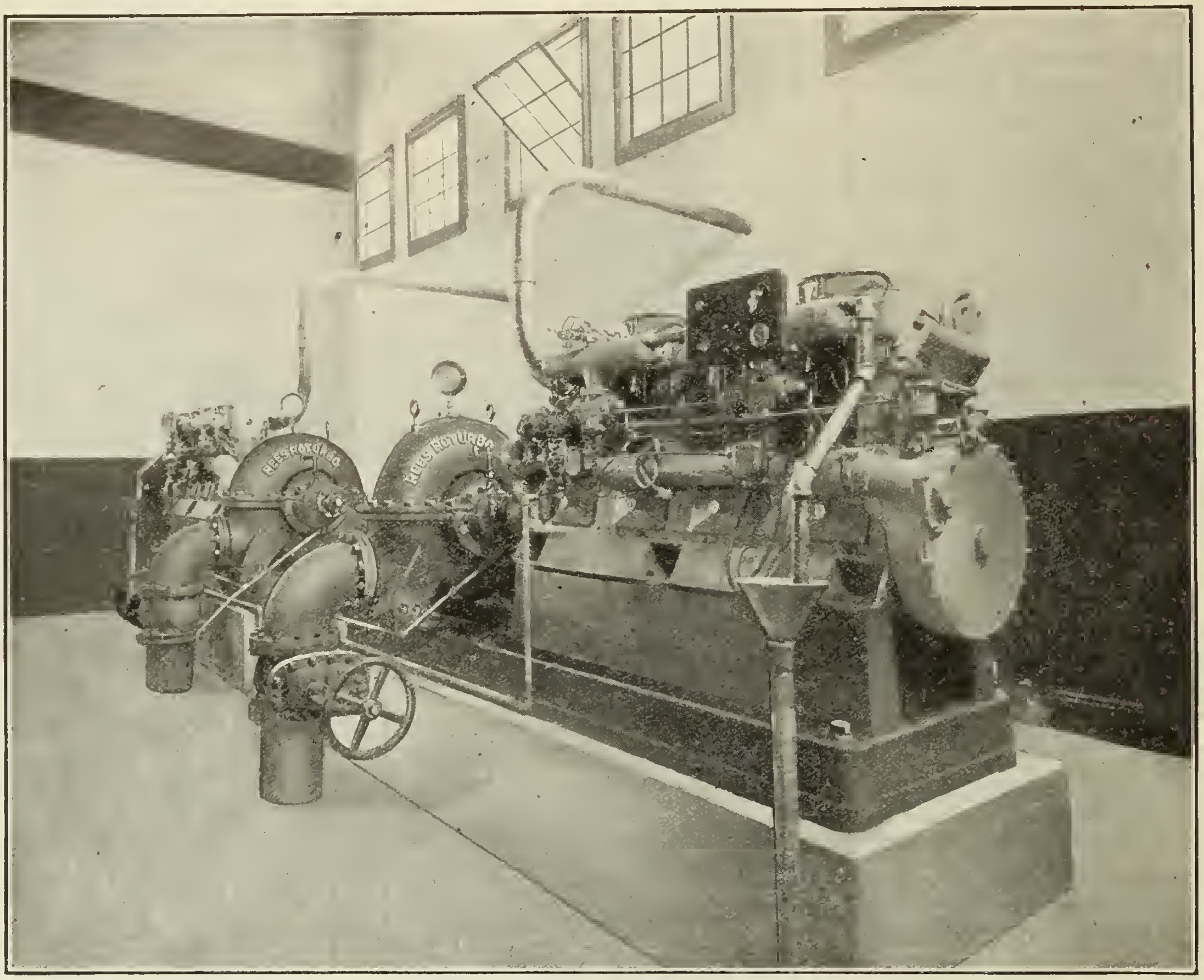

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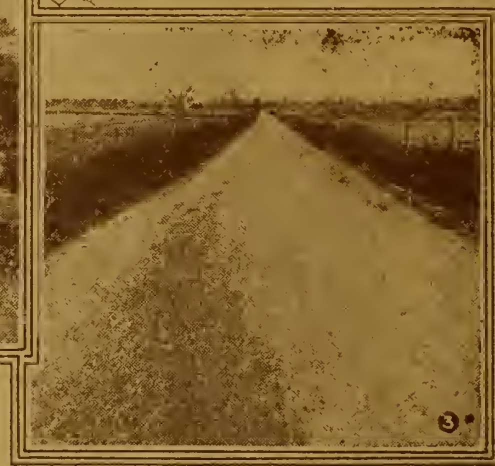

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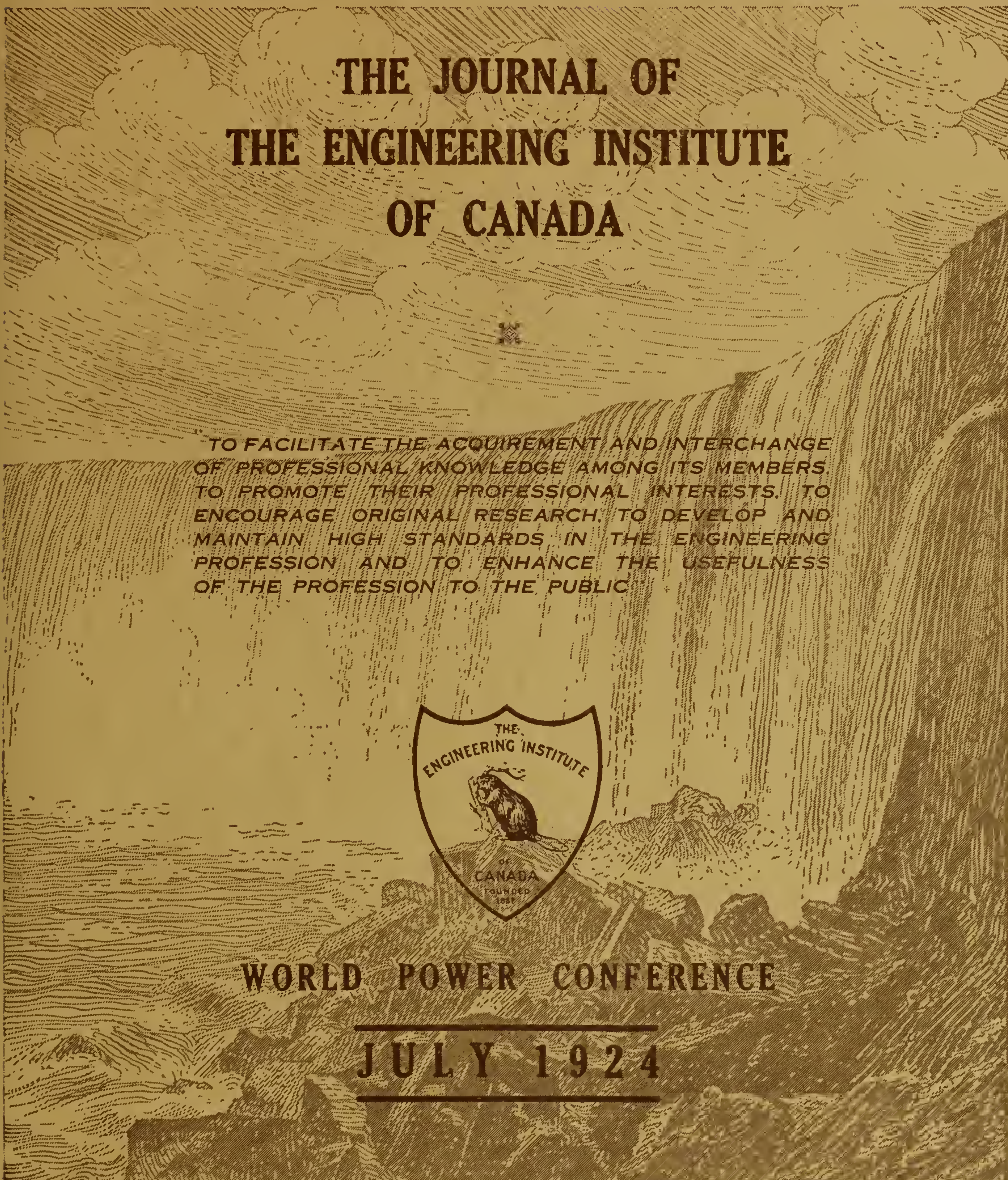

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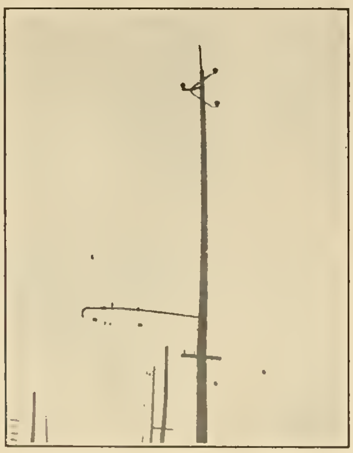
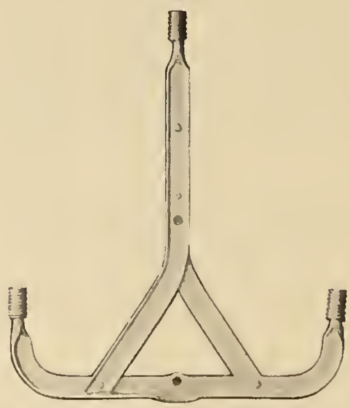
Vol. VII No. 7





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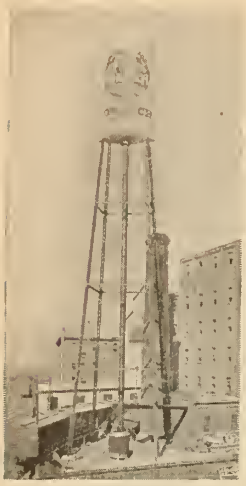

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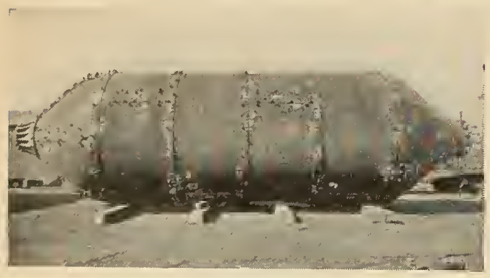

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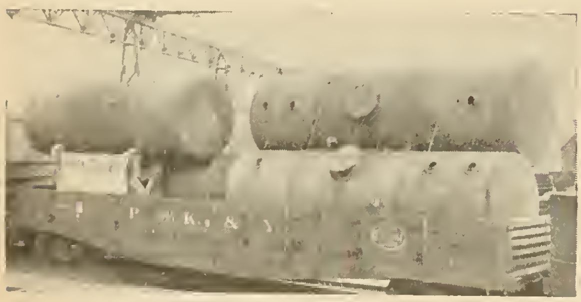

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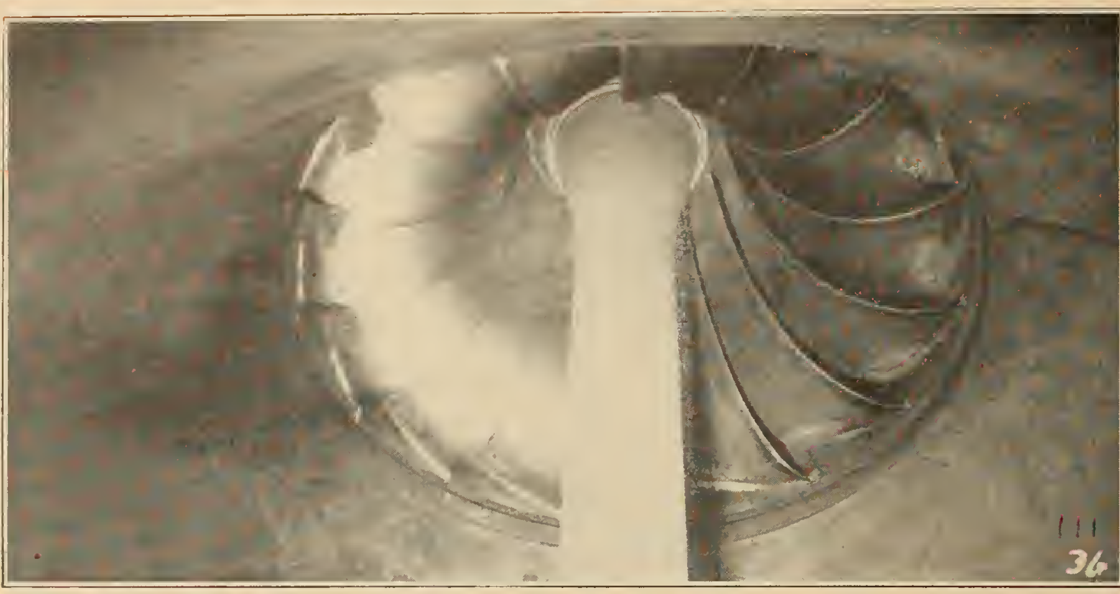

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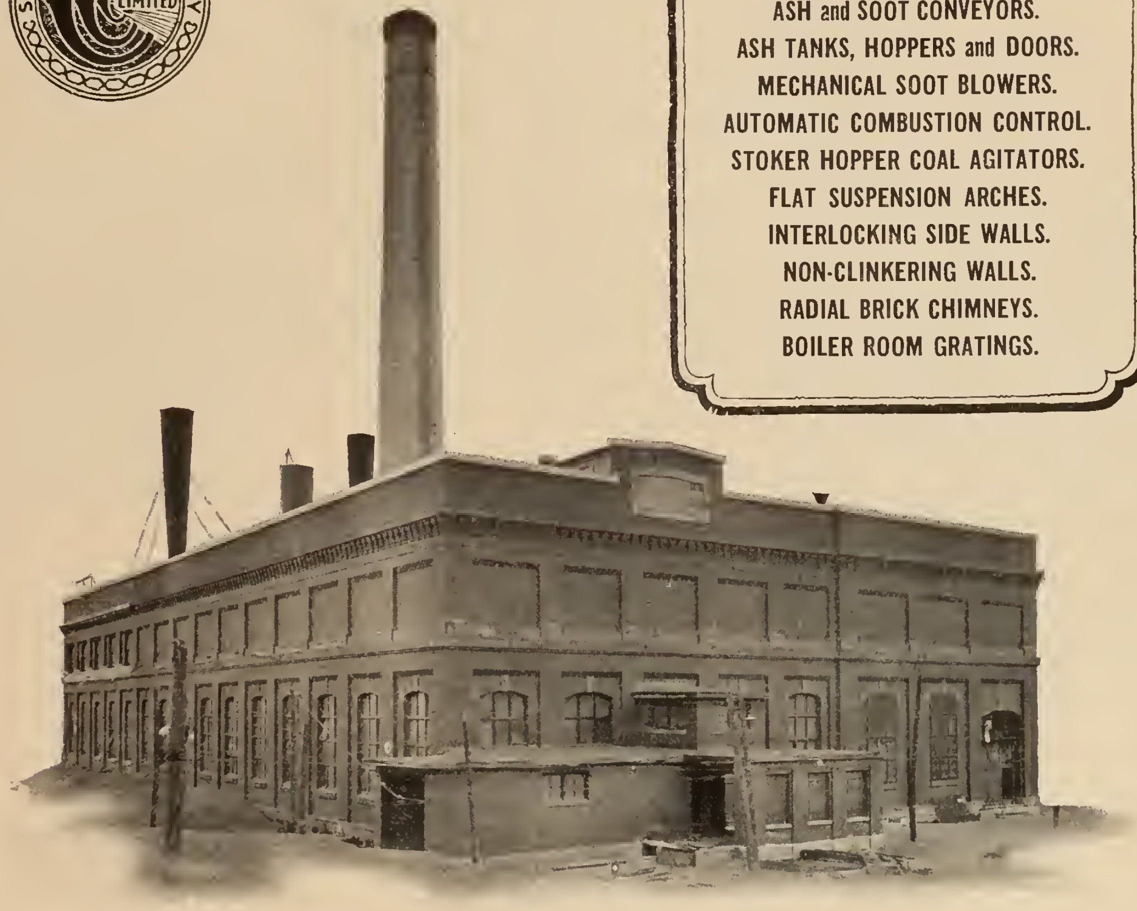

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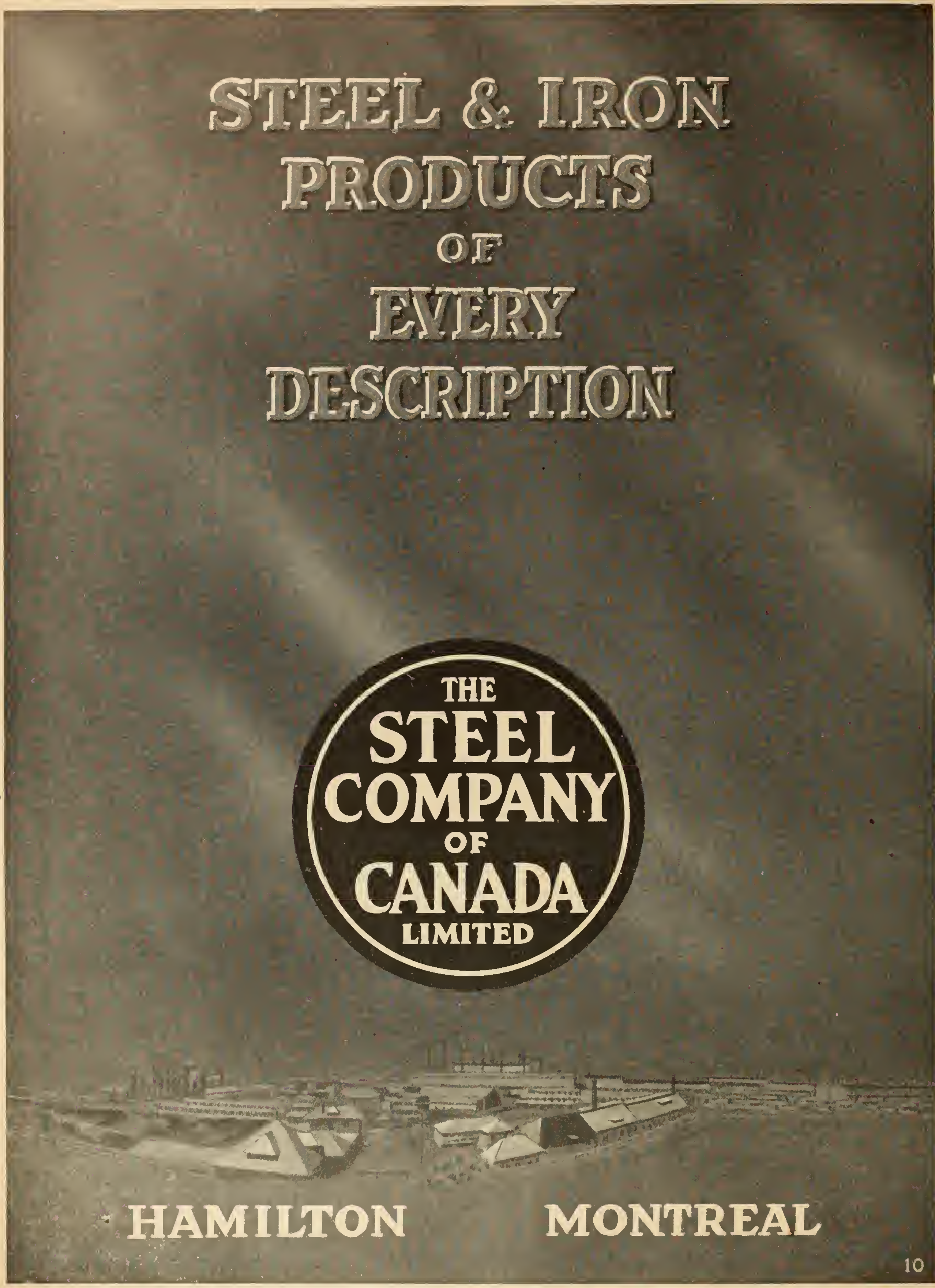
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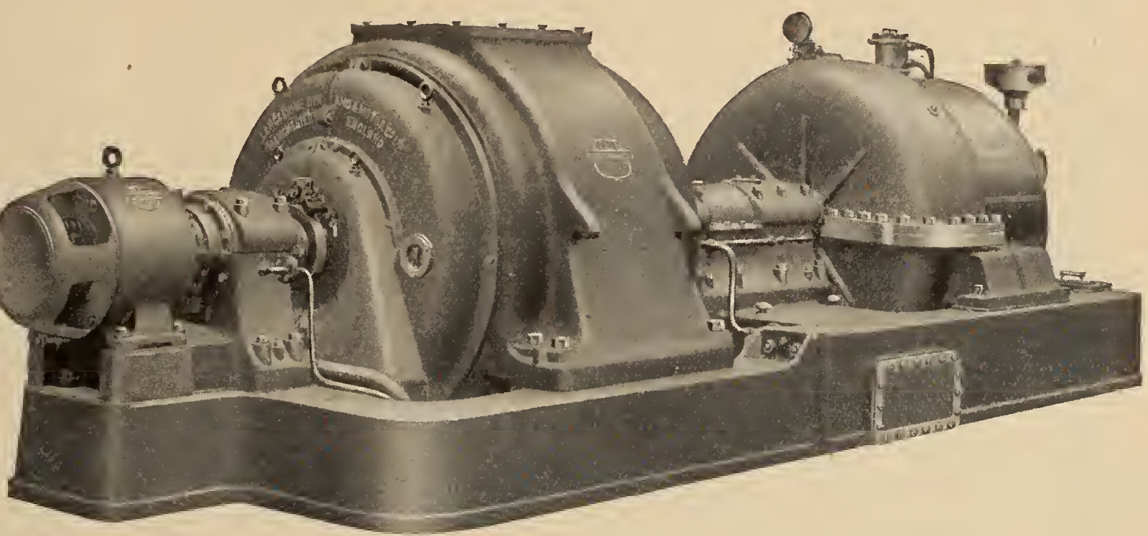

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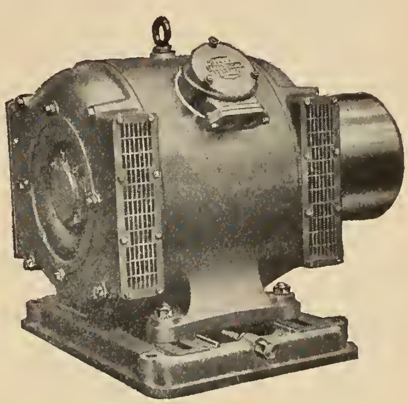

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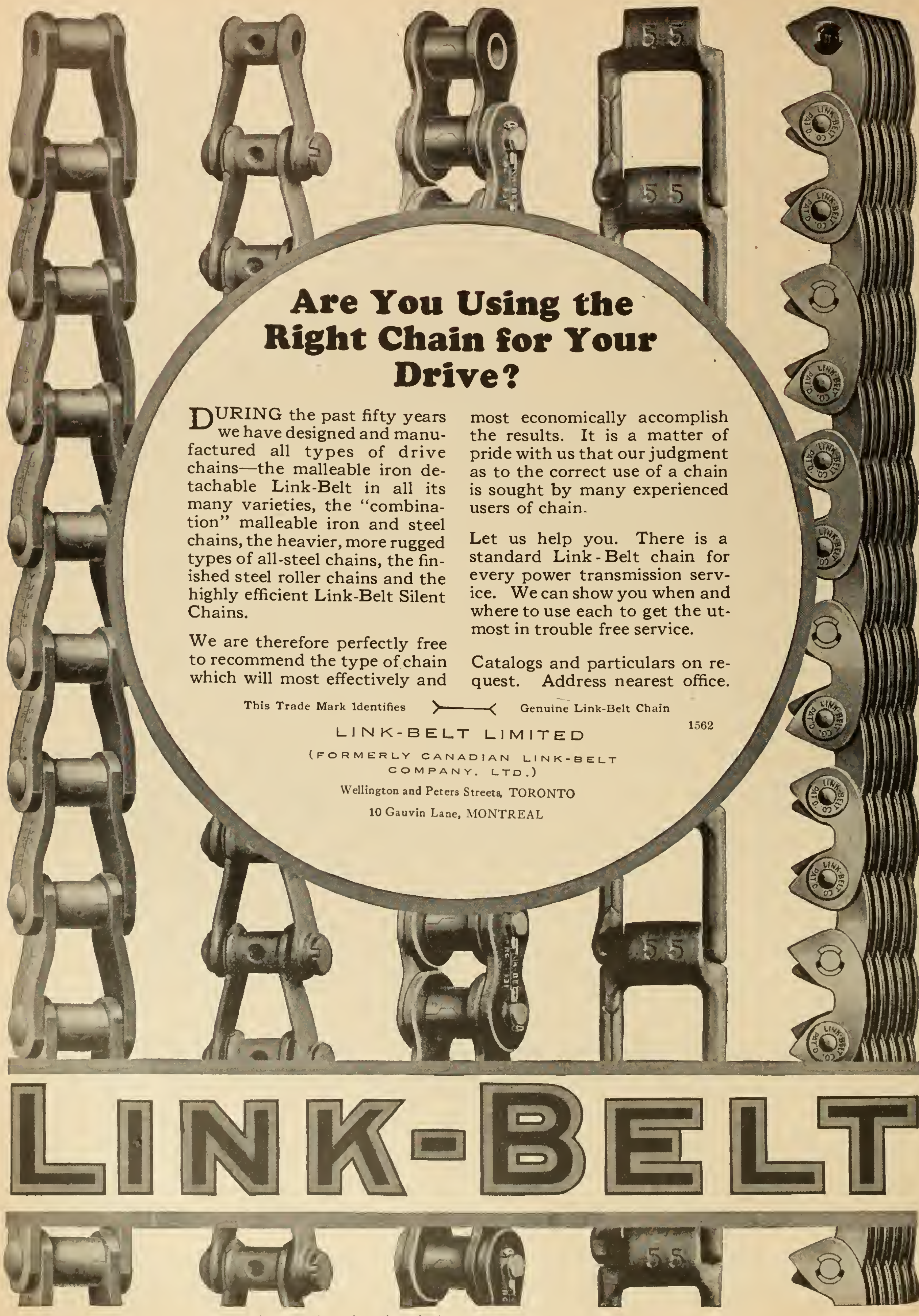
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DURING the past fifty years we have designed and manufactured all types of drive chains—the malleable iron detachable Link-Belt in all its many varieties, the "combination" malleable iron and steel chains, the heavier, more rugged types of all-steel chains, the finished steel roller chains and the highly efficient Link-Belt Silent Chains.
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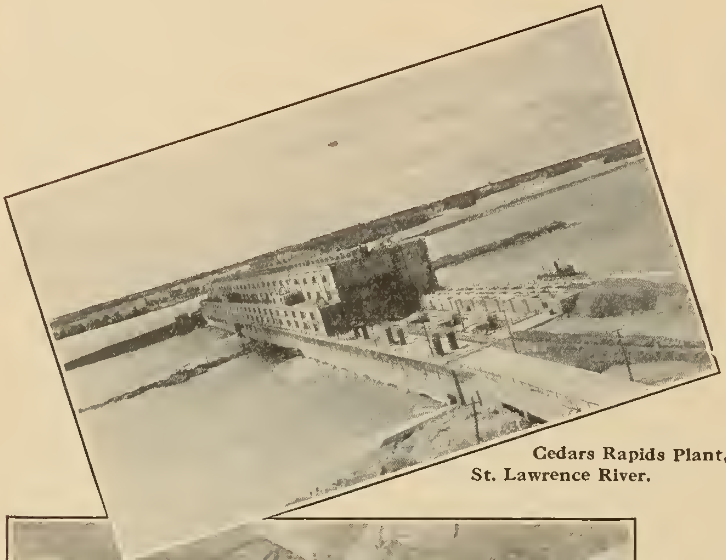
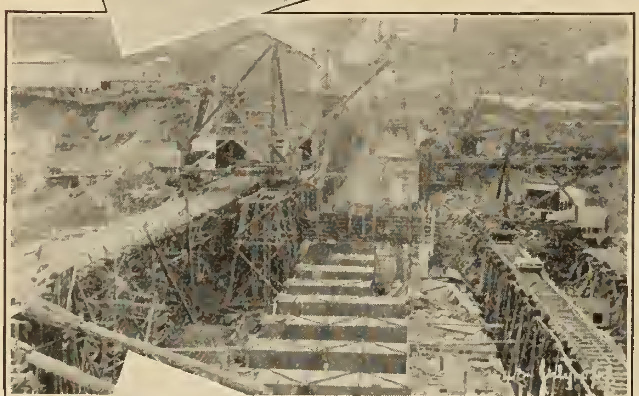


Cedars Rapids Plant, St. Lawrence River.



Gouin Dam, St. Maurice River.

Big Eddy Dam, Spanish River.

AN unbroken record of continuous engagement in the development of Canada's power resources.

THE LIST of dams and water power plants built by this Company includes many of the notable structures of their kind in Canada, as follows:—

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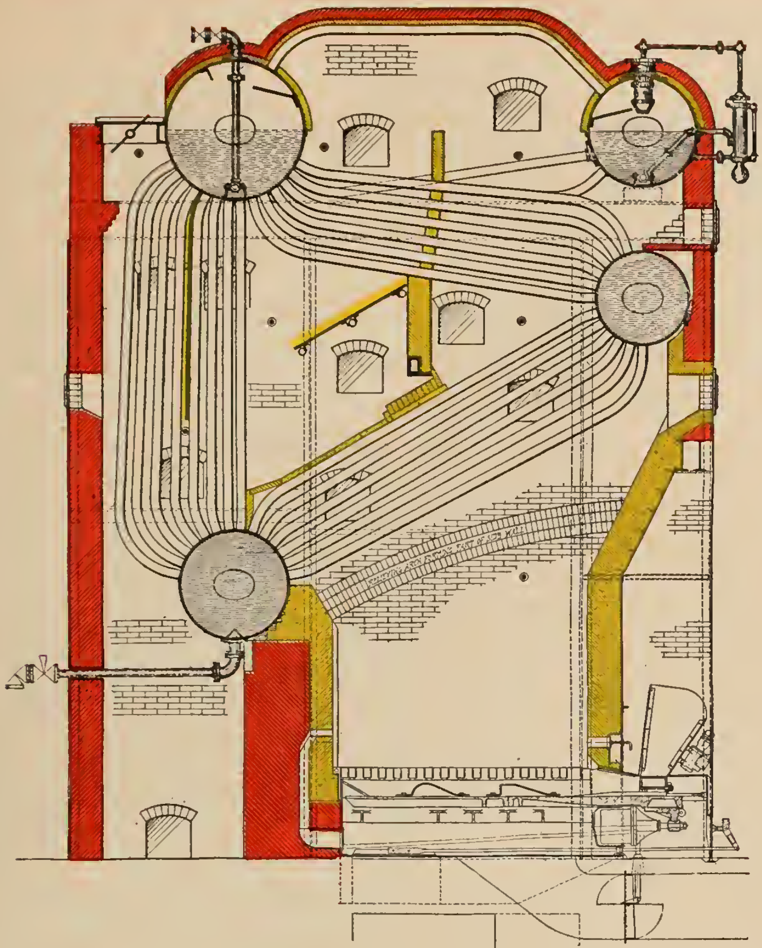

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WITH

TYPE "E" STOKER

Represents the greatest advance in boiler design during the last 30 years, and surpasses all other designs in the following particulars:

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It has a safe overload capacity never before reached, and can operate at 300% to 400% of rating continuously with safety, and the steam is superheated 10 to 40 degrees or more, according to the method of firing used.

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By reason of the above stated facts this design as to Efficiency of Invested Capital exceeds all others, and it is this particular efficiency which is most important, and interests the man who pays the bills.

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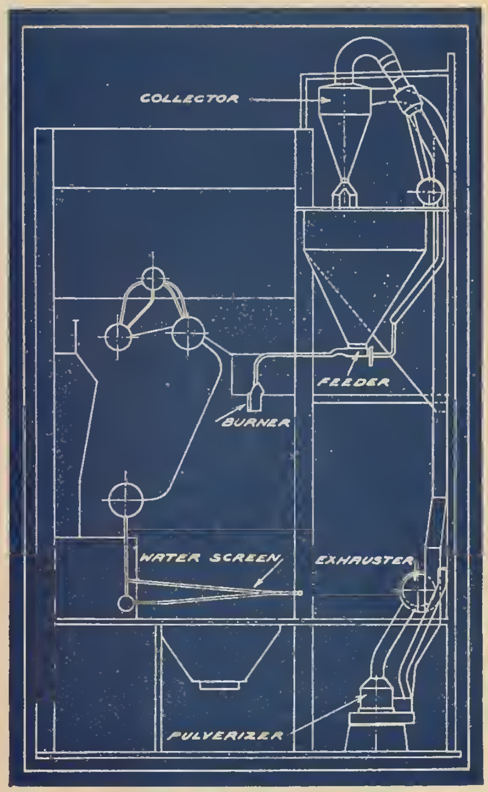
in British Empire

COAL is conveyed from the river, a short distance away by means of belt conveyors in underground tunnels. After being crushed in the bunker house (A) it passes through the Piron low temperature ovens (B) where the by-products are extracted.

The residue coke is then returned to the pulverized fuel bins in the boiler room and in the course of its return it is cooled by passing through a water jacketed screw conveyor.

The low temperature products pass from the ovens to the gas coolers and scrubbers (C) and thence to the by-product house (D), where oil tar and ammonia are taken off. These products are further reduced and sulphate of ammonia, light oils and gasoline are recovered.



Section through boiler plant showing arrangment of equipment.

Equipped with

Lopulco Pulverized Fuel System

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POWER PLANT LIMITED EQUIPMENT

STOKERS OF ALL TYPES
PULVERIZED FUEL SYSTEMS
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The investor whose money makes possible the transformation of idle water power into active, profitable electric energy, benefits not only himself, but the nation as well.

For developed water power is the key to the expansion of our other industries, and the successful exploitation of the resources of our forests and mines. It is the magnet which attracts to Canada many new industries which bring in their train increased population and prosperity.

Having played the pioneer part in the financing of many water power developments we are today more than ever convinced that in no other way can the future prosperity of Canada be better promoted and in no other class of security can equal safety be obtained than by the purchase of Water Power Bonds.

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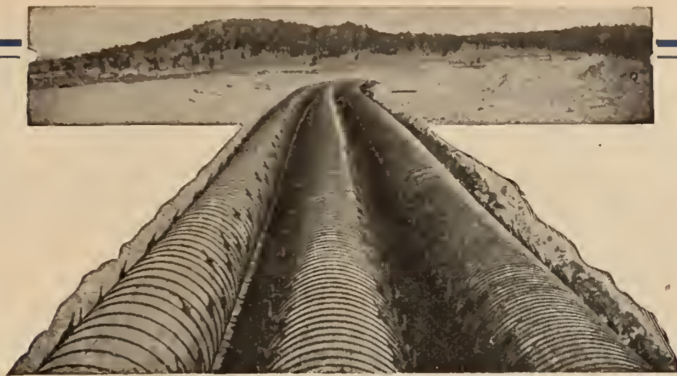
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HIGHEST EFFICIENCY
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GREATEST SIMPLICITY OF INSTALLATION

1924

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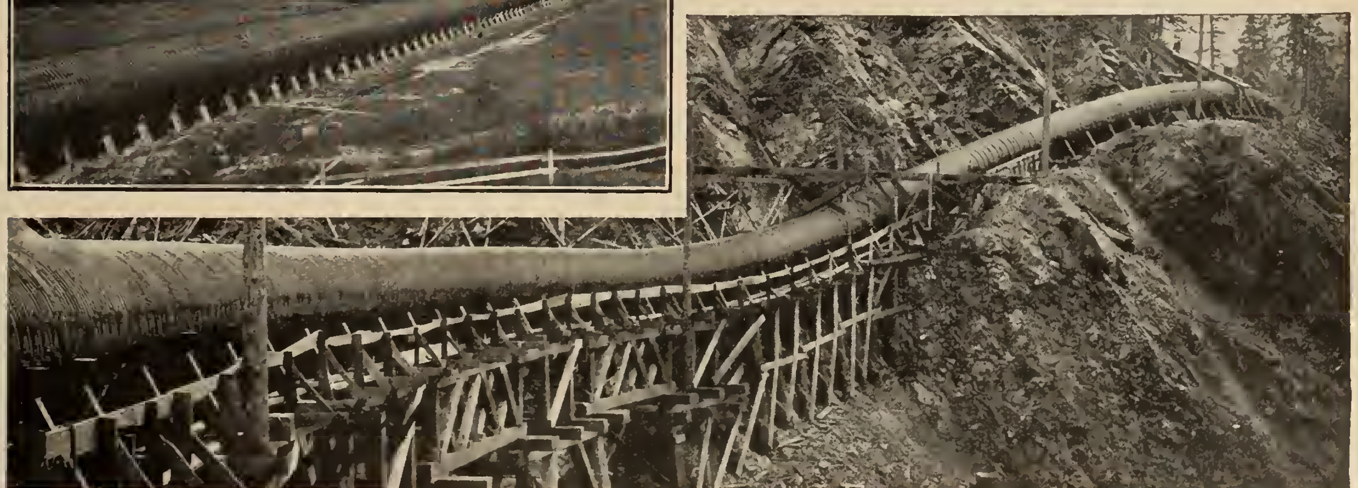
Our Wood Stave Pipe made from Douglas Fir is Standard Construction for Hydro-Electric Development.

Musquash Hydro-Electric Development New Brunswick Electric Power Commission near St. John, N.B.

East Branch Wood Stave Pipe Line 10 feet in diameter, one-half mile in length.

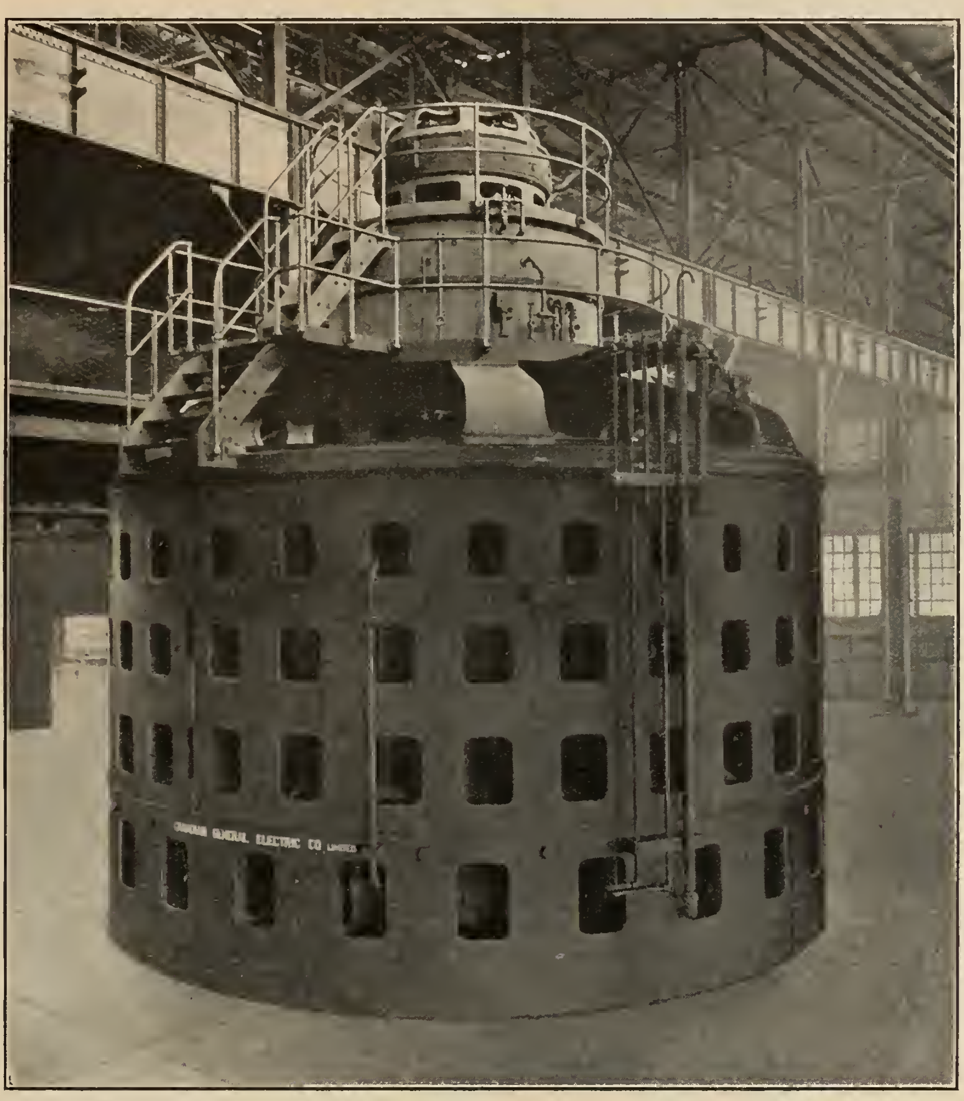
West Branch also Wood Stave Pipe 8 feet inside diameter 1½ miles in length.


6-Foot Continuous Wood Stave Pipe Line at Anyox, B.C. 20 to 310-Foot Head.

PACIFIC COAST PIPE COMPANY, LIMITED

1151 GRANVILLE STREET - - - VANCOUVER, B.C.

A Tribute To Canadian Engineering Enterprise and Industry



One of the C.G.E 54,000 Kv.a. Generators installed at Queenston for the Hydro-Electric Power Commission

OF the forty Generators now installed, or being installed, in the four largest Stations at Niagara Falls, Ont., aggregating approximately 725,000 Kv.a., it is significant that twenty-eight units, or 63 per cent of the entire capacity, were supplied by the Canadian General Electric Company, Limited.

The Generator illustrated above is being built at our Peterboro Works, and is part of the C.G.E. installation for the Hydro-Electric Power Commission's development at Queenston.

These Generators are amongst the largest water wheel driven machines in the world. They are rated at 54,000 Kv.a., at 187½ r.p.m, 12,000-volt, 3-phase, 25-cycle, and weigh approximately 600 tons each.

Canadian General Electric Co. Limited

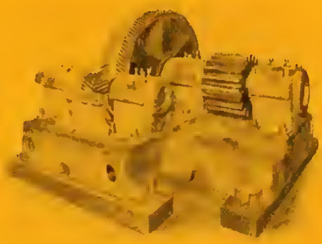
Head Office — TORONTO, Canada

Cut Gears
and Gear Drives

CUT GEARS

of every type and material

for Mill, Mine, Factory or Power Plant


We offer a complete gear service backed by the largest and best all 'round gear plant in Canada.

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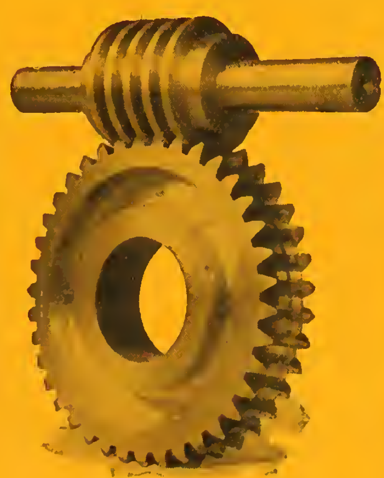


(*See also other side of this page*)

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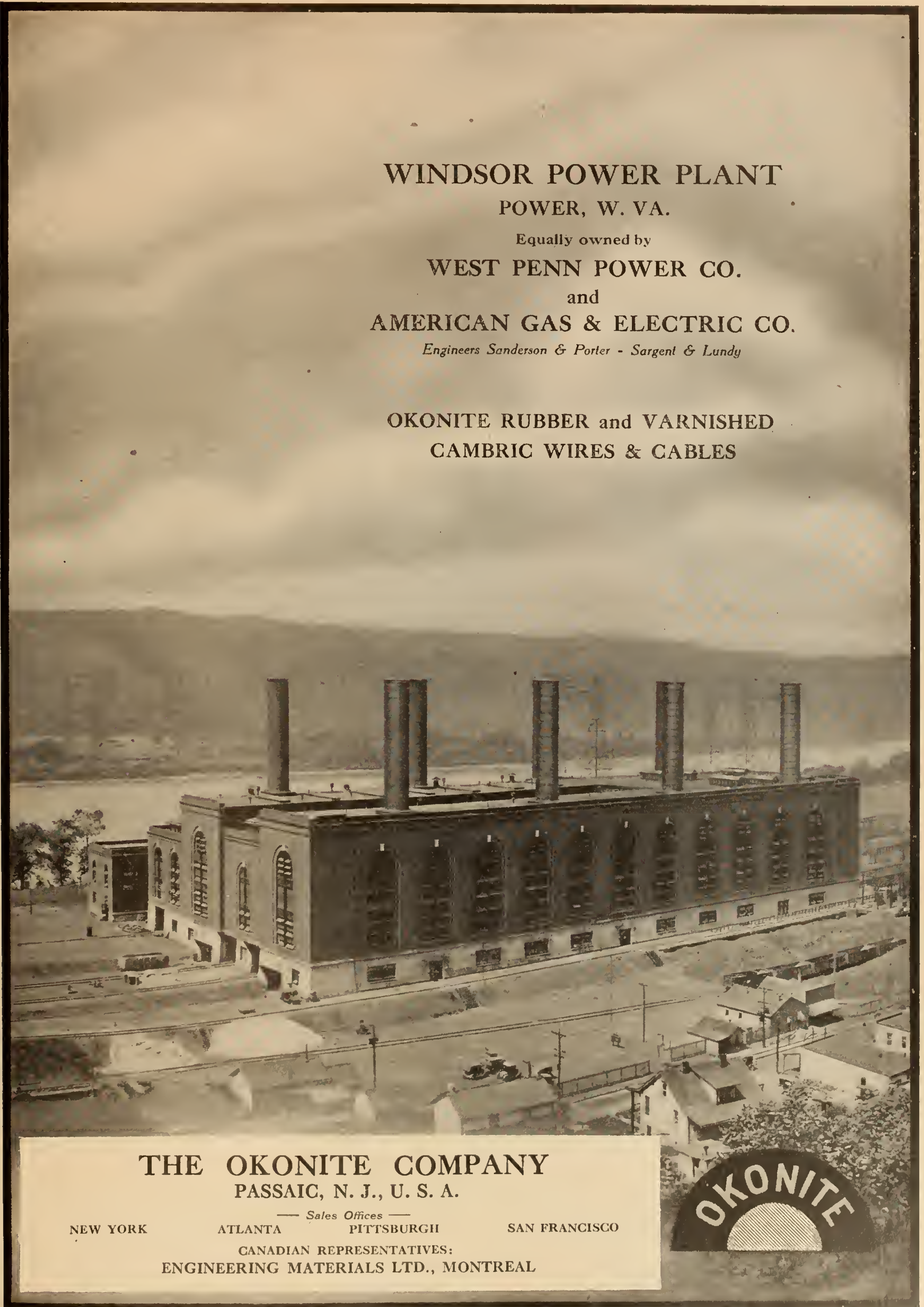
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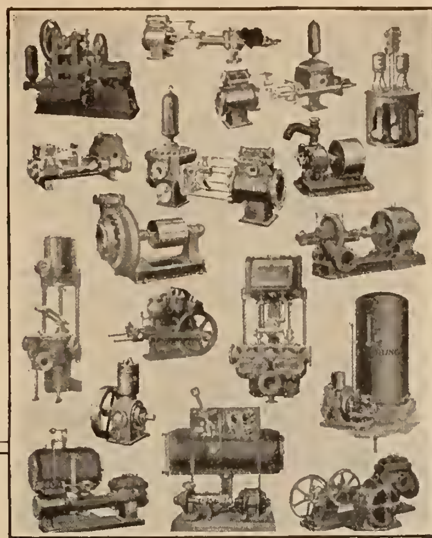

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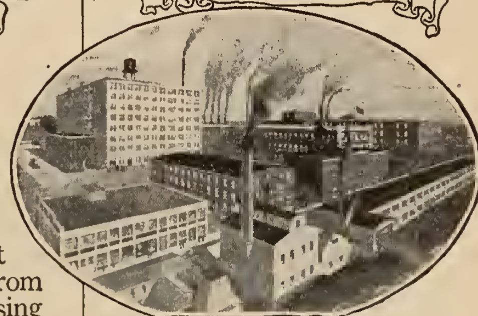

PLANT OF MOIRS, LIMITED HALIFAX

Illustrated are a few PROMINENT BUILDINGS in Canada in which the DARLING PRODUCT is INSTALLED.

A large number of the most notable buildings in Canada, from Halifax to Vancouver, are using DARLING PUMPS, STEAM AND HEATING APPLIANCES and other POWER HOUSE EQUIPMENT manufactured by us, as well as DARLING PASSENGER and FREIGHT ELEVATORS.

Some Darling equipment can be used to advantage in every building. Our EXPERIENCE of THIRTY-SIX YEARS enables us to determine what is the most suitable equipment to use to obtain the greatest efficiency.

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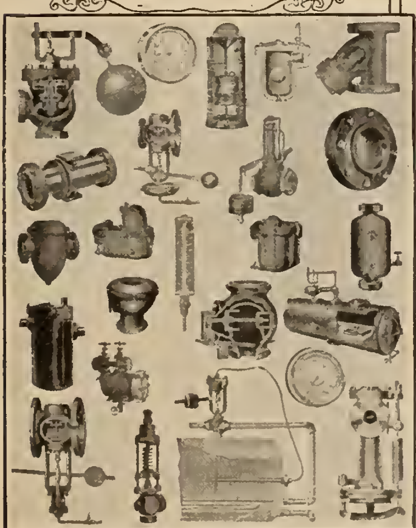

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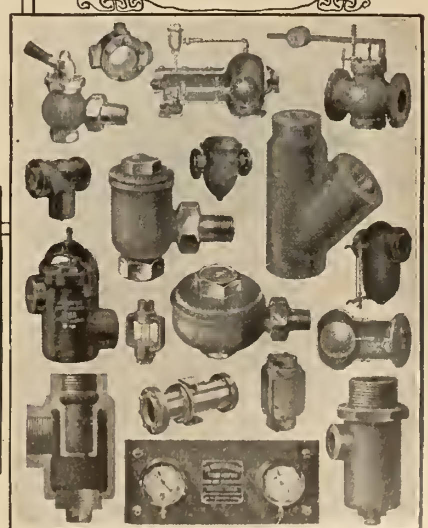

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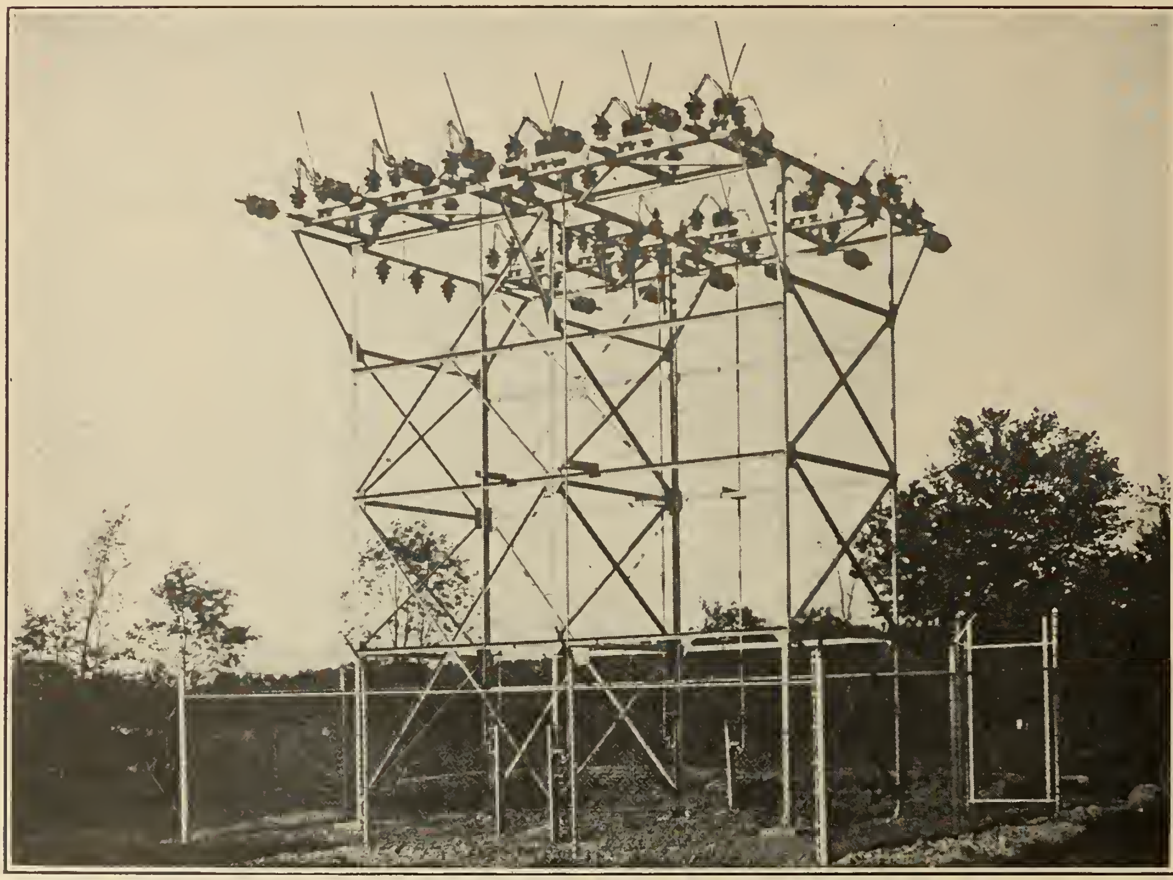

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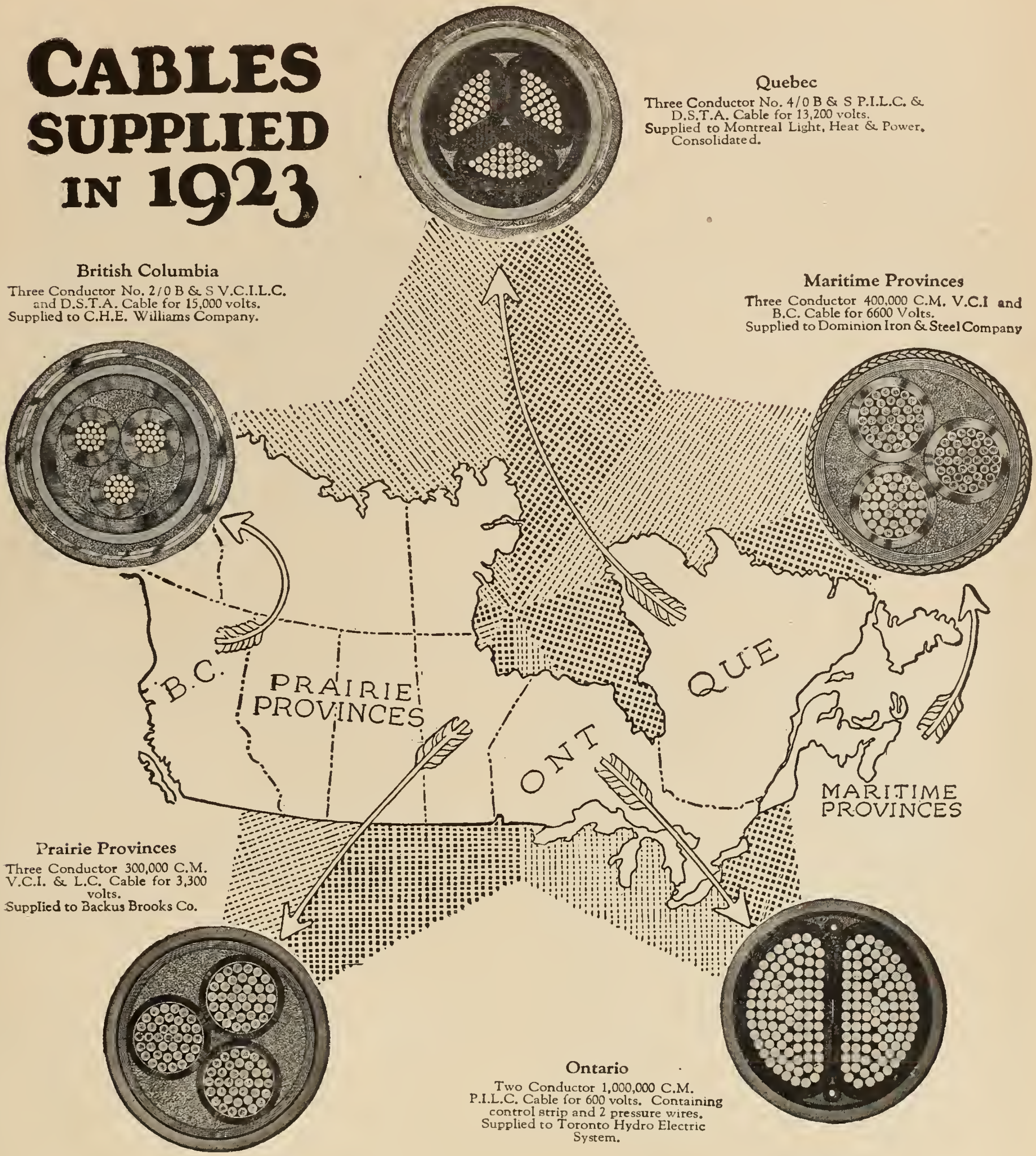
CABLES SUPPLIED IN 1923



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Prairie Provinces
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Two Conductor 1,000,000 C.M. P.I.L.C. Cable for 600 volts. Containing control strip and 2 pressure wires.
Supplied to Toronto Hydro Electric System.

Northern Electric Company
LIMITED

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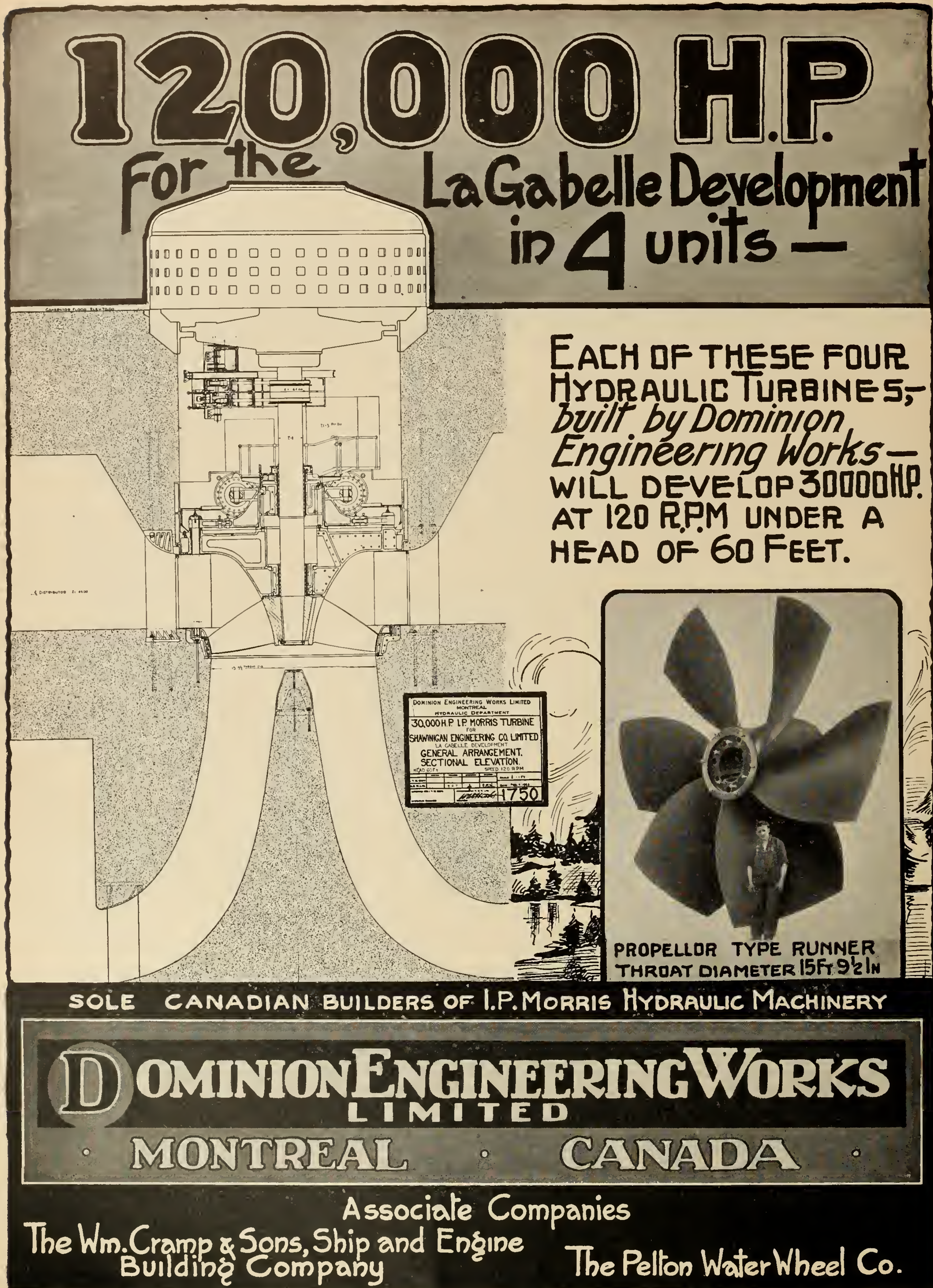
Stocks of Iron Ore at Sydney, N.S.


120,000 H.P.
For the La Gabelle Development in 4 units —
EACH OF THESE FOUR HYDRAULIC TURBINES,— built by Dominion Engineering Works — WILL DEVELOP 30000 H.P. AT 120 R.P.M UNDER A HEAD OF 60 FEET.
DOMINION ENGINEERING WORKS LIMITED
30,000 H.P. I.P. MORRIS TURBINE
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PROPELLOR TYPE RUNNER
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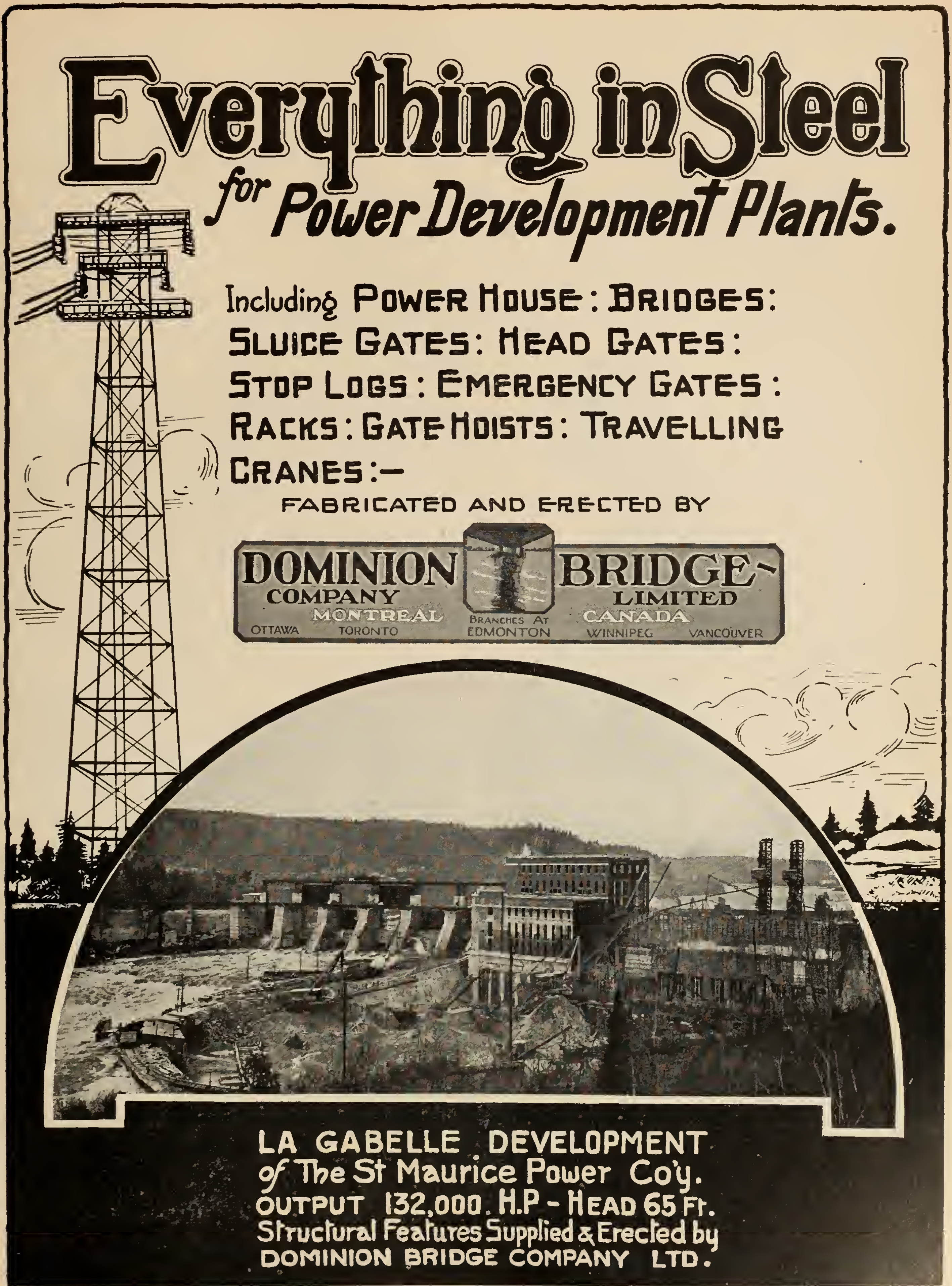
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OUTPUT 132,000. H.P - HEAD 65 FT.
Structural Features Supplied & Erected by
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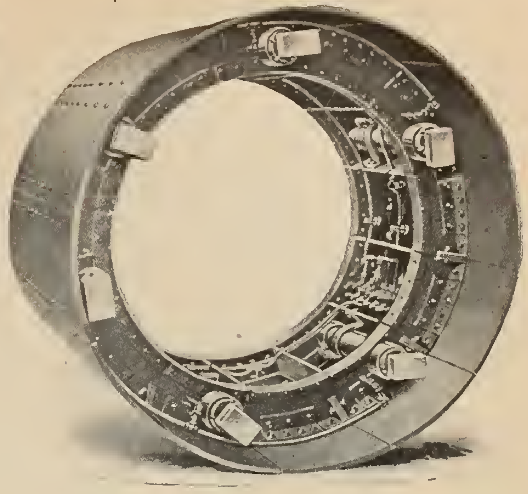


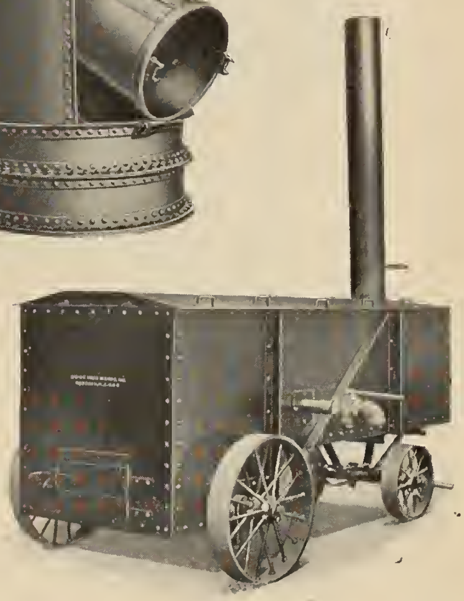
Union Tunnel Shields
Figure shows shields with inner plates removed to show hydraulic piping. Designed and built from 6-ft. 0-in. to 30-ft. 0-in diameters.

developed line of Equipment

Side or Sliding Door Air Lock. Can furnish any type of Air Lock both standard and special.

ienced and critical engineers and contractors.
The UNION LINE has played no inconsiderable part in the big construction work of this era both in this country and throughout the World.

We shall be pleased to send you our latest catalog giving full details.



Union Road Builders
Standard 500-gal. capacity asphalt and tar heater.

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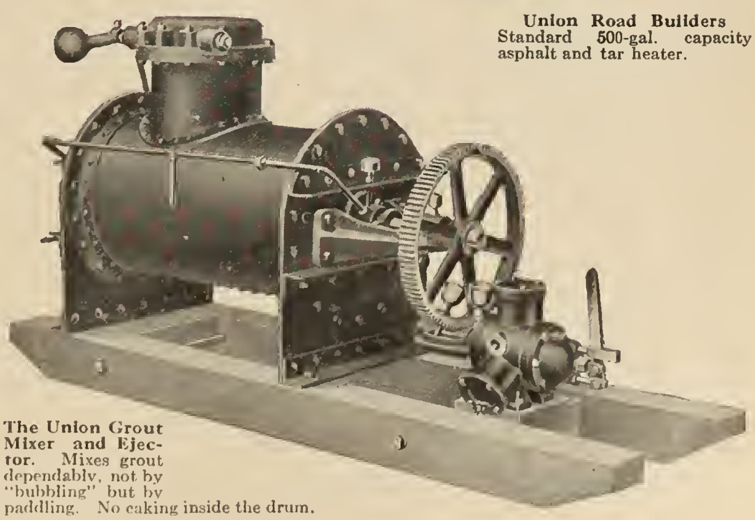
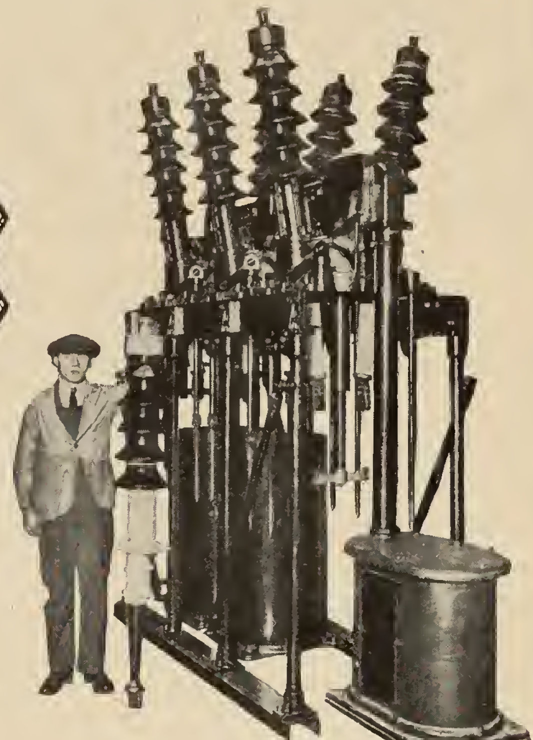
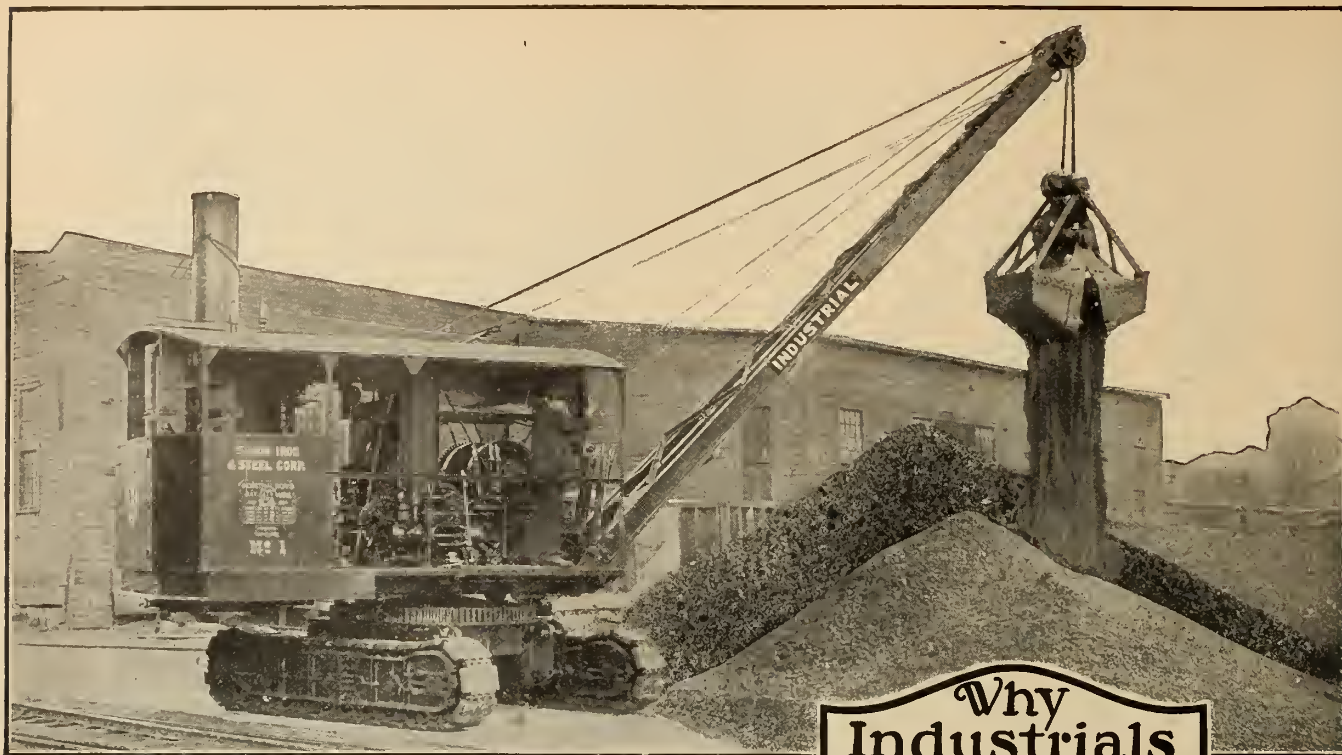


The Union Grout Mixer and Ejector. Mixes grout dependably, not by "bubbling" but by paddling. No caking inside the drum.





Announcing a new INDUSTRIAL!

THE INDUSTRIAL WORKS offers to modern industry another engineering achievement — a sturdy 10-ton crawling tractor locomotive crane. Like all INDUSTRIAL cranes, this new type D excells in its class by outstanding superiority in design, construction, power, speed, endurance and general utility. The requirements of all classes of industry and the universal demand for a better-built crane of moderate capacity are now fulfilled.

The type D is built for either steam, electric, or gasoline power and is mounted on crawling tractor belts, wide gauge traction wheels or standard railway trucks of four or eight wheels. It may be used interchangeably with clamshell bucket, electro-magnet, hook and block, dipper-arm shovel, dragline, or pile driver leaders.

It is designed and executed from tread to boom tip in one plant by America's pioneer crane builders. Fifty years of highly specialized engineering experience and business integrity constitute the guarantee back of this newest INDUSTRIAL achievement.

A 16-page booklet fully describing and illustrating the type D crawling tractor crane will be sent immediately upon request.

ASK FOR BOOK No. E-120.

INDUSTRIAL WORKS BAY CITY, MICHIGAN

F. H. HOPKINS & CO. Ltd.

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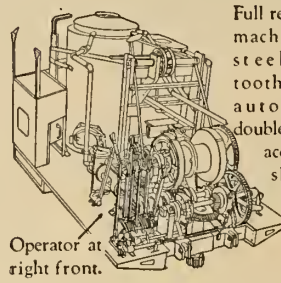
Why Industrials Excel

11 ULTRA-MODERN DESIGN

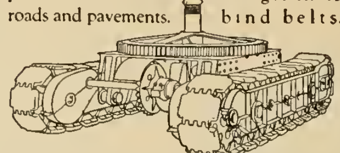


Operator can propel, slew and hoist boom at same time. Each motion has separate controlling friction clutches.

12 INDEPENDENT STEERING

Shoes of large area shaped to protect surface of roads and pavements.

Closefit shoes, no obstruction can get in to bind belts.



Crane propels and steers independent of all motions, with boom in any direction. Either belt may drive, coast or be held by brake to make a turn of any degree

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CRAWLING TRACTOR CRANES

Advertisements have an educational value. Read them carefully.

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JULY 1924

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Section 3.

CONTENTS—(*Continued*).

Power Resources

Their Development and Utilization in Canada

First World Power Conference, London, England, July, 1924

Foreword

The World Power Conference initiated by the British Electrical and Allied Manufacturers Association and organized by a committee comprising the various technical and scientific institutions and industrial organizations in the British Isles, affords the Dominion of Canada a unique opportunity to present before the world her magnificent power resources, both water and fuel, and the efficient and economic manner in which they have so far been utilized. It is singularly appropriate that this conference should be held in London during the progress of the British Empire Exhibition where all of the Dominion's resources will be adequately displayed.

By direction of the Honourable Charles Stewart, Minister of the Departments of Mines and Interior, Canadian participation in the conference has been organized with the support of a strong committee of directly interested men, eminent in the public life of the Dominion, and with the advice and assistance of technologists representative of all phases of power production in the various provinces.

The important part of Canadian participation is the presentation of six papers by recognized experts in the principal technical aspects of power production and use. While each of these papers is self contained, they have been carefully co-ordinated, and taken together form a concise yet comprehensive analytical summary of the power resources and their utilization which should command the interest of the First World Power Conference.

These papers demonstrate clearly that Canada has already a very extensive development of her power resources; that these have been developed in a dependable and efficient manner; that a great diversity of industry and trade has been built up and is supported thereby; and that there is a very large surplus of undeveloped resources, administered in such a manner as to encourage further development, and favourably situated for an enormous expansion of the industrial life of the Dominion.

While the efforts of the Canadian national committee have been directed mainly to the presentation of the papers referred to, it has succeeded, with the co-operation of Dominion and Provincial Governments, of public service corporations and commissions, of technical organizations, and of engineers in consulting practice, in arranging for the personal attendance at the Conference of a number of recognized authorities in the industry.

Through the courtesy of the High Commissioner for Canada in London and the Commissioner General for Canada in Paris, opportunities will be afforded to extend Canadian hospitality to the members of the British Committee and the delegates from other countries. While Canada will undoubtedly greatly benefit from adequate participation in the Conference, it is hoped that her contribution to its discussions and records may prove of advantage to other countries.

While conferences of this character cannot, from their very nature, be frequently held, the Canadian Committee is of the opinion that an international discussion of power production problems, say every three or five years, would, by promoting the arts of peace and industry, prove a prime factor for better international understandings. To this end it might not be amiss for the Canadian delegates to urge upon the proper occasion, that the Second World Power Conference be held in North America. What more appropriate environment for a world convocation upon power matters than within sound of the mighty Niagara?

CHARLES CAMSELL, M.E.I.C.

Ottawa, March 1924. *Chairman Canadian Management Committee.*

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of
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Water Powers of Canada

Their Nature, Extent and Administration, A National Review.

J. B. Challies, C.E., M.E.I.C., M.Am.Soc. C.E.
Director and Chief Engineer, Dominion Water Power and Reclamation Service, Department of the Interior, Ottawa.

Synopsis of Paper

Canada is indeed fortunate in the nature, extent and the location of her power-producing resources. Water power is available in every province. It is most bountifully supplied in the central provinces where the need is greatest, whilst the other provinces possess almost unlimited resources of usable coal. These resources of power assure beyond peradventure a continuous and progressive industrial development. Water power is one of the chief natural advantages of the Dominion, and its development may, without exaggeration, be termed one of the romances of engineering industry. This development has been in progress almost since settlement first begun. In the early days water power was extensively used to drive the saw-mills, grist-mills and the other manufacturing requirements of the pioneer communities. The general use of steam power caused water power to languish for a time, until the possibility of using it as a source of electric energy gave a fresh impetus to water power development and began a new era in the industrial progress of Canada.

Since its beginning about 1895, the modern water power industry in Canada has shown a steady and remarkable growth, and there is every indication that its future growth will be even more rapid than in the past. During the last ten years, while the population increased twenty-two per cent, the developed water power increased nearly one hundred per cent and its use in industry two hundred and forty-five per cent. The total amount now developed is 3,227,414 horse power and 750,000 additional horse power is now under construction.

This extensive development has been made possible largely by technical skill and by the financial stability of the earlier enterprises, which has made water power development a favourite field for investment. The capital invested in water power development, transmission and distribution has grown from $121,000,000 in 1910 to $688,000,000 in 1923, and it is estimated that it will reach $1,000,000,000 within the next ten years.

The openings for further investment in Canadian hydro-electric enterprises are numerous; the varied resources of raw material are exceptionally abundant; labour conditions are stable; the total manufactures and the proportion of manufactured exports show rapid and sustained increase; for legitimate power projects governmental co-operation is constructive and positive; the next few years will, therefore, see a large increase of foreign investment in the Canadian water power industry.

The predominance of water power in Canada is strikingly shown in connection with the central station industry, for 97.7 per cent of the total power output of all such stations throughout the country is derived from water. In the pulp and paper and mining industries also water power is of paramount importance. The leading position which Canada has secured in the former industry is due to the abundant supply of growing pulpwood and the cheap power available in the same vicinities, and in the mining industry even coal mines use hydro-electric energy where it is available.

The water power resources of Canada are widely distributed and are of very great extent. With the exception of parts of the prairie provinces they are to be found in all parts of the country, although their size and importance varies with the climatic and topographical conditions, and with the distribution of population. A glance at the map will show where they are chiefly situated, and the number and size of the rivers gives a rough indication of where the principal water powers will be found.

The rocky ridge which forms the back-bone of Nova Scotia, the uplands of New Brunswick, the great Pre-Cambrian Shield of Quebec and Ontario, together with the continental divide and the Coast mountains of British Columbia, constitute the main topographical features of the country; and these, with the abundant rainfall, form the sources of water power.

The most recent investigations estimate the total water power throughout the Dominion at over 40,000,000 commercial horse power at ordinary minimum flow, of which as mentioned above, about 3,000,000 horse power has been developed.

By far the greater part of the undeveloped water powers of Canada belong to the Crown, either in the right of the Dominion or of the provinces, and much of that already developed is under government control, either by reason of their being held under lease or license from the Crown or by reason of statutory conditions.

The water powers belonging to the Crown are administered partly by the Parliament of Canada and partly by the provincial legislatures according to where they are situated. The Parliament of Canada is the administrative authority with respect to water powers situated on public lands of the Dominion, that is, those in Alberta, Saskatchewan, Manitoba, and in the Northwest and Yukon Territories; and also exercises control over water powers on Indian lands and those resulting from the construction of public works and canals.

The legislative assemblies of the provinces of British Columbia, Ontario, Quebec, New Brunswick, Nova Scotia and Prince Edward Island are the administrative authorities with respect to the water powers situated within their respective territorial boundaries, as the lands in these provinces were the property of the province prior to the federal union or Confederation and have never belonged to the Dominion.

Water power administration has in recent years received a great deal of study, both by the legislatures and by administrative officers, and the regulations under which the Crown water powers are leased for development purposes in each jurisdiction, although differing in many details, are alike in their essential principles, and grant to the lessee security of tenure for a definite term of years and reasonable protection to capital, combined with such extent of control as is considered necessary in the public interest. In some of the provinces, developments have been made directly by government agencies, in others, private enterprise under government control is alone responsible for the supply of hydro-electric energy. Each province has adopted the means to secure a plentiful supply of cheap power which appeared best suited to local customs and conditions. Public and private ownership flourish side by side as the dominating policies in the neighbouring provinces of Ontario and Quebec respectively, and each in its own sphere has given beneficial results.

Section I. General Outline

Canada is indeed fortunate in the nature, extent and the location of her power-producing resources. Water power is available in every province. It is most bountifully supplied in the central provinces where the need is greatest, whilst the other provinces possess almost unlimited resources of usable coal. These resources of power assure beyond peradventure a continuous and progressive industrial development. Water power is one of the chief natural advantages of the Dominion, and its development may, without exaggeration, be termed one of the romances of engineering industry.

A brief reference to the general water power map of Canada,* will confirm the statement that not only is practically every industrial centre throughout the Dominion now served with hydro-electric energy, but that all have ample reserves of water power within easy transmission distance. (See also plate No. A-3).

During approximately the last decade in Canada, while the population increased 22 per cent, the water power developed increased nearly 100 per cent, the use of water power in industry 245 per cent and the capital invested in manufacturing industries 175 per cent. Not only was there large growth of purely Canadian manufacturing but some 700 branches of United States factories have been established in Canada and the manufactured portion of Canadian exports, which was 11 per cent, is now 39 per cent of the whole.

The water power now developed in Canada amounts to 3,227,414 horse power and represents, including transmission and distribution, a capital investment of $688,000,000. Despite the continuous development that has taken place in the past and the 750,000 horse power of new construction now in hand the demand constantly exceeds the supply and it is estimated that some $300,000,000 of additional capital will be needed to meet the actual power demand of the next ten years.

The water power available, (table No. 1 and plate No. A-1), minimum 24-hour continuous power, is over 18,000,000 horse power, equivalent to an ultimate installation of some 40,000,000 turbine horse power and will therefore meet all possible requirements for many years to come. Furthermore this water power is distributed so that it is available near all the centres of population from coast to coast except small areas in southern Alberta and Saskatchewan which have large coal resources available.

*See insert map opposite page 358

Table No. 1. — Available and Developed Water Power in Canada*

Province	Available 24-hour power at 80% efficiency		Turbine Installation h.p.
	At ordinary minimum flow h.p.	At flow depend. for 6 months. h.p.	
British Columbia	1,931,142	5,103,460	355,517
Alberta	475,281	1,137,505	33,067
Saskatchewan	513,481	1,087,756	....
Manitoba	3,270,491	5,769,444	162,025
Ontario	4,950,300	6,808,190	1,445,480
Quebec	6,915,244	11,640,052	1,116,398
New Brunswick	50,406	120,807	44,539
Nova Scotia	20,751	128,264	54,950
Prince Edward Island	3,000	5,270	2,239
Yukon and North-West Territories	125,220	275,250	13,199
Total	18,255,316	32,075,998	3,227,414

* The estimates of available power are based upon sites where the head is definitely known or well authenticated. They omit many falls, rapids or possible concentrations, regarding which information is not reasonably definite and reliable. They may be looked upon, therefore, as representing *the minimum water power possibilities of the Dominion.*

All power estimates represent continuous twenty-four hour power at an efficiency of generation of eighty per cent. Minimum as used in this memorandum is based on "Ordinary Minimum Flow" which is the average over all the years for which records are available, of the mean flow for the two lowest consecutive seven-day periods in each year. Six-month power is based on the "Ordinary Six-Month Flow" which is the average over all the years for which records are available, of the mean flow for the lowest seven consecutive days in the lowest of the six high months in each year.

Six-month power has been adopted to give some reasonable general estimate of the total dependable power available, as distinguished from minimum figures. It is based upon the assumption that it is often good commercial practice to install turbines at a site up to the capacity of the six-month power, the deficiency during the low flow months being provided from storage or by the installation of fuel power plants as auxiliaries; as illustrative of this, detailed analysis of the power resources of New Brunswick and Nova Scotia disclose most advantageous reservoir facilities and it is estimated that these provinces possess within their respective borders 200,000 and 300,000 commercial horse power. The ratio of six-month power to actual installation at sites now developed indicates an eventual installation for Canada of 42,000,000 h.p.

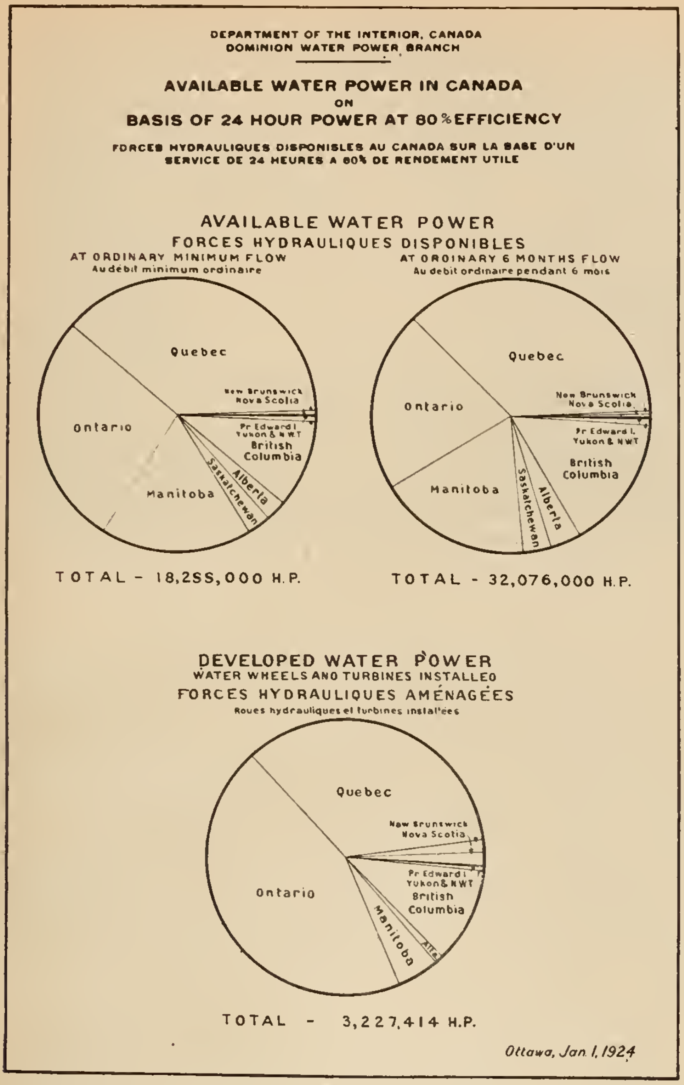


Plate No. A-1.—Available Water Power in Canada on basis of 24-Hour Power at 80 per cent Efficiency.

Financial Stability

The sustained, and in many cases increased earning power of existing hydro-electric undertakings, both publicly and privately owned, during the period of post war vicissitude has been reflected by the financial standing of the securities of these concerns. The manner in which these securities have stood the strain of general depression and deflation is reflected in the readiness with which capital can be obtained for extensions and new developments when these are properly sponsored.

The capital invested in water power development, transmission and distribution has grown from $121,000,000 in 1910 to $688,000,000 in 1923 or nearly 500 per cent and it is estimated that it will reach $1,000,000,000 within the next ten years.

The rapidity of hydro-electric expansion in Canada is very largely the result of the financial showing made by the leading public utility companies which have acquired the reputation for stability of capital and regularity of dividend desired by the conservative investor. The justification for such reputation is found in the ranges of prices of the stocks and bonds of these companies and of their dividend payments during the past twelve years.

In 1921, of the total capital invested in Canadian water power 68 per cent was held in Canada, 6.4 per cent in the United Kingdom, 13.6 per cent in the United States and 12 per cent in other countries. The large proportion of home capital evidences the substantial support accorded this class of investment by the Canadian investing public.

The development of water power in Canada is no longer speculative but has become a highly specialized art and is recognized as such by leading financial houses and by individual investors all over the world and particularly in the Dominion. The openings for further investment in Canadian hydro-electric enterprises are numerous; the varied resources of raw material are exceptionally abundant; labour conditions are stable; the total manufactures and the proportion of manufactured exports show rapid and sustained increase; for legitimate power projects govermental co-operation is constructive and positive; the next few years will, therefore, see a large increase of foreign investment in the Canadian water power industry.

Current Progress

The period of high and uncertain construction costs current with war-time conditions is definitely passing. Works which a few years ago would not be undertaken by contractors except on a cost-plus basis can now be met by simple inclusive tender. Labour problems are sta-

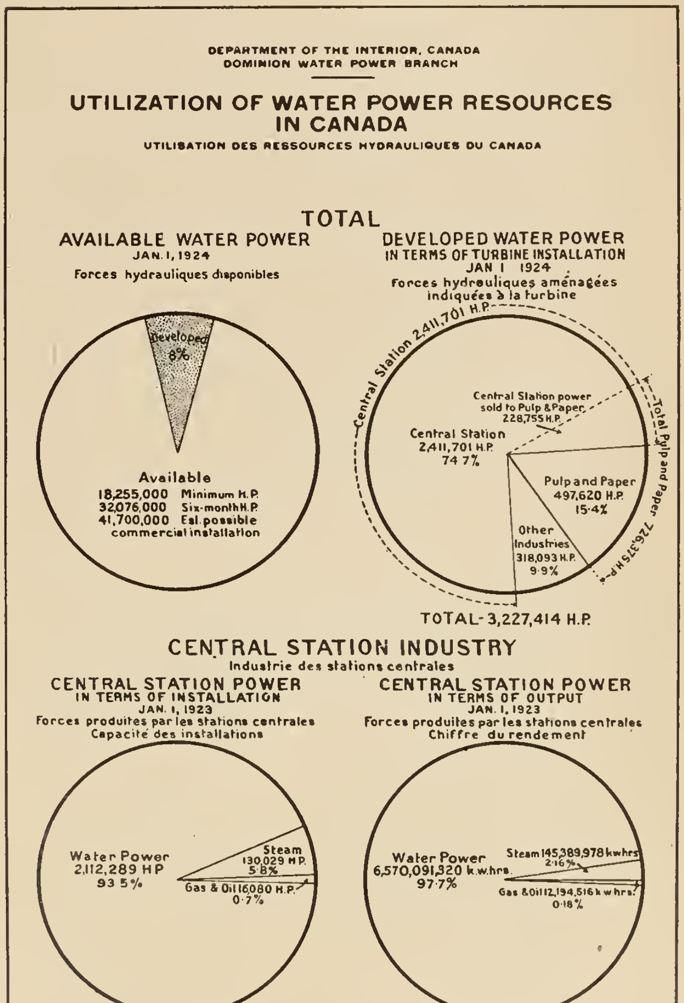


Plate No. A-2.—Utilization of Water Power Resources in Canada.

bilizing themselves. The power industry has established its capacity to manufacture cheaply and market its wares profitably under trying and exacting circumstances. There seems little to impede and much to encourage increased development.

In each of the past two years upwards of 250,000 h.p. of new installation has been recorded, but even greater significance lies in the number of new projects actually in progress of construction or actively in prospect. These projects when complete will add more than 900,000 h.p. to Canada's total installation and are evidence that a continuance of healthy progress can be confidently expected.

Utilization of Developed Water Power

Table No. 2 analyzes, while plate No. A-2 shows graphically the classification of the present turbine installation of 3,227,414 h.p. in regard to its principal uses.

The classification is briefly as follows:—2,411,701 h.p. is installed in central stations for general distribution for all purposes; 497,620 h.p. is installed in pulp and paper mills in addition to the 228,755 h.p. purchased by these mills from central stations while 319,093 h.p. is installed for industries other than central stations and pulp and paper mills.

Table No. 2. — Developed Water Power in Canada

February 1st, 1924

Province	Turbine Installation in horse power: In Central Stations	In Pulp and Paper Mills	In other Industries	Total	Population June 1, 1923	Total Installation per 1,000 Population
1	2	3	4	5	6	7
British Columbia...	242,401	55,140	57,976	355,517	553,500	642
Alberta............	32,380	....	687	33,067	634,200	52
Saskatchewan......	....	....	....	....	814,200	.....
Manitoba..........	145,625	....	16,400	162,025	642,800	252
Ontario............	1,142,403	174,189	128,888	1,445,480	3,028,900	477
Quebec............	791,795	237,232	87,371	1,116,398	2,443,500	457
New Brunswick....	23,613	13,728	7,198	44,539	396,900	112
Nova Scotia.......	23,196	17,331	14,423	54,950	532,600	103
Prince Edward Isl...	288	....	1,951	2,239	88,000	25
Yukon and N.W.T..	10,000	....	3,199	13,199	11,400	1,158
Canada............	2,411,701	497,620	318,093	3,227,414	9,146,000	353

Column 2 includes only hydro-electric stations which develop power for sale.

Column 3 includes only water power *actually developed* by pulp and paper companies. In addition to this total, pulp and paper companies purchase from the hydro power central stations totalled in column 2, 96,985 h.p. in Ontario, 131,120 h.p. in Quebec and 650 h.p. in New Brunswick. The total hydro power utilized in the pulp and paper industry is therefore 726,375 h.p.

Column 4 includes only water power actually developed in connection with industries other than the central station and the pulp and paper industries. These industries also purchase blocks of power from the central stations totalled in column 2.

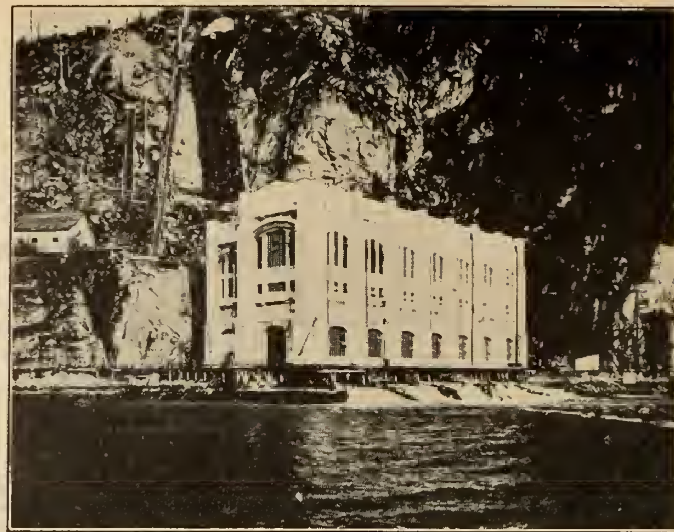
Column 5 totals all turbines and water wheels installed in Canada.

Column 6 population at June 1st, 1923, as estimated by Dominion Bureau of Statistics.

Column 7 averages the developed water power per 1,000 population.

The total installation for the Dominion averages 353 h.p.* per thousand population, a figure which place Canada amongst the leading countries of the world in the per capita utilization of water power.

* Based on Bureau of Statistics estimate of population as at June 1, 1923, viz. 9,146,456.



Coquitlam — Buntzen Development No. 2 of the British Columbia Electric Railway Company — 40,500 h.p.

This extensive use of hydro-electrical energy is largely dependent upon and evidence of its low cost. Plate No. A-3 illustrates the source and character of the power supply for the industrial centres of the Dominion, and shows that water power not only completely dominates the situation in central Canada, where no native coal is found, but it also controls the market for industrial energy in the maritime provinces and British Columbia where excellent coal is found. The importance of ample low priced power can hardly be exaggerated, and it is of interest to again refer to the general Water Power Map of Canada and note that ample reserves of undeveloped water power exist to guarantee the energy necessary for many years of industrial expansion.

Water Power in the Central Station Industry

Modern developments in high tension electrical transmission, which permits the economic transportation of power at small loss over relatively long distances has made possible the use of hydraulic power for manufacturing in established centres where labour is plentiful and of a permanent character, with shipping and distributing facilities readily at hand. Such centres, with their variety of manufacturing needs and processes, street railways to be operated, buildings to be lighted and heated, municipal needs for street lighting and water pumping, form an ideal market for the product of the central electric station and have resulted in the central station industry attaining enormous proportions in a relatively short period of time.

The central station industry of Canada is practically the monopoly of water power for as is indicated on the lower half of plate No. A-2, 93.5 per cent of the installation and 97.7 per cent of the power output is water power. Throughout the Dominion at January 1st, 1923, there were hydro-electric central stations with an installed turbine capacity of 2,112,289 h.p. or a generator installation of 1,617,281 kv.a., of which 1,531,847 h.p. is installed in commercially or privately owned and 580,442 h.p. in municipal or publicly owned stations.

The units vary in size from 10 h.p. to the 55,000 h.p. turbines in the Queenston-Chippawa development at Niagara. The turbine units in the industry average 3,358 h.p. while the average installation of the 270 hydro-electric generating central stations is 7,823 h.p.

Table No. 3. — Developed Water Power in Canada utilized in the Central Station Industry
February 1st, 1924.

Province	Commercial Stations			Municipal Stations			Total				
		Installation			Installation			Installation			
	No.	Generator kv.a.	Turbine h.p.	No.	Generator kv.a.	Turbine h.p.	No.	Generator kv.a.	h.p. per turbine unit	h.p. per Station	Total Turbine h.p.
1	2	3	4	5	6	7	8	9	10	11	12
British Columbia	24	153,686	232,356	8	6,353	10,045	32	160,039	4,108	7,375	242,401
Alberta	3	22,250	32,380	..	......	......	3	22,250	2,414	10,793	32,380
Saskatchewan	..	......	......	..	......	......	...	......	.....	.....	......
Manitoba	4	58,350	78,400	2	57,312	67,225	6	115,662	6,935	24,271	145,625
Ontario	69	395,659	503,375	37	457,472	639,028	106	853,131	4,109	10,777	1,142,403
Quebec	79	606,813	771,820	17	14,962	19,975	96	621,775	3,552	8,248	791,795
New Brunswick	7	8,460	11,703	3	9,363	11,910	10	17,823	1,073	2,361	23,613
Nova Scotia	9	3,204	3,749	12	15,389	19,447	21	18,593	828	1,124	23,196
Prince Edward Island	7	331	288	..	......	......	7	331	32	41	288
Yukon	1	6,000	10,000	..	......	......	1	6,000	5,000	10,000	10,000
Canada	203	1,254,753	1,644,071	79	560,851	767,630	282	1,815,604	3,682	8,552	2,411,701

Commercial Stations include all privately owned.
Municipal Stations include all publicly owned.
Note. — Statistics in this table are based upon a census of the industry made by the Dominion Bureau of Statistics in co-operation with the Dominion Water Power Branch.

Water Power in the Pulp and Paper Industry

Pulp and paper manufacturing is a typical and important Canadian industry with a prosperous future, the result of two natural advantages, — abundant supply of growing pulpwood and cheap accessible motive power in large quantities. The importance of low cost power lies in the fact that it takes practically 100 horse-power to produce one ton of paper per day. It is not surprising therefore that motive power used in this industry is almost altogether restricted to hydraulic energy and that Canada's premier advantage and position in the pulp and paper field rests on adequate and abundant water power well distributed among extensive timbered areas.

Table No. 4. — Developed Water Power in Canada utilized in the Pulp and Paper Industry
February 1st, 1924.

Province	No of Mills	Installed and Purchased Power in horse power					
		Turbine Installation in the Industry					
		Direct Drive	Hydro-Electric Drive	Total	Purchased Hydro-Electric Power	Total Hydro-Elec. Col. 4 + Col. 6	Total Utilized in the Industry Col. 5 + Col. 6
1	2	3	4	5	6	7	8
British Columbia	5	26,790	28,350	55,140	......	28,350	55,140
Ontario	46	89,066	85,123	174,189	96,985	182,108	271,174
Quebec	56	151,792	85,440	237,232	131,120	216,560	368,352
New Brunswick	4	2,668	11,060	13,728	650	11,710	14,378
Nova Scotia	10	17,251	80	17,331	......	80	17,331
Canada	121	287,567	210,053	497,620	228,755	438,808	726,375

Column 3 includes all turbines actually installed in the industry and directly driving mill equipment.
Column 4 includes all turbines actually installed in the industry and transmitting power through *electric drive*.
Column 5 totals the turbine capacity actually installed in the industry.
Column 6 includes only power purchased from hydro-electric central stations for the operation of pulp and paper mills.
Column 7 totals the hydro-electric power used in the industry.
Column 8 totals the water power used in the industry.

Water power is operating 121 pulp and paper mills in Canada, 726,375 h.p. being employed. Of this total 497,620 h.p. is *actually installed* in connection with the mills and 228,755 h.p. is *purchased* from hydro-electric central stations. (See table No. 4).

The innovation of the electric drive is having a marked and favourable influence on pulp and paper manufacturing processes. It makes possible the centralized operation of fewer and larger mills receiving power from several power sites together with the further advantage of uniform speed and better control in grinding, thus lessening costs of operation, construction and shipping. Of the 497,620 h.p. *actually installed* in pulp and paper mills, approximately 210,000 is used in the electric drive, besides which there is 228,755 h.p. of hydro-electric energy purchased from central stations, bringing the total horse power employed in the electric drive up to approximately 439,000.

Quebec and Ontario possess the largest natural pulpwood areas in Canada and they lead in pulp and paper production with 368,352 h.p. utilized in this industry in Quebec and 271,174 h.p. in Ontario; other producing

Jordan River Development on Vancouver Island, of the British Columbia Electrical Railway Company — 25,000 h.p.

provinces are, British Columbia 55,140 h.p., New Brunswick 14,378 h.p. and Nova Scotia 17,331 h.p.; total installation for pulp and paper mills, 726,375 h.p.

Water Power in the Mining Industry

The mining industry of Canada owes its present rapid development to water power, even coal mines use hydro-electric energy where possible. The metalliferous mines of Northern Ontario now utilize in excess of 100,000 h.p. of hydro-electric energy and the development of further water power sites is rapidly proceeding in order to overtake the demand for energy. If the mines of Ontario had to depend upon imported coal for their power requirements, the greatly increased operating cost would, in a great measure, have throttled their productiveness making the working of any but the richer deposits unprofitable and seriously reducing both the annual production and profitable life of the properties.

Great as the mining industry of Canada is, it is only in its infancy and there can be no doubt that new dis-

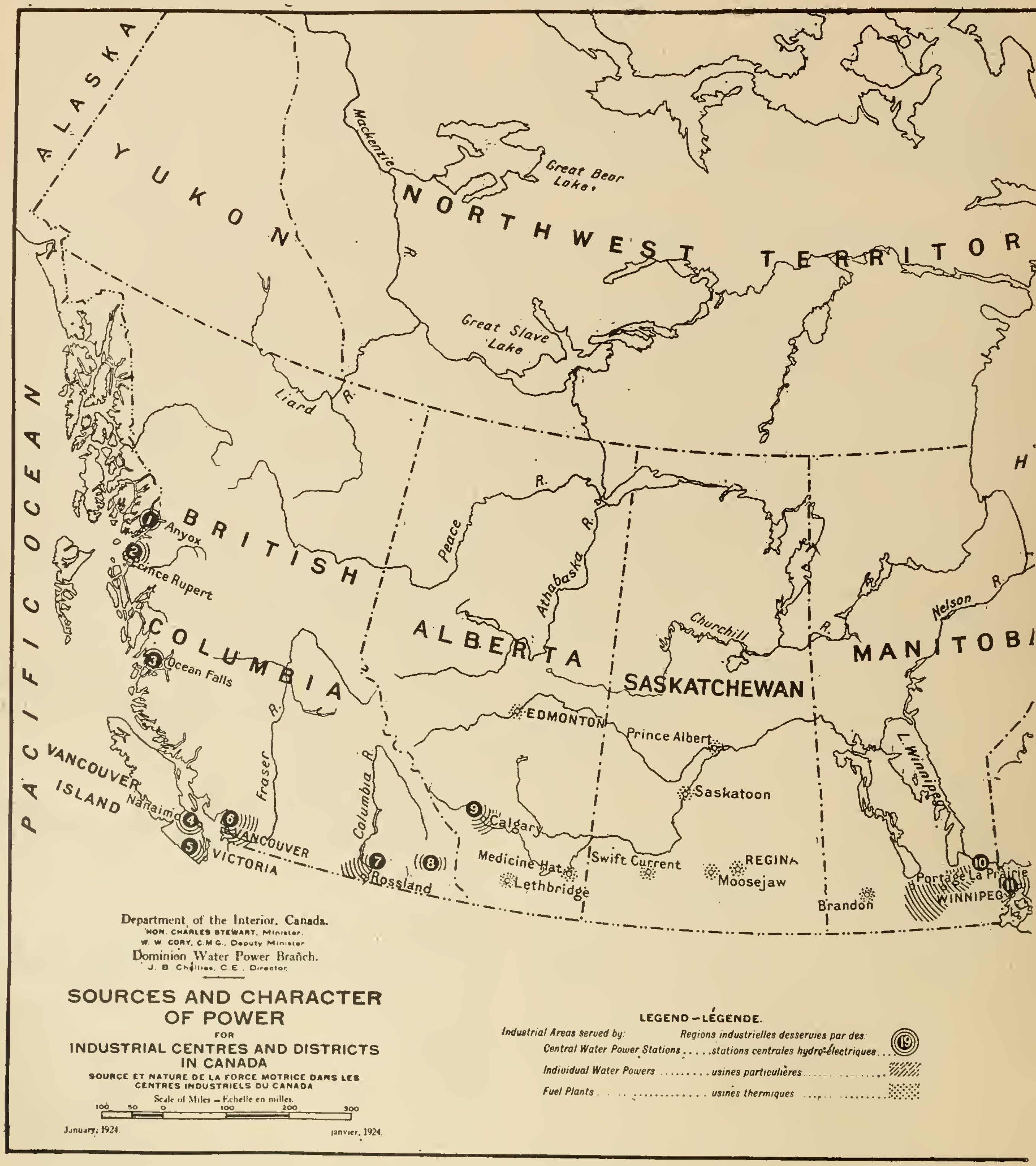


Plate No. A-3.—Sources and Character of Power coveries will be made as the great Laurentian plateau of Northern Canada becomes more and more accessible. Water power will prove an important, and in some cases basic, factor in converting these discoveries into definite mining enterprises.

Past and Future Growth in Utilization of Water Power

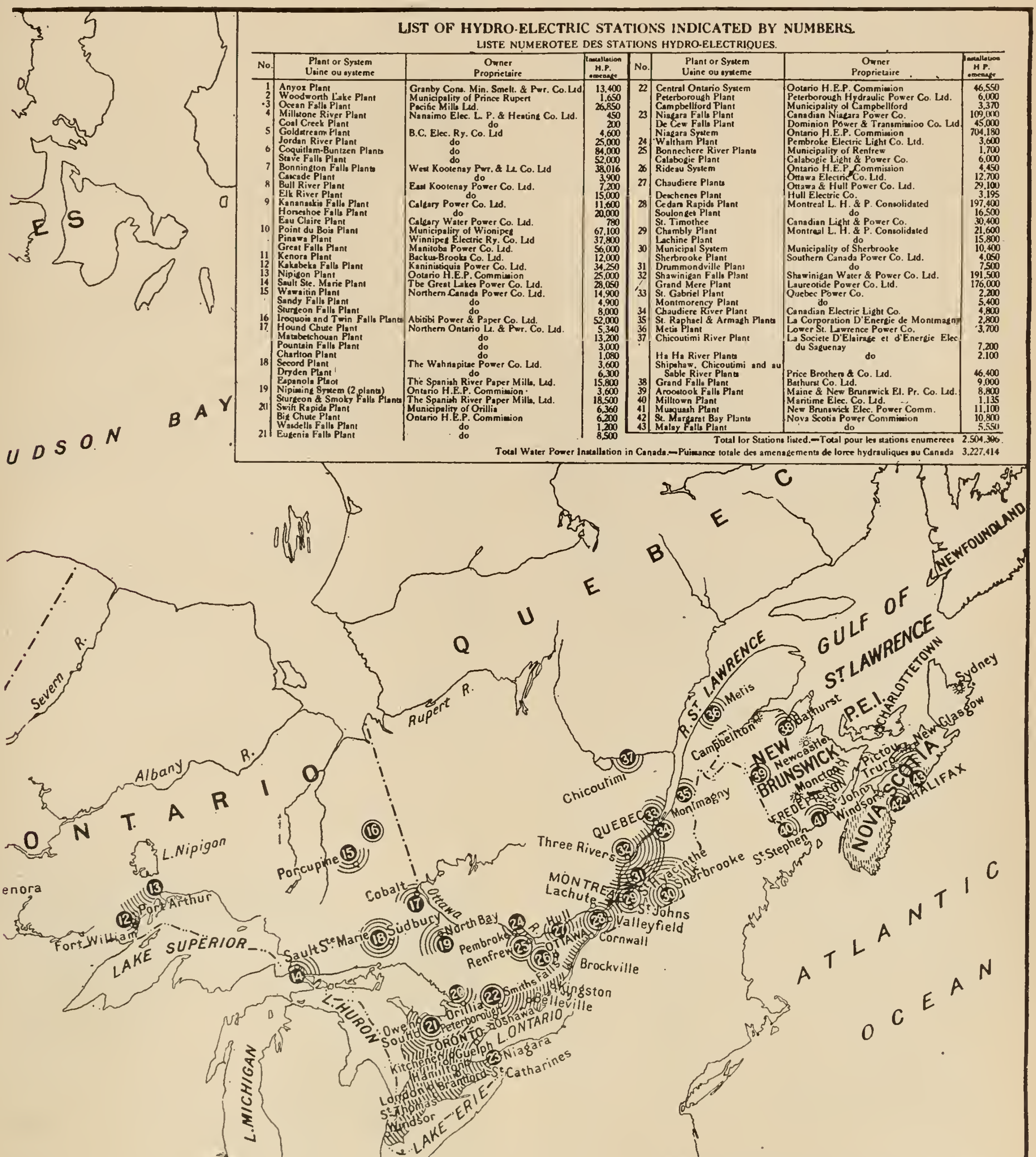
The growth of water power development in Canada as illustrated in plates Nos. A-4 and A-5 has been striking. The total installed horse power has grown from 975,000 to 3,227,414 h.p. since 1910, and in this period the growth in central station installation has been from 605,000 to 2,411,701 h.p. while in the pulp and paper industry the installation has increased from 191,000 to 497,620 h.p. While the increase since 1910 has been more rapid than during the first decade of the century the installation in 1900 only registered the beginning of water power development in Canada.

There is every reason to believe that this rate of

LIST OF HYDRO-ELECTRIC STATIONS INDICATED BY NUMBERS.

LISTE NUMEROTEE DES STATIONS HYDRO-ELECTRIQUES.

No.	Plant or System / Usine ou systeme	Owner / Proprietaire	Installation H.P. amenage
1	Anyox Plant	Granby Cons. Min. Smelt. & Pwr. Co. Ltd	13,400
2	Woodworth Lake Plant	Municipality of Prince Rupert	1,650
3	Ocean Falls Plant	Pacific Mills Ltd.	26,850
4	Millstone River Plant	Nanaimo Elec. L. P. & Heating Co. Ltd.	450
	Coal Creek Plant	do	200
5	Goldstream Plant	B.C. Elec. Ry. Co. Ltd	4,600
	Jordan River Plant	do	25,000
6	Coquitlam-Buntzen Plants	do	84,000
	Stave Falls Plant	do	52,000
7	Bonnington Falls Plants	West Kootenay Pwr. & Lt. Co. Ltd	38,016
	Cascade Plant	do	3,900
8	Bull River Plant	East Kootenay Power Co. Ltd.	7,200
	Elk River Plant	do	15,000
9	Kananaskis Falls Plant	Calgary Power Co. Ltd.	11,600
	Horseshoe Falls Plant	do	20,000
	Eau Claire Plant	Calgary Water Power Co. Ltd.	780
10	Point du Bois Plant	Municipality of Wionipeg	67,100
	Pinawa Plant	Winnipeg Electric Ry. Co. Ltd	37,800
	Great Falls Plant	Manitoba Power Co. Ltd.	56,000
11	Kenora Plant	Backus-Brooks Co. Ltd.	12,000
12	Kakabeka Falls Plant	Kaninistiquia Power Co. Ltd.	34,250
13	Nipigon Plant	Ootario H.E.P. Commission	25,000
14	Sault Ste. Marie Plant	Tbe Great Lakes Power Co. Ltd.	28,050
15	Wawaitin Plant	Northern Canada Power Co. Ltd.	14,900
	Sandy Falls Plant	do	4,900
	Sturgeon Falls Plant	do	8,000
16	Iroquois and Twin Falls Plants	Abitibi Power & Paper Co. Ltd.	52,000
17	Hound Chute Plant	Northern Ontario Lt. & Pwr. Co. Ltd.	5,340
	Matabetchouan Plant	do	13,200
	Pountain Falls Plant	do	3,000
	Charlton Plant	do	1,080
18	Secord Plant	The Wahnapitae Power Co. Ltd.	3,600
	Dryden Plant	do	6,300
	Espanola Plaot	The Spanish River Paper Mills, Ltd.	15,800
19	Nipissing System (2 plants)	Ontario H.E.P. Commission	3,600
	Sturgeon & Smoky Falls Plants	The Spanish River Paper Mills, Ltd.	18,500
20	Swift Rapids Plant	Municipality of Orillia	6,360
	Big Chute Plant	Ontario H.E.P. Commission	6,200
	Wasdells Falls Plant	do	1,200
21	Eugenia Falls Plant	do	8,500
22	Central Ontario System	Ootario H.E.P. Commission	46,550
	Peterborough Plant	Peterborough Hydraulic Power Co. Ltd.	6,000
	Campbellford Plant	Municipality of Campbellford	3,370
23	Niagara Falls Plant	Canadian Niagara Power Co.	109,000
	De Cew Falls Plant	Dominion Power & Transmissioo Co. Ltd	45,000
	Niagara System	Ontario H.E.P. Commission	704,180
24	Waltham Plant	Pembroke Electric Light Co. Ltd.	3,600
25	Bonnechere River Plants	Municipality of Renfrew	1,700
	Calabogie Plant	Calabogie Light & Power Co.	6,000
26	Rideau System	Ontario H.E.P. Commission	4,450
27	Chaudiere Plants	Ottawa Electric Co. Ltd.	12,700
		Ottawa & Hull Power Co. Ltd.	29,100
	Deschenes Plant	Hull Electric Co.	3,195
28	Cedars Rapids Plant	Montreal L. H. & P. Consolidated	197,400
	Soulonges Plant	do	16,500
	St. Timothee	Canadian Light & Power Co.	30,400
29	Chambly Plant	Montreal L. H. & P. Consolidated	21,600
	Lachine Plant	do	15,800
30	Municipal System	Municipality of Sherbrooke	10,400
	Sherbrooke Plant	Southern Canada Power Co. Ltd.	4,050
31	Drummondville Plant	do	7,500
32	Shawinigan Falls Plant	Shawinigan Water & Power Co. Ltd.	191,500
	Grand Mere Plant	Laureotide Power Co. Ltd.	176,000
33	St. Gabriel Plant	Quebec Power Co.	2,200
	Montmorency Plant	do	5,400
34	Chaudiere River Plant	Canadian Electric Light Co.	4,800
35	St. Raphael & Armagh Plants	La Corporation D'Energie de Montmagny	2,800
36	Metis Plant	Lower St. Lawrence Power Co.	3,700
37	Chicoutimi River Plant	La Societe D'Elairage et d'Energie Elec du Saguenay	7,200
	Ha Ha River Plants	do	2,100
	Shipshaw, Chicoutimi and au Sable River Plants	Price Brothers & Co. Ltd.	46,400
38	Grand Falls Plant	Bathurst Co. Ltd.	9,000
39	Aroostook Falls Plant	Maine & New Brunswick El. Pr. Co. Ltd.	8,800
40	Milltown Plant	Maritime Elec. Co. Ltd.	1,135
41	Musquash Plant	New Brunswick Elec. Power Comm.	11,100
42	St. Margaret Bay Plants	Nova Scotia Power Commission	10,800
43	Malay Falls Plant	do	5,550
	Total lor Stations listed.—Total pour les stations enumerees		2,504,396
	Total Water Power Installation in Canada.—Puissance totale des amenagements de lorce hydrauliques au Canada		3,227,414



for Industrial Centres and Districts in Canada.

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growth will not diminish. New uses for electric current of the greatest import in industrial processes and services are being constantly discovered. Canada's strategic advantage in the location of large reserves of water power within transmission distance of her centres of population should attract special industries to these centres in increasing numbers. Population follows industry and at once an added market is created for power for domestic and municipal uses. All the modern tendencies in the utilization of cheap power indicate that the rate of growth of hydro-electric development in Canada will increase rather than lessen.

The rate of installation of water power equipment after 1910 was in the neighbourhood of 200,000 h.p. per year. With the outbreak of the war a lull set in lasting until 1920, from which date the rate of installation has shown a steady acceleration. The curve on plate No. A-4 has been projected into the future along two lines, the first following the curve of present growth and the second along a line which is considered to be extremely conservative. It can be estimated therefore, that there will be installed by the close of 1925, 4,000,000 h.p.; 1930 from 5,000,000 to 5,500,000 h.p.; 1935 from 6,000,000 to 7,000,000 h.p. By the close of 1940, with the normal course of expansion, the total water power installation should reach 7,000,000 h.p. and may even be as great as 8,500,000 h.p. Available reserves are more than ample to take care of such an expansion.

The importance of water power to Canada can hardly be exaggerated. It has brought about and will continue to produce, a national prosperity far in advance of anything which would have been possible without its assistance.

Section II. Review by Provinces

Historically, water power development in Canada falls into two periods, the first covering the period from the earliest settlement up to the beginning of high tension transmission of electric energy, while very interesting, has only a minor bearing on the present day situation, early settlers introducing the practices of their homeland constructed and installed water-wheels at convenient places to drive saw-mills, grist-mills, etc., to meet pioneer requirements. Upwards of a century ago the manufacture of paper in Canada was begun and this industry early took advantage of falling water as a source of energy for the driving of machinery and by 1891 the annual output had reached a value exceeding one million dollars. About this time electrical science had developed generators for the production of and apparatus for the useful application of electricity and where towns were located adjacent to waterfalls, as for instance at the city of Ottawa, where electric power was produced and sold about 1890, or Kenora where a municipal power plant was established in 1892.

The second period may be said to commence in 1895 when a small development of 1,200 horse power was developed on the Batiscan river near Quebec and transmitted 17 miles at 11,000 volts to the town of Three Rivers; incidentally, this was the first high tension transmission of water power within the British Empire. In the "nineties" a number of hydro-electric stations were established and it is difficult to differentiate between those using high tension transmission at that time and those doing a purely local low tension distribution but a rapid survey shows that between 1895 and 1905 hydro-electrical energy began to become generally available

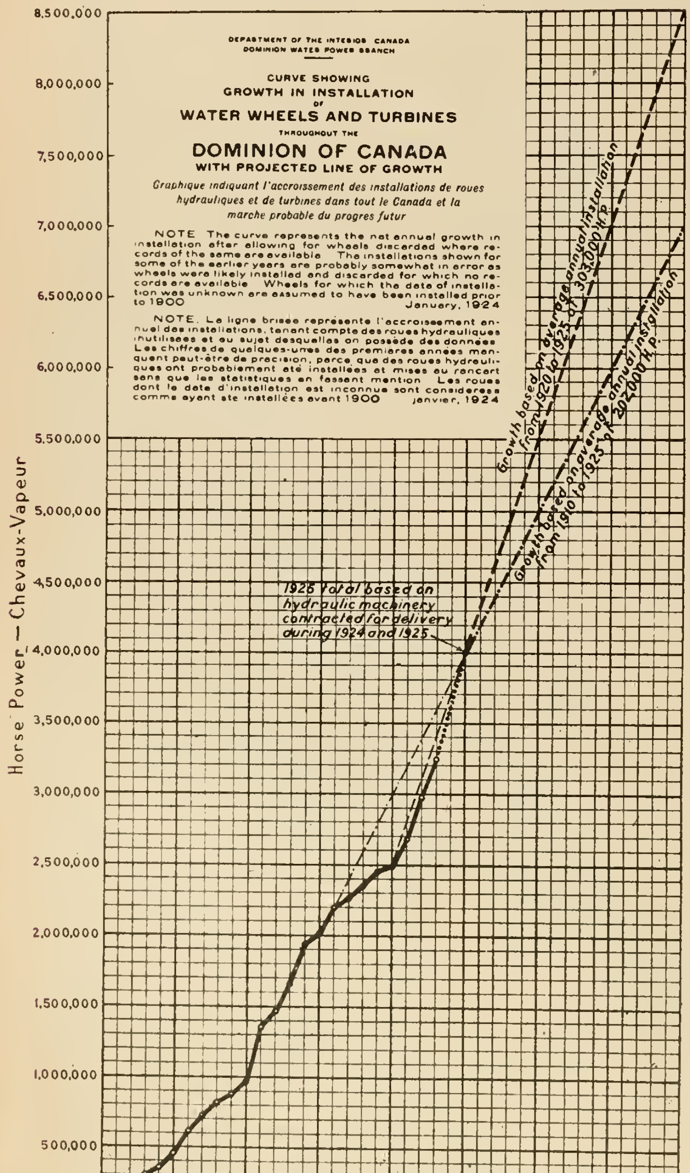


Plate No. A-4.—Growth in Installation of Water Wheels and Turbines throughout the Dominion of Canada with projected line of Growth.

Stave Falls Development on the Stave River, of the British Columbia Electric Railway Company — 52,000 h.p.

Horseshoe Falls Development on the Bow River, Alberta, of the Calgary Power Company — 20,000 h.p.

wherever it was conveniently located, high tension transmission being utilized when necessary. In British Columbia, Victoria received power from the Goldstream river in 1898; the Kootenay river was supplying power in 1897, the Illecillewaet river supplied Revelstoke in 1899, while the first supply to Vancouver began in 1904. Winnipeg received power from the Winnipeg river in 1906, while a second development came into action in 1911.

The first Niagara development was that of the International Railway Company in 1893 of 4,000 h.p.; the Canadian Niagara Company followed ten years later and the present Canadian installation at Niagara is approximately 800,000 h.p. The development of power for mining in Ontario could be readily dated by the sudden growth in output shown in the mineral statistics. The International Nickel Company of Canada installed 6,200 h.p. on the Spanish river in 1905 while the Northern Ontario Light and Power Company commenced supplying Cobalt in 1909 and the Northern Canada Power Company supplied the gold mines first in 1911.

The first high transmission voltage, as has already been mentioned, belongs to the province of Quebec, and it is of historical interest that an installation of 24,000 h.p. on the St. Anne river in 1916 was based on the original grant of January 15th, 1636. Montreal first received power from the St. Lawrence at Lachine in 1898, from the Richelieu river in 1901, while the great Cedar Rapids power station did not start delivering power until 1914. The first development at Shawinigan on the St. Maurice river was producing power in 1901.

The last half decade in the nineteenth and the first half in the twentieth century also saw the beginning of modern hydro-electrics in the maritime provinces.

British Columbia

Undeveloped Power Resources

The water power resources of the province of British Columbia are estimated at 1,930,000 h.p. minimum and 5,100,000 h.p. for six months, of which 355,000 h.p. has

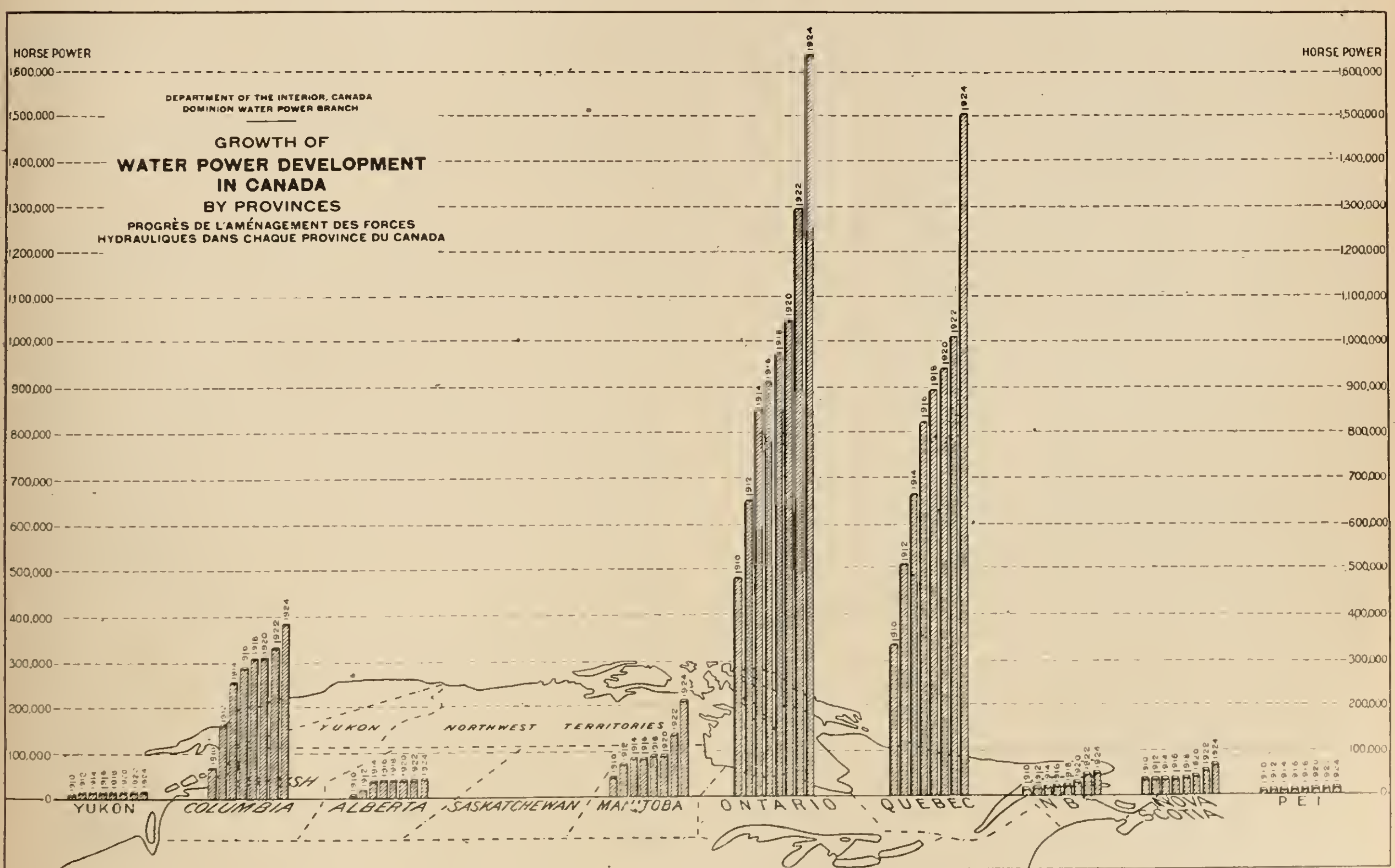


Plate No. A-5.—Growth of Water Power Development in Canada by Provinces.

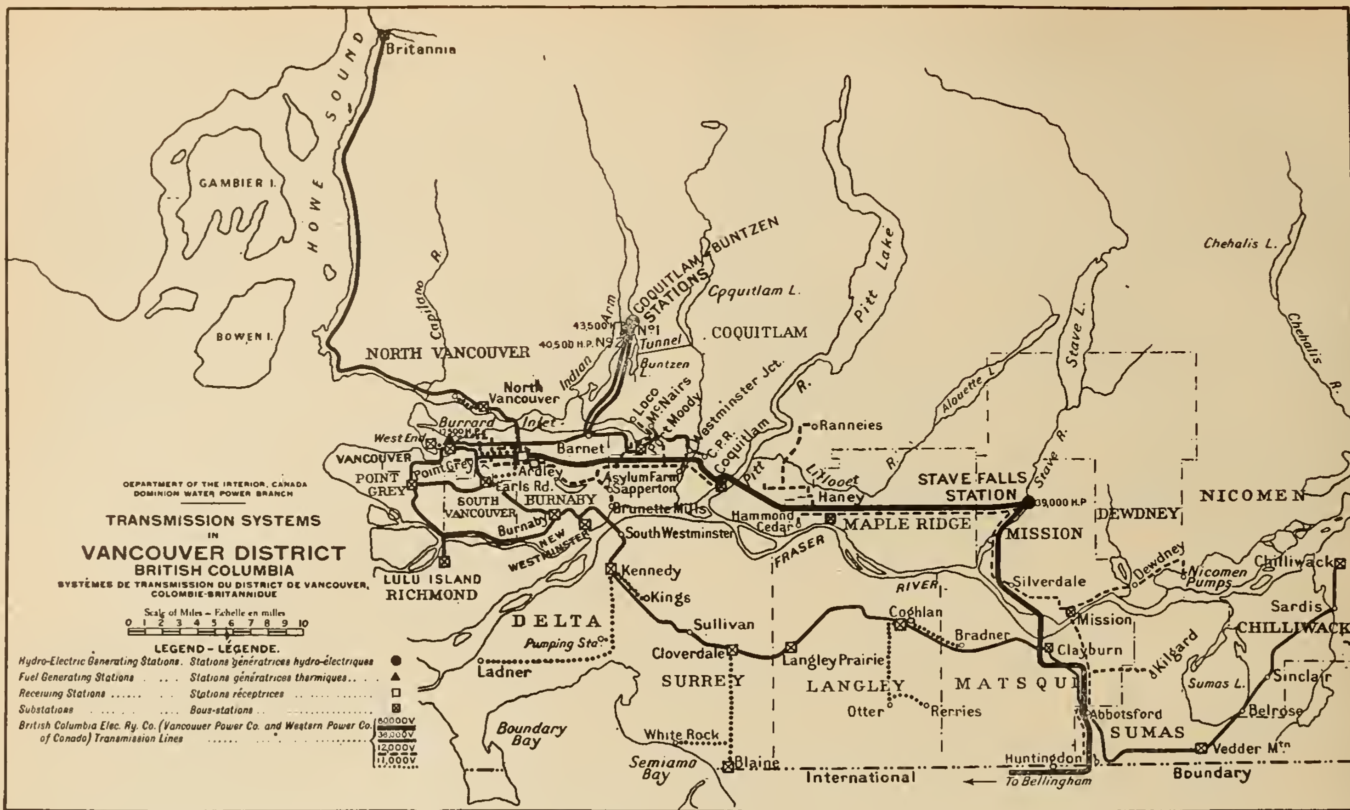


Plate No. A-6.—Transmission Systems in Vancouver District, British Columbia.

already been developed. The wide variations of topography and climate consequent upon the existence of three mountain ranges in the province produce power opportunities ranging from the low and medium up to heads exceeding 2,000 feet.

The principal high head sites are to be found in the coastal region and Vancouver Island where considerable elevations and high precipitation (exceeding 100 inches per annum), are conditions favourable thereto; the full opportunities of this region are, however, not reflected in the figures given above as these figures are, in most cases, based upon the actual unregulated flow of streams and rivers and take no account of numerous natural opportunities for storage, concentration of flow of several streams and so forth which would undoubtedly make possible the development of power very considerably in excess of the sum of the powers available on the individual streams.

The largest low to medium head sites are to be found on the larger rivers, Fraser, Columbia, Kootenay, Pend d'Oreille. In the Selkirk and Rocky Mountain districts high heads are again available, although the precipitation is less and the storage facilities less numerous than in the coastal region, the importance of these sites is very considerable.

Developed Power

The development of power in British Columbia has reached its largest proportions around centres of population in the form of central station enterprise and is here used for the general industries and facilities of the population served. Much power is also developed primarily for use in mining and smelting or for the pulp and paper industry some of these developments however also function as central stations where there is demand for this service. It might also be noted that although the power requirements of fish canning plants in the coastal regions are small they are nevertheless very largely supplied by small water power developments.

The principal central station systems in British Columbia are those supplying the Vancouver, Victoria and Nelson districts.

Vancouver District

The Vancouver District draws its power supply from three water power developments. (See plate No. A-6.) Two of these are located on the North Arm of Burrard Inlet, 16 miles from Vancouver, and draw water from lake Buntzen which in turn is supplied by water stored in and diverted through a tunnel from lake Coquitlam; these two plants operate under a head of 395 feet and have an aggregate installation of 84,000 horse power. The third development is located on Stave river 36 miles from Vancouver and the works also control the water level of Stave lake thereby converting the lake into a storage reservoir; the plant operates under an average head of 110 feet and has an installation of 52,000 h.p. These plants are all controlled by the British Columbia Electric Railway Company and the transmission system is shown on plate No. A-6.

A further power development is now being constructed, the outlet of Alouette lake is being dammed and the lake thereby converted into a storage reservoir. The stored water is to be diverted through a short tunnel into Stave lake on the shores of which, with an average head of 140 feet, a 10,000 h.p. development is to be established. The water diverted from Alouette lake will become available to the plant on the Stave river where a further 25,000 h.p. can thereby be developed; it will also be available at the lower site on the Stave river and will raise its possibilities to 80,000 h.p.

Victoria District

Victoria and district power supply is controlled by the same company as supplies Vancouver and the transmission system is illustrated in plate No. A-7. The power is generated at two stations, the first on the Goldstream river 12 miles from Victoria where, under an average head of 670 feet, 4,600 h.p. is developed; the second station is at the mouth of the Jordan river 36 miles west of Victoria where, under an average head of 1,145 feet, 25,000 h.p. is installed.

Nelson District

This district is supplied by the developments of the municipality of Nelson and of the West Kootenay Power and Light Company on the Kootenay river at the Upper and Lower Bonnington falls and by a development on the Cascade river controlled by the company. The aggregate power installation of these developments is 45,500 h.p.

While the above are the principal central station systems in British Columbia, mention should be made of the East Kootenay Power Company's developments on the Bull and Elk rivers aggregating 22,000 h.p., which supply Fernie, Cranbrook and other places in the Crowsnest region, and of the municipal developments of Kamloops and Revelstoke.

Water Power Developments for Mining

The principal mining developments in British Columbia from the water power standpoint are three in number; the Britannia Mining and Smelting Company, Limited, has 15,430 h.p. installed on Britannia creek under a head of 1,920 feet, exclusive of an additional 1,400 h.p. installation upstream from the main station which is utilized at seasons of low water; the Granby Consolidated Mining, Smelting and Power Company has an installation at Anyox on Falls creek where, under an average head of 375 feet, 13,400 h.p. is installed; the third large development is that of Canadian Collieries (Dunsmuir) Limited, in Vancouver Island which has a 275-foot head, 12,000-h.p. installation on the Puntledge river. Numerous other mines are operated with water power and among these may be mentioned the mines of The Hedley Gold Mining Company; the Belmont Surf Inlet Mines, Limited, and the Premier Gold Mining Company, Limited.

Water Power used in Pulp and Paper Industry

Three companies operate six mills in British Columbia with a total water power installation of 55,140 h.p. The Pacific Mills of Vancouver has two mills, the largest on the Link river at Ocean Falls where, under a head of 140 feet, 26,850 h.p. is installed. The Whalen Pulp and Paper Mills Limited has three mills, the first at Woodfibre

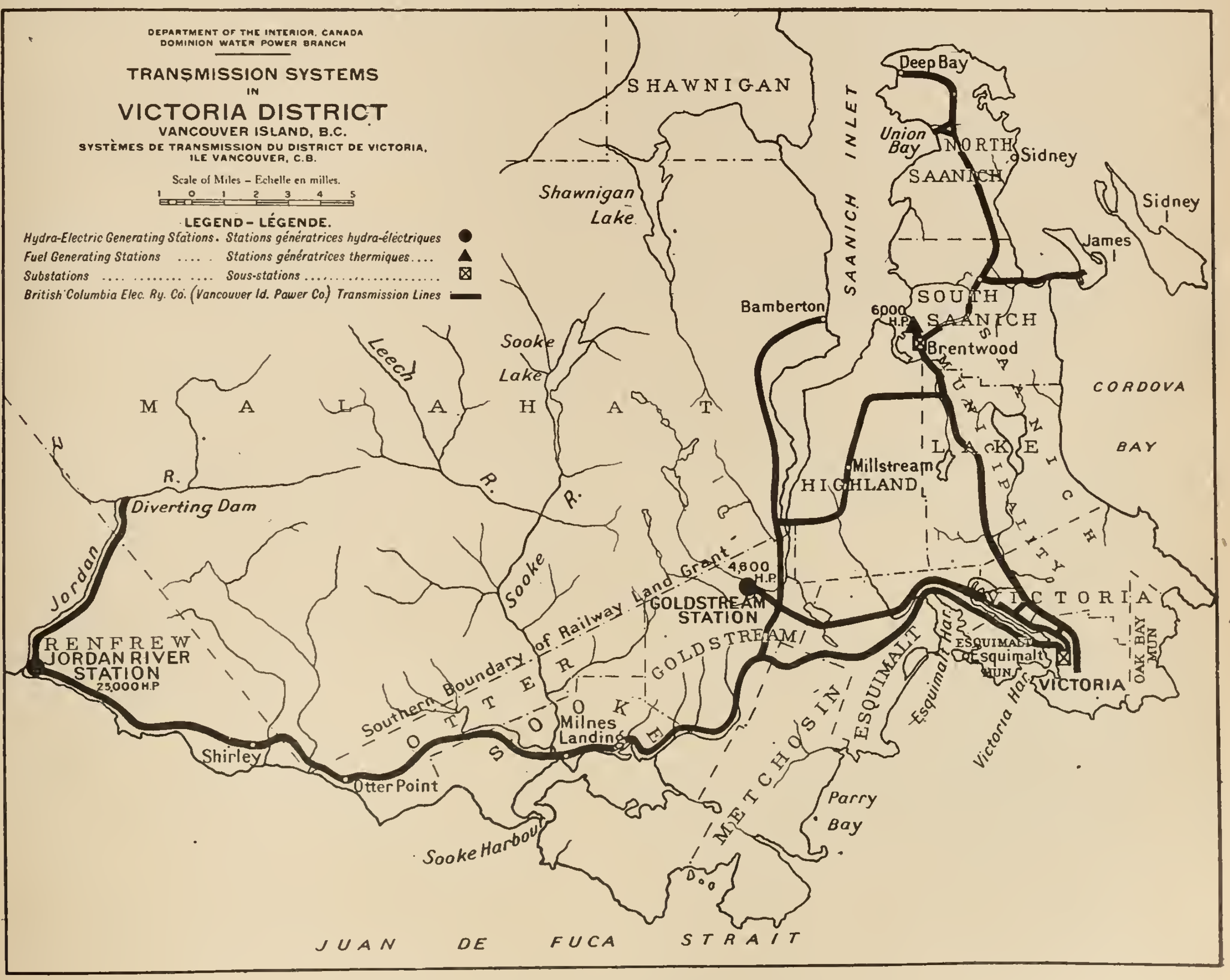


Plate No. A-7.—Transmission Systems in Victoria District.

draws water from Mill creek under a 580-foot head and from Cedar creek under 1,100-foot head and develops 2,240 h.p.; the second near Swanson Bay where an installation of 1,750 h.p. draws water under a head of 130 feet from Swanson creek; and the third mill at Port Alice has a 300-h.p. installation. The third pulp and paper company is the Powell River Company, Limited, which has a 24,000-h.p. installation operating under a head of 147 feet on the Powell river.

Upper Bonnington Falls Development, on the Kootenay River, of the West Kootenay Power Company — 34,000 h.p.

The Prairie Provinces

The provinces of Alberta, Saskatchewan and Manitoba which occupy the area south of the 60th parallel of latitude extending from Hudson bay to the crest of the Rocky mountains are generally known as the prairie provinces. The prairies themselves are practically without water power resources as the rivers and streams traversing them are in the main of gradual gradient without well defined rapids or falls, they are also flashy and subject to periods of extremely low flow and are therefore unsuited for power development. The country bordering on the prairies is however well supplied with water power resources which are found in the mountains and foothills to the west and in the Laurentian plateau to the north and east.

Undeveloped Power Resources

The water power available in these provinces aggregates 4,260,000 h.p. minimum and practically 8,000,000 h.p. for six months. Approximately three-quarters of these resources belong to Manitoba, the remainder being nearly equally divided between the other two provinces. The turbine installation amounts to 162,000 h.p. in Manitoba, 34,000 h.p. in Alberta and is negligible in Saskatchewan.

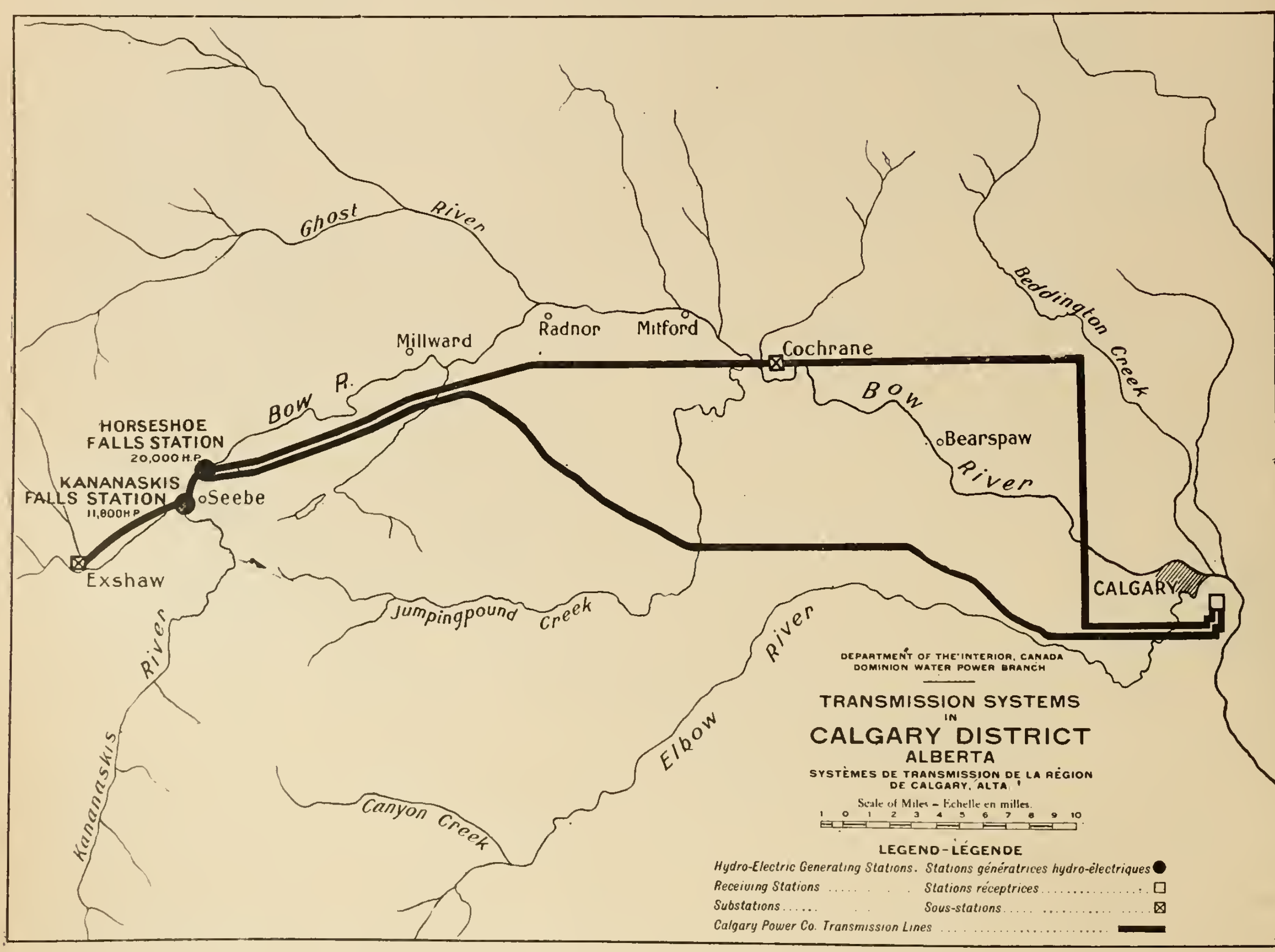


Plate No. A-8.—Transmission Systems in Calgary District, Alberta.

The greatest power river of the prairies is the Nelson draining lake Winnipeg and its vast watershed to Hudson bay, the great area of the lake, 9,500 square miles, is responsible for the high and regular discharge of the Nelson which at twenty-two sites has available 2,440,000 h.p. minimum with 3,660,-000 for six months.

Pointe du Bois Development on the Winnipeg River, Manitoba, of the City of Winnipeg — ultimate capacity 100,000 h.p.

While the Nelson is the greatest, the Winnipeg, owing to its accessibility, is at present the most important power river. This river originates in a country liberally supplied with large lakes and consequently has naturally a very uniform run-off. This uniformity has been accentuated by storage dams in the upper waters and will become even more marked as further storage is provided. In addition to regularity of run-off the fall in the river occurs in such a manner that the whole head can be concentrated at nine desirable sites several of which offer exceptional pondage facilities which largely increase their peak load capacities.

Of the nine sites, six are still undeveloped and these have an aggregate of 170,000 h.p. minimum available which with storage can be increased to 230,000 h.p. The total eventual power installation on the Winnipeg river when storage is fully developed will in all probability exceed 500,000 h.p.

Next to the Nelson in point of size the greatest power rivers of the prairie provinces are, in Alberta, the Slave, Peace and Athabaska rivers; in Saskatchewan the Churchill, Reindeer and Saskatchewan, and in Manitoba the Churchill and the Saskatchewan. These rivers exhaust the largest portion of the power resources. Certain other rivers owing to their location in regard to markets have important power resources as for instance the Bow river above Calgary which has in addition to two developments, five undeveloped sites which have an aggregate of 15,000 h.p. minimum available and 37,000 for six months. The Bow river sites would be of even greater economic value, if, as it is suggested, storage reservoirs supplying high head developments in the mountains nearby can be developed. The combination of low-head developments on the Bow river with high-head power-storage plants to make up the winter deficiency will render 250,000 commercial horse power available for southern Alberta. It is only a matter of time until Alberta cities will be enjoying the advantages of dependable power in quantity from the high head sites of the upper Bow River tributaries.

Developed Power of the Prairie Provinces

With the exception of some small plants the power developments of the prairies are confined to the Bow and Winnipeg rivers. The Calgary Power Company has, on the former river, two developments, see plate No. A-8, the first operating under a 70-foot head at Horseshoe falls where 20,000 h.p. is installed and the other at Kananaskis falls two miles upstream, where 11,600 h.p. is installed under the same head. These plants supply Calgary, but owing to low winter flow the output has to be supplemented by fuel power generated by the municipal station at Calgary during this season of the year.

In addition to the undeveloped sites upon the Winnipeg river in Manitoba, there are three developed sites, two on the main river and one on the Pinawa channel, a highwater overflow channel which was enlarged to carry water to a power station erected by the Winnipeg Electric Railway Company which is fully developed having 37,800 h.p. installed with an operating head of 42 feet. A subsidiary of this company has recently completed a 56,000-h.p. initial installation at Great falls on the main river where 56 feet is the available head, this being but one-third of the ultimate installation planned for the site. In addition to these the municipality of the city of Winnipeg has a power station at Pointe du Bois falls where with an operating head of 46 feet, 67,900 h.p. is already installed of an ultimate designed installation of 100,000 h.p.

The power generated on the Winnipeg river is transmitted to and used in Winnipeg and the surrounding district, the transmission systems being shown on plate No. A-9.

Ontario

With the exception of a small portion bordering lakes Huron, Erie and Ontario and the St. Lawrence river in the south, and the coastal plains bordering Hudson and James bays in the north, the whole of Ontario is occupied by the Laurentian plateau or "pre-Cambrian Shield". The drainage system of the province is typical of this formation, — almost innumerable lakes and small rivers find egress into larger streams upon which as well as upon the smaller ones many rapids and waterfalls provide sites aggregating large water power resources. The run-off of the rivers is in the main suitable for power development in that forest cover, muskegs and lakes all contribute to regulating the run-off.

Great Falls Development on the Winnipeg River, Manitoba, of the Manitoba Power Company — ultimate capacity 168,000 h.p.

The water power resources of Ontario are estimated at 4,950,000 h.p. minimum, 6,808,000 h.p. for six months, and the present installation amounts to 1,445,000 h.p.

Undeveloped Power Resources

The western extremity of the province is drained by the upper Winnipeg and English rivers and on these together with their tributaries there are numerous power sites. On the upper Winnipeg, in addition to the power still capable of development at its outlet from the Lake of the Woods, there is a site at White Dog falls where 35,000 h.p. minimum and 57,000 h.p. for six months is available. The English river has four sites aggregating 95,000 h.p. minimum and 158,000 h.p. for six months and it is estimated that with artificial regulation of the flow 133,000 h.p. will be continuously available.

Tributary to lake Superior, the most important power rivers are the Nipigon, Kaministikwia, White, Magpie, Michipicoten and Montreal, the first named of which has three undeveloped sites aggregating 60,000 h.p. minimum and 85,000 h.p. for six months, in addition to the Cameron Falls site which is only partially developed.

Passing from lake Superior to lake Huron the St. Mary's river has a total capacity of 107,000 h.p. minimum and 132,000 h.p. for six months to be divided between Canada and the United States, of this 42,000 h.p. is already developed on the Canadian side.

Tributary to upper lake Huron and Georgian bay there are a number of rivers upon which some development has already taken place but upon which there are still a large number of undeveloped sites aggregating large resources, amongst these mention may be made of the Mississagi, Spanish, French, Maganatawan, Muskoka and Moon rivers. Along the lower shores of lake Huron and along lake Erie we find but few undeveloped sites of importance since the principal streams such as the Severn, Beaver, Saugeen and Grand rivers are already fairly fully utilized.

The Niagara river joins lakes Erie and Ontario which have a difference of surface elevation of 326 feet, approximately half of which occurs at Niagara Falls. If the total flow of the river were utilized for power purposes without regard to the preservation of the scenic beauty of the Falls, with an effective head of 308 feet, there would be available 5,400,000 h.p. minimum and 5,900,000 h.p. for six months to be divided between Canada and the United States. By treaty the diversion for power purposes is limited to 20,000 c.f.s. for the United States and 36,000 c.f.s. for Canada, thus Canada's total resource at 308 feet head amounts to a little over 1,000,000 h.p., the major portion of which has already been developed.

Tributary to lake Ontario there are a number of small rivers the power resources of which are already almost completely developed, the only considerable undeveloped resources are to be found on the Trent Canal system where out of a total of twenty-four sites ten aggregating 16,000 h.p. minimum and 29,000 h.p. for six months are not yet developed; of these ten, however, two are now being developed.

The St. Lawrence river for a considerable stretch below lake Ontario forms the international boundary and in this portion of the river there are rapids capable of concentration which have an aggregate capacity of 1,470,000 h.p. minimum and 1,770,000 h.p. for six months.

The only remaining water powers in Ontario in the streams flowing to the Atlantic are those upon the Ottawa river and its Ontario tributaries. For a considerable portion of its course the Ottawa is the boundary between

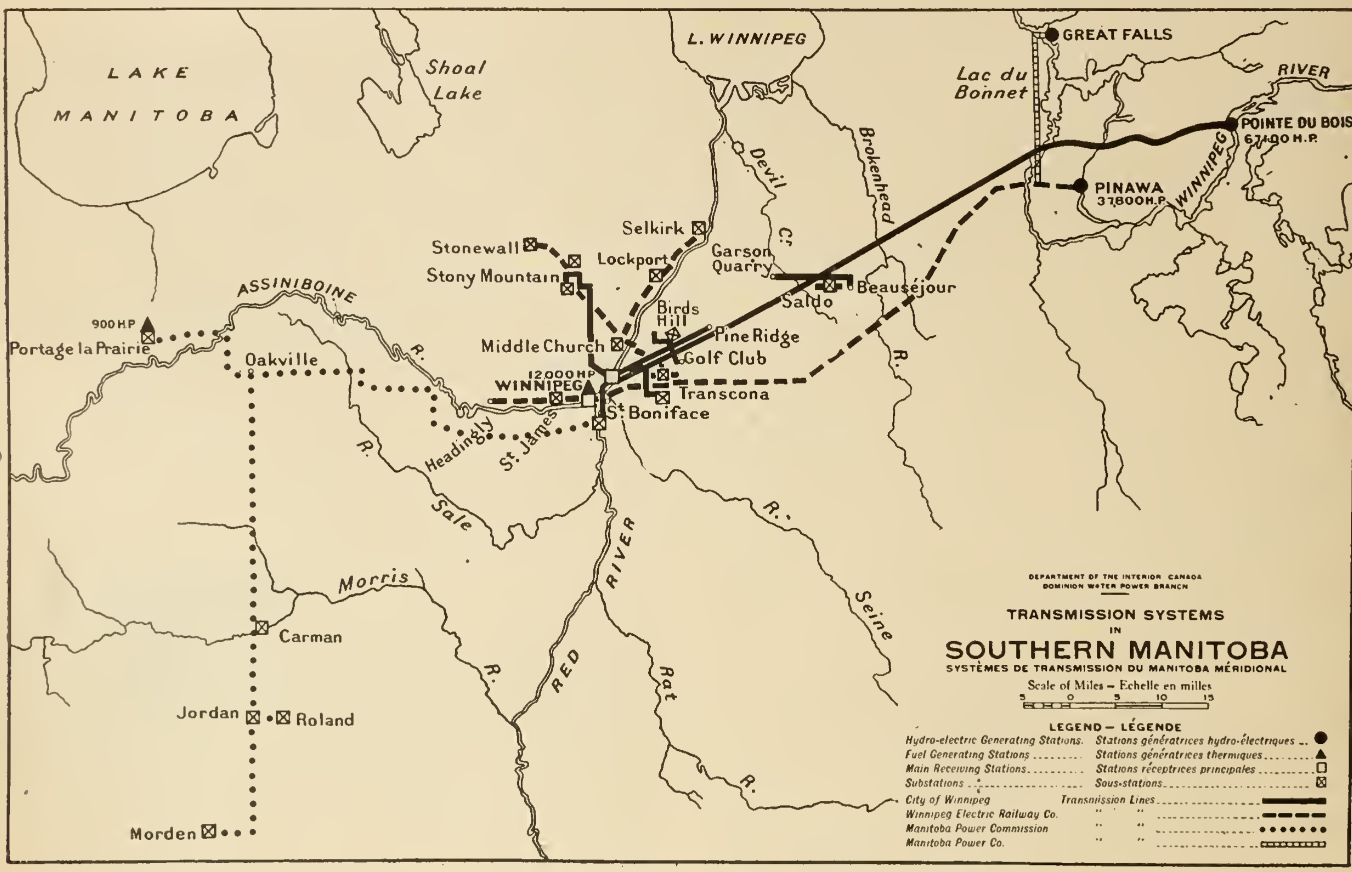


Plate No. A-9.—Transmission Systems in Southern Manitoba.

Ontario and Quebec and consequently the powers in this reach belong to both provinces, these amount to 383,000 h.p. minimum and 713,000 h.p. for six months divided between thirteen sites. The more important undeveloped sites on Ontario tributaries to the Ottawa are to be found on the Blanche, Montreal, Petawawa and Madawaska rivers.

The rivers flowing towards Hudson bay rise at elevations varying from 1,000 to 2,000 feet and between their sources and the coastal plain numerous and in their aggregate large power opportunities exist. The largest power resources are to be found on the Abitibi with eight sites (exclusive of two developed) with an aggregate of 268,000 h.p. minimum and 422,000 h.p. for six months and the Mattagami in addition to four developed sites has eleven undeveloped sites with 110,000 h.p. minimum and 300,000 h.p. for six months available. In addition to these there are extensive resources on the Severn; Attawapishkat; Albany and its tributaries the Ogoki and Kenogami; the Groundhog and Kapuskasing, tributaries of the Mattagami; the Missinaibi which, like the Mattagami, is a tributary of the Moose and others too numerous to mention. All these resources will undoubtedly have a great effect in developing the mineral and timber resources of the region.

Developed Water Powers

The development of water powers for central station service has reached its present proportions largely as a result of the operations of the Ontario Hydro-Electric Power Commission which operates thirteen systems, owns and operates twenty hydro-electric generating stations having a total installation of 801,629 h.p. of which seven stations containing 379,500 h.p. of the installation have been built by the commission. The largest system, the Niagara, supplies practically the whole of South-western Ontario from Toronto to Windsor with power from Niagara 373,000 h.p. being secured from the plants which the commission has secured by purchase and 330,000 h.p. from the Queenston-Chippawa station, built by the commission, which has an ultimate designed capacity of from 550,000 to 600,000 h.p.

The other systems are supplied from plants either purchased or built by the commission on the Severn, Beaver, Muskoka, Nipissing, Nipigon, and Mississippi rivers and seven plants on the Trent Canal system; these have an aggregate installation of nearly 100,000 h.p., the largest single installation being that on the Nipigon river at Cameron falls where 25,000 h.p. of an ultimate 75,000 h.p. is already developed.

While the commission controls the bulk of the municipal central station distribution in Ontario there are a number of important districts supplied by private companies whilst others again are supplied by central stations constructed primarily in connection with the pulp and paper, mining or milling industries. Amongst the privately owned stations may be mentioned the 34,250 h.p. development at Kakabeka falls on the Kaministikwia river supplying Port Arthur and Fort William; a 109,000 h.p. installation at Niagara Falls and a 45,000 h.p. development at De Cew falls nearby; 12,700 h.p. developed on the Ottawa river at Chaudiere falls; 28,000 h.p. at Sault Ste. Marie and 10,000 h.p. on the Wanapitei river. The transmission systems of southern Ontario are shown on plate No. A-10.

The Pulp and Paper Installations

There are forty-six pulp and paper mills in Ontario using water power to the extent of 271,000 h.p., of which 174,000 h.p. is produced by the industry and the remainder

Plate No. A-10.—Transmission Systems in Southern Ontario.

View of Niagara Falls and Canadian Shore showing, left — Electrical Development Company Plant of the Hydro-Electric Power Commission of Ontario — 164,000 h.p.; centre — Canadian Niagara Power Company's plant — 109,000 h.p.; right — Ontario Power Company plant of the Hydro-Electric Power Commission of Ontario — 208,000 h.p.

purchased; of the power produced 90,000 h.p. is used in the direct drive of machinery and the remainder hydro-electrically. The principal power developments are those of J. R. Booth on the Ottawa river at Ottawa, 29,000 h.p.; Ontario and Minnesota Paper Company on the Rainy river at Fort Frances, 8,580 h.p., while they also purchase 1,800 h.p. from an allied company; Backus-Brooks Company at the outlet of the Lake of the Woods at Kenora, 8,600 h.p.; The Spanish River Pulp and Paper Mills, 14,400 h.p. on the St. Mary's river at Sault Ste. Marie, 15,820 h.p. on the Spanish river at Espanola, 5,200 h.p. at Smoky falls and 13,390 h.p. at Sturgeon falls on the Sturgeon river; The Abitibi Power and Paper Company, Limited, 28,000 h.p. at Iroquois falls and 24,000 h.p. at Twin falls on the Abitibi river; other important pulp and paper developments have been made on the Mattagami and Kapuskasing rivers.

The Mining Industry

The mining industry of northern Ontario has reached its present status largely by the aid of water power developed in central stations either owned by the mining companies or constructed for the purpose of selling the power output to the mines. Eight sites aggregating 45,000 h.p. supply the copper-nickel industry, the largest being those of the International Nickel Company on the Spanish river where at two sites a total of 21,000 h.p. is developed. The Northern Ontario Light and Power Company has four sites developing 20,000 h.p. which supply the silver mines, while gold mining absorbs 36,000 h.p. developed at seven sites, the largest being those of the Northern Canada Power Company on the Mattagami which at three sites has a total installation of 28,000 h.p. The total installation for the mining industry is over 100,000 h.p. and this will shortly be increased by a 25,000 h.p. development on the Abitibi river and by power transmitted from the Quinze river in Quebec, these last being developed for gold mining.

Quebec

The province of Quebec is roughly triangular in shape and is divided into three main drainage systems, the first and largest comprising the rivers flowing into the St. Lawrence river and gulf; the second, those draining into Hudson bay; and the third into the north Atlantic.

South of the St. Lawrence river above Quebec the general elevation remains relatively low until the United States boundary is reached, where the general elevation is above 1,000 feet. On the north side of the St. Lawrence and on the south side below Quebec an elevation of from 1,000 to 2,000 feet is quickly reached, this general elevation maintains practically throughout the southerly two-thirds of the province whilst the northern and western slopes lie at a general elevation less than 1,000 feet and fall away rapidly to sea level as the sea-shore is approached.

Geologically, north of the St. Lawrence, Quebec forms part of the Laurentian plateau, lakes and muskegs are numerous and many well defined waterfalls occur. The precipitation is generally higher than in Ontario, along the St. Lawrence it is in the neighbourhood of 40 inches annually, diminishing gradually both northerly and towards the gulf where it ranges between 30 and 35 inches annually; the precipitation amounts to between 20 and 25 inches in the latitude of James bay; these figures are rough average figures derived from scattered data for, except in the southern districts, meteorological stations are few and far apart.

The regimen of the rivers of Quebec under natural conditions is regular, forest cover, innumerable lakes and muskegs and the general flat character of the terrain all contribute to the equalization of run-off. High flows occur in the spring when the winter's snow is melting and low flows during the late summer and in the middle of winter when the whole territory is frost-bound; the maximum flow of most streams is usually ten to twenty times the minimum and this not excessive natural variation can in most cases and has already in some been much reduced by the construction of regulating works.

Undeveloped Power Resources

Unlike Ontario, water power development in Quebec has not occurred in any but the St. Lawrence drainage, the southern watershed is wider than in Ontario and the exploitation of resources and the drift of settlement has not yet crossed the divide so that data concerning the rivers flowing into the north Atlantic and Hudson bay is very incomplete. The opportunities for power development in the southern area are however very great and in addition to the natural resources of virgin timber and quite probably of minerals we find large rivers with many well defined waterfalls either close to or actually at tide water, so that the development of a notable external trade in manufactures is only a question of time.

The water power resources are estimated at 6,915,000 h.p. minimum and 11,640,000 h.p. for six months. The largest sites in the St. Lawrence drainage are on the St. Lawrence itself which after leaving the international section flows practically entirely through Quebec, the river has two sites with an aggregate capacity of 2,150,000 h.p. minimum and 2,619,000 h.p. for six months, existing installations here amount to 250,000 h.p.

The first important tributary to the St. Lawrence in Quebec is the Ottawa which, in addition to resources of 383,000 h p. minimum and 713,000 h.p. for six months which have already been referred to as being shared with Ontario, has further sites above and below the interprovincial section which aggregate 91,000 h.p. minimum and 166,000 h.p. for six months. The principal tributaries of the Ottawa in Quebec are the Quinze, Rouge, Lievre and Gatineau rivers and these have in addition to developed sites undeveloped possibilities aggregating 330,000 h.p. minimum and 692,000 h.p. for six months; other tributaries such as the Coulonge, Black and North rivers also have valuable sites.

South of the St. Lawrence between Montreal and Quebec, known as the "Eastern Townships", much development has taken place, nevertheless, 60,000 h.p. minimum and 107,000 h.p. for six months are the estimated resources of the undeveloped sites of the St. Francis and Chaudiere rivers. Below Quebec the height of land south of the St. Lawrence approaches quite near to the river and gulf consequently the power resources, though numerous, are with the exception of the Magdalen river, (11,000 h.p. minimum and 20,000 h.p. for six months), relatively small.

The St. Maurice river enters the St. Lawrence from the north about half way between Montreal and Quebec and has in addition to developed sites eleven undeveloped aggregating 420,000 h.p. minimum and 624,000 h.p. for six months. The Gouin and three smaller reservoirs constructed or acquired by the Quebec government have practically doubled the capacity of these sites. Tributaries to the St. Maurice have a minimum capacity of 40,000 h.p.

The only important undeveloped sites between the St. Maurice and Saguenay rivers are on the Batiscan river where nearly 16,000 h.p. minimum is still available.

The Saguenay joins lake St. John with the St. Lawrence and has two sites in the relatively short portion above Chicoutimi, the head of sea going navigation. These sites aggregated 327,000 h.p. minimum and 614,000 h.p. for six months, while with regulation of Lake St. John 764,000 h.p. would be continuously available. Power to the extent of 16,500 h.p. minimum is still available on the Shipshaw river. Entering lake St. John are a number of important rivers the largest being the Peribonka and the Chamouchouane, the power resources of the tributaries to lake St. John are approximately a quarter of a million h.p. minimum and nearly double that amount for six months.

Below the Saguenay the whole northern shore of the St. Lawrence is pierced at intervals by rivers falling steeply to sea level. These have water power resources reaching an aggregate of about 850,000 minimum and 1,500,000 h.p. for six months.

Tributary to James and Hudson bays there are a number of large rivers concerning which however the available data is indefinite. Estimates have been made concerning the Nottaway, Rupert, Eastmain, Big and Great Whale rivers and it is considered reasonable to place the combined power resources of these rivers at 800,000 h.p. minimum. Tributary to Ungava bay the Koksoak river is thought to have a minimum power capacity of 300,000 h.p.

The only river entering the Atlantic from northern Quebec concerning which any information is available is the Hamilton; 250 miles from its mouth explorers state that there is a fall at which, with an effective head of 900 feet, an estimated 400,000 minimum horse power could be obtained. There are also lakes in the upper watershed which might be available for water storage, in which case the estimated power resources might be increased. This site will probably remain undeveloped until the area is opened up, possibly many years hence. Muskrat falls, 25 miles from the mouth of the river, has more modest but probably more valuable present possibilities estimated at 45,000 h.p.

Developed Power

Practically every community of any size in the province of Quebec has hydro-electric central station service. These communities are most numerous along the northern shore of the St. Lawrence from the Ontario boundary to below Quebec and through the Eastern Townships lying between this section of the river and the United States boundary. Plate No. A-11 illustrates the transmission systems of this district and it is interesting to note the concentration of systems supplying Montreal and Quebec as well as the extent of the areas supplied by the various stations.

Montreal and district draws power from a number of developments. The Montreal Light, Heat and Power Company owns and operates four plants, three of which are on the St. Lawrence, at Cedar rapids, Lachine rapids and Soulanges canal, and the fourth on the Richelieu river at Chambly, the aggregate installation being 228,000 h.p. The Canadian Light and Power Company has a 30,000 h.p. development on the Beauharnois canal and the power supply is still further contributed to from Shawinigan.

Quebec city and district including Levis is served by the Quebec Power Company which draws power from two developments on the Montmorency river and one each on the Jacques Cartier, St. Anne de Beaupre and Chaudiere rivers, aggregating 32,600 h.p. in addition to which Quebec also receives power from Shawinigan.

The Eastern Townships are particularly well supplied with hydro-electricity. The Southern Canada Power Company has an extensive transmission system distributing power developed on the St. Francis and Magog rivers, as well as power purchased from the Montreal

Light, Heat and Power Company. In addition to this, power is produced on the St. Francis and Magog rivers for transmission and distribution by the municipality of Sherbrooke and on the St. Francis by the St. Francis Water Power Company. Power from Shawinigan is also distributed in this area.

The St. Maurice river is the largest present source of power in the province of Quebec, 547,000 h.p. being now installed at three sites. At Shawinigan Falls the Shawinigan Water and Power Company has an installation of 191,000 h.p., while it also controls a partially completed 120,000 h.p. development at La Gabelle, in which provision is made for the installation of additional units. In addition to these the company operates the 164,000 h.p. development at Grand'Mere, this last is owned by the Laurentide Power Company, which uses 50,000 h.p. of the output in its pulp and paper mills. The Northern Aluminum Company also develops 52,000 h.p. and the Belgo Company 18,000 h.p. at Shawinigan for use in their industries.

The Hull district adjacent to Ottawa, is supplied with power from plants at Chaudiere falls and Deschene rapids on the Ottawa river, three developments aggregating 41,300 h.p.

The Pulp and Paper Installations

In addition to the central station industry, water power to the extent of 368,000 h.p. is used in fifty-six pulp and paper mills in Quebec and 237,000 h.p. of this is developed purely for these mills, amongst these may be mentioned 14,000 h.p. on the Ottawa at Hull; 6,900 on the Lievre at Buckingham; plants on the St. Francis river, aggregating 26,000 h.p.; on the Jacques Cartier, 8,500 h.p.; on the Chicoutimi and Ouiatchouan 28,000 h.p.; on the Au Sable and Shipshaw rivers, 59,000 h.p.; in addition to these lower down the gulf of St. Lawrence there is a 11,000 h.p. development on the Marguerite river and 5,600 h.p. on the Madeleine. These are in addition to the mills at Shawinigan and Grand'Mere and to a very extensive development now being constructed on the Saguenay near the outlet of lake St. John.

Maritime Provinces

The provinces of New Brunswick, Nova Scotia and Prince Edward Island are known as the maritime provinces, and these geographically and geologically depart markedly from the conditions observed in Ontario and Quebec. The Laurentian plateau does not extend into these provinces, the climate is more moderate, the precipitation greater and the watersheds smaller. The existence and development of coal resources has in the past made water power a relatively less vital resource than it is in central Canada; nevertheless the ample precipitation, (40 to 55 inches annually), comparatively high altitudes approaching to the sea shore and numerous natural reservoir sites all contribute to the making of a number of attractive sites.

Small water power sites also have a very considerable economic value, a site which can be developed without heavy capital outlay to produce power for which a local market already exists is a distinct asset to the community and these sites, which are comparatively numerous in the maritime provinces, are in the aggregate a most important natural resource.

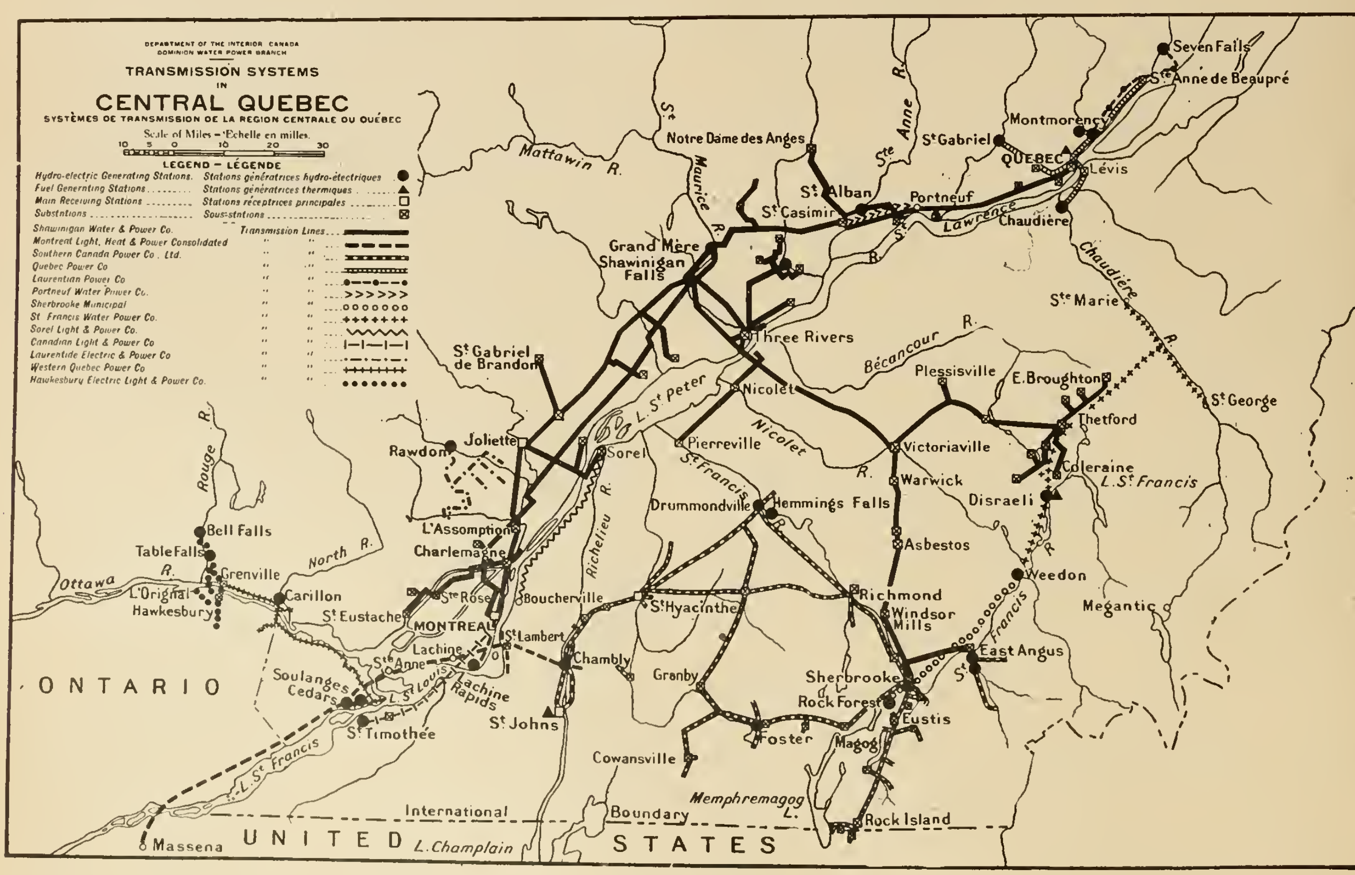


Plate No. A-11.—Transmission Systems in Central Quebec.

New Brunswick

The water power resources of New Brunswick are estimated at 50,000 h.p. minimum and 120,000 h.p. for six months, but stream flow regulation will, it is thought, make it possible to develop 200,000 h.p. which will be economic for commercial use, of this however 20 per cent has already been developed.

The principal power site in New Brunswick is at Grand falls of 130 feet on the St. John river where 22,500 h.p. minimum and 59,000 h.p. with storage is available. Other sites are to be found on the St. Croix river which is an international boundary stream, the Lepreaux, Magaguadavic, Musquash, Nepisiguit and Miramichi rivers.

The developed water powers of New Brunswick total 42,000 h.p., a considerable proportion of which are comprised in small sites developed for local requirements of pioneer communities in saw and grist mills. The principal developments producing power for general distribution are the Musquash development of the New Brunswick Electric Power Commission with an installation of 11,100 h.p., the Aroostook falls development of the Maine and New Brunswick Electric Power Company 8,800 h.p. and the St. Croix river development of 1,135 h.p., owned by the Maritime Electric Company at St. Stephen, (see plate No. A-12). The pulp and paper industry has four mills and 14,000 h.p. developed, the two largest being those of the Bathurst Company at Grand falls on the Nepisiguit, where 9,000 h.p., is installed.

Nova Scotia

At ordinary minimum flow Nova Scotia has available 21,000 h.p. but utilization of storage has already justified the installation of 47,000 h.p., and it is estimated that the full utilization of advantageous reservoir sites will make the development of 300,000 h.p. commercially feasible. As bearing out this estimate of resources, it may be stated that upwards of one hundred individual sites which have been listed in some detail give an aggregate of about 12,000 h.p. minimum, whereas with storage development the same sites would yield nearly 100,000 continuous h.p.

Nova Scotia has a large number of rivers and streams which, with storage development will yield much valuable power. The Liverpool river has three sites with a total of 20,000 h.p. capacity, the Gaspereau river has a 7,000 h.p. site whilst other valuable sites are to be found on the Bear, Lequille, Nictaux, St. Croix, Tusket, Medway, Lahave and other rivers.

The largest power developments for general distribution are those of the Nova Scotia Power Commission which has two large stations at St. Margarets bay on the Northeast river near Halifax and a small one on the Mushamush river, aggregating 11,645 h.p., while on the East River Sheet Harbour there is a development of 5,500 h.p. furnishing energy to the coal mining and industrial centre of Pictou county, and a development now under construction on the same river which will furnish 6,000 h.p. for a pulp and paper industry in the immediate vicinity with provision for increase to 9,000 h.p. (See plate No. A-12).

Many of the smaller centres of population are served with hydro-electric energy, of these the municipal development of the town of Liverpool on the Mersey of 750 h.p. is one of the larger plants whilst among other towns receiving power from smaller developments may be

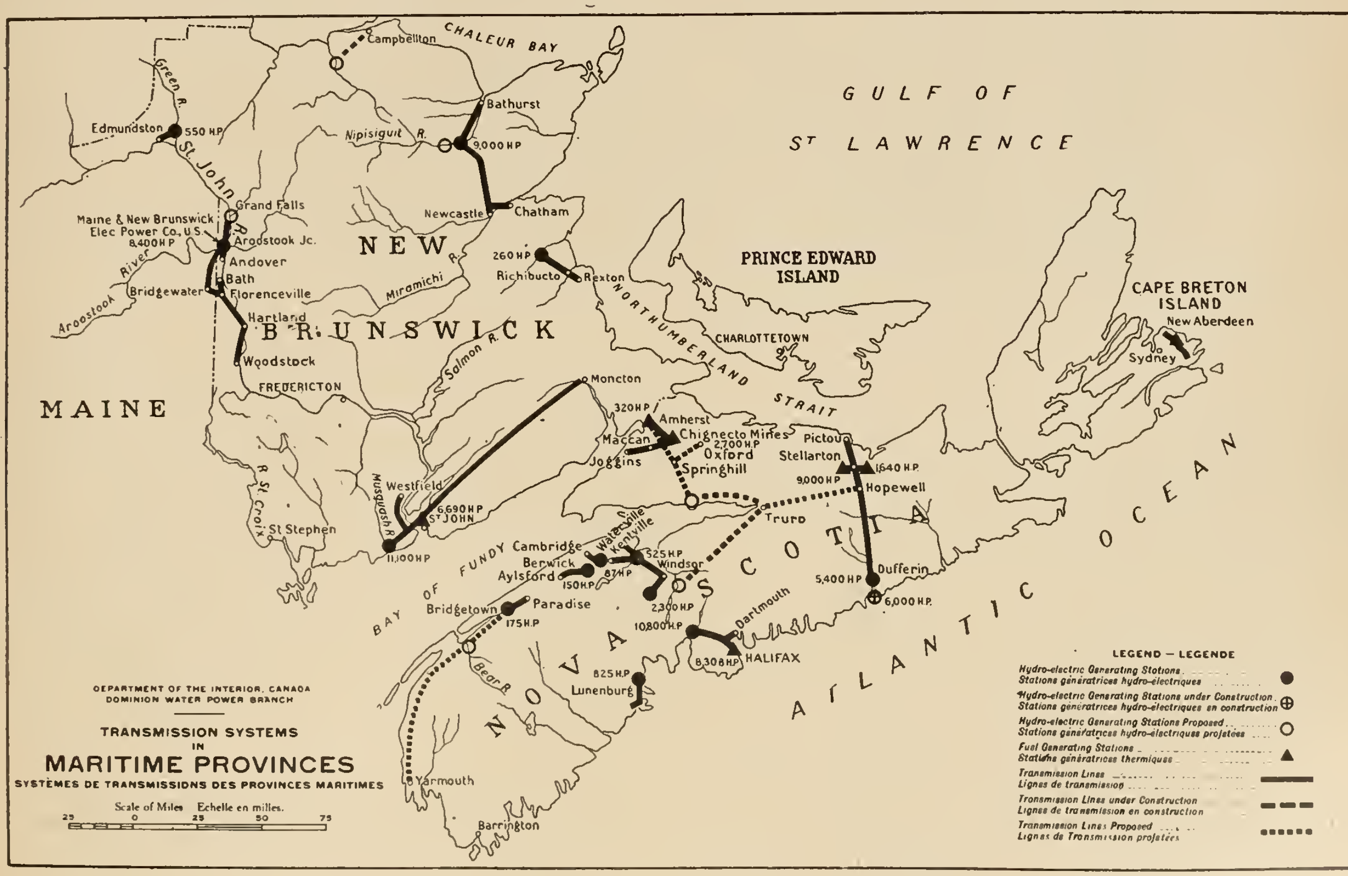


Plate No. A-12.—Transmission Systems in the Maritime Provinces.

mentioned Wolfville, Yarmouth, Bridgewater and Annapolis Royal.

In addition to these the pulp and paper industry is responsible for the development of 17,000 h.p. in ten plants, of which the largest are those of the MacLeod Pulp and Paper Company on the Mersey river at Liverpool, two in number, aggregating 6,000 h.p. Other considerable developments devoted to the pulp industry are to be found on the Sissiboo river at Weymouth, the Clyde at Port Clyde, two on the Medway and one on the Gaspereau and another on the St. Croix at Windsor.

Prince Edward Island

Prince Edward Island has a large number of small sites most of which have been developed at one time or another for local purposes on a purely hydraulic basis, most of them are capable of great improvement by means of modern hydro-electric installations and at least one very interesting modern application of the overshot wheel has been made.

Tidal Power

During recent years there has been a considerable amount of discussion as to the possibility of utilizing the rise and fall of the tides for the production of power and projects have been outlined in considerable detail for different points where the range of tide and general physical conditions appear favourable thereto, although hitherto no considerable tidal power development has yet been constructed.

The bay of Fundy is famous for the range of its tides and the ebb and flow into the bay represents an expenditure of many millions of horse power. Along the shores of the Bay are a number of bays and estuaries which would appear to lend themselves to the construction of the basins necessary to produce a continuous flow of power from the varying water level conditions incidental to the tides, in fact the possibility of developing tidal power by utilizing the estuaries of the Petitodiac and Memramcook rivers in New Brunswick have recently been actively canvassed.

The development of tidal power must involve heavy capital expenditure and its economic possibility depends on an adequate and profitable market for the maximum output obtainable. This being the case the best informed opinion is that the interests of the maritime provinces, which enclose the bay of Fundy, will, for a long time at any rate, be best served by the gradual and progressive development of its water powers, the extent of which, as well as the note-worthy progress already made, has been described above.

Section III. Administration

Administrative Responsibilities, National and Local.
Legislative and Administrative Policy for the Production of Low Cost Power.

The Dominion of Canada consists of a federal union of provinces under a central government in which all are represented. The constitution of Canada is embodied in the British North America Act of 1867 and amending acts, all of which have been passed by the parliament of Great Britain and Ireland. This act defines the powers which may be exercised by the Dominion parliament and the legislative assemblies of the provinces, respectively.

In accordance with this distribution of legislative powers, the administrative control of the Canadian water powers is vested partly in the parliament of Canada and partly in the provincial legislatures, according to where those water powers are situated. The parliament of Canada is the administrative authority with respect to water powers situated on public lands of the Dominion, that is those in Alberta, Saskatchewan, Manitoba, and in the Northwest and Yukon Territories; and also exercises control over water powers on Indian lands and those resulting from the construction of public works and canals.

The legislative assemblies of the provinces of British Columbia, Ontario, Quebec, New Brunswick, Nova Scotia and Prince Edward Island are the administrative authorities with respect to the water powers situated within their respective territorial boundaries, as the lands in these provinces were originally the property of the province and have never belonged to the Dominion, and their management and sale is one of the subjects assigned by the British North America Act exclusively to the provinces.

In addition to having control of the management and sale of their public lands, the provinces are also assigned by the British North America Act the exclusive legislative authority with regard to property and civil rights within the provinces, and it is upon these two fundamental powers that their administration of water powers is based. With the exception of Quebec, the laws relative to property and civil rights in all the provinces are derived from the corresponding laws of England as they existed at the time of the erection of each province. Those of Quebec are derived from the Custom of Paris introduced into the Royal Province of New France in 1664. In each case the original laws in regard to water and water rights have been much modified by legislative enactments for the purpose of enabling the various uses of water to be adapted to local necessities. This is particularly the case in the English provinces, where (except in New Brunswick, Prince Edward Island and to a less extent in Manitoba), the old common law rights of riparian owners have been largely curtailed and in some cases abrogated.

Dominion Control of Navigable Waters

The Dominion government, under the authority of the British North America Act, exercises control over the navigable waters of Canada in the interests of navigation, and is thus in a position to influence all water power developments on navigable streams. The exact nature and extent of this influence is still a matter of doubt, although it is in no sense a proprietary right but one of legislative jurisdiction only, and it is probable that it does not extend beyond a paramount right to protect and to provide for navigation. That power developments must conform to the requirements of and be subservient to navigation is generally conceded, and this is expressed in the Navigable Waters Protection Act, (cap. 115 R.S.C. 1906 and amending acts), section 4 of which reads in part as follows:—

> "No work shall be built or placed in, upon, over, under, through or across any navigable water unless the site thereof has been approved by the Governor in Council, nor unless such work is built, placed and maintained in accordance with plans and regulations approved or made by the Governor in Council."

An exception to this rule is made in favour of small and unimportant works. The act does not attempt to define what are to be considered navigable waters, and this may lead to difficulties in some cases, but as regards the large rivers of Canada, it does afford an effective means of control by the Dominion government.

Production of Low Cost Power

The production of low cost power is sought to be attained,

(1) by the development of power sites and the transmission and sale of power at cost by commissions appointed by certain of the provincial governments, acting under legislative authority and financially supported by the credit of the province;

(2) by the granting of power privileges to municipalities, companies and individuals, on reasonable terms but under government control of rates to consumers, and subject to charges for the privilege granted.

The former policy is general in the settled industrial areas of Ontario, and in a limited way is adopted in New Brunswick, Nova Scotia and Manitoba. In Manitoba the Power Commission has directed its energies more towards the transmission and supply of power, than to its generation. The latter policy is adopted in the other parts of Canada.

Chaudiere Falls Developments on the Ottawa River at Ottawa, Ontario, and Hull, Quebec — 90,000 h.p. installed in various plants.

It is a unique tribute to Canadian adaptability and progress that under two policies showing such radical and basic differences, power development, distribution and use have progressed under them both with remarkable rapidity and with great satisfaction to the affected general public. The Hydro-Electric Power Commission of Ontario is the largest public ownership enterprise of its kind; its ramifications comprehend all phases of power production, distribution and use. The people of the province of Ontario have repeatedly indicated at the polls their abounding satisfaction with the general progress made under the aegis of the Commission, which, by a policy of "power production and sale at cost" has rapidly extended its systems until to-day it has become the world's largest power producing and distributing agency. The people of the adjoining province of Quebec are equally satisfied with the service rendered them by a strong group of ably-managed public utility corporations, which, under governmental rate control, have succeeded in furnishing power to the progressive advantage of the general public and with profit to their own share-holders. Advocates of the policies so extensively adopted in the provinces of Ontario and Quebec assiduously point out the advantages enjoyed by the public in their respective fields of operation. The statistical statements herein are eloquent of the substantial and steady progress achieved in hydro-electric practice in both provinces.

Direct State Aid

No direct state aid is given to water power development in Canada, either by subsidy or by tax exemption. In some cases municipalities give assistance to industrial and power developments by granting free sites, exemption from local taxation or a fixed assessment for a term of years, as an inducement for industries to become established within their boundaries.

Indirect State Aid

Indirect assistance is given in a variety of ways, of which the following are the most important:—

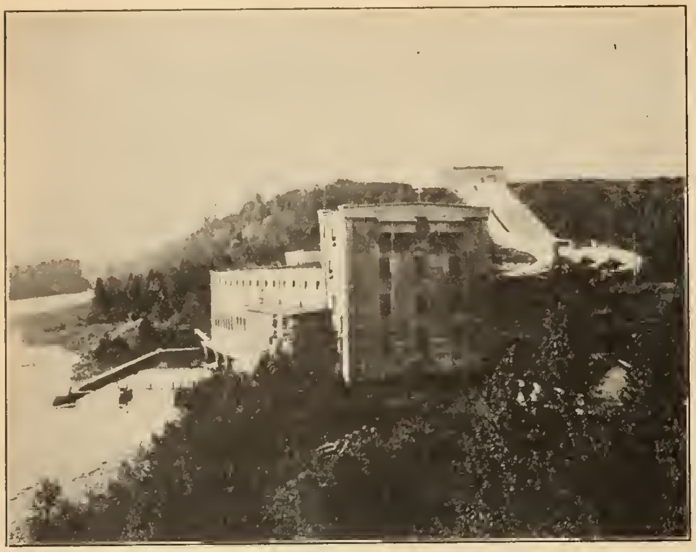
1. The Meteorological Service of Canada, (including Newfoundland and Bermuda), under the Department of Marine and Fisheries, publishes monthly records of pressure, temperature, humidity, cloudiness, wind, (velocity and direction), precipitation and evaporation. Information is supplied free of charge.

2. The Dominion Water Power Branch of the Department of the Interior, through the Hydrometric Survey of Canada, makes an investigation of the surface water supply. The results of the survey and hydrometric data are published in free annual or biennial reports.

3. Water Resources Index Inventory, established by the same department, in co-operation with cognate provincial and federal power authorities.

(a) To co-ordinate and systematize the gathering of power and general water resources information throughout the Dominion.

(b) To create a centralizing agency for the efficient analysis of such information in relation to location and use of power to industry; to industrial centres; industrial opportunities; transportation systems, rail and navigation; mineral resources; timber resources; coal and fuel supplies; electro-chemical and electro-metallurgical opportunities; irrigation, drainage and reclamation projects; alternative sources of power; and to use of and market for power in general; and to compile the material into immediately available and usable form and for whatever purpose required.



Kakabeka Falls Development on the Kaministiquia River, Ontario, of the Kaministiquia Power Company — 34,000 h.p.

These three agencies supply the fundamental data which is essential to all interested in water power development.

4. Indirect assistance to the production of cheap water power is also given by most of the governmental administrative authorities in other ways, as shown by the legislation described below.

Dominion Water Power Legislation

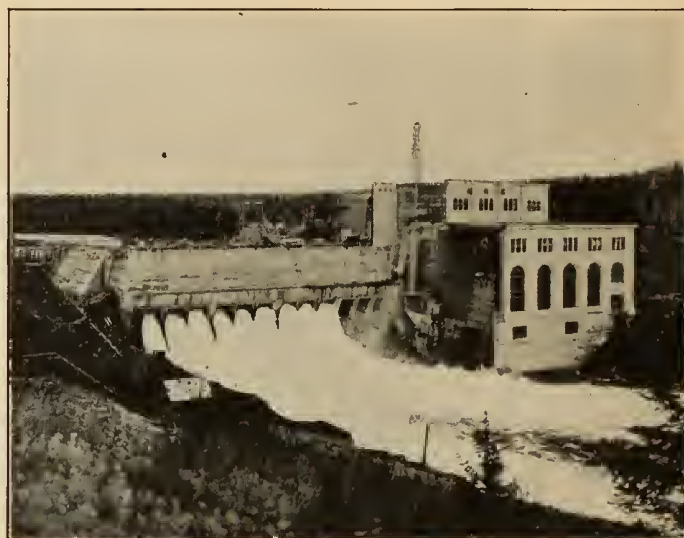
The water powers on the public lands of the Dominion, with some exceptions noted below, are under the conduct and disposition of the Minister of the Interior, acting upon the advice of the Director of Water Power, the chief executive of the Dominion Water Power Branch of the Department of the Interior. The administrative policy is based upon the Dominion Water Power Act, (9-10 Geo. V, cap. 19), and the regulations thereunder dated October 31, 1921.

The Dominion Water Power Act.

The general plan of the act is to provide that the water powers on lands of the Dominion and the additional Crown lands essential to the development or protection of such water powers are to remain vested in the Crown, no outright sale of them being permitted, but they may be leased to any approved licensee for a definite term of years upon certain specified conditions.

This act is intended to provide means for exercising an effective measure of control over not merely the development itself, but also over all the auxiliary works necessary for storing and using the waters and for transmitting the power, as well as the construction of the works and the management of the property. The undertaking authorized by license under this act may thus extend far beyond the limits of the Crown lands on which the water power is situated and include more than the physical structures and property; and the right of the constituted authorities to control all the essential operations of the licensee is fully established by the act, whether these operations are conducted wholly on Dominion Crown lands or partly also on privately owned lands or on provincial Crown lands. This in fact was one of the main purposes of the act, namely, to establish a statutory authority with the right to control not only the power site, but all the lands, works and operations necessary for developing and using the power.

The Water Power Act also provides means for expropriating water powers which have been sold in the past or any private lands required in connection with them, and for cancelling leases of or interests in Crown land similarly required, subject of course in each case to compensation; for making all necessary surveys and investigations, both of streams in their natural conditions and of licensed developments; for the development under one license of two or more water powers situated so as to make this economically desirable; for co-operative agreements with provincial authorities in regard to power and other surveys; and for proper methods of protecting and augmenting the water power resources.



Cameron Falls Development on the Nipigon River, Ontario, of the Hydro-Electric Power Commission of Ontario — ultimate capacity 75,000 h.p.

Regulations under the Dominion Water Power Act

As stated before the Dominion Water Power Act provides an adequate statutory authority for the administration of the Dominion water powers and the undertakings established in connection with their development and use; the regulations made in pursuance of the act determine the principles on which the administrative procedure is based. There are two leading principles underlying the regulations, namely, to adequately safeguard the public interest in the Dominion water powers by carrying out the provisions and intentions of the act, and to protect the legitimate rights of those who undertake their development, including the capital which they invest. These two principles are kept well in view throughout the regulations.

The most important parts of the regulations are those dealing with:—

(1) The procedure to acquire a license;
(2) rights and obligations of a licensee; and
(3) the financial conditions affecting a licensee.

(1) Procedure to Acquire a License

To obtain a license, the applicant must file certain plans and other information so as to show fully what is proposed to be done and its effect upon other structures or interests, and prove that he is financially able to carry out his proposed undertaking. Applicants for a license may be permitted to make use of plans and other information in the possession of the Department of the Interior.

The license itself is granted in two stages, first the interim license, which is granted as soon as the application has been definitely approved, before construction begins, and which remains in force until the development is completed, and second the final license which is intended to be in force during the whole period of operation.

(2) Rights and Obligations of a Licensee

The interim license, besides stating the conditions upon which the Crown lands may be used and under which the development is to be constructed, also contains the principal conditions which are afterwards to be embodied in the final license. These include, the quantity of water which may be used or diverted, a brief description of the undertaking, stating the use which is to be made of the power, and if a public utility, the territory within which it may be diverted or sold, the term of the final license, and the rental payable annually during the first twenty years. The final license is in effect a renewal or a confirmation of the interim license after certain preliminary conditions have been fulfilled, and is granted to the licensee as a matter of right after the satisfactory fulfillment of these preliminary conditions.

There is however this important difference between the interim and the final licensee, necessary for the protection of the public interest, the former may be summarily cancelled in case the licensee fails to begin construction within a specified time, the latter can only be cancelled by an order of the Courts, and that only as an extreme and final measure.

Eugenia Falls Development on the Beaver River, Ontario, of the Hydro-Electric Power Commission of Ontario, 8,500 h.p.

(3) Financial Conditions affecting the Licensee

The financial conditions affecting the licensee may be grouped under four headings:—

(a) The initial financing of the undertaking;
(b) rentals payable to the Crown;
(c) compensation when the license is cancelled or terminated; and
(d) the regulation of rates, service and the issue of securities.

(*a*) *Initial Financing.* — The initial financing is necessarily a matter which depends largely on considerations outside the scope of the regulations, but they are intended to assist the applicant in this matter so far as may reasonably be done. As stated above, the applicant may receive an interim license as soon as he has shown that he is prepared to carry out a sound and beneficial enterprise. He thereupon acquires a definite equity in the power site for a fixed term of years, subject only to his complying with conditions to which he then agrees, and this before he has expended any money on the undertaking beyond what is necessary for preliminary purposes. The other financial conditions are also such as indirectly to affect the initial financing by the protection from confiscation which they afford.

(*b*) *Rentals payable to the Crown.* — The rental which the licensee must pay for the use of the power site is fixed in his interim license for the first twenty years of the operating period. After that time it is subject to revision every ten years by mutual agreement, or failing which, by a board designated for that purpose by the Governor in Council. The rental during the first twenty year period varies according to a sliding scale from a minimum of ninety cents to a minimum of seventy-five cents per horsepower-year, decreasing as the load factor improves. An additional rental may also be charged for Crown lands used or occupied.

(*c*) *Compensation.* — The final license is granted for a period not exceeding fifty years. At the end of that time it may or may not be renewed, according to conditions then prevailing. If not renewed the whole development including all works, buildings and machinery reverts to the Crown. The license may also be cancelled at any time, upon one year's notice, if circumstances render it desirable to enlarge the development beyond what the licensee is prepared to undertake, or in case of the development conflicting with rights existing or created under the Irrigation Act. The site may also be recaptured by the Crown and the license terminated at any time after thirty years of the term of the license has expired, also upon one year's notice. In each case compensation is provided for in accordance with certain principles laid down in the regulations.

Compensation for the power site is based upon the actual cost of the physical structures comprising the power development adjusted to represent present value by making allowance for any variations in the purchasing power of the money standard which may have occurred between the construction of the plant or any part of it and the time of the valuation, as shown by official statistics, less depreciation. Land also is valued at its

De Cew Falls Development on a diversion from the Welland Canal, of the Dominion Power Transmission Company — 45,000 h.p.

Electrical Development Company Plant of the Hydro-Electric Power Commission of Ontario at Niagara Falls — 164,000 h.p.

actual cost, adjusted as before, and any other property of the licensee which may be taken over by the Crown is valued in accordance with the principles which appear most equitable under the circumstances. If the license is cancelled or terminated before the end of the term of the concession, compensation may also be allowed for severance losses and other intangibles, and suitable adjustments made.

(*d*) *The Regulation of Rates, Service and the Issue of Securities.* — As these regulations are in force not only in the prairie provinces where local governments have long been established, but also in the unorganized territories, it is necessary that the Minister of the Interior, as the executive officer of the Crown, should have power to make rules, under the authority of the Governor in Council, for the proper conduct of public utilities where no other statutory authority exists, and this is provided for in the act. In Alberta and Manitoba public utility commissions have been established by acts of the provincial legislatures, (see Alberta act 1923 cap. 53 and cap. 166 R. S. Manitoba 1913), and it is probable that the regulation of public utilities operating under Dominion license would be referred to such local authorities wherever their jurisdiction applied.

The regulations contain a number of other provisions, intended to secure effective control of licensed undertakings and to protect the licensee in his operations, which need not be described in detail. Small and unimportant water powers not exceeding five hundred horse power in capacity are granted under a simplified procedure for a maximum term of twenty years, renewable for successive terms of five years, and subject to compensation based upon principles similar to those applicable to the larger power sites. Provision is also made for the adoption of suitable measures for stream regulation and water conservation, in connection with which the owners or licensees of power sites may be required to pay their share of the cost, in proportion to the benefits received.

State Ownership in the Prairie Provinces

The policy of the Dominion government in regard to the water powers belonging to the Dominion is that they should be developed by private or municipal enterprise under government supervision, although provision is made in the Dominion Water Power Regulations for taking over and operating power developments directly by government agencies if such a course of action should be found necessary in the public interest. When power sites are being leased for public utility purposes, the regulations contemplate preference being given to an application by a province or a municipality over one by a private corporation but up to the present it has not been the policy of the Dominion government to develop any of those sites as a direct government enterprise.

As regards the prairie provinces, Saskatchewan has not taken any steps towards government ownership of power developments; Alberta has been considering this question for some time and has filed an application with the Minister of the Interior for the lease of a power site on the Bow river, which is now under consideration; Manitoba has been for some years engaged in the distribution and sale of electrical energy.

The power policy of Manitoba dates from 1919, in which year the legislature passed the Electrical Power Transmission Act (1919 cap. 135 as amended by 1920 cap. 31 and 1921 cap. 21) which enables the provincial Minister of Public Works, with the assistance of a board known as the Manitoba Power Commission, the members of which are appointed by the Lieutenant-Governor in Council, to enter into contracts for the purchase of power in bulk from generating agencies, and for its transmission and sale to municipalities and other corporations and individuals. The Manitoba Power Commission has built several transmission lines under the authority of this act, the principal one extending from Winnipeg to Portage la Prairie with a branch from Oakville to Morden, the distances being about sixty-five and fifty-six miles respectively. The commission has also installed distribution systems and one or two small fuel power plants, and has acquired a hydro-electric plant at Minnedosa.

Water Powers incidental to Canals and Navigation Improvements

Besides the Dominion water powers on lands of the Dominion which are placed under the control of the Minister of the Interior, there are a number of other water powers which belong to the Dominion under the terms of the British North America Act owing to their having been created by works intended primarily for the improvement or formation of navigable waters.

Water powers on canals are under the control of the Minister of Railways and Canals, and a number of them have been leased at rentals varying from two dollars to six dollars per horsepower-year. The comparatively high rental being due to the fact that the most expensive part of the development is provided ready for the lessee's use. Certain water powers on the Ottawa river which also belong to the Dominion have been placed under the control of the Minister of Public Works, and are leased at a rental of sixty-six and two-thirds cents per horsepower-year for a term of twenty-one years, renewable for ever on similar terms at the same rental, but subject to expropriation by the Crown for a public purpose at any time.

Water Power Legislation in British Columbia

British Columbia has had for many years past elaborate water legislation by means of which a right to the use of a definite quantity of water for a specified purpose may be acquired by grant or license from the Crown; and it is in this way, and in this way only, that a right to use water for the development of power may be acquired.

Riparian owners, as such, have no right to the use of water except for ordinary domestic purposes, and for a number of years past rights to the use of water for all other purposes have been granted under the authority of a single act. This system, both in its legislative foundation and in its administrative procedure, has reached a high degree of perfection in British Columbia. It enables the water in any stream or district to be apportioned among different users for various purposes in the most economical and effective manner.

In unnavigable streams the province may grant authority to use or divert the entire flow, but in navigable waters, the Dominion authorities may intervene to prevent any use or diversion detrimental to navigation. The water license is usually made appurtenant to the land on which it is to be used or to a particular undertaking, and a transfer of the land or undertaking in such a case involves a corresponding transfer of the water right.

The British Columbia Water Act, 1914

Water powers in British Columbia are administered under the Water Act, 1914 and amending acts, under the control of the Minister of Lands. Licenses for the use of water are issued by the Comptroller of Water Rights, who is the principal administrative officer under the act. All questions with regard to existing rights and claims to the use of water are dealt with by a Board of Investigation, appointed by the Lieutenant-Governor in Council with power to hold hearings and issue orders, from which appeal may be taken to the Court of Appeal.

The act gives full details of the procedure to acquire a license for the use of water. When the purpose is to acquire a right to develop power for sale this procedure involves the following steps: posting of notice of intention to use on the ground and filing of notice with the local water recorder, publication of notice in a local newspaper and in the official Gazette, application in approved form, payment of fees, hearing of petition on undertaking. If the application has been approved up to this stage, the applicant is granted a certificate of approval of the undertaking which defines its purpose and scope, and an authorization to make surveys.

After the surveys have been made and the plans filed, the applicant must give notice by publication in a local newspaper and in the official Gazette that the plans are open to inspection at the office of the local water recorder, and a further hearing may be held to deal with any objections raised. When the plans have been approved, the applicant is granted a conditional water license, intended only to cover the period of construction which defines his particular rights and obligations, including the dates when the works are to be begun and finished, and if necessary, a permit for the use of Crown lands or authority to acquire private lands. When the works have been satisfactorily completed and upon proof of the same, a final license is issued, which, together with the certificate of approval of the undertaking and a plan incorporated with the license, determines the conditions under which the water is to be used and the power delivered or sold. The maximum term of a final license for "power purpose" is fifty years, except in the case of power used for operating a railway, when the maximum term is ninety-nine years.

What is to happen when a final water power license expires is not definitely provided for in the act. There is no provision for renewal or for compensation, or even for terminating the licensee's possession at the end of the term. Section 81 is the only one in the act which throws light on this subject; it empowers the Minister of Lands "to make such orders as may in the public interest be deemed just", and to alter the certificate of approval of the undertaking or to issue a new certificate to meet changed conditions. With this somewhat vague promise of consideration the licensee must remain satisfied for the present, but there is no reason to doubt that in due time the British Columbia authorities will grapple with this problem as they have with many others encountered in water administration, and embody reasonable and just provisions in the act.

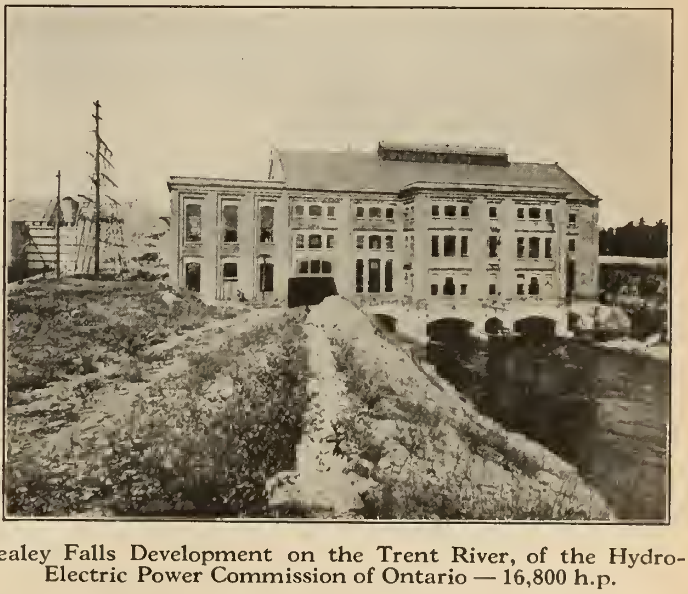
Regulations under the Water Act.

The Water Act is in itself so complete as to procedure and the other matters with which it deals, that the regulations thereunder, which are dated February 22nd, 1921, are brief and comparatively unimportant. They deal with fees, rentals, entry upon Crown lands, and the plans and specifications which are to be filed.

With regard to rentals a distinction is made between rentals payable during what are called the "survey-construction period" and the "operation period". During the former the rental varies from about seventeen cents to four cents per horse power, based on the estimated amount of power which can be developed at the site from the flow of water applied for. During the latter the rental varies from twenty-five cents to two dollars per horsepower-year for developed power, with an additional charge for undeveloped power of five cents per horse power up to 5,000 and two and one-half cents for each horse power over 5,000.

The rentals charged at the present time are fixed at an arbitrary rate per horsepower-year on the output of the plant, within the above limits, but the regulations provide that the rental may be based upon the economic value of the site after that has been determined by the Board of Investigation.

By the Water Act, the Minister of Lands may enter into an agreement with a power company fixing the rental for a period of twenty-one years, and this agreement shall also provide for a renewal of the agreement for a further period not exceeding twenty-one years, fixing the rental that time according to the regulations then in force. It will be noted that the rentals are based solely on the right to use a certain quantity of water. The Water Act does not provide for any rental for the use of Crown lands.



Healey Falls Development on the Trent River, of the Hydro-Electric Power Commission of Ontario — 16,800 h.p.

Regulation of Public Utilities

There is no public service commission in the usual sense of that term in British Columbia, but the Board of Investigation has authority under the Water Act to hold hearings for the purpose of considering questions as to rates charged by power companies licensed under the act, and all such rates must be approved by the board before they become effective. The board also determines the period during which the rates are to remain in force without being reconsidered and approved, which period is fixed by the act at a maximum of ten years.

State Ownership in British Columbia

British Columbia has not entered the field of state ownership of power developments and the Water Act does not provide for such a contingency, although the Crown owns the right to the use of all the unrecorded water power. Most of the developments have taken place under private ownership, but there are also seven municipalities which own and operate hydro-electric power plants. The Water Act gives protection to water rights owned by or required for municipalities, although more in connection with water supply than for power purposes. Unrecorded water may be reserved for their use or indeed for any special purposes.

Water Power Legislation in Ontario

The water powers of Ontario may be divided into two classes:—

(1) Those belonging to the Crown;
(2) Those privately owned.

The former are leased under general regulations when situated on public lands of the province, or by special agreements as in the case of those at Niagara Falls. The latter both in their natural and developed states are subject to several acts described below.

Rights on Unnavigable Streams

Unnavigable streams may be divided under the laws on Ontario into two classes, private and public. The former are those which are entirely unsuited at any time of the year for the floating of loose logs. The latter include all those down which logs may be floated, for floating has been declared by the Legislature to be a public right.

On unnavigable streams the English common law riparian rights are still in existence, and the owner of riparian lands on such a stream may develop and use the power available on his own land without a license from the Crown, subject of course to the similar rights of other riparian owners, to providing means for the passage of logs, if the stream is a floatable one, and to certain limitations and restrictions recently imposed by the Water Powers Regulation Act 1916 and the Rivers and Streams Act 1922, which are explained more fully below.

The Bed of Navigable Waters Act

On navigable streams conditions are entirely different. The Bed of Navigable Waters Act, (cap. 31 R.S.O. 1914), declares that:—

> "Where land bordering on a navigable body of water or stream has been heretofore, or shall hereafter, be granted by the Crown, it shall be presumed, in the absence of an express grant of it, that the bed of such body of water or stream was not intended to pass to the grantee of the land, and the grant shall be construed accordingly and not in accordance with the rules of the English Common Law."

This ruling, which it will be noted is retroactive, is subject to some exceptions, as in the case of rights determined by a court decision, or when the power on such a river has been developed in good faith prior to the passing of the act. This act was passed for the express purpose of reserving to the Crown water powers on navigable streams, and of depriving the riparian owner of any proprietary interest in them. It does not, however, define what are to be considered navigable streams.

Regulations for Leasing Water Powers on Crown Lands

The administration of water powers on the Crown lands of Ontario is under the control of the Minister of Lands and Forests, and they are leased in accordance with regulations approved by the Lieutenant-Governor in Council on January 16, 1907, based upon section 58 of the Public Lands Act, (cap. 28 R.S.O. 1914). These regulations specify the information to be supplied by an applicant for a water power privilege, with plans and proof of his financial ability and intention to carry out a satisfactory development. Before the lease is issued the applicant is usually required to deposit a sum of money, varying with the importance of the project, as an earnest of good faith.

If the application is approved, a lease of the power site is issued by the Minister of Lands and Forests upon such terms and conditions and at such rental as may be fixed by the Minister. In practice the rental is usually fixed at fifty cents per horsepower-year for the developed power, together with a small annual rental for the Crown land occupied. The maximum term of the lease is twenty years, but the lessee has the right of renewal for two further and successive terms of ten years each upon such conditions as may be agreed upon or may be fixed by the Minister. The lease specifies the amount of power to be developed in a given time, provides for inspection during construction, maintenance, fixation of rates, expropriation by the Crown, the protection of fisheries, floating and navigation, cancellation for non-fulfillment of conditions, (without the right of appeal to the Courts), and other matters.

At the expiry of the lease the water privilege reverts to the Crown, together with the permanent structures erected by the lessee on the land covered by the lease. The lessee is permitted to remove his machinery, and may also be compensated for the permanent structures to an extent determined by the Lieutenant-Governor in Council and approved by a vote of the Legislative Assembly.

These regulations only apply to water powers having a natural capacity in excess of one hundred and fifty horse power.

The Water Privileges Act

Three other acts should be referred to as having an important bearing on the rights and privileges of water power owners. The first of these is the Water Privileges Act, (cap. 129 R.S.O. 1914), which enables the owner or legal occupant of a water privilege to obtain possession of private lands required for the proper development and use of his water privilege, subject to compensation as provided in the act.

The Water Powers Regulation Act, 1916

The second act which affects the rights and privileges of water power owners is the Water Powers Regulation Act, 1916, (6 Geo. V, cap. 21 as amended by 7 Geo. V, cap. 22, 8 Geo. V, cap. 20 sec. 57 and 10 Geo. V, cap. 19). Its general purpose is to ensure economy in the utilization of water used or capable of being used for the development of power. To this end all water power developments throughout the province may be inspected by any commission or persons designated for that purpose by the

Lieutenant-Governor in Council, and ordered to make alterations or improvements. An appeal may be taken from such an order to the Lieutenant-Governor in Council whose decision is final, but which may include compensation for the improvements made.

This act also provides for approval of new works purchased or constructed, or any alterations or extensions, (this being in addition to the approval required under the Rivers and Streams Act referred to below), and for a determination of the quantity of water which a water power owner is entitled to use, or the amount of power which he is entitled to develop, subject to arbitration before a referee, or in certain cases a commission composed of three judges of the Supreme Court of Ontario. This latter provision has special reference to the use of water at Niagara Falls.

The Rivers and Streams Act, 1922

The third act to be noted is the Rivers and Streams Act, 1922, (12-13 Geo. V, cap. 55), which is designed to afford means to harmonize conflicting interests making use of the waters of any particular stream. especially when used for floating and power purposes, and to regulate works in water. It is divided into two parts, the first of which only applies to such streams as are by proclamation declared subject to its provisions; the second applies to all streams within the meaning of the Rivers and Streams Act, (cap. 130 R.S.O. 1914).

Part I provides that all questions arising in relation to any river to which the act has been made applicable by proclamation,

(a) as to the right to construct or use improvements thereon;

(b) as to rights of floating thereon; and

(c) as to the right to alter the flow of water,

are to be determined by the Minister of Lands and Forests, whose decision shall be final.

Part II provides for the approval of dams or other works for impounding water by the Lieutenant-Governor in Council. Dams already constructed may also be made subject to the act, and the owner may be required to make repairs and improvements considered necessary for the protection of public or private interests. Officers may also be appointed to regulate the use of rivers.

Regulation of Public Utilities

The general authority for the regulation of public utilities in Ontario is the Railway and Municipal Board, which has the usual powers of hearing and determining applications, from which determinations appeal may be taken to a Divisional Court, and in certain cases to the Judicial Committee of the Privy Council.

The Hydro-Electric Power Commission also exercises some of the functions of a public service commission, and takes the place of the Railway and Municipal Board

Grand Mere Development on the St. Maurice River, Quebec, of the Laurentide Power Company — 164,000 h.p.

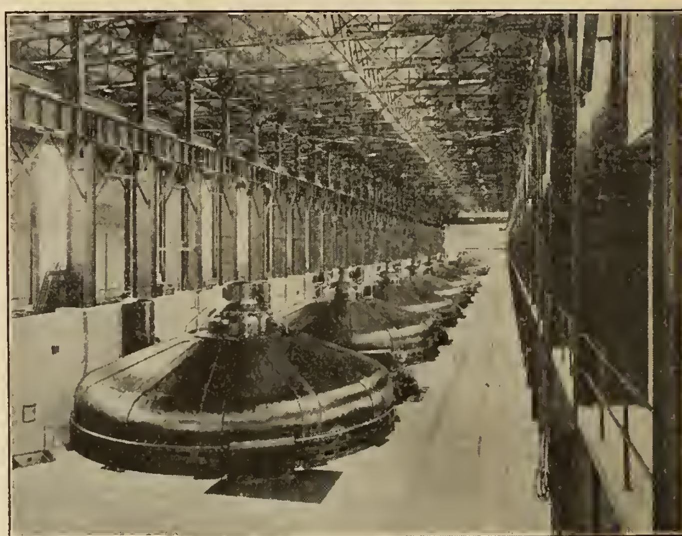
in regard to all matters which are within its jurisdiction. The rates chargeable by any municipal corporation generating or distributing electrical energy, and the rates charged by any company or individual receiving power from the commission and reselling it, are subject to the approval and control of the power commission, from whose decision there is no appeal. Rates charged and conditions imposed by lessees under the water power regulations above described may also be determined by the power commission, and if approved by the Lieutenant-Governor in Council, they become binding and conclusive.

The commission is given authority to make regulations as to the design, construction, maintenance and operation of all electrical works and applicances used by all who generate or use electricity, and may employ inspectors to see that such regulations are carried out. The power commission has also exclusive jurisdiction with regard to the approval of transmission lines or distributing systems making use of public highways.

The Hydro-Electric Power Commission of Ontario

Ontario has evolved a unique system of securing and furnishing power under state auspices. The power is generated or purchased in bulk and transmitted to municipalities or other corporations or individuals, by whom it is distributed to individual consumers. All the government enterprises of this nature are under the control of the Hydro-Electric Power Commission of Ontario, whose operations, now on a most extensive scale, have profoundly affected the supply of electrical energy in almost all the settled parts of the province. This commission at the present time owns and operates twenty separate hydro-electric generating stations with an aggregate rated turbine installation of over 800,000 horse power. More than 3,000 miles of transmission lines supply power to 355 municipalities and companies. The total investments of the commission in the construction and purchase of works, which include electric railways and a number of subsidiary enterprises, now amount to over $160,000,000. In addition to this sum, the municipalities which it supplies have expended some $43,000,000 in their distribution systems.

Cedars Rapids Development on the St. Lawrence River, Quebec, of the Montreal Light, Heat and Power Consolidated — ultimate capacity 220,000 h.p.



Interior of the Cedars Rapids Development showing 10,000 kv.a. Generators.

The Hydro-Electric Power Commission of Ontario was first appointed on June 7, 1906 by Order in Council under the provisions of an act to provide for the transmission of electrical power to municipalities, (6 Edw. VII, cap. 15), of that year. This act was replaced in the following year by the Power Commission Act, (7 Edw. VII, cap. 19), which now forms chapter 39 of the Revised Statutes of Ontario, 1914 and, with the numerous amending acts passed since that time, forms the authority under which the commission operates.

The power commission consists of three persons appointed by the Lieutenant-Governor in Council, two of whom may be and one of whom shall be a member of the Executive Council. The commission may report to council as to what property and sources of power should in their opinion be acquired for the purposes of the act, and, when so authorized by council, may purchase, lease or otherwise acquire lands, water powers, or works to be used for producing power from water or any other source and transmitting and delivering the same The commission may similarly be authorized to contract for the purchase of power and for its sale to municipalities and others. The money required for these operations is raised by means of government loans approved by the legislature, and by bonds issued by the commission and guaranteed by the province.

Up to October 31st, 1922, the commission had borrowed from the provincial treasurer about $118,000,000, on which it pays interest to the province at the rate of five per cent per annum, and had issued debentures to the extent of about $25,000,000.

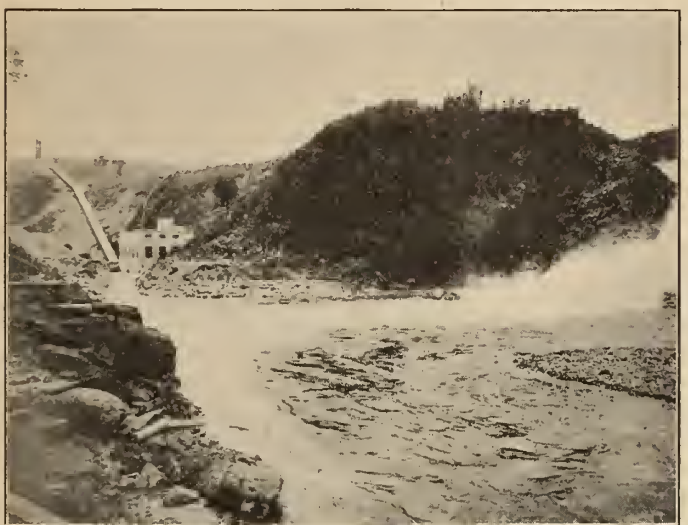
Water Power Legislation in Quebec

As stated before, the laws of property in Quebec have a different origin from those in the other parts of Canada, and they have been applied to water power administration in a somewhat different manner. By several important enactments passed during the last forty years, the proprietary interest of the province in its water powers has been greatly increased, so that at the present time there are very few undeveloped water powers of commercial importance which do not form dependencies of the Crown domain. In order to understand the rights of the Crown in regard to water powers in Quebec a few words of explanation are necessary.

Ownership of Water Powers

The rivers in that province may be divided into two main classes, those which are navigable and floatable, and those which are not navigable or floatable. By the Quebec law a river is considered navigable and floatable only when it is navigable in a commercial sense, and may be used for floating timber in the form of cribs or rafts, (en trains ou radeaux). A river which can be used only for floating loose logs, (flottable à bûches perdues), is not by law a navigable or floatable stream. According to Article 400 of the Civil Code navigable rivers and the navigable parts of rivers are considered as being dependencies of the Crown domain. The beds and shores of non-navigable rivers may in certain cases be held as private property by riparian owners, subject however to the public right of floating, which exists in all waters capable of being used for that purpose.

In grants of Crown lands made prior to 1884 the general rule was that when the grant bordered on a navigable and floatable stream, title to the bed of the stream remained vested in the Crown; and when the grant bordered on a non-navigable or non-floatable stream, the title to the bed to the middle of the stream passed to the riparian grantee. This rule in regard to navigable and floatable streams still prevails, but since June 1st, 1884, all sales and free grants of Crown lands bordering on non-navigable rivers and lakes have been subject to a reserve three chains in depth along the water's edge, with certain exceptions at the discretion of the Minister of Lands and Forests. This reserve as first instituted was declared to be for fishing purposes, and there were doubts as to whether the Crown had retained the ownership of this strip, or had granted it with the adjacent land, subject to a servitude for a special purpose. These doubts were removed for the future by an act passed in 1919, (9 Geo. V, cap. 31 sec. 1), which declares that this reserve remains in full ownership by the Crown, (en pleine propriété). In order to extend still further the rights of the Crown in provincial waters, Article 400 of the Civil Code was amended in 1918, (8 Geo. V, cap. 72), to provide that all lakes and non-navigable rivers and streams bordering on lands alienated by the Crown after February 9th, 1918, are also considered as being dependencies of the Crown domain.



Seven Falls Development on the St. Anne de Beaupré River, Quebec, of the Laurentian Power Company — 24,000 h.p.

From the above explanation it follows that to the Crown in the right of the province belong:—

(1) With regard to ungranted Crown lands, all water powers situated thereon, whether on navigable or non-navigable waters:

(2) With regard to lands alienated from the Crown,
- (a) all water powers on navigable and floatable streams, except those already disposed of by special grant;
- (b) all water powers on non-navigable and non-floatable streams, the riparian lands bordering on which have been alienated subsequent to June 1, 1884, except those already disposed of by special grant.*

Water powers may be private owned,—

(1) by reason of a Crown grant covering a particular site;

(2) as a legal right incidental to the ownership of riparian lands bordering on a non-navigable stream, Crown granted prior to June 1st, 1884.

Chicoutimi Development on the Chicoutimi River, Quebec, of Price Brothers and Company — 10,000 h.p.

Leases of Water Powers belonging to the Crown

In Quebec the Minister of Lands and Forests is charged with the control and management of the provincial water powers, in which he is assisted by the hydraulic service of his department. The right to the use of a provincial water power is as a general rule granted in the form of an emphyteutic lease which specifies the conditions of development and use; although small and unimportant power sites are in some cases sold outright. There are no formal regulations in force on which to base an administrative procedure, but a definite policy has been evolved as the result of experience, and the water power leases are alike in their principal conditions, although the details differ in each case according to the importance of the site and the purpose for which it is to be used.

Conditions of Water Power Lease

When the Minister of Lands and Forests decides to lease a water power site, for which he has reason to

* This rule may require some qualification. The Courts have not yet determined the effects of the act 9 Geo. V, cap. 31 above referred to, and the situation as regards water powers on non-navigable rivers contiguous to lands granted between June 1st, 1884, and February 9th, 1918, is at the present time very uncertain.

St. Raphael Development on the Du Sud River, Quebec, of La Corporation d'Énergie de Montmagny — 2,400 h.p.

believe there is a public demand, an announcement is made in the Official Gazette and in the principal newspapers of the province to that effect, giving the main conditions under which the site will be leased, and inviting tenders or bids at public auction. The tenders or bids are usually in the form of the amount which the applicant offers as an annual rental for the Crown lands to be occupied, in excess of the upset rental price advertised, the other conditions of the lease being fixed in advance. When the site is to be used in connection with a timber limit for mill purposes, the rental is sometimes also fixed in advance and the element of competition is confined to the bids received for the timber on the berth leased along with the power site.

The following are the principal conditions contained in the standard form of water power lease.

(1) The terms of the lease, which varies from twenty to ninety-nine years. The most usual term is seventy-five years.

(2) The annual rental to be charged for the use of Crown lands occupied, during the whole term of the lease, in accordance with the accepted bid or tender.

(3) An annual royalty of fifty cents per horse power developed, based upon the maximum installed capacity. In recent cases an additional royalty of fifty cents per horse power may be charged on the amount of power permitted to be exported out of the province.

(4) The times when the royalty is to be revised, usually every ten years, and the procedure in case of disagreement.

(5) A money guarantee to be deposited by the lessee and to be returned to him when the initial development is completed.

(6) The amount of power which is to be produced within a given time. Usually two years are allowed within which the works are to be begun, and two years more for their completion.

(7) Conditions for sale of surplus power.

(8) Special tariff to be charged for surplus water due to storage.

(9) The lease may be cancelled by the Lieutenant-Governor in Council without legal proceedings,
(a) for non-payment of rental or royalties;
(b) for neglect or failure to carry out conditions of lease.
In the latter case the lessee is given three months after due notice in which to make good his default

(10) When the lease terminates or is cancelled, the power and lands covered by the lease revert to the Crown, together with all works, buildings and immovable property thereon, without compensation. The lessee is to be given a reasonable time in which to remove his machinery, failing which, this also becomes the property of the Crown without compensation.
In certain cases a clause has been inserted in the lease to provide for an appraisal at the end of the term, and payment by the government of compensation for at least part of the works.

The lease also contains other provisions of minor importance dealing with the filing of plans, inspection, maintenance, annual statement of operations, transfer of lease, and the protection of other interests using the stream.

Legislation affecting Private Developments

By the law of Quebec, "every proprietor of land may improve any water course bordering upon, running along or passing across his property, and may turn the same to account by the construction of mills, manufactories, works and machinery of all kinds, and for this purpose may erect and construct in and about such water course, all the works necessary for its efficient working, such as floodgates, flumes, embankments, dams, dykes and the like." Article 7295 R.S.Q. 1909.

Also every water power of an average natural force of at least two hundred horse power and large enough for industrial purposes is declared to be a matter of public interest, and the owner of one may under certain conditions expropriate the adjacent lands necessary for its proper use. (See Articles 7287-7294d R.S.Q. 1909.)

All new power developments such as those referred to in the article which has just been quoted and storage reservoirs require to be approved by the Lieutenant-Governor in Council in all cases when the proposed structure will effect private or public property or rights. This provision does not, however, apply to works constructed before February 9, 1918. (See 8 Geo. V, caps. 68, 69 and 70 as amended by 10 Geo. V, cap. 86 secs. 1 and 2.)

Musquash Development on the Musquash River, New Brunswick, of the New Brunswick Electric Power Commission — 11,000 h.p.

Regulation of Public Utilities

The regulation of public utilities in Quebec effected by means of the Public Service Commission, which consists of three members appointed for a term of ten years by the Lieutenant-Governor in Council. The jurisdiction of the commission extends, among other matters, to questions in regard to tolls charged by public services, their use of roads and streets, differences between municipalities and public utilities, municipal administration when so ordered by the Lieutenant-Governor in Council and the use of streams by floating, power and other interests.

The decision of the commission upon any question of fact within its jurisdiction is final, but in regard to any question as to its jurisdiction, or upon any question of law, except in expropriation matters, leave may be given to appeal to the Court of King's Bench.

The Quebec Streams Commission

The water powers of Quebec have been developed entirely by private and municipal enterprise, and the state has taken no steps toward entering this field of activity in competition with existing interests. It is, in fact, the policy of the government to give encouragement and protection to the development of water powers, and the building up of industries dependent thereon, through private enterprise, combined with the means of regulation and control which have already been outlined. In addition to the encouragement given to water power development by granting the power sites under favourable conditions, the province has also given valuable assistance by constructing engineering works of great magnitude and importance to store flood waters and regulate and augment stream flow; measures which have proved successful in a striking degree.

These works have been constructed at the expense of the province under the direct supervision of the Quebec Streams' Commission, which was established by act of the Legislature in 1911. (See 1 Geo. V, cap. 5.). This commission consists of three members, appointed by the Lieutenant-Governor in Council, who are experts in hydrography and the management of forests, and a secretary.

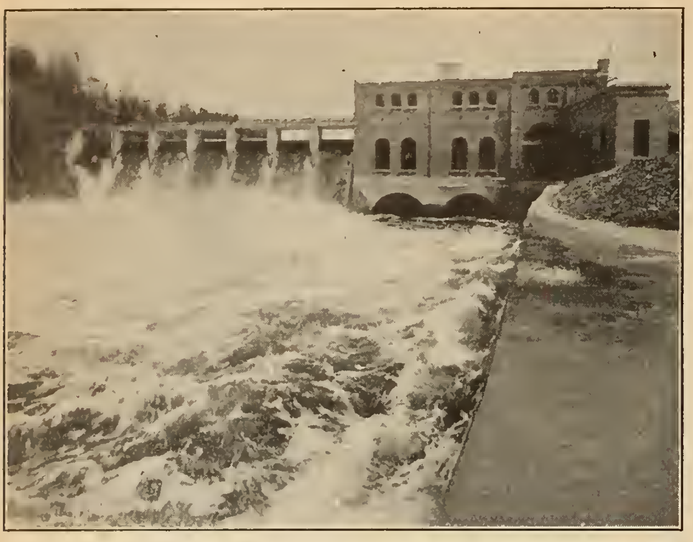
The most notable enterprise of the commission has been the construction of the Gouin dam on the St. Maurice river. The Gouin dam was built by contract under the supervision of the commission's engineers between 1915 and 1917 so as to form an immense reservoir covering an area of three hundred square miles, with a storage capacity of one hundred and sixty billion cubic feet. Three existing storage dams on the Manouane river were also acquired by the commission, the total cost of the scheme amounting to $2,500,000. The use of the stored water for regulating purposes has doubled the low water flow of the river, and will provide additional power equivalent to 140,000 horsepower-years, when all the water powers on this river are utilized. The cost of the works will be borne by the power and lumber companies making use of the stored water under contracts for a term of forty years. The annual payments include interest on the capital cost, a sinking fund to redeem the bonds in thirty years, maintenance, operation and a small profit to the province. In 1922 the revenue from the dam amounted to $212,459.68, paid by four companies.

The commission has also carried out similar schemes under similar financial arrangements on the St. Francis and Ste. Anne de Beaupre rivers, and is now constructing reservoirs on lake Kenogami and on the river Metis. Each scheme is authorized by a special act of the legislature. To date the commission has spent on completed works about $3,500 000, on which the revenue is about $300,000. The commission has also examined a large number of river systems throughout the province, and has considered many of the difficult legal questions involved in the management of running waters. Much of the provincial legislation which has just been described was passed as a result of the commission's recommendations.

Water Power Legislation in Nova Scotia

From a very early time the General Assembly of Nova Scotia had considered that the lakes and rivers of the province which were capable of being used for public purposes should be regarded as public utilities and consequently subject to public use. Navigation and floating were, until recent times, the most important uses of the streams, and these were duly recognized by law as general public rights, the former being exercisable at all times, the latter during the spring, summer and autumn freshets. At first the use of water for power purposes was regarded as a

Shawinigan Falls Development on the St. Maurice River, Quebec, of the Shawinigan Water & Power Company — 191,500 h.p.



Rock Forest Development on the Magog River, Quebec, of the City of Sherbrooke — 3,000 h.p.

private right, incidental to riparian ownership by the English Common Law, which was introduced into Nova Scotia when it became a British possession, but water power has gradually come to be regarded as being of sufficient importance to be also classed as a public utility, and as such, subject to regulation in the general interest.

Unfortunately the greater part of the public lands of the province had been disposed of before the importance of the water powers on them was properly recognized, and most of the power sites passed from the direct control of the Crown without any conditions being stipulated as to their development and use. Water powers on the ungranted public lands are under the control of the Attorney-General acting as Commissioner of Crown Lands, but no regulations have yet been made for their utilization.

The Water Act, 1919

In order to acquire a satisfactory degree of control over water powers which had become private property, as well as over the other uses of water, it was necessary to make a fundamental change in the existing law, and this has been effectually done by means of the Nova Scotia Water Act, 1919 (9-10 Geo. V, cap. 5, amended by 10-11 Geo. V, cap. 75), which is one of great interest and importance, and is the governing authority for the granting of water power rights in Nova Scotia. This act may be regarded as the logical result of the view already referred to, namely that all lakes and rivers are primarily public utilities, and that private interests therein must be subordinate to public interests. The most important section of this act is the following:—

> "Notwithstanding any law of Nova Scotia, whether statutory or otherwise, or any grant, deed or transfer heretofore made, whether by the Crown or otherwise, or any possession, occupation, use or obstruction of any water course, or any use of any water by any person for any time whatever, every water course and the sole and exclusive right to use, divert and appropriate any and all water at any time in any water course, is declared to be vested forever in the Crown in the right of the Province of Nova Scotia."

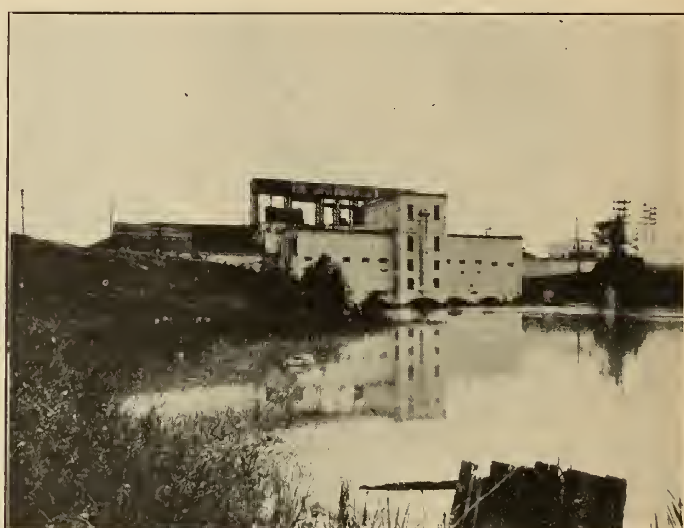
Water course is defined to include every water course and the bed thereof and every source of water supply, but does not include small rivulets and brooks unsuitable for milling, mechanical or power purposes.

The Water Act, while it prevents new rights being acquired or exercised by reason only of riparian ownership, and also abrogates the old public right of floating, does not and is not intended to abolish rights in use at the time of the passing of the act. On the contrary, it enables existing users of water to acquire a definite legal status by means of authorization, issued to all those who satisfactorily establish their right of use. Authorizations may also be issued for new uses of water, under suitable conditions, and if such uses are found to interfere with existing riparian rights or works in water, compensation is provided.

Regulations under the Water Act

Authorizations for water power developments under the Water Act are made by the Governor in Council on the recommendation of the Minister of Public Works and Mines in accordance with tentative rules approved by the Minister for purposes of the act. These rules deal with the method of making application for the use of water, the general considerations affecting approval of applications, and the conditions of authorizations.

The term of the authorization varies from ten to fifty years according to circumstances, and the original grantee is given the preference in any renewal which is permitted. The annual rental is based on a rate of one dollar per year per horse power of continuous capacity, although in some cases only nominal rentals are charged; there is also an initial charge of twenty-five dollars. No works in water may be constructed until detail plans of the same have been filed and approved, and the construction, maintenance and operation of the works are subject to the inspection and approval of the Minister throughout the life of the authorization. Where necessary adequate facilities must be provided for log driving and fisheries, and the grantee may be required to pay his share for benefits due to storage and control works. If the Governor in Council is satisfied that the grantee has "failed to observe or fulfill any of these terms or conditions, or has failed to use the said water course or water therein under this authorization, the Governor-in-Council may revoke this authorization".



Soulanges Development on the St. Lawrence River, Quebec, of the Montreal Light, Heat and Power Consolidated — 16,000 h.p.

Regulation of Public Utilities

The regulation of public utilities in Nova Scotia is ffected by means of a Board of Commissioners of Public Jtilities, appointed by the Governor-in-Council under he authority of the Public Utilities Act. (3 Geo. V, cap. 1 ınd amending acts). Its jurisdiction extends to public treet railways, heat, light and power plants, water supply ınd telephones, owned by individuals or companies, and o municipal heat, light and power plants and water upply, and it is given authority to deal adequately with ıll matters affecting rates, service and the issue of ecurities.

State Ownership in Nova Scotia

Within the last five years Nova Scotia has embarked on a policy of power development and distribution by government agency similar to that of Ontario already lescribed. This has been done by means of a power commission of three persons appointed by the Governor n Council, two of whom may be members and one of vhom shall be a member of the Executive Council, and nvested with suitable powers under the Power Commision Act, (9-10 Geo. V, cap. 6 as amended by 10-11 Geo. V, cap. 76 and 11-12 Geo. V, cap. 66).

The Nova Scotia Power Commission Act follows along very similar lines to the corresponding Ontario Act, except that the Nova Scotia commission is given greater reedom of action and a more direct responsibility.

The Nova Scotia Act states that:—

(1) "The commission may generate, accumulate, transmit, distribute, supply and utilize electrical energy and power in any part of the province of Nova Scotia, and do everything incidental thereto or deemed by the commission necessary or expedient therefor."

(2) "The commission is hereby authorized and empowered to — "

then follows a detailed list of powers, the most important of which are, acquire any sources of water or fuel power in the province with the property and rights necessary for their development, transmission and use; enter into contracts for the purchase of power in bulk and its sale to municipalities and others; acquire water courses and mprove them for water power, logging and conservation purposes; and acquire shares in power companies.

Although exercising independent judgment in a number of matters such as expropriation of property, the main operations of the commission can only be undertaken with the approval of the Governor in Council, who controls the funds for capital expenditures, and validates contracts between the commission and the municipalities which it supplies with power.

The commission has already constructed several mportant developments and is supplying power to Halifax Lunenburg, Rive. ort and other parts of the province. About $2,500,000 have now been expended on three generating stations with a total installed capacity of 11,400 horse power, and about thirty-two miles of main transmission lines.

Water Power Legislation in New Brunswick

Although the province of New Brunswick is well supplied with water powers, some of which are of considerable size and importance, very little legislation has been passed in connection with their development and use. New Brunswick is the only one of the Canadian provinces, with the exception of Prince Edward Island, in which the water powers are of very small extent, which has no general law or regulations applicable to the development by private enterprise of water powers situated on the public domain.

Drummondville Development on the St. François River, Quebec, of the Southern Canada Power Company — 7,500 h.p.

Development by Riparian Owners

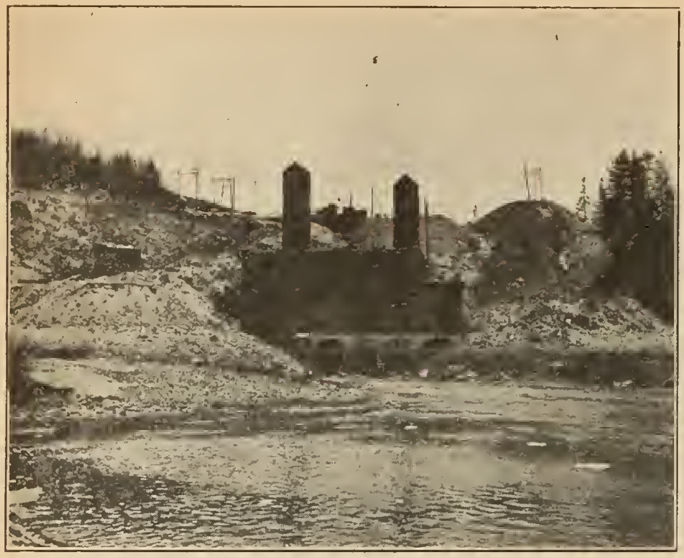
Most of the power sites have been granted by the Crown along with the adjacent lands to companies or settlers without any reservation or conditions of use, and so have passed out of the direct control of the province. Those sites which are privately owned may be developed by riparian owners, whether individuals or corporations, in the manner recognized by the English Common Law, with or without the authority of a private act, subject in every case to other existing private or vested rights and to the public right of navigation and floating, but without direct government control, except that works in water require the approval of the Lieutenant-Governor in Council under the Dams Act of 1921, which is described below.

The Four Rod Act

For many years the Crown lands in New Brunswick were granted without any reservation of the waters, but in 1884 an act was passed to provide for the survey and protection of lumber lands, (47 Vict. cap. 4), in which the following section occurs:—

> "In all Grants hereafter to be made of Crown Lands adjacent to the following rivers and streams:— (twenty in number), and all such other rivers, lakes and streams as the Governor-in-Council may hereafter declare by proclamation published in the Royal Gazette, — there shall be reserved to the Crown a strip or portion of land, four rods in width from the banks of the streams or lakes on each side thereof, and the riparian ownership of the said streams shall remain wholly vested in the Crown; provided always, that the owner or occupier of any lot abutting upon said strip of land shall have a right of way across the same to and from the said river or stream."

At that time a large part of the land bordering on those rivers was still held by the Crown, and the effect of this act, which is known as the Four Rod Act, has been to effectually reserve for future disposition and use many valuable power sites. No other streams have been added by proclamation to those named in the act. They include most of the larger rivers in the province, with the exception of the St. John River system and the lower navigable parts of some other rivers. The water powers on these reserves, as well as any others situated on ungranted Crown lands, are under the control of the Minister of Lands and Mines, but no provision has yet been made for granting rights to their use in accordance with modern principles of water power administration.



Aroostook Falls Development on the Aroostook River, New Brunswick, of the Maine and New Brunswick Electrical Power Company — 8,800 h.p.

Water Power Acts of 1903 and 1904

Two acts of the legislature passed with reference to water power development in 1903 and 1904 should be mentioned. They may perhaps owing to changed conditions and policies, be looked upon as obsolete, but as they are still on the statute book, they provide a possible means for administrative action. Both were passed with special reference to the Grand falls on the St. John river, which, as the most important power site in the province, has been the subject of a good deal of legislation. Several companies have in turn been granted the privilege of developing it, but up to the present time no development has taken place.

The act passed in 1903, (3 Edw. VII, cap. 3), enables the Lieutenant-Governor in Council to grant the right to develop power at Grand falls to any approved company, duly incorporated for that purpose. The act of 1904, (4 Edw. VII, cap. 32), extends this authority to the leasing of other water powers which may be acquired for this purpose by agreement or expropriation. No water powers have been acquired or leased under this latter act, owing largely to certain financial limitations which it contains, and the present policy of the government, as will be seen later, favours public ownership and operation of the principal power sites.

Approval of Works in Water

In 1921 an act was passed, (11 Geo. V, cap. 16), which provides that all dams or other works in water which have the effect of holding up the waters of any river, stream or lake shall be constructed only after plans and specifications of the same have been approved by the Lieutenant-Governor in Council.

Works already constructed, which by their failure might injure any bridge or culvert, require to be similarly approved within fourteen months after the passing of the act, otherwise they may be ordered to be removed by or at the expense of the owner.

Coquitlam-Buntzen Development No. 1 of the British Columbia Electric Railway Company — 43,500 h.p.

The essential purpose of this act is to prevent injury to bridges through the failure of poorly constructed dams, but it also enables a large measure of control to be exercised over the design and construction of hydro-electric developments, if such should prove necessary. The Minister of Lands and Mines may order the removal of any dam which has not been so approved, but this power is intended to be exercised only in urgent cases, and it is expresely stated that "nothing in this Act shall apply to driving dams on brooks and small streams, nor to reservoirs for the supply of water to cities, towns or municipalities".

Regulation of Public Utilities

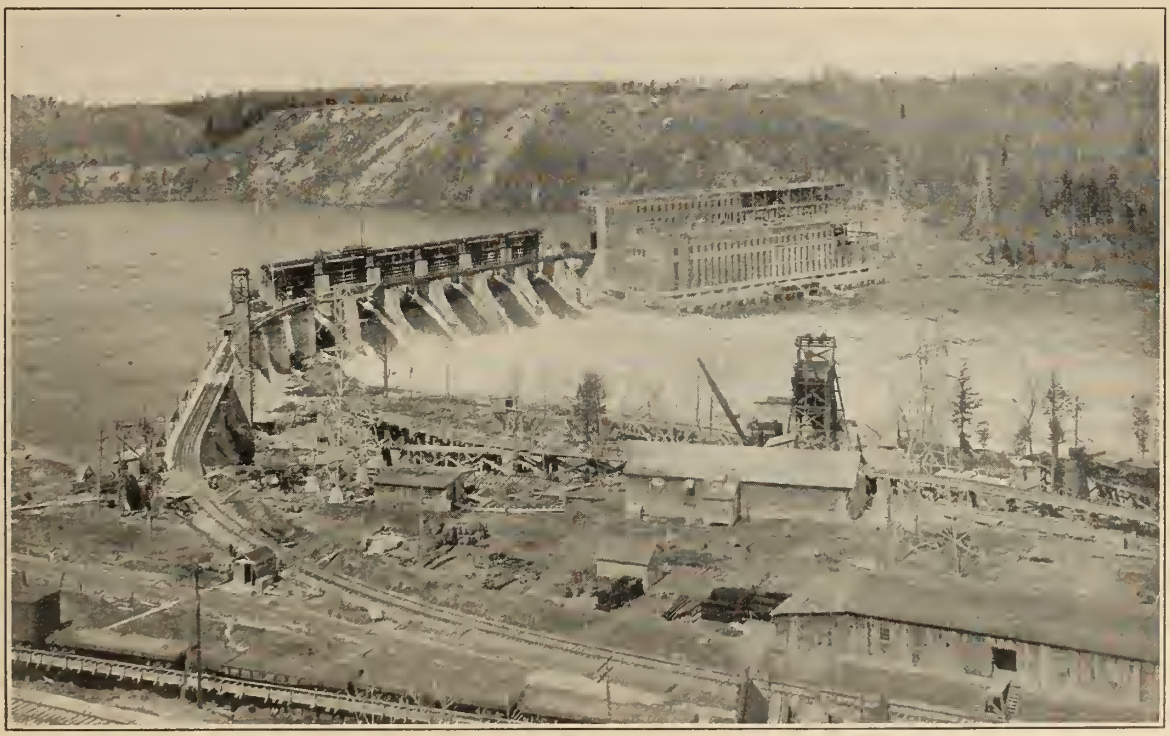
The operations of public utilities in New Brunswick have since 1910 been regulated by means of a board of commissioners consisting of three members appointed for a term of ten years by the Lieutenant-Governor in Council. (See 10 Edw. VII, cap. 5 and amending acts, also 10 Geo. V, cap. 63 and 11 Geo. V, cap. 15.) The utilities under their control comprise telephones, street railways, works producing or furnishing heat, light, water, natural gas or power, and steam railways in regard to the provision of local traffic connection. This control applies whether the utility is privately or municipally owned or operated. The Board is given authority to hold hearings and obtain all information necessary for properly determining all matters or complaints regarding rates, service and the issue of securities. Appeal may be taken from any order of the Board to the Supreme Court of the province, whose decision shall be final.

State Ownership in New Brunswick

New Brunswick has within the last few years followed the example of Ontario and Nova Scotia, though with some hesitation, in regard to the development of the principal water power sites in the province under the direction of a government commission invested with appropriate authority. This commission was appointed under the New Brunswick Electric Power Act, 1920, (10 Geo. V, cap. 53 amended by 11 Geo. V, cap. 39, 12 Geo. V, cap. 21 and 13 Geo. V, cap. 15), and consists of three persons appointed by the Lieutenant-Governor in Council, one of whom may be a member of the Executive Council. The powers of the commission are almost precisely the same as those entrusted to the Ontario Power Commission and the acts under which they operate are alike in almost all respects. This applies both to the powers which the commission may exercise and to the financial provisions of the act.

St. Margaret's Bay Development on the North East and Indian Rivers, Nova Scotia, of the Nova Scotia Power Commission — 11,000 h.p.

The New Brunswick Electric Power Commission, since its formation in 1920, has examined and reported on



General view of LaGabelle Power Development, St. Maurice River, of the Shawinigan Water and Power Company, under construction.

a number of promising developments. It has developed a power site on the Musquash river with an installed capacity of 11,100 horse power and built a twelve mile transmission line to St. John and an eighty-eight mile transmission line from St. John to Moncton, the power being sold in bulk for distribution in these two cities; and has also built a transmission line thirty-seven miles in length to supply power to Newcastle bought in bulk from the Bathurst Company Limited. The total expenditure of the commission to date is about $3,180,000.

Water Power Legislation in Prince Edward Island

Owing to its size and geographical formation, the rivers in Prince Edward Island are short and have comparatively small drainage areas. Consequently, although the rainfall is considerable and well distributed throughout the year, the water powers of that province are all of small extent. There are however a large number of power sites, widely scattered throughout the island, many of which have at one time or another been used for local manufacturing purposes. A considerable number of these are still in use, and there are seven or eight modern hydro-electric plants operating as public utilities. A few water power companies have also been incorporated by acts of the General Assembly, but these companies have not been granted any water privileges in excess of the rights which they might lawfully exercise as riparian owners.

Absence of General Laws

No laws have been passed by the General Assembly of Prince Edward Island with reference to water power administration, ownership of water rights, or development and use of water powers. All developments have taken place in the exercise of the water rights of riparian owners or occupiers as recognized by the English Common Law, which was introduced into the province when it became a British possession in 1758 and has not since been changed or curtailed in that respect, except by the recognition of floating as a public right.

At a very early stage in the history of the province, in 1767, almost the whole island was granted in township lots of about 20,000 acres each to proprietors, on the understanding that the lands were to be leased on liberal terms to settlers. These grants included the lands covered with water lying within their boundaries; no water powers or water rights were reserved by the Crown. In this manner all the water power sites passed out of the Crown's possession, and consequently there has been no necessity to make rules for disposing of water powers situated on the public domain, as is the case in the other Canadian provinces.

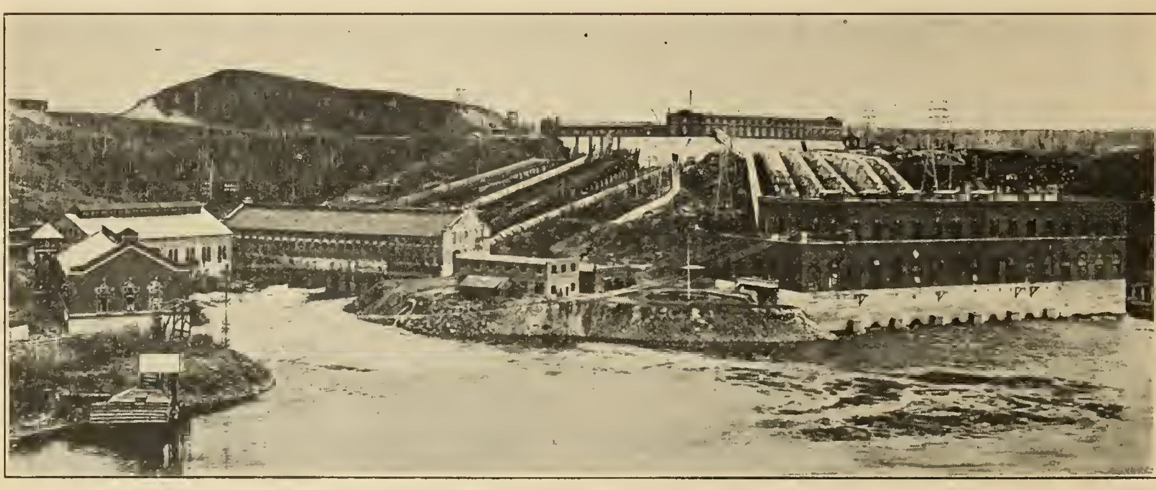
Regulation of Public Utilities

There is no board or commission in this province for regulating public utilities.

State Aid in Prince Edward Island

The government of Prince Edward Island has taken no steps towards acquiring or developing the provincial water powers as a public undertaking, all developments are the result of private or municipal enterprise. On the other hand the government has in recent years taken a great interest in securing and publishing information regarding the extent and availability of the water power resources of the province, in which work it has been assisted by the Dominion Water Power Branch of the Federal Department of the Interior, which, as stated before, conducts a water resources survey for the whole of Canada.

There is now plenty of evidence to show that water power development may be successfully carried out at a number of sites conveniently situated throughout the province and that under proper engineering advice, possibly with some assistance from the state, the water power resources of Prince Edward Island will prove a great benefit to the population, which is largely rural, but is living for the most part in thickly settled communities well adapted for the economic distribution of electrical energy.



Power Plant of Shawinigan Water and Power Company at Shawinigan Falls, Que.

The Fuel Resources of Canada and their Utilization for the Production of Power and other Purposes

B. F. Haanel, B.Sc., M.E.I.C.,
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Synopsis of Paper

In this paper, the author, has endeavoured to show how the fuel resources of Canada are being utilized for industrial power and other purposes. The fuel resources, with reference to their location, have been dealt with in some detail, in order that an intelligent opinion may be formed regarding the problems arising from the absence of coal measures in the more populous and industrialized portions of the Dominion and the efforts that are being made to find a satisfactory solution.

Coals of all grades are mined in a large number of collieries in the eastern and western coal fields. Practically the entire production is used for metallurgical, power, steam raising and industrial purposes, but up to the present time the railroads of Canada in general and the industries of the province of Ontario and a portion of the province of Quebec are largely dependent on imported coals. The author indicates how this adverse situation can be ameliorated by introducing systems for burning lignite and the lower grade fuels in the powdered forms, both on railways in those sections traversing the western provinces in which lignites occur and for power and industrial purposes in those portions now dependent on imported coals.

Regarding the preparation of the coals produced, it is stated that no standard method is adopted, but that the coals are graded, sized and washed, if necessary, as the local requirements necessitate. The purification of coal is not attempted, although it is reported that the Trent process for de-ashing all grades of coals will be introduced into eastern Canada for the manufacture of a domestic and industrial fuel from low grade coals.

The peat committee appointed by the federal and Ontario governments and which recently completed its investigation regarding the feasibility of utilizing the vast deposits of the provinces of Quebec and Ontario for fuel purposes, has developed machinery which makes possible, under strict business management the commercial manufacture of a fuel from peat.

In an effort to extend the use of Canadian fuels and more especially to render Canada less dependent on foreign sources for oil and a domestic fuel, the federal government through its Department of Mines has conducted extensive research work, which indicates that, at the present time, the lignite coals, peat, oil shales and tar sands cannot be seriously considered an economic source of oils. This situation, the author points out, will change when crude oil becomes scarce and its cost increases.

The steam boiler and power installations are enumerated and those possessing unique features are described in detail. Considerable headway is being made in introducing powdered fuel systems for burning low grade fuels for generating steam and the production of power from steam, in general, is carried out in installations of the most modern types, efficiency being the main objective. Producer gas power plants are not in great favour, though in past years considerable interest was manifested in the possibilities of that type of plant. The larger producer gas power plants, which were installed, have been replaced by steam power and hydro-electric energy. Oil engines of the Diesel and other types are employed in isolated localities and when the power requirements are rather small and intermittent.

The necessity for finding a substitute for the anthracite coal now largely used for domestic purposes in the provinces of Ontario and Quebec led to the undertaking of an investigation regarding the feasibility of erecting by-product coke ovens at strategic points. The establishment of such a plant in Central Ontario on an extensive scale, the author has shown, will not only partially solve the fuel problem, but also make available large quantities of power, which are at present much needed and also materially augment the supply of motor spirits and other oils which are now almost entirely obtained from foreign sources. The relative merits of high and low temperature carbonization are discussed as well as their relation to the production of power, oils and a domestic fuel.

The paper treats of the above subjects in detail; charts, tables, diagrams and figures are included to elucidate the description of power and steam plant installations, powdered fuel systems as installed at two of the principal steam power plants in Canada, and the low temperature carbonizing process as installed at the Ford Motor Works, Walkerville, Ontario. The research work, conducted by the Department of Mines at Ottawa in connection with low temperature carbonization on bituminous and lignitic coals and oil shales, peat and tar sands, as well as the work conducted by the Lignite Utilization Board in developing a process for the low temperature carbonization and briquetting of Saskatchewan lignites, are illustrated by tables giving the results obtained and when necessary figures.

Section I

Introductory

The nature and extent of the fuel resources of Canada are well known and the value of the high and low grade solid fuels including peat, for industrial and domestic purposes has been fairly accurately determined by extensive investigations, which have involved the testing of these fuels on a large scale for steam raising, the production of a power and industrial gas, coke making and the recovery of oils. Information concerning the manner in which fuels are utilized for steam raising or for the production of a power and industrial gas and the type of prime mover employed in the case of a power plant is, however, meagre and such statistics as are available are very incomplete. Accurate information on which intelligent opinions regarding the best methods to employ for generating power and electric energy from solid, liquid and gaseous fuels can be obtained only by conducting a detailed power survey. Such a survey has been made for water power developments and the information concerning those and the uses to which hydro-electric energy is put, is very complete. A survey of the methods employed for utilizing fuels for power, industrial and other purposes will be undertaken some time this year.

While there are a large number of boiler and power installations in Canada ranging from a few horse power up to several thousand, large carbo-power developments are particularly conspicuous by their absence. This is due to the numerous large water powers which abound in the most thickly populated and highly industrialized area and to the absence in this area of coal formations of any economic value. Consequently, hydro-electric developments in the provinces of Ontario and Quebec, which constitute the above area, have been undertaken on a large and rapidly increasing scale. Generally speaking, hydro-electric energy has for some years and does now take care of practically all the power requirements of the large industries, public utilities and municipal transportation lines of these provinces. The conditions in this area are now changing. The hydro-electric energy available in the industrial centre of southern Ontario will not in the near future be able to economically meet the demands for power. Consequently, the Hydro-Electric Commission for Ontario is planning to meet the peak load and a portion of the future requirements by steam generated electric energy in central stations of large capacity. Similar installations both private and publicly owned will follow if the industrial growth of this portion of Canada continues at the rate maintained during the past few years. Although Canada, at the time of writing has no carbo-power plants approaching in capacity those commonly seen in the United States and Europe, this country does possess power plants which are sufficiently unique in many details and representative of the most modern practice in the art of generating power from coal to merit some description.

A general survey of Canada's fuel resources is included, in order to assist in an understanding of the fuel situation, existing in different parts of the Dominion, and the problems arising therefrom. The present and future trend, in the use of Canadian fuels is indicated in a general discussion of the purposes for which fuel is used and the quantities involved, the preparation of coals at the collieries and research and development work which has been conducted on low grade fuels with a view to increasing their value for industrial and domestic purposes.

Fuel Resources

Coal

Canada has an abundance of coal of all qualities ranging from low grade lignites to high grade bituminous and semi-anthracite. This is concentrated in the western and eastern extremities leaving a wide stretch of territory comprising the more thickly populated and industrialized provinces of Ontario and Quebec dependent on foreign sources of supply. The area represented by these two provinces has been termed the "Acute Fuel Area," since its fuel supplies for heating and industrial purposes is subject to interruption from strikes or other causes in a foreign country over which it can exercise no control. The anomaly of this situation is more striking when Canada's present coal consumption is considered in conjunction with known reserves. The annual consumption of coal for all purposes is about 32 millions of short tons and the known reserves 1,234,269 millions of metric tons.

Table No. 1, — Available Coal Reserve of Canada

(In millions of metric tons. Estimated by the Geological Survey, 1913)

Province	Metric tons	Province	Metric tons
Nova Scotia	9,719	Alberta	1,072,627
New Brunswick	151	British Columbia	70,035
Ontario	25	Yukon	4,940
Manitoba	160	Northwest Territories	4,800
Saskatchewan	59,812	Arctic Islands	6,000

Total reserves, all Canada, 1,234,269.

Peat

The peat resources of Canada are of very considerable extent and in the provinces of Ontario and Quebec where coal is lacking, are strategically situated with respect to inhabited communities and transportation facilities. The total area in Canada overlain by peat bogs is estimated at 37,000 square miles, of which the central provinces of Manitoba, Ontario, Quebec and New Brunswick have 12,000 square miles with an average depth of 6 feet. This 12,000 square miles will produce 9,800,000,000 tons of peat equivalent in heating value to 5,400,000,000 tons of good coal.

The Department of Mines have investigated and mapped about 228,000 acres of peat bogs comprising 46 bogs in Ontario, 27 in Quebec, 7 in Manitoba and 27 in the maritime provinces, estimated to be capable of producing 199,450,000 short tons of fuel. Seven bogs within shipping distance of Toronto are estimated to be capable of producing 26,500,000 tons; seven in the vicinity of Montreal 23,500,000 tons, and five bogs in the lower St. Lawrence conveniently situated as regards water transportation to Quebec, 16,250,000 tons. In considering the present value of these bogs for the manufacture of fuel, the economic shipping distance for the peat fuel has been arbitrarily fixed at approximately 100 miles.

Wood

Wood as a potential source of heat energy is only of importance as an auxiliary supply for domestic heating, and to some extent for the manufacture of charcoal and chemical products. Wood suitable for the manufacture of pulp and paper will not be included in this estimate, since the growth of the pulp and paper industry is increasing rapidly and consequently all kinds of wood which can be converted into paper will be drawn on heavily to supply the mills. The hardwoods suitable for fuel purposes cover an area of approximately 21,800,000 acres of young and mature hardwood and about 5,000,000 acres of cut-over land. The total hardwood resources are estimated to be about 150 millions of cords and the annual consumption is estimated to be 8 to 9 millions of cords. The distribution of acreage covered by hardwood by provinces is as follows:

Table No. 2, — Acreage Covered by Hardwood
(In millions of acres)

Province	Young and mature	Cut-over land	Total No. cords
Ontario	7½–8	3–3½	
Quebec	8	2–3	150
New Brunswick	3.8	–	millions
Nova Scotia	2.5	–	

Oil and Natural Gas

The oil, oil-shales and natural gas resources have never been serious contributors to the annual fuel requirements. An oil field of limited extent exists in southwestern Ontario which has been producing crude oil of high quality for a number of years, but during the past few years this field has shown signs of exhaustion.

Oil has been found in Alberta and the Northwest Territories but no large quantities have been produced. Prospects are, however, encouraging. The provinces of New Brunswick and Nova Scotia have large deposits of oil shales which may prove a valuable source of oil when the oil fields which now meet all the requirements for oil approach exhaustion. About 98 per cent of the crude oil and refined oil products used in Canada are imported from foreign sources.

Production, Consumption, Imports and Exports

Notwithstanding the enormous coal reserves, this country imports more than 50 per cent of all classes of coals required for industrial, power and domestic purposes, and practically the entire quantity of crude oil used in the various oil refineries — in addition a large quantity of refined oil products is annually imported. Regarding the imports of coal, attention might again be directed to the isolated position of the "Acute Fuel Area" and its almost complete dependence on foreign sources of fuel supplies. This area is the most populous and highly industrialized and naturally consumes a large percentage of the total imports of both coal and oil for industrial, commercial and domestic purposes. This unfortunate condition cannot be entirely rectified, even if the low grade fuels found in the area are utilized to the greatest extent, since the annual increase in population and industries creates an additional and rapidly increasing demand for fuels. The following tables Nos. 3 and 4 show the production, exports, imports and consumption of coal from 1913 to 1922, both years inclusive, and importations of United States coal into Ontario and Quebec.

Table No. 3, — Canada's Coal Balance Sheet
(In millions of short tons)

	1913	1915	1916	1917	1918	1919	1920	1921	1922
Production	15.0	13.3	14.5	14.0	14.9	13.7	16.9	19.0	15.0
Exports	1.5	1.8	2.1	1.7	1.8	2.1	2.5	1.9	1.8
Imports:—									
bituminous	13.5	8.4	13.0	15.5	16.9	12.4	15 9	13.5	11.6
anthracite	4.6	4.0	4.5	5.3	4.8	4.9	4.9	4.6	2.7
Consumption	31.6	23.9	29.9	33.1	34.8	28.9	35.2	31 2	27.5

Table No. 4, — Importations of United States Coal into Ontario and Quebec
(In millions of short tons)

	1916	1917	1918	1919	1920	1921	1922
Into Ontario:—							
Anthracite	2.95	3.09	3.62	3.44	3.24	3.07	1.64
Bituminous	10.68	13.31	13.01	9.25	12.34	10.71	9.44
Into Quebec:—							
Anthracite	1.22	1.25	1.84	1.38	1.54	1.31	0.79
Bituminous	2.72	4.00	4.23	2.67	3.50	2.68	1.31

Table No. 5 shows the imports of crude and refined oil products from 1917 to 1922, both years inclusive. The annual increase appears to be about constant and with this rate of increase the consumption of crude oil and refined oil products doubles every 10 years, but the number of motor vehicles, the principal consumer of gasoline and motor spirits, is increasing at a more rapid rate and future imports and consumption will mount more rapidly.

Table No. 5, — Imports of Crude and Refined Oil Products

Year	Quantity Imperial Gallons	Annual Increase
1917	379,148,913	————
1918	420,733,643	41,584,520
1919	451,303,731	30,570,088
1920	491,372,140	40,068,409
1921	510,884,372	19,512,232
1922	546,707,839	35,823,465

Production of Coal

Coal is mined in 158 principal collieries. Their location and production during 1922 are stated in the following table.

Table No. 6, — Canadian Collieries in Operation and their Production

Province	No. of Collieries	Production short tons	Class of coal
Nova Scotia	22	5,558,446	bituminous
	small operators	10,626	"
New Brunswick	8	285,245	"
	small operators	2,268	"
Saskatchewan	9	342,455	lignite, (low grade)
	small operators	39,982	"
Alberta	1	40,417	semi-anthracite
	25	2,845,608	bituminous
	small operators	797	"
	84	2,909,325	lignite, (high grade)
	small operators	194,764	"
British Columbia	10	2,926,437	bituminous
	small operators	596	"
	Total	15,156,966	

The semi-anthracite produced in 1922 amounted to 40,417 tons; bituminous coking and non-coking 5,773,438 tons and lignite coal 3,486,526 tons in western collieries and 5,856,585 tons bituminous coals in eastern collieries. Of this quantity 1,800,000 tons were exported The balance was used on the railways, for bunkering, for domestic and industrial purposes. The consumption of coal and oil in industrial plants is shown on plate No. B-1. In addition to the coal used in industries as shown on plate No. B-1 about 650,000 short tons of gas coal was imported from the United States for the manufacture of town gas.

Many of the Nova Scotia coals and all of those of New Brunswick, which have been examined in detail, have a high sulphur and ash content. The ash, moreover, has a low temperature of fusibility, but notwithstanding these adverse characteristics the coals are used for steam raising in stationary boiler installations and on railway locomotives. Coke made from the Nova Scotia coals, with a low temperature fusibility ash, is also used for metallurgical and domestic purposes. (See table No. 7.)

A very material reduction in both the sulphur and ash can be obtained by proper and careful washing, but the necessity, at the present time, for purifying such coals does not seem to be urgent. The demand for Nova Scotia coals is increasing and the annual production is rapidly being increased to meet present demands and those created by new markets. A satisfactory gas coal is not produced in Nova Scotia or New Brunswick and such coals as are, in some particulars, more or less suitable, are barred on account of the high sulphur content.

The ash in western coals is fairly high in the coals mined from certain seams, but on the whole this is satisfactory, while the sulphur is reasonably low. (See table No. 7.) The temperature of fusibility of the ash of western coals and lignites has not been determined; information concerning this will be available at a later time.

Alberta and British Columbia produce good coking, and steam raising coals and coals very satisfactory for domestic purposes, and the operating mines are developed on a sufficiently large scale to enable production to be increased to meet demands far in excess of present requirements.

The value of lignite coals for various purposes cannot be determined by chemical analysis. The physical properties possessed by such fuels are even more important as regards their use for steam raising and domestic purposes. As stated previously, Canadian lignites vary widely in both chemical and physical characteristics, but disintegration on exposure to weather and heat is common to all to a more or less degree. The moisture as well as the oxygen content varies from a high percentage in the youngest freshly mined lignites to only a few per cent in the older, and these have an important bearing on their weathering properties and tendency to disintegrate.

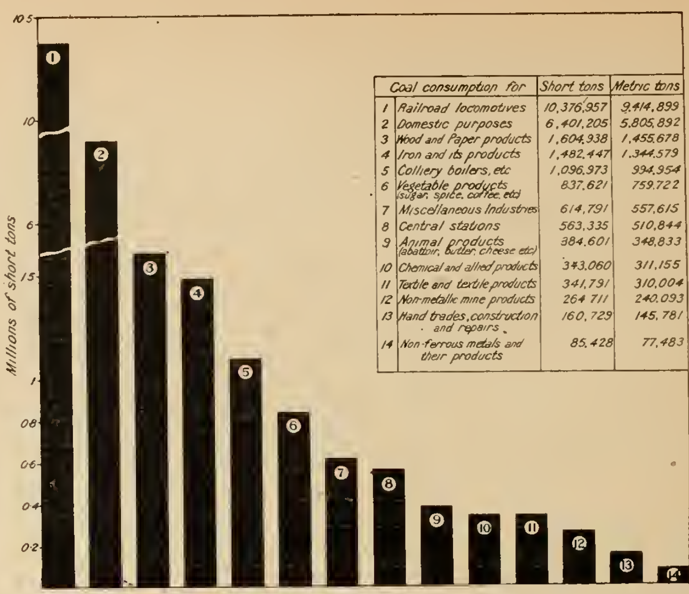


Plate No. B-1.—Chart showing coal consumption in Canada, 1920, in industries and railway transportation.

All of the true lignite coals are liable to spontaneous combustion when stored in a finely divided condition in large heaps and for this reason great care must be exercised to permit the use of the fuel in such a manner that storage over long periods can be avoided. The liability to spontaneous combustion is more noticeable in some lignites than others and cannot, generally, be said to be greater for lower grades than certain of the higher grades.

Peat fuel when properly manufactured, and stored in heaps or piles of large dimensions, exposed to the weather or under cover, does not suffer any alteration or disintegration and is not liable to spontaneous combustion. But the quantity of fines stored with the fuel must be reduced to a minimum and the moisture content reduced to below 40 per cent or there about to prevent freezing. Freezing causes peat to rapidly disintegrate and this must be avoided.

These statements are based on observations regarding the peat fuel manufactured, stored, shipped and used for the generation of power and for domestic purposes, by the Federal Department of Mines. Many thousands of tons of peat have been manufactured by this department and the peat Committee appointed jointly by the Federal and Ontario governments in the course of their investigations extending over several years.

Table No. 7, — Typical Analysis and Characteristics of Canadian Coals

Fuels as received	No. of analysis taken from	Moisture per cent	Ash per cent	Volatile matter per cent	Fixed carbon per cent	Sulphur per cent	Calorific value B.t.u. per lb.
Nova Scotia—bituminous	60	1–9	4–22	22–40	45–64	0.5–7	11,200–13,900
New Brunswick—bituminous	24	1–1.5	13–20	30–33	47–54	5–9	10,900–12,700
Saskatchewan—lignite	45	30–37	5–12	24–34	28–34	0.3–0.9	6,400– 7,500
Alberta—lignite	89	9–28	4–14	24–35	35–52	0.2–1.3	7,900–10,900
sub-bituminous	31	5–9	5–17	27–37	46–53	0.1–0.3	10,000–12,000
bituminous	38	1–5	5–20	20–31	50–64	0.1–1.7	11,300–14,300
semi-bituminous	55	0.5–4	3–20	12–23	62–80	0.4–1.8	11,500–14,900
semi-anthracite	6	0.5–2	6–18	8–13	70–82	0.5–0.7	12,200–14,300
British Columbia—							
sub-bituminous	5	3–8	4–14	36–38	44–55	0.7–0.9	11,100–11,800
bituminous	56	0.5–4	7–19	21–42	42–66	0.3–2.5	11,600–13,700
semi-bituminous	41	0.6–2.3	2–16	17–24	71–77	0.5–0.9	13,800–15,100
Ontario—Alfred peat	—	dry basis	5	68	27	———	8.700

Preparation of Solid Fuels for Industrial and other Uses

There is no standard method for preparing Canadian coals for industrial or domestic purposes. Such treatment as certain coals receive at the mines is governed by the conditions obtaining and the result it is hoped to attain. Even in a given field the coals produced in the various collieries, which are used for the same purpose are not prepared in the same manner. Anthracite suitable for domestic purposes without briquetting is not at present mined in Canada, hence no attempt is made to prepare this coal into different grades. Bituminous coals and lignites are utilized for steam raising and domestic purposes and are prepared for the market according to different methods in different parts of the coal fields.

Screens and picking belts are used extensively in every coal producing province and a large proportion of the coals mined are marketed as screened, run-of-mine, without attempting to grade into various sizes.

The bituminous grades of coals mined in the east and in the provinces of Alberta and British Columbia in the west are generally screened to produce lump and slack and picking belts are employed quite extensively. In Nova Scotia collieries the slack through ¾-inch is collected and sent to a central coking plant where it is first washed and then coked in by-product recovery coke ovens. The coke produced is utilized for metallurgical, foundry and domestic purposes. The principal market for the production of western bituminous collieries is a locomotive fuel for the railways. For this purpose run-of-mine coal is suitable, but care must be taken to insure the proper proportion of lump coal.

The United States tariff on imported coals which permits slack coal through ¾-inch screens to be imported into that country free of duty has created a tendency on the part of coal operators to make a specialty of slack through ¾ inch. This has encouraged the handling and rehandling of lump coal through bars and screens to increase the proportion of slack.

The various sizes of bituminous coals prepared by means of different kinds and sizes of screens with and without picking belts are:—

Lump, — over either 4, 2 or 1-inch screens;
Nut, — through 4, 2 and over ⅝-inch screens;
Screened coal, — over 2 or ⅝-inch screens;
Steam coal, — through 2-inch screens;
Slack coal, — through 1 or ⅝-inch screens.

Another series of sizes for bituminous coals produced in western collieries which is more or less general is:—

Lump, — over 3-inch round holes.
Egg, — through 3-inch and over 1¼-inch round holes.
Nut, — through 1¼-inch and over ¾-inch round holes.
No. 1 Pea, — through ¾-inch and over ½-inch round holes.
No. 2 Pea, — through ½-inch and over ¼-inch round holes.
Slack, — through ⅜-inch and over 3/16-inch round holes.

For the lignitic and sub-bituminous coals of the provinces of Alberta and Saskatchewan which are used extensively as household fuels, the government of the province of Alberta is reported to have adopted the following sizes:—

Lump coal, — over 3-inch.
Egg or stove coal, — through 3-inch and over 1½-inch.
Nut coal, — through 1½-inch and over ¾-inch.
Pea coal, — through ¾-inch and over ½-inch.
Dust coal, — through ¼-inch.
Slack coal, — through ¾-inch.
Nut slack coal, — through 1½-inch.
Slack coal, — over 1½-inch.

Various types of screens both stationary and shaking are employed. These comprise round holed, square meshed wire, and bar screens. The principal types of washers used are, the British Baun washer in the east, and in the west a washer of the Robertson type, cone washer and Luhrig gigs.

Lignite Coals

The lignite coals found in Canada are of all grades from those difficult to distinguish from high grade sub-bituminous to the low grade lignites of Saskatchewan and southern Manitoba. Canada, so far as is known at present, possesses no lignites which are comparable physically and chemically to the brown coals of Europe and elsewhere. The supposition that a similarity existed has led to many fruitless attempts to briquette the low grade Saskatchewan lignites without preliminary heat treatment, and thus render them in a form suitable for transportation and domestic use. A striking characteristic of all Canadian lignites, but especially of those of Saskatchewan, is their marked tendency to disintegrate when exposed to the weather. As a consequence of this property these lignites must undergo extensive preparation in order to render them suitable for domestic and in certain cases industrial purposes.

It is pretty generally agreed by those who have investigated the problem that lignitic coals of this type must undergo heat treatment before briquetting can be attempted. In order to develop an economic process for briquetting Saskatchewan lignites, a large amount of research and development work, the latter on a commercial scale, has been conducted, from 1918 to 1924, by the federal government and the governments of the provinces of Manitoba and Saskatchewan. But while certain of the problems involved have been technically solved, an economic process, at the time of writing, cannot be said to have been developed. The process in the course of development involves low temperature carbonization and briquetting. This will be described under carbonization.

For industrial purposes, the preparation or treatment the lignites require depends not only upon the purpose for which the fuel is to be used, but also on the type of lignite. Many of the lignites can be successfully utilized for steam raising without any preliminary treatment and this applies also to the Saskatchewan lignites when these can be used soon after they have been mined, i.e., without too long exposure to the weather. But when a comparatively long transportation is required to reach the point of consumption, the excessive moisture should be reduced before shipment and perhaps the calorific energy also might be raised by carbonization to advantage. To reduce moisture content as well as to carbonize requires the expenditure of heat and whether or not the resulting fuel can economically stand the expenditure of the required heat for drying and the cost of processing in general is at present problematical. Recent developments in the use of low grade as well as high grade fuels for the generation of steam for power and other purposes, which will be dealt with later, may however render costly processing unnecessary, unless it can be shown that the by-products recovered will realize in credits an excess over the cost of processing.

Purification of Coal

The reduction of the ash and sulphur contents of high and low grade fuels has been successfully accomplished technically and plants have been erected to carry out on a commercial scale, at least, one of the most promising of the several processes devised.

The Trent process which has received considerable attention in the United States and, the writer has been informed, in England and France also, will be dealt with in some detail inasmuch as it is reported that arrangements are being made to install this process in a plant in eastern Canada for the manufacture of a domestic fuel.

The reduction, according to this method, of the ash content of a coal high in ash, depends upon the selective affinity of oil for the carbonaceous matter, and of water for the mineral ash content. To obtain a satisfactory separation of the mineral matter and a complete agglomeration of carbonaceous matter with oil, the coal, to be treated, must be in a finely divided condition. The degree of pulverization depends on the reduction in ash content it is desired to obtain. The general practice, however, s to pulverize to about 200 mesh. The pulverized fuel, mixed with a large quantity of water, is placed in a churn, called an amalgamator, and thoroughly agitated. During the period of agitation oil is slowly admitted. The quantity of oil required, while materially differing for different coals, was, according to tests conducted on Canadian coals, in the vicinity of 40 to 45 per cent by weight of the coal treated, but this quantity the writer has been informed is now materially reduced. When the mixture of oil, water and finely divided coal is briskly agitated, the oil and carbonaceous matter begin to agglomerate and the ash settles in the water. When the operation is complete, a separation of the oil and carbon, in small globules, and the water containing the mineral ash content, is very marked. The time required for making a complete separation varies with different coals and may be from two to three minutes to fifteen or more minutes with bituminous and anthracite coals. The time required to complete the separation of ash in the case of lignites was much longer viz: twenty-five minutes to several hours.

Nine samples of coal, comparatively high in ash, were selected from collieries in Nova Scotia, Alberta, British Columbia and Saskatchewan. Six of these were obtained from Nova Scotia, one from Alberta, one from British Columbia and one from Saskatchewan. These samples were treated in laboratory apparatus and yielded the following results:—

Table No. 8, — Results of Tests on Nine Samples of Coal

Coal	Original ash removed per cent	Carbonaceous matter recovered per cent	Oil used by weight per cent
Saskatchewan, lignite...........	64	..	44
Nova Scotia, bituminous........	72	98	43
" "	62	98	42
" "	79	99	43
" "	60	98.5	43
" "	57	98.8	43
" "	65	98	40
Alberta, "	47	99	42
British Columbia "	57	99.5	47

The six Nova Scotia samples were taken from different seams of one of the large collieries, and the ash content as received ranged from 15 per cent to about 23 per cent. The ash content as received of the British Columbia sample was 12.85 per cent and of the Alberta and Saskatchewan samples 19 to 15 per cent respectively.

Purified Product

The purified product is a mixture of oil, finely divided coal with a reduced quantity of mineral matter and a small amount of moisture. The fuel in this form has been successfully used for domestic purposes and for raising steam. It is, however, dirty to handle and unless great care is exercised in unloading into household bins would not prove an acceptable fuel for domestic purposes.

A special method has been devised for coking the amalgam and a good quality of coke has been produced not only from purified coking coals but from non-coking coals. An important claim made by the inventor of this process is, that anthracite coal when treated in the manner described and carbonized according to his method will produce an excellent coke. The intimate association of oil with the carbonaceous matter of a coal does markedly improve the coking properties of a poorly coking coal, but the writer did not witness any tests with a non-coking coal and cannot therefore substantiate the claim made regarding anthracite coal.

While a field for this or other purifying processes may exist in those countries which for economic reasons must utilize coals high in ash and sulphur, it does not appear that the time has yet arrived when such a process can be employed profitably in Canada.

Briquetting

The semi-anthracite coal mined at Bankhead, Alberta, by the Canadian Pacific Railway Company, is largely in a finely divided condition. This necessitates for locomotive purposes, screening or the preparation of the fines into a form suitable for mixing, in order to maintain the proper proportion of lump coal. To reduce the quantity of fines thrown on the dump, a briquetting plant was erected and operated for a number of years. The briquettes produced were mixed with the fines and used for locomotive purposes and a limited quantity in excess of that required by the railway was marketed for domestic use These briquettes gave entire satisfaction as a household fuel, but for economic reasons the plant, after having turned out over one million tons of briquettes, has been closed down.

Peat

Peat in its natural state cannot be used for the generation of heat since the combustible substance is associated with a large quantity of water. The water content of the peat bogs so far examined in Canada averages 90 per cent, the remaining 10 per cent representing the combustible substance and ash. It is, therefore, necessary to remove, by some means, the major portion of the water content before the combustible substance can be utilized for the production of heat. The removal of the water content, rapidly and economically, presents problems which have baffled investigators of all parts of the world and it can safely be said that to-day no process for economically separating the large water content of peat by mechanical means, either through pressing or drying by the application of artificial heat, has been devised. The advantages of a process which would permit of an extension of the period during which the manufacture of peat fuel could be conducted, are evident, but notwithstanding the numerous investigations which have been conducted along such lines and the very large sums of money already expended on fruitless attempts only one process can to-day be termed economic. This is the air-dried machine-peat process which utilizes the heat of the sun for evaporating the associated water. The development of the peat resources in certain sections of the provinces of Ontario and Quebec is of sufficient

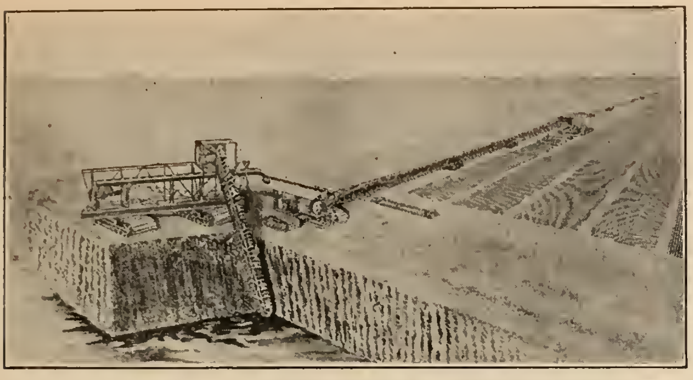


Plate No. B-2.—Peat plant developed by Federal and Ontario Governments' Peat Committee.

importance to Canada to merit here a brief outline of this process and the results which both the federal and Ontario governments have achieved through investigations conducted individually and jointly.

The air-dried machine-peat process consists of the carrying out of the following operations:—

1. — Excavation of raw peat.
2. — Pulping of excavated peat.
3. — Delivery of pulped peat to drying field.
4. — Spreading and cutting peat laid on drying field.
5. — Harvesting of dried peat and loading on cars for shipment or delivery to power plant on or near the bog.

This process differs from all others in that the removal of moisture is effected wholly by the natural agencies of sun and wind. All the operations involved are mechanical requiring the use of machinery or the employment of manual labour. The latter through the use of automatic machinery developed by the Peat Committee, appointed jointly by the federal and Ontario governments in 1918 and which completed its work in 1923, has been reduced to a minimum. The special features of the plant developed by this committee, Plate No. B-2, which is estimated to be capable of producing 20,000 tons of salable fuel with a moisture content of 30 per cent during a season of one hundred twenty hour days, are:—

1. — The mounting of the various machines on caterpillar aprons.
2. — The employment of a portable belt conveyor.
3. — The introduction of a swing-hammer-mill shredder for pulping.
4. — The employment of a mechanically operated reversible spreader equipped with automatic devices for cutting the spread peat in blocks.

The belt conveyor, which is 850 feet long and is mounted on eleven caterpillar aprons, conveys the pulped peat automatically from the pulping mill to the spreader. The mounting of the excavator and conveyor on caterpillar aprons permits of the movement of the combined plant in any direction by one or two operators instead of several labourers as was the case when the plant was mounted on rails and had to be moved by cables and a power winch. The employment of a swing-hammer-mill instead of the conventional pulping mills, which are in common use in European peat using countries, has resulted in a marked improvement of the fuel as regards density and resistance to breakage.

Under Canadian climatic conditions the air-dried machine-peat process can be employed for a period of only 100 days during the summer.

While the cost of manufacture of air-dried peat fuel has been reduced to a very low figure by employment of the automatic machines developed, the bulkiness of the fuel and its lower calorific value compared with coal make it important that its subsequent handling be conducted with the greatest possible economy, and that it be burned under favourable conditions. Maximum efficiency in the use of air-dried peat as a fuel cannot be obtained in ordinary steam boiler installations designed to use coal. The employment of step grates in conjunction with specially designed combustion chambers has, however, led to the obtaining of very satisfactory results in its use. Investigations conducted by the Mines Branch, Department of Mines, have shown that air-dried peat can be very efficiently used as a fuel for the production of power through the media of a gas producer and gas engine.

The manufacture of peat fuel according to this method, on many of the bogs so far examined, which are strategically situated with regard to inhabited centres, will open up an extensive field for the production of power in by-product recovery producer gas plants since the average nitrogen content of the peat bogs examined in detail is 2 per cent and over. This nitrogen content refers to absolutely dry peat.

Economic success in the utilization of a low grade fuel such as peat as a source of power will depend largely on selection of suitable deposits for working, sound methods of financing operations, careful restriction of overhead costs and general good management.

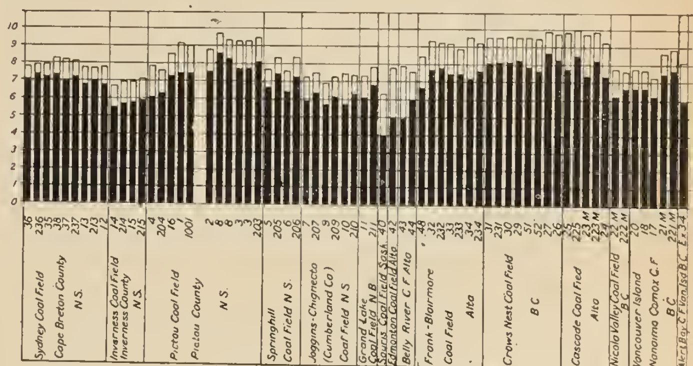


Plate No. B-3.—Chart showing equivalent evaporation per pound of coal fired and per pound combustible.

Section II

Value of Canadian Solid Fuels for Steam Raising and the Production of a Power and Industrial Gas

With a view to obtaining information regarding the value of the solid fuels produced in Canada for steam raising, the generation of a power and industrial gas, for coke making and other industrial purposes, the Federal Department of Mines in co-operation with McGill University carried out an extensive investigation which involved the testing of coals representative of eastern and western Canada, including low as well as high grade coals, for steam raising, the production of a power and industrial gas in gas producers, all on a commercial scale and the testing of coals to determine their coking value. This investigation was later continued at the Fuel Testing Station of the Federal Department of Mines. Extensive investigations were also conducted regarding the purifica-

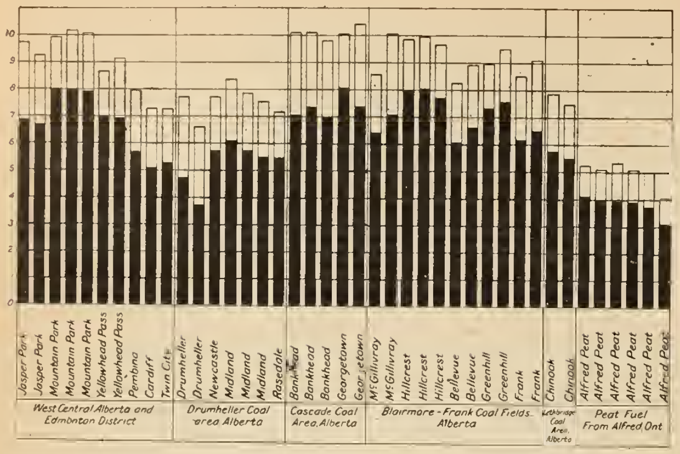


Plate No. B-4.—Chart showing equivalent evaporation from and at 212°F. per pound of coal fired and per pound combustible.

tion of coal by washing according to standard methods and the weathering of coals when stored in large piles.

The steam raising tests were carried out in Babcock and Wilcox boilers at both McGill University and the Fuel Testing Station at Ottawa. These boilers were of standard construction and design and were representative of the best boiler practice in small installations at that time. All the fuels burned under the boilers were hand-fired and, while an effort was made to burn the coals in a manner best suited to the individual coals so that the best results under the conditions would be obtained, the tests do not in any sense indicate the efficiencies which might be realized if the various fuels were burned in boiler settings modified to suit the individual fuel.

Mechanical stokers were not employed since a particular stoker suitable for one fuel might prove more or less unsuitable for another and consequently the results prove of less value for comparison than when using the method of hand-firing. One hundred and ten trials were carried out on 60 different fuels; 69 of these were made in the laboratories of the department of mechanical engineering, McGill University and 41 at the Fuel Testing Station, Ottawa. Plates No. B-3 to B-6 show the efficiencies, and general results obtained under the conditions cited and are included here solely to show the comparative value of the different fuels for the generation of steam.

The results of the tests indicate that practically all the solid fuels mined or manufactured, as in the case of peat fuel, in Canada, offer no difficulties when burned under a boiler of standard design and when fired in the ordinary manner and that when burned under conditions specially suited to the peculiarities of the fuel, high efficiencies can be realized. High sulphur, and high ash coals with an ash having a low temperature of fusibility, will of course prove troublesome but even such coals can be burned with high efficiencies and without giving any serious trouble when burned in boiler settings especially designed to meet the conditions created by the characteristics of the coal. The low grade lignitic coals are not generally suitable for burning on any of the standard stokers, although claims are made to the contrary, and while such coals have been and are now being used to generate steam on a comparatively large scale, it has been found in certain instances that a more expensive coal in the last analysis is the cheapest. This applies to the burning of low grade lignites in boiler settings designed for hand firing and mechanical stokers but does not apply to these fuels when burned in the pulverized form. The difficulty in burning low grade lignites in the ordinary manner is not due to the low heating value, but to the disintegration of the fuel into small particles when exposed to weather or to heat. This undesirable characteristic is more evident when attempts are made to increase the boiler rating.

The higher grade lignites are being burned with satisfaction in several of the large western steam power plants and there appears to be no difficulty in operating boilers at 175 to 200 per cent rating.

Lignite coals, unfortunately, cannot be burned on the railways traversing the western provinces owing to the fire hazard produced by the emission of flaming or hot cinders.

Gas Producer Trials

A large number of samples of bituminous, semi-bituminous and lignitic coals and peat were tested in gas producers of different types. The most successful tests were those carried out with peat in a gas-producer constructed by the Korting Brothers of Hanover, Germany. This producer was similar to several in successful operation in Germany, Sweden and elsewhere and was erected complete with gas engine in the Fuel Testing Laboratories, Ottawa. The plant was of 60 b.h.p., and it was assumed would offer no difficulties to the gasification of Canadian peat. Exhaustive tests, however, showed that the producer could not deliver a gas sufficiently clean for burning in a gas engine and that the trouble could not be eliminated by re-designing the gas purifying system. The producer was re-designed and re-built by the Korting firm and re-erected in Ottawa. Subsequent and exhaustive trials of long duration, involving the burning of about 250 tons of peat fuel, completely demonstrated that Canadian peat with a moisture content of not over 35 per cent, could be efficiently and successfully gasified in this type of producer. Such a type of producer is limited to small powers, since any large power installation would comprise gas producers of the by-product-recovery type designed to recover the maximum of the nitrogen content of the peat. Peat fuel is one of the easiest and most satisfactory fuels to gasify in a gas producer and should meet with favour in localities contiguous to peat manufacturing plants where a load up to 1,000 b.h.p., can be disposed of.

The results of the trials conducted with coals were not entirely satisfactory. Certain of the lignite coals tested, proved entirely satisfactory as fuels for gasification but other lignites could not be successfully gasified in the type of producer employed. The bituminous and semi-bituminous coals proved even more troublesome. However, with a producer adapted for burning those fuels no trouble

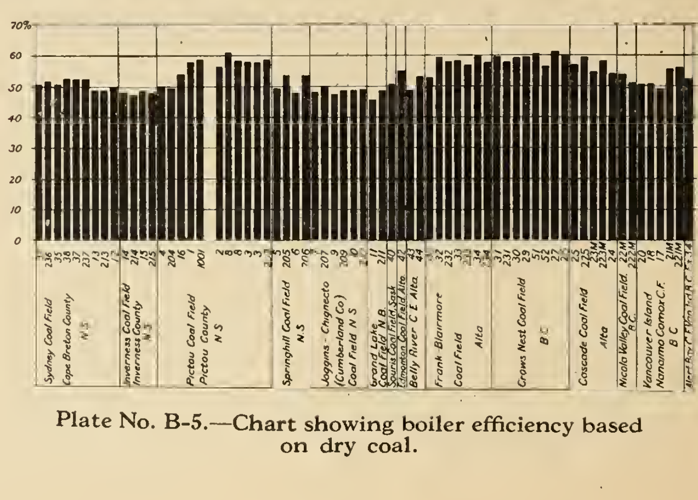


Plate No. B-5.—Chart showing boiler efficiency based on dry coal.

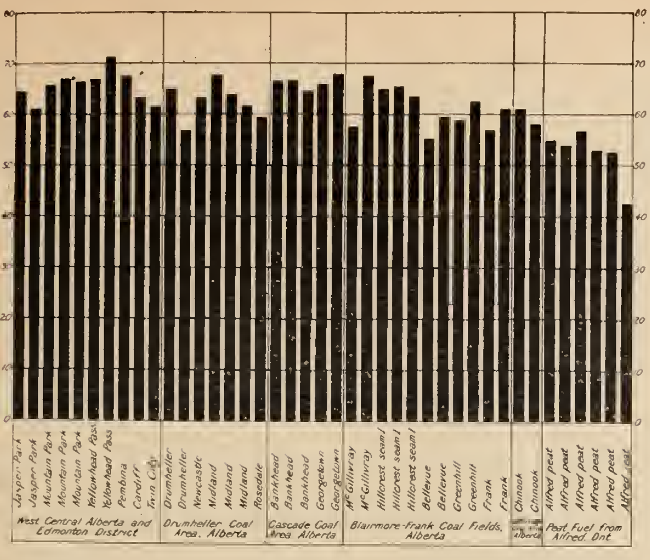


Plate No. B-6.—Chart showing boiler efficiency based on combustible.

of any moment should be experienced. The results of the producer trials are not included inasmuch as they would prove of no service in estimating the value of Canadian fuels, with the exception of peat, for the production of a power and industrial gas through the medium of a gas producer.

Marked improvements have been made in the treatment of and especially in the manner of burning low grade fuels for steam raising and results which can now be realized with such fuels would render the tests described above of little value for more than comparative purposes, even if the individual coals had been burned according to the best practice in common use when the tests were made and the methods best adapted to the individual fuels.

Retort Gas Manufactured

Town gas is manufactured in practically all cities and large towns in Canada and according to different methods, depending on requirements and character of the load. Straight retort gas is made in certain localities, a combination of this and carburreted "blue or water gas" in others while the preponderant gas in some instances is carburreted "blue gas". Coke oven gas, up to the present, time has not been used for domestic purposes. The gas manufactured in retorts or by other processes, is used almost exclusively for domestic purposes, i.e., cooking and to a limited extent for heating dwellings, a very small proportion being used for illuminating. Hence the practice has been to increase at the expense of the illuminating powers of the gas the quantity and total heating effect. Town gas is also used, to some extent, for industrial purposes, but the quantity so used is not known and that used for power purposes is negligible.

About 650,000 tons of gas coal is annually required in the town gas plants of Canada, the larger portion of this, by far, being consumed in Montreal and Toronto, and all or practically all of this coal is imported from the United States. The reason for this has been ascribed to the unsuitability of Nova Scotia coals for such purposes and the high cost of that coal due to transportation charges from mines to point of consumption so far as the east is concerned. Western Canada has been in the habit of imported coals not only for gas-making but for other purposes, irrespective of the value or suitability of local fuels.

This unfavourable situation is rapidly changing and it is not improbable that the demand created for a good gas coal for the manufacture of a domestic gas, will serve to locate a source of such a coal from out of the enormous fuel resources of western Canada or demonstrate satisfactorily to present consumers of such coals that suitable gas coals are already mined and can be produced in sufficient quantities to meet present needs.

Steam Boiler and Steam Power Installations

The total nominal horse power installed in Canada in stationary plants for steam raising and the production of power is very considerable when considered in relation to the hydro-electric energy developed in the entire country. The boilers installed for stationary purposes are estimated to have a nominal value of 1,300,000 h.p., based on the conventional boiler rating of 10 square feet of heating surface per nominal horse power per hour. The actual boiler horse power developed depends, of course, on the rating at which the boiler installations are operated which rating varies up to 300 per cent.

The total boiler horse power on railway locomotives in Canada is about 4,500,000 of which a little more than one half is in service. This estimate however, is based on the actual horse power the locomotives are capable of

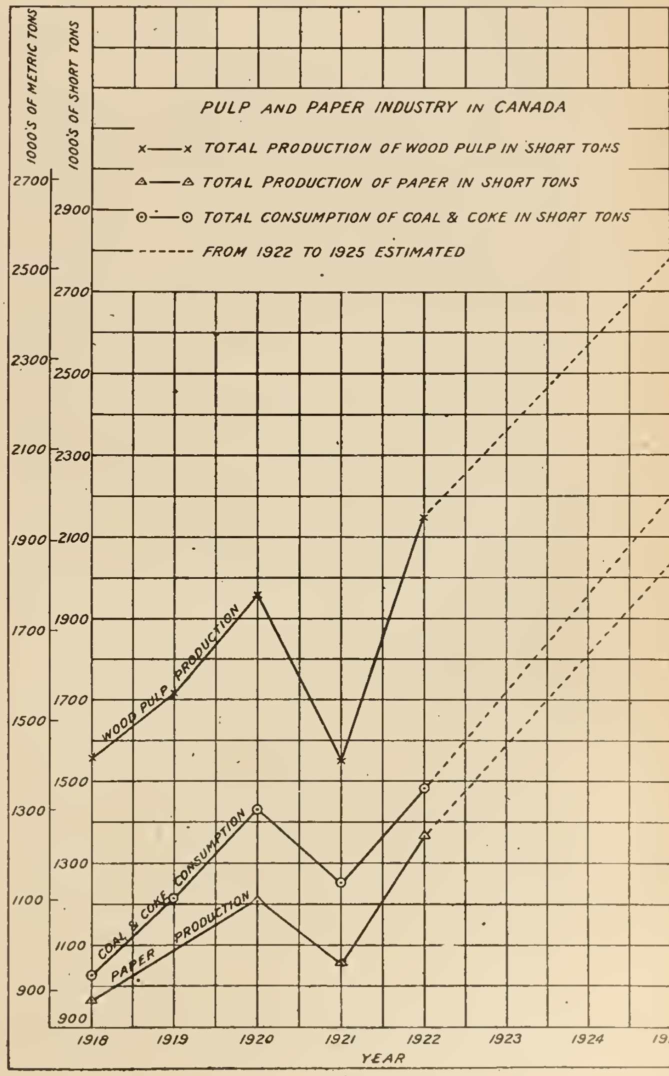


Plate No. B-7.—Chart showing pulp and paper produced and coal and coke consumed in pulp and paper industry in Canada.

developing and must not therefore be confused with nominal horse power rating.

The stationary boiler installations include these primarily intended for the production of power in conjunction with some type of prime mover, for processing in chemical and industrial plants and for general purposes, but do not include boilers installed for the heating of buildings and dwellings. Some of the boiler installations are used also for the two fold purpose of generating power and processing or heating, but unfortunately the distribution of such plants, their available horse power, the actual steam used for power purposes, and that for processing and heating, are not known.

The total estimated horse power in stationary installations includes boilers of all types of settings and designs from the ordinary return tubular boiler of the locomotive type with inexpensive settings to the water tube boilers and settings representing the most modern practice. The number of plants equipped with mechanical stokers and of those hand fired are not known but the type and number of steam boiler installations which are equipped to burn fuel in the powdered form are accurately known, and the most interesting of these will be cited later.

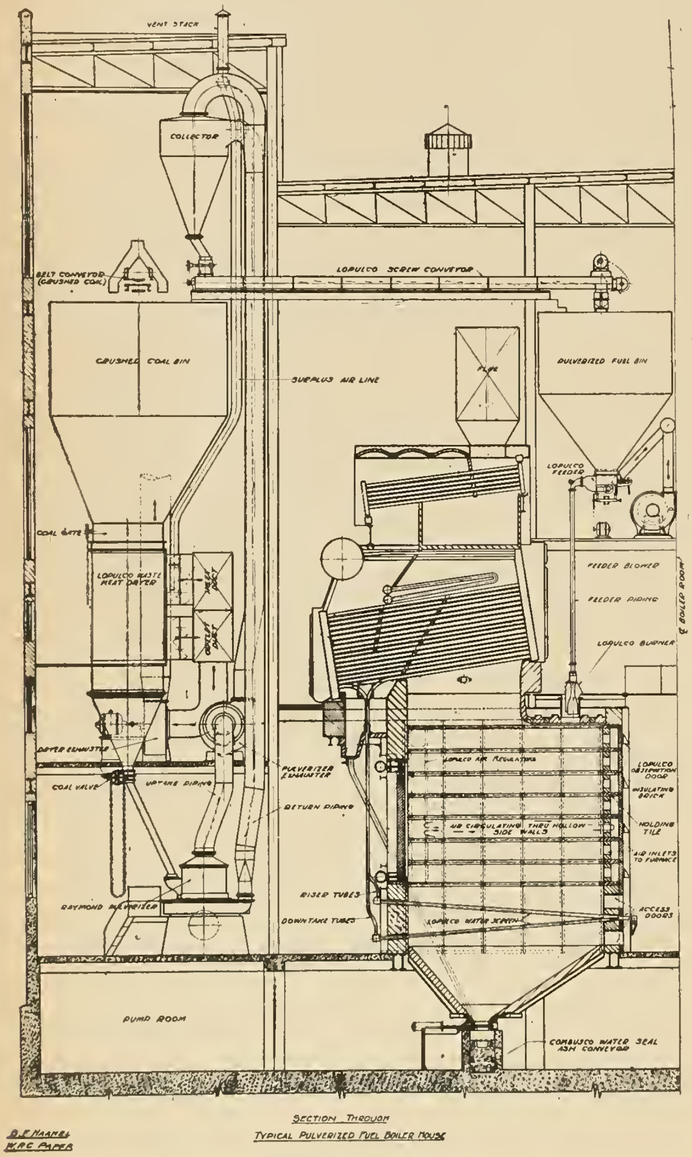


Plate No. B-8.—Section through typical pulverized fuel boiler house.

The following estimate of boiler horse power installed in some of the leading industries is based partly on statistics concerning boiler installations and partly on the coal consumed in raising steam for specific purposes for which information is available.

Boiler horse power in use in Canadian Industries

1 — Steam-electric stations	96,500 h.p.
2 — Industrial steam power plants	662,000 "
3 — Pulp and paper industry	150,000 "
4 — Collieries	81,500 "
5 — Metallurgical industries, steel, copper, nickle, coke plants, etc.	80,000 "
6 — Railway locomotives based on engine power	4,500,000 "
	5,570,000 h.p.

The railways are by far the largest individual users of coal and are heavy importers of steam coals from the United States in addition to crude or fuel oil which is used on the mountainous sections of the Canadian transcontinental railways.

Certain of the steam-electric stations have been superceded by hydro-electric energy, the steam plants in such cases serving as stand-bys. Notwithstanding the energetic development of water powers in all provinces possessing such source of energy, steam-electric plants are increasing in numbers and some are increasing their capacity.

The installations enumerated, burn all grades of coal from low grade Saskatchewan lignites, high grade Alberta lignite slack to western and eastern bituminous coals, coke breeze and wood. The method of firing varies from hand firing to mechanical stokers, the latter in many cases being selected with regard to the coal to be burned. Some of the more modern boiler installations burn the fuel in the powdered state.

Pulp and Paper Industry

Special attention is given to the boiler installations in this industry on account of the fact that it is rapidly becoming the largest individual user of steam for heating, digesters, and drying and moreover, as a rule, generates steam with economy as regards fuel. Reference to plate No. B-7 will show the increase in the growth of this industry in the past and succeeding years. While at the present time the annual consumption of coal for steam raising in the paper industry, is approximately one million short tons, a few years time will probably witness a coal consumption of double this amount.

The heavy demand for steam will be appreciated when it is realized that for every ton of newsprint manufactured, from 1,000 to 1,500 pounds of coal and from 10,000 to 13,000 pounds of steam are required. The average coal and steam consumption of seven of the leading mills in Canada is 1,400 pounds of coal and 10,700 pounds of steam. Over one million tons of newsprint in addition to a large tonnage of sulphite pulp was manufactured in Canada during 1923.

The writer has been informed that Canadian pulp and paper companies are very much interested in anything that promises to reduce the cost of steam used in the process, since the cost of steam is a most important item in the total cost of making paper. Coal and the steam generated by it represents not less than 10 per cent and frequently as high as 15 per cent of the total cost of making paper, and if the cost of the wood entering in the process were omitted the steam would represent 30 to 40 per cent of the cost of the conversion of the products into paper. Steam constitutes the second

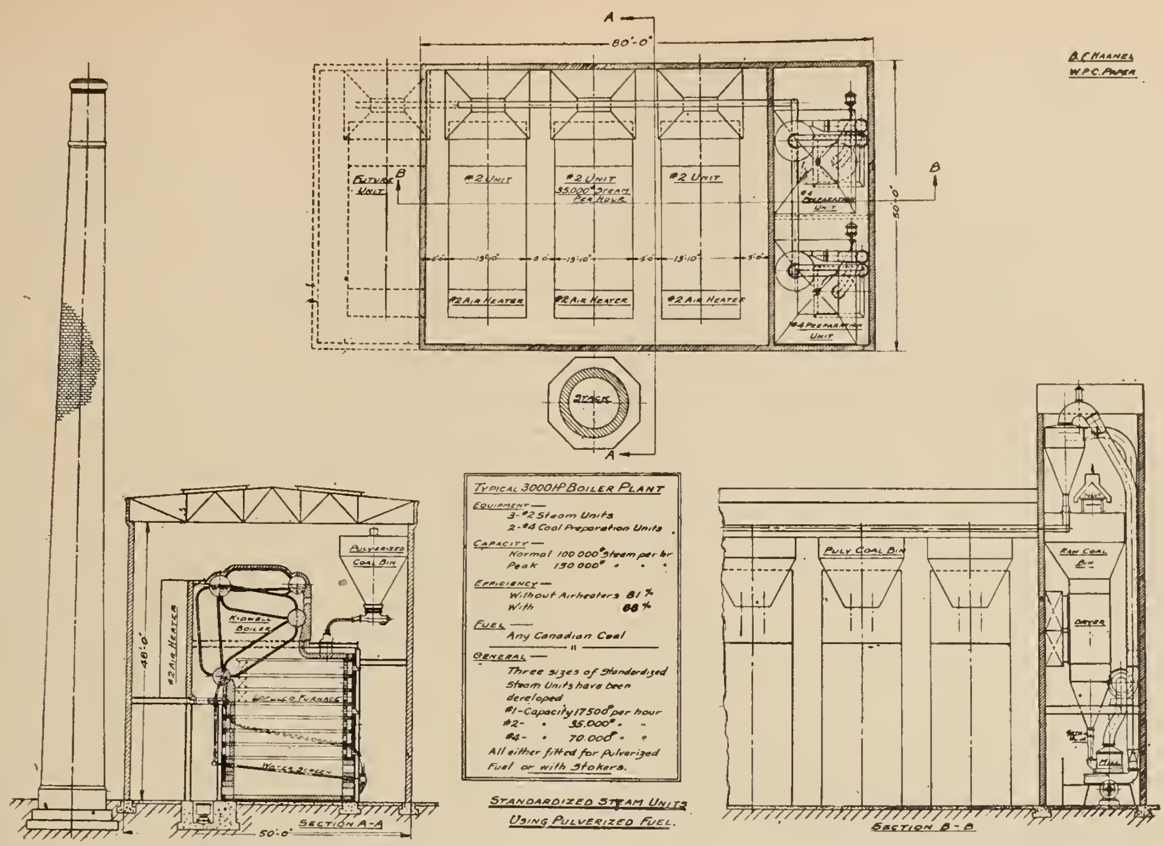


Plate No. B-9.—Standardized boiler plant using pulverized fuel.

highest single item of cost in the industry. As the industry grows, and it is growing rapidly, the necessity for introducing every possible economy will become more apparent and serious attention will be given to the possibilities offered by further economizing in the generation and use of steam. Low grade fuels will be in greater demand and the most efficient methods for burning them and utilizing the heat of combustion will be employed.

The coal used in the pulp and paper industry is practically all burned under boilers for producing process steam, but little if any, in the majority of mills, is converted into electric energy, since the mills are generally located on a waterway contiguous to a water power or are within easy transmission distance of an hydro-electric plant. Many of the larger mills have their own hydro-electric plants, and the development of these on a scale commensurate with the future growth of the industry has resulted, in some cases, in the development of a large excess of power which cannot be economically disposed of for power in the neighbourhood and must therefore be utilized inefficiently or else wasted. This situation has led to the installation, in some mills, of boilers generating steam from electric energy aggregating several thousand horse power. The utilization of electric energy for heating is a degradation of energy and is opposed to all principles of efficiency, as the following calculation will show:—

1 e.h.p.hour = 746 watts = 2,544 B.t.u.

Evaporative power of 2,544 B.t.u. = 2.6 lbs. of water from and at 212°F. at 100 per cent efficiency.

Evaporative power of 1 lb. of coal of 12,500 B.t.u. per lb. = $\frac{12,500 \times 0.7}{970}$ = 9 lbs. of water from and at 212°F.

Thus one pound of coal will evaporate $\frac{9}{2.6}$ = 3.44 times as much water, assuming a boiler efficiency of only 70 per cent, as one e.h.p.hour while one pound of coal is capable of producing only one e.h.p. when the coal is converted into a gas and then burned in an internal combustion motor of higher over all efficiency than a steam power plant. In other words, 1 e.h.p.hour or 2,544 B.t.u. = 12,500 B.t.u. as electrical energy, while 12,500 B.t.u. as coal = 3.44 e.h.p.hours for raising steam.

Generally speaking, electrically generated steam can never play an important part in supplying the steam requirements of any of the Canadian industries, for the reason that electric energy must be available at not more than 10 dollars per k.w. year in order to equal coal at 6 dollars per ton. Ten dollars is below the profitable selling cost of power and it will only be disposed of at this price when there is no other demand for the surplus power. But as soon as a market is created the price of electrical energy will rapidly mount and electric generated steam will then have to make way for coal generated steam.

Powdered Fuel for Steam Raising

The burning of a solid fuel in the powdered form for the generation of steam for power and other purposes is making rapid advances in the United States and is gaining a strong foothhold in Canada, where several steam plants equipped for burning powdered coal are in operation and others are in course of erection.

The burning of powdered fuel for steam raising on a large scale is of comparatively recent origin, its development period covering the past decade, and it is only very recently that the method has been sufficiently perfected to permit it to take its place along with the older well tried and long established mechanical stoker. (See plate No. B-8). But while all the high grade coals can be efficiently burned in powdered form and also in the solid state on mechanical stokers specially adapted to the grade of coal to be burned, it is in connection with low grade fuels,

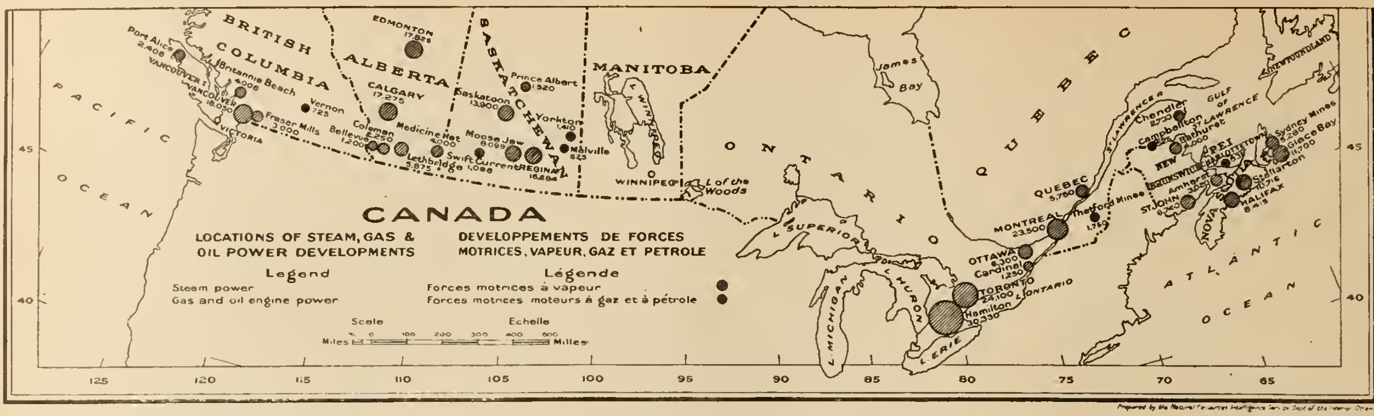


Plate No. B-10.—Chart showing location of steam gas and oil developments in Canada.

mine dumps, coals high in ash and sulphur, lignite coals of all grades and peat, that the pulverized coal system may be considered of special interest. The rapid increase in the use of electric power not only for industrial but also for domestic purposes; the advancing price of coal at the mine and the heavy transportation costs when long distances are involved, makes it imperative that the most efficient methods be introduced in producing either steam or power from coal.

The necessity for taking the fullest advantage of low grade fuels is more manifest in Canada than in the United States, although even that country is very much alive to the economies resulting from the use of low grade coals, since cost of mining coal is also advancing, and transportation costs are not dissimilar to those in Canada. As a matter of fact the first successful system for burning coal in the powdered form in stationary boiler installations of large capacities might be said to have had its development in that country. Fuel in the powdered form, has of course, been used in other countries, notably Sweden, where the system for burning peat powder on the Swedish State Railways, was successfully developed and is, according to the writer's information in successful operation to-day. Powdered fuel has also been used in cement works and in metallurgical works prior to its introduction for steam generation, but the writer believes that credit for the pioneer work done in developing systems for burning all kinds of coals in the powdered state in large central stations is due the United States.

The chief advantages of powdered fuel steam generation are:—

1. — High boiler efficiencies.
2. — Efficient utilization of low grade fuels.
3. — Efficient use of coals high in ash and sulphur.
4. — No difficulties in using fuels with low temperature fusing ash.
5. — Flexibility and ease of control.
6. — No stand-by fuel losses.

This system is especially adaptable to lignite coals which slack on exposure to the weather and in general to all coals which exhibit a tendency to slack as the fuel must be first reduced to 200 mesh before it is in a condition for burning in the powdered form. Fuels unsuitable for efficiently burning under boilers in the ordinary manner, can be utilized with the maximum efficiency in the powdered form. The field for powdered fuel is not, however, confined to stationary steam plants. The opportunity for its successful introduction as a fuel on railway locomotives, in those sections of the country where lignite is the only fuel and which for reasons cited above cannot be burned in the ordinary manner, is very considerable. The use of powdered lignites would not only eliminate the fire hazard but would permit the full locomotive power to be developed, which is not feasible when lignite coals are burned on grates. It is the opinion of those who have investigated the lignites of Saskatchewan and southern Manitoba with a view to ascertaining their adaptability for burning in the powdered state, that the high moisture content of the freshly mined lignite, viz: 30 to 35 per cent, will not have to be reduced to the degree necessary in other coals. Artificial drying, it may be found, can be dispensed with and air-drying resorted to for reducing the moisture by the necessary amount. Lignites pulverize readily and this operation is therefore less expensive than in the case of true coals.

In order to meet the demand which exists in the Canadian pulp and paper industry for boiler plants to produce steam at the lowest cost, a Canadian consulting engineer has developed a standardized boiler plant for burning pulverized fuel which may be had complete in multiples of 1,000 horse power up to a total capacity of 10,000 horse power or 330,000 pounds of steam per hour. In each of these plants the coal preparation section has been designed to give the maximum of capacity and flexibility in the minimum space. Plate No. B-9 shows a plan and sectional view through a standard plant consisting of four 1,000 h.p., units on continuous rating and capable of developing a total of 6,000 h.p., or 198,000 pounds of steam over 8-hour peak periods. Such a plant complete with all equipment building and foundations will cost approximately 300,000 dollars ready to operate and will develop its maximum efficiency when producing 150,000 pounds of steam per hour. It will use a low grade of Canadian coal and the wet wood refuse from the barking process in the pulp mill may be burnt simultaneously in the same furnaces.

Central Electric Stations

Steam Electric Stations

The number, location and types of central steam electric stations have been fairly completely recorded by the Dominion Water Power Branch, Department of the Interior, Ottawa, and plate No. B-10 prepared from information obtained from that source and through the courtesy of engineering companies, shows the disposition of such plants from Halifax on the Atlantic to Vancouver on the Pacific coast.

Nominal boiler horse power installed in central steam-electric stations is estimated to be 158,507, of which 345 boilers totalling 42,871 h.p., are of the horizontal return tubular type and 295 totalling 115,636 h.p., are of the water tube type. The engine and turbine horse power installed is 325,825 of the following types:—

Table No. 9, — Steam Engines and Steam Turbines Installed

Type	Number	Horse Power
1 Reciprocating engine	251	69,613
2 Exciter steam engines	15	1,101
3 Steam turbines	82	252,706
4 Exciter steam turbines	20	2,405

One hundred and seventy-two stations have been recorded of which,—

43 are of 1,000 horse power and over,
25 are of 500 horse power to 1,000 horse power, and
104 are up to 500 horse power.

The larger plants are in general well designed and equipped with modern power machinery and boilers.

Producer Gas Power Plants.

The possibilities of high fuel economies from burning low grade fuels and in general fuels unsuitable for steam raising led, some years ago, to the installations of producer gas power plants in several towns and cities in Canada, but these plants, on the whole, failed to give the measure of satisfaction expected. The producers were not adapted in the majority of cases to the fuel it was desired to burn, while in individual cases the plant was entirely incapable of handling the fuel, for which the agents represented it was especially designed. Gas producer plants, as a result of this shortsighted policy earned a bad reputation and this together with the notable improvements made in the method for burning certain coals, heretofore unsuitable for steam raising, led to the abandonment of the most important producer plants and to the installation of steam power.

The most notable, even though on a small scale, of the producer gas power plants installed in Canada were those of Kitchener, Ontario, and Edmonton, Alberta. The former, the writer was informed, gave entire satisfaction up to the time hydro-electric energy became available. This plant was then abandoned. At Edmonton prior to the war a combination steam and producer gas power plant was installed for the municipality. The producer was installed to burn the lower grade lignites obtained within the vicinity of that city, and though not entirely

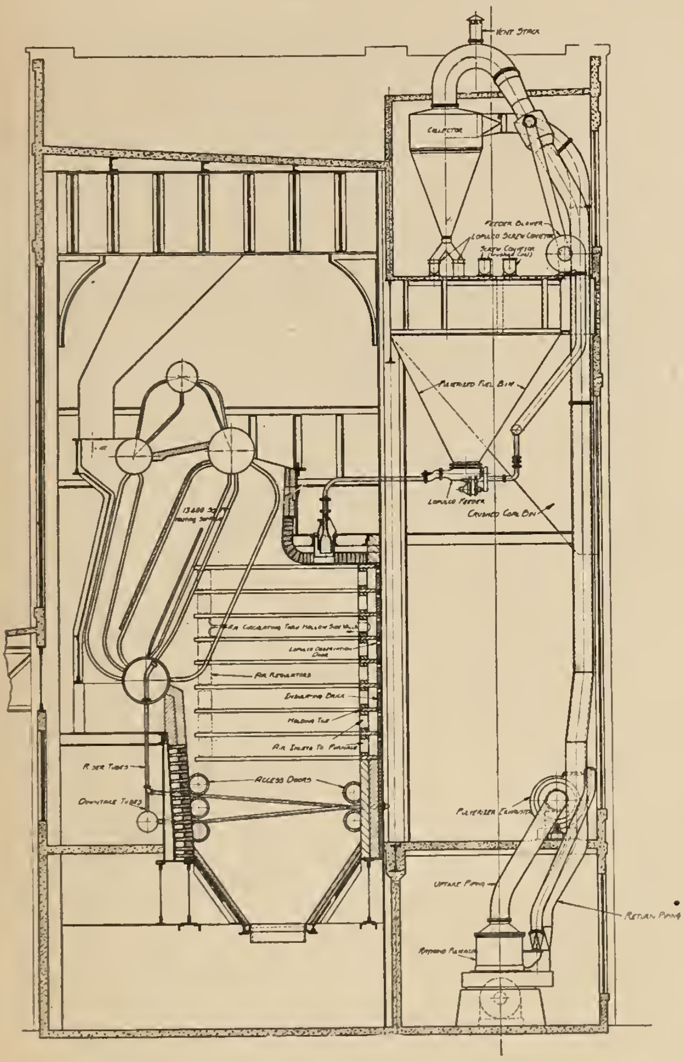


Plate No. B-11.—Section through boiler room, Ford Motor Co., Walkerville, Ontario.

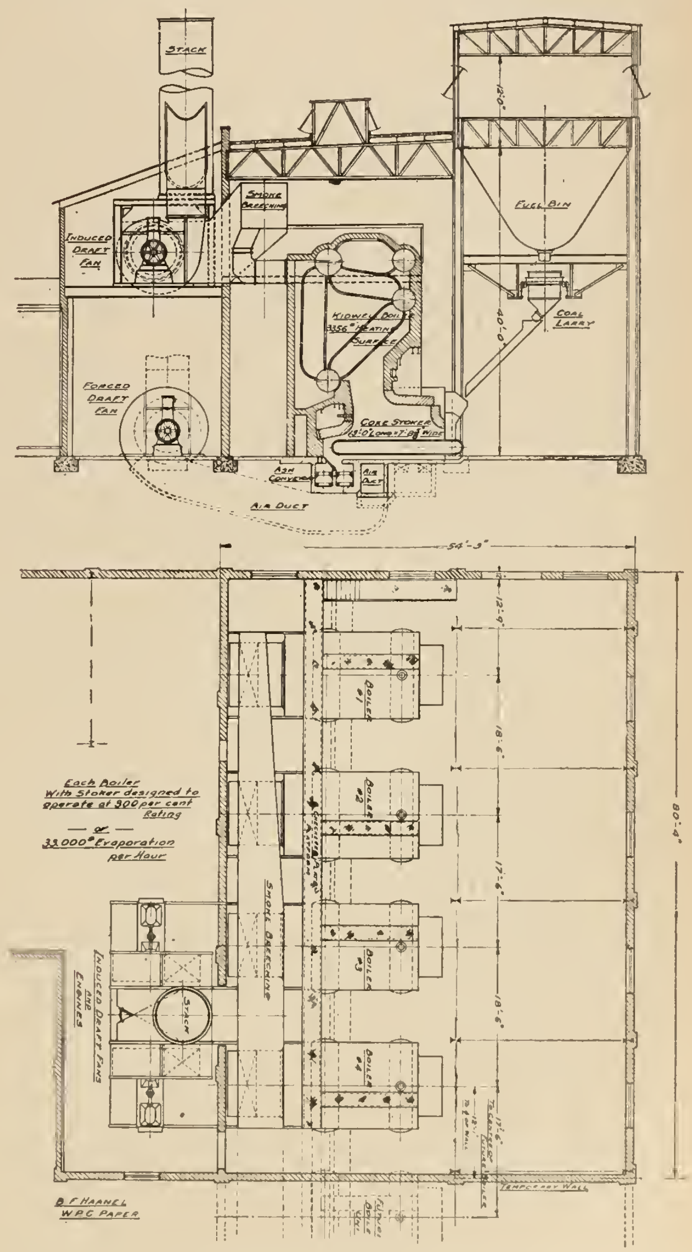


Plate No. B-12.—Boiler plant for Imperial Oil Company Limited, Calgary, Alberta Refinery.

adapted to the burning of these grades of fuel, the plant gave fair satisfaction. The principal difficulties encountered, however, were not due to either gas producer or gas engine design but to improper installation. The gas engines, for example, were placed on poor foundations which gave rise to breakages and consequent high cost of repairs. When the enlargement of this plant was under consideration, the then superintendent had under consideration the installation of additional gas producer and gas engine units. The plant, however, was eventually converted wholly into steam power.

Other producer gas power plants of lesser importance, were those installed at Swift Current and Melville, Saskatchewan; Winnipeg, Manitoba; Campbellton, New Brunswick; and Charlottetown, Prince Edward Island. The plants at Swift Current and Melville according to information, are still in operation. The former consists of two gas producer units with a combined capacity of 483 b.h.p., and the latter has three producer gas units totalling 525 b.h.p.

Oil Engines

Oil engines of all types and of powers ranging up to 500 b.h.p., are used for the production of small powers in isolated localities and in industrial plants when power is required intermittently. Oil engines of the full and half Diesel type are employed for the larger powers. The Moose Jaw electric railway when first constructed was operated by electric energy generated by two Diesel units. Fuel oil was burned and the advancing price of this prompted the abandonment of the plant and the purchase of power from the Moose Jaw steam electric station, a modern plant in which high grade coals as well as lignites are burned efficiently on mechanical stokers.

Information is available for only those producer gas and oil engine power plants which are used for generating electric energy for municipal purposes. The number of small oil engine installations must be considerable and the aggregate horse power possible of development sufficiently large to permit this type of power plant to compare quite favourably with the smaller steam power installations.

Industrial Power Plants

The aggregate horse power capable of being developed in industrial plants is very large, comparatively speaking, but as in the case of internal combustion engine and gas producer installations, detailed information is available for only the larger and more important. The principal industrial plants and those central steam-electric stations which are of special interest will be described. Cross-sections of the boiler installations of the Imperial Oil Company, Calgary and the Ford Motor Works at Walkerville, Ontario, are included since it is believed that these will be of particular interest to those interested in the development of recent Canadian boiler plant practice.

The Winnipeg Municipal Hydro-Electric System, has designed and is now constructing a steam stand-by and central heating station at Winnipeg. The initial installation will consist of three 1,140 Erie City vertical water tube boilers set singly, which will be equipped with Lopulco pulverized fuel system for burning Souris lignites. These lignites are situated in southern Manitoba and are low grade. Their heating value as mined is about 7,480 b.t.u., per pound, and air dried to 18 per cent moisture 8,770 b.t.u. per pound. They wil probably be fired with the latter moisture content. One stack 175 feet high supplemented with induced draft will serve the three boilers, which are designed to operate at a pressure of 240 pounds per square inch and at a rating of 200 per cent continuously. The total power developed will, therefore, be over 10,000. In designing the plant provisions were made to double the capacity. Steam will be supplied to two 5,000-k.w., and one 1,000-k.w., turbo generators manufactured by the James Howden Company, Scotland. It is expected that this plant will be in operation by September 1st, 1924 and it is believed that steam will be produced at a lower cost per 1,000 pounds than at any plant in Canada.

Ford Motors Limited, Walkerville, Ontario. The Ford Motor Company has completed at Walkerville, Ontario, a new steam plant consisting of three 1,350 MacAleenen water tube boilers, set singly, and each equipped with Lopulco pulverized fuel system. (See plate No. B-11). The fuel used at this plant will be the pulverized low temperature coke obtained from the Piron by-product low temperature ovens that are being constructed by the company installing the boiler plant. The powdered fuel furnaces are equipped also to burn gas and tar when either of these products are available from the by-product coke ovens. This steam plant will represent the highest refinement of finish in any steam plant in Canada.

Edmonton Municipal Steam Electric Station. Reference was made to the municipal steam power station at Edmonton. The boiler installation in this station consists of eight 500 and eight 400-h.p., Babcock and Wilcox boilers. This plant has recently been changed over as stated from a gas producer plant and steam power plant to straight steam power. Multiple retort stokers were installed in some of the boilers in 1922. The installation of the travelling grate type as well as a pulverized fuel system is at present under consideration. The electric energy generated is disposed of in Edmonton and the surrounding district.

Pacific Mills Paper Company, Ocean Falls, Vancouver, B. C. The power plant of this company consists of four 504-h.p., Badenhausen, two 286-h.p., Babcock and Wilcox, two 572-h.p., Stirling, six 159-h.p., Casey Hedges, six 162-h.p., Casey Hedges and one 163-h.p., (maker not known). The first eight boilers are all equipped with type "E" underfeed stokers. Fuel oil has been used more or less extensively on the British Columbia coast for steam raising but it has been determined at this plant that fuel oil must be obtainable at less than $1.50 per barrel in order to equal coal at $6.40 per ton. The coal at present burned in this plant is obtained from the mines on Vancouver Island and costs less than the above amount. Oil is therefore not used. This is said to represent the most efficient paper mill boiler installation in Canada.

British Columbia Sugar Refining Company, Vancouver, B.C. The steam boiler installation of this company is of special interest owing to the fact that it was changed from stokers, which were originally installed, to oil burning boilers and in 1919 changed over to burn pulverized coal. The plant consists of four 500-h.p., and two 250-h.p., water tube boilers. It also represents the first large and successful pulverized coal installation made in Canada and has been in continuous operation since 1919, giving entire satisfaction. The coal burned is obtained from the Vancouver Island mines.

Imperial Oil Company, Calgary, Alberta. This plant is of special interest, since it represents a modern boiler installation, erected at an oil refinery, for supplying steam for distillation in which a lignite coal is used in place of oil. In 1923 the Imperial Oil Company constructed a new refinery at Calgary and installed in conjunction with it the most modern stoker fired boiler plant in western Canada. (See plate No. B-12). The boiler plant consists of four 363-h.p., Kidwell water tube boilers, set singly, each equipped with Coxe travelling grate stokers. These burn a very low grade Drumheller slack coal and are of sufficient capacity to operate the boilers at 300 per cent of rating continuously. In other words each boiler is capable of developing 1,000 horse power. In connection with this plant a Combusco ash drag conveyor is used. This is a British invention. The steam produced is used for processing, although a small amount is used for generating electric current.

Granby Consolidated Mining and Smelting Company, Anyox, B. C. The steam power installation of this company is probably one of the most interesting in Canada. It consists of six 500-h.p., water tube boilers fired by oil supplemented by gas from the coke ovens operated by the same company. The plant supplies steam for 6,000-k.w., turbo generators and turbine driven blowers used in connection with the smelting operations. At the Granby by-product coke ovens there are installed four 400-h.p., water tube boilers with Coxe travelling grate stokers and in the side walls of the boiler settings are gas and tar burners and in the rear are oil burners. This plant therefore operates on a combination of gas, tar and coke breeze, but is capable of being operated to full capacity on any one of these fuels or in an emergency on oil.

Spanish River Pulp and Paper Company, Sault Ste. Marie, Ont. This steam boiler installation is merely mentioned on account of the fact that in addition to coal, about 100 cords a day of wood refuse is burned during the summer months. This particular plant consists of water tube boilers capable of developing 7,000 to 8,000 horse power continuously. All the steam is used for processing.

Proposed installations. The Ontario Hydro-Electric Power Commission are considering the erection in 1925 of a steam power plant in Ontario. This will have a capacity of 100,000 horse power divided into three or four steam turbine driven generating units. Steam will be supplied by water tube boilers which may probably be adapted for the burning of pulverized coal. The completion of this plant, it is said, will be the forerunner of several more of equal size. These plants will take care of the load on the Ontario Hydro-Electric Power Commission system which is increasing at the rate of about 100,000 horse power per year. The load on the Ontario Hydro-Electric Power Commission system is increasing at a more rapid rate than they expect to be able to develop hydro-electric energy after the limit of the capacity of their present installations is reached.

Section III

Carbonization of Peat, Oil Shales, and the Lower Grade Coals and the Relation of the Carbonization of Coals to the Production of Power

Canada, as previously stated, is confronted with fuel problems which are peculiar to the sections of the Dominion affected and which bear to one another no similarity. The fuel problem of western Canada, for example, is one which concerns the creation of markets for the large variety of coals which can be produced in almost any amount, but for which at the present time and probably for a long time to come, only a comparatively small and limited market is available. The fuel problem of central Canada, on the other hand, is created by its dependence on foreign fuel supplies for domestic and industrial purposes. This is directly due to the absence of coal measures of any economic importance and to the impracticability of shipping into this part either eastern or western coals. This area comprises the province of Ontario and a portion of Quebec. This is the fuel problem of most serious importance with which Canada has to deal and it is of interest here and is only mentioned because of its relation to and bearing on the development of power for industrial and other purposes.

Carbonization of bituminous coals, the lower grade coals, peat and oil-shales is of special interest in view of the possibilities it offers to a partial solution of the fuel problem just mentioned and as a source of oil which now is practically entirely foreign.

With a view to ascertaining whether or not the lower grade and certain of the high grade coals are of any economic importance as a source of oil, the Mines Branch of the Federal Department of Mines, conducted a large amount of research work relating to the carbonization at varying temperatures and pressures and in different atmospheres, of lignites, peat, high volatile bituminous coals and oil shales. The results of this work indicated that the lignite coals are of no value for carbonizing when the main objective is the recovery of oils suitable for the preparation, by distillation, of motor spirits, lubricating and other oils. Peat and oil shales, however, may at some time prove of value as a source of oils and other by-products when carbonized under the proper condition. Inasmuch as a statement of the value of Canadian fuels for carbonizing with a view to the recovery of by-products may prove of interest, the different fuels investigated will be dealt with in some detail.

Research Work on Carbonization of Canadian Fuels

Peat

Small scale laboratory experiments have been conducted with a view to determining the yield and calorific value of the residue and quantity of by-products when peat is carbonized at different temperatures. The maximum calorific value for the char was attained when the carbonization was carried out at a temperature of approximately 600°C. At this temperature the calorific value was increased 75 per cent over that of the raw peat with a moisture content of 25 per cent. However, almost half of this increase in calorific value may be obtained by reducing the peat to bone dryness.

Larger scale experimental runs were made on air-dried machine-peat blocks in a retort at which the temperature was maintained at about 300°C, the exothermic point of wood. These experimental runs were followed by tests on a commercial scale in which the same quality of peat was carbonized in hardwood distillation ovens for the purpose of comparing the yields and value of the charcoal and liquid products with those realized when hardwood is distilled according to the same method. (See tables Nos. 10 and 11). The yield of peat charcoal was over 750 pounds per ton of 2,000 pounds. The yield of acetate of lime and methyl alcohol was however disappointing. The yield of the former was practically nil, while that of the latter was only one quarter of that obtained from wood. The weight of peat charcoal per bushel was 35 pounds as compared with 21 pounds for hardwood charcoal. This is important, since this product is sold for special fuel purposes by bulk, generally in paper bags. The value therefore of the charcoal per ton of peat carbonized will be less than that of wood charcoal produced from an equal weight of hardwood.

At the present time when hardwood for distillation purposes can be readily obtained, peat cannot be considered as a feasible substitute. In the future, however, when air-dried machine-peat is manufactured on a large scale, and there is every prospect that it will be, and hardwood becomes too scarce to be employed in the hardwood distillation industry, peat may then serve as a substitute.

Table No. 10, — Comparison of Commercial Products from Peat by Low and High Temperature Carbonization

Products (per 2,000 lbs. of air-dried-peat)	Low temperature carbonization in in wood ovens (Canada)	High temperature carbonization in gas retorts (England)
Peat, Charcoal or Coke		
Per cent of air-dried peat charged	37 2	25 1
Pounds per ton	745	503
Per cent ash (dry basis)	12 7	9 9
Per cent volatile matter (dry basis)	28 7	3 9
Calorific value B.t.u., per lb.	11,940	12,650
Peat Tar Oils		
Total produced, (imp. gallons)	14 1	14 2
Specific gravity at 60°F.	0.968	0.992
Fraction to 170°C. (per cent weight)	6.7	2.5
Fraction 170° to 230°C. (per cent weight)	30.9	13.9
Fraction 230° to 270°C. (per cent weight)	12.4	15.4
Fraction 270° to 335°C. (per cent weight)	24 0	34.7
Pitch and loss (by difference)	26 0	33.5
Aqueous Liquor products		
Total liquor (imp. gallons)	86	87
Ammonium sulphate (lbs.)	15.1	22.6
Crude alcohol	1.08	0.34
Gas (cu.ft. per ton)	less than 4,000	about 12,000
Crude motor spirits (imp. gallons)	2.10	0.75

Table No. 11, — Carbonization of Peat according to Hardwood distillation Practice

(*See Carbonization of Peat in Commercial Hardwood Distillation Ovens — by Gilmore and Kohl, Mines Branch Investigations for 1922*)

Air-dried Peat from Alfred, Ontario

Proximate analyses	Air Dried Peat	Dry Basis	Carbonized with temperature controlled at 300°C.	
			Laboratory Scale	Plant scale in Hardwood Ovens
Moisture, per cent	25.6	—	—	—
Ash, per cent	4.6	6.2	13.1	12.7
Volatile matter, per cent	48.5	65.3	24.7	28.7
F.C. (by difference), per cent	21.3	28.5	62.2	58.6
Calorific value B.t.u. per lb.	7,040	9,470	12,290	11,940

Comparison of Commercial Products from Peat and Hardwood

Commercial products per 2,000 lbs. carbonized	Air Dry Basis (25% moisture)	
	Peat	Hardwood
Charcoal, (lbs.)	756	540
Oven liquor, (imperial gallons)	86	100
Gas, (c.f. as measured)	3,700	—
Tar oils, (imperial gallons)	14 1	8 5
80% acetate of lime, (lbs.)	8.3	105
95% methyl hydrate, (imperial gallons)	1.08	4 25
Average B.t.u. per cu.ft. of gas	310	250

Oil Shale and Bituminous Sands

The oil shales of New Brunswick and Nova Scotia and the bituminous sands deposits on the Athabasca river in Alberta must be regarded only as future potential sources of oil, since it does not appear that the yield and quality of the valuable light oil products which can be obtained from these raw materials, together with the cost of recovering and refining same, will permit of their economic utilization while a relatively inexpensive crude petroleum oil can be obtained in large quantities from California, Mexico, Wyoming and Texas in the United States and from other portions of the world.

The bitumen content of the Alberta bituminous sands is of asphaltic base and resembles Trinidad asphalt. The valuable light oil products are not available until the bitumen is given a heat treatment and the yield of these depends on the extent to which the heavier oils have been subjected to a cracking process with or without pressure, hydrogenation, etc.

Development of a process for utilizing these bituminous sands is still in the experimental stage, but in the destructive distillation of bituminous sands containing 15 per cent to 17 per cent bitumen, not more than half of the total bitumen content is recovered in the form of light oils. The remainder is either uncondensed gas or a pitch which remains in the sand residue.

When the bitumen content is separated from the sands through the medium of hot water and agitation with or without chemical reagents, yields approaching the theoretical are attained. The bitumen recovered in this manner may be used for road asphalting or water proofing purposes. Heat treatment may, however, be necessary in order to adjust to definite melting point and penetration specifications, etc.

The oil shales of New Brunswick and Nova Scotia are similar to those of Scotland in that the crude shale oil obtained by heat treatment is of paraffin base in each case. The New Brunswick and Nova Scotia oil shales as regards their oil content vary considerably. The oil content of a few samples yielded as high as 40 to 50 imperial gallons per ton of 2,000 pounds, but, so far as is known at the present time, there is no appreciable quantity of oil shales that have an oil content averaging over 30 imperial gallons per ton of 2,000 pounds, and it is doubtful if this yield could be maintained in commercial operation. The crude shale oil recovered by destructive distillation with the employment of steam will contain as high as 30 per cent of water held in the oil in the form of an emulsion. For this reason it is necessary in interpreting results of different investigators to ascertain whether the results pertain to crude wet oil or dry oil and whether the yield in gallons per ton refers to imperial gallons per long ton, imperial gallons per short ton or United States gallons per short ton.

Lignite

A large amount of research work has been conducted by the staff of the Fuel Testing Division of the Department of Mines on the low grade (brown) lignites of Saskatchewan. The results of this work indicated that carbonized lignite residue or char attains its maximum calorific value when the temperature at which carbonization is conducted is from 550 to 600 degrees centigrade. The yield of carbonized residue at this temperature averages about 43 per cent of the total quantity of 33 per cent moisture lignite carbonized, and the increase in the calorific value of the char over that of the raw lignite is in the vicinity of 70 per cent. Above these temperatures both the yield and calorific value of the residue decreases as the ash of the char and yield and heating value of the gas increases. The content of volatile matter of the char produced at 600°C is about 10 per cent and the ash content about 12 per cent.

During the laboratory experiments the temperature was fairly uniform throughout the charge. It was more difficult to maintain a uniform temperature in the larger scale tests. In this connection it is interesting to note that the content of volatile matter of the individual particles of lignite char is liable to vary over a considerable range and that this has a bearing on the briquetting properties of the char. Lignite char with a low content of volatile matter was found to possess better briquetting properties than char with a high content of volatile matter. Moreover, lignite char with a uniform content of volatile matter requires less binder and makes a better briquette than when the volatile matter varies over a wide range. In tables 12 and 13 a summary is given of the yields of products and the analyses of both raw material and products obtained. These have either been published or are on record in the fuel testing laboratories of the Mines Branch, Department of Mines.

Carbonization of Saskatchewan Lignites with a view to the commercial briquetting of the carbonized residue

The Lignite Utilization Board, which was appointed in 1918, for the purpose of developing a process for carbonizing and briquetting Saskatchewan lignites, carried out large scale operations on at least two different types of semi-commercial ovens before they selected the type of oven for installation in their large commercial plant at Bienfait, Saskatchewan. A battery of six of this type of oven, was constructed and given a thorough trial, after which it was abandoned owing to unsatisfactory performance. The Hood-Odell retort, designed and operated by the United States Bureau of Mines in conjunction with the University of North Dakota, was finally adopted and erected at Bienfait on account of the successful results obtained with it when carbonizing both North Dakota and Saskatchewan lignites. This retort depends on internal combustion to supply the heat for carbonizing. Plate No. B-13 shows a section of this retort as erected by the Lignite Utilization Board at Bienfait, Saskatchewan.

The carbonizing chamber is a vertical shaft with tapered walls open at the top. Baffles are inserted in the centre as shown for the purpose of imparting a mixing action to the coal in its passage through the retort. The shaft is constructed of fire brick and contains one course of Sil-o'-cel insulating brick. The cooler consists of a metal chamber supplied with baffles as shown in which the hot lignite char is cooled by radiation. Provision is also made for blowing steam or water on the carbonized lignite to assist the cooling action of the cooler.

The carbonized residue is discharged from the cooler by means of a paddle wheel which rotates at a constant speed. The angle of repose of the char is such as to permit a constant amount to be discharged by each pocket of the wheel as it revolves. Carbonization is effected by burning the distilled gases and a portion of the fixed carbon of the fuel and air for combustion is blown in through cast iron air boxes as shown in plate No. B-13. These boxes are provided with slots which insure an even distribution of the air through the length of the retort. Combustion takes place at two zones which are known as the upper and lower "hot zone" and side baffles suspended on the air boxes create a surface of lignite fuel on which air is blown resulting in combustion and distillation. A fresh surface is continually presented by the slowly moving mass of lignite. The excess gas is drawn off through an offtake, in the coal mass immediately above the upper hot zone, which consists of a pipe of suitable dimensions provided with slots. A metal curtain which partially surrounds this pipe provides clearance space for gas removal. Sufficient suction is employed to draw the gas into this opening and by a proper adjustment of air pressure at the offtake all the vapors are removed and no gases escape from the top.

The yield of char obtained in this oven is from 42 to 45 per cent of the raw fuel charged. The ash content of the char by actual test was 15 per cent with an average volatile matter ranging from 15 per cent to 20 per cent,

Table No. 12, — Carbonization of the Lower Grade Coals. Brown Lignites from Saskatchewan. Large scale Laboratory Experiments

Fuel Testing Laboratories Experiments on Shand and other Lignites — See Mines Branch Summary Report for 1918 — pages 87 to 105.

Analyses (Shand coal)	As mined	Dried	Carbonized at 580 to 600°C.	Carbonized at 775 to 800°C.
Proximate Analyses				
Moisture, per cent	35.0	—	—	—
Ash, per cent	8.1	12.5	17.5	20.3
Volatile matter, per cent	25.5	39.2	11.7	2.8
F.C. (by difference), per cent	31.4	48.3	70.8	76.9
Ultimate Analyses				
Carbon, per cent	40.6	62.5	74.0	76.6
Hydrogen, per cent	6.5	3.9	2.4	1.0
Ash, per cent	8.1	12.5	17.5	20.3
Sulphur, Nitrogen, Oxygen, per cent	44.8	21.1	6.1	2.1
Calorific Value				
B.t.u. per lb	6,600	10,240	11,920	11,800
Fuel ratio	1.25	1.25	6.05	27.8
Carbon Hydrogen ratio	6.2	16.1	30.8	77.4
Increase in Calorific Value over that as mined, per cent	—	69	79	77
Commercial Products per 2,000 lbs. of raw coal carbonized				
Carbonized residue or char, (lbs.)	—	—	885	850
Gas, (cu. ft.)	—	—	3,810	5,400
Tar oils, (imperial gallons)	—	—	5.6	2.9
Ammonium sulphate, (lbs.)	—	—	11.8	16.6
B.t.u. per cu.ft. of gas	—	—	405	377

Table No. 13, — Commercial Products from Saskatchewan Lignite

(Internal combustion oven at Bienfait)

Coal from Western Dominion mine used

	Coal as mined	Dry Basis	Average char	Briquettes from char
Proximate Analyses				
Moisture, per cent	33.3	—	—	5.0
Ash, per cent	6.4	9.6	15.3	13.0
Volatile matter, per cent	27.6	41.4	19.9	22.5
Fixed carbon, per cent	32.7	49.0	64.8	64.5
Calorific Value				
B.t.u. per lb.	7,390	11,080	10,910	11,100

Carbonization Products (per 2,000 lbs.)

Carbonized residue or char	850 lbs.
Gas produced cu. ft.	15,000
B.t.u. per cu. ft. of gas	98
Tar oils (approximately)	3 imperial gallons

Comparison of Brown Lignite, Black Lignite and Sub-bituminous coals

Class of Coal	Commercial Products per short ton: Char lbs.	Tar Oils Imperial gallons	Gas Yield cu. ft.
Brown lignite (Estevan)	850	5	3,100
Black lignite (Drumheller)	1,170	6⅛	3,700
Sub-bituminous (Saunders)	1,460	8⅔	3,100

	Moisture as mined	B.t.u. per lb. Raw coal	Char	Per cent increase in heating value
Brown lignites	33%	6,600	11,920	79
Black lignites	17%	9,860	13,310	45
Sub-bituminous	7%	11,760	13,430	14

depending on the kind of lignite used, and the uniformity with which the carbonization was carried out. The calorific value of the char was less than 11,000 B.t.u., per pound. This was increased considerably after the char was briquetted.

Briquetting experiments have recently been made with this char at the North Dakota experimental station and a fair to good lignite briquette was produced by using a mixture of coal tar pitch and flour as binder. About 10 per cent of the former with the addition of 2 per cent flour was required.

The lignites of Alberta vary considerably in quality but are practically all of a higher grade than those of Saskatchewan which are known as brown lignites. In contradistinction to Saskâtchewan lignites they are sometimes termed black lignites and the higher grades of these may be classed as sub-bituminous. These latter coals contain less than 10 per cent moisture when freshly mined, while the black lignites range from 10 per cent to 25 per cent moisture.

The main objective for carbonizing the lower grade coals is to raise their calorific value over and above that of raw coal and to so alter the physical characteristics of the fuel that it will submit to briquetting. The carbonized residue which is in a more or less finely divided state can be pulverized and used for steam raising and for other industrial purposes, but for a household fuel this char requires to be briquetted. The objective as stated of the Lignite Utilization Board was to produce a household fuel. The calorific value of the carbonized residue of the lower grade brown lignites is almost double that of the raw coal when the carbonization is conducted in a closed externally heated retort. In the case, however, of the black lignites the increase in calorific value, as shown in the char, is only about 50 per cent that of the raw coal as mined, and in the case of sub-bituminous coals the increase is less than 15 per cent. Unless the value of the by-products are considerable there does not appear to be as much advantage in carbonizing the sub-bituminous coals as there is for the lower grades of lignites. The yield of char of course is greater for the sub-bituminous but this class of coal, however, as well as the higher grade of lignites find general use in the raw state for both domestic and industrial purposes.

Table No. 13 shows the commercial products obtained from Saskatchewan lignites when carbonized in the Hood-Odell oven at Bienfait, also those obtained by carbonization of the brown lignites, black lignites and sub-bituminous coals on a laboratory scale.

High and Low Temperature Carbonization

The work just discussed relates entirely to low temperature carbonization. This is a more or less recent development which cannot be said to have passed the experimental stage, but much is hoped for it and investigators and inventors are still earnestly engaged in increasing the fund of date regarding this method for heat treating solid fuels or devising processes for putting into effect the knowledge already gained. The principal advantage claimed for low temperature carbonization is an increase, over other methods, of by-products, more especially, tar oils.

A real necessity exists in certain countries for extracting from a fuel all the valuable products which can be economically made available before the fuel is finally used for generating heat. So to-day one witnesses the dismantling of the old bee-hive coke ovens and in its place the erection of a modern by-product recovery coke oven. This aims at the maximum production of coke for metallurgical purposes with the maximum recovery of by-products such as benzole, tar-oils, ammonium sulphate and gas. But the objective which many are striving for,

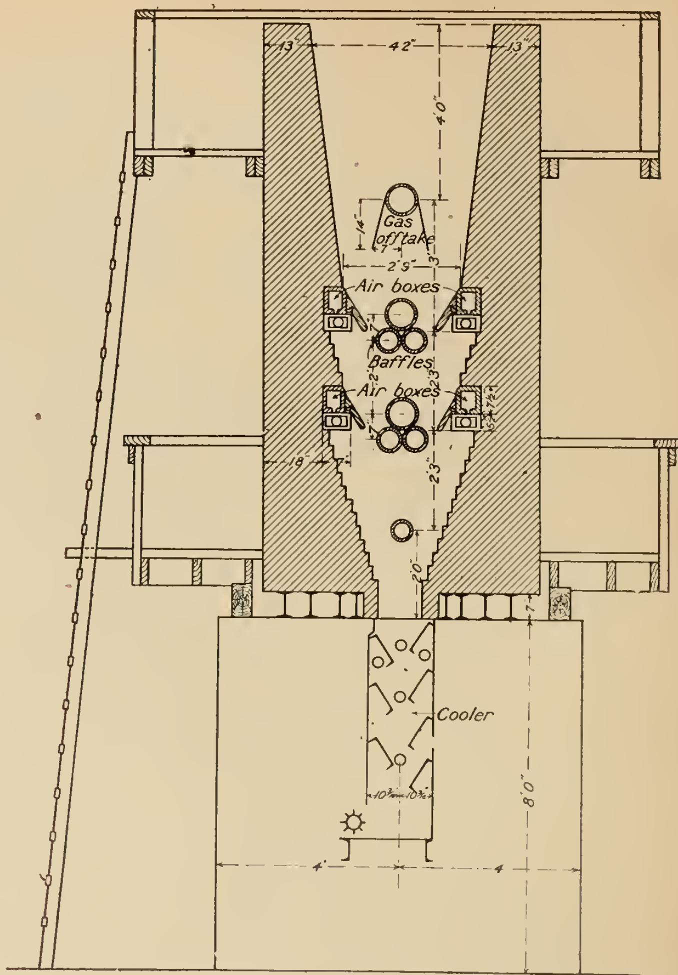


Plate No. B-13.—Lignite carbonizer installed at L.U.B. plant, Bienfait, Saskatchewan.

to-day, is the maximum quantity of tar-oils and gas of relatively high heating value though comparatively low in yield, and a maximum quantity of carbon residue; since there is an ever increasing demand for a liquid fuel for internal combustion motors and a solid fuel for industrial and domestic purposes.

The feeling is growing that the natural supplies of liquid fuel, crude oil, are rapidly approaching exhaustion, whether the ultimate date of such exhaustion be fifteen, twenty-five or even fifty years hence, and this has been largely responsible for the great activity displayed in the field of low temperature carbonization. Heretofore, the most valuable aromatic products of high temperature carbonization have been benzol, anthracene, etc. Low temperature tar-oils on the other hand are not valuable as a source of these aromatic compounds since low temperature carbonization aims at the production of large quantities of motor spirits of the paraffin series, and the dye industry which must have anthracene, etc. will still have to draw its supplies from high temperature tar-oils.

Motor Spirits

A steady and increasing supply of motor spirits is absolutely necessary to prevent an industrial collapse in the more highly industrialized countries of the world. The colossal dimensions to which the motor industry has grown and its multifarious ramifications are not properly understood or appreciated by even the better informed, and an intelligent and complete understanding is essential if the relation between the various industries and society in general are to be kept intact for the longest possible period. Of no less importance is the relation which Natures fuel supplies bear to mankind and his activities.

As the industrial world is at present organized, the motor industry which is one of the largest and actually the most important on account of the firm grip it has on the destinies of mankind, must be permitted and in every way assisted to steadily increase until the saturation point of consumption is reached, and then a new order of things must come into existence.

A partial inventory has been taken of Canada's power requirements and the methods she is employing to meet them, but no stock has yet been taken of her internal combustion motor requirements nor of the source of liquid fuels from which a supply of motor spirits is to be drawn to feed them. The power requirements from this source, it will be shown, is second only to that of the great railways actually, but potentially even greater.

The magnitude and annual rate of increase of the motor vehicle industry in the United States may be generally pretty well known, but the number of motor vehicles of all kinds in use in Canada may not be so generally known. It is estimated that 500,000 motor vehicles, private and commercial, agricultural machinery, tractors and a large number of marine craft propelled by internal combustion motors, etc., are in actual use in this country. If the average horse power of the vehicle motor be taken as ten, then the total potential horse power represented in the motor vehicles alone will be five millions. This is greater than the total installed locomotive horse power which has been estimated to be four million five hundred thousand. The actual power developed may be conservatively estimated at half this amount, and although the service is of a very intermittent character and no average load factor can be assumed, it is probable that the average horse power developed continuously throughout the year is of very large amount. Now as regards a supply of motor spirits, it has again, been estimated that the consumption of this per car per year is about four hundred imperial gallons which makes the total annual requirements as at the present time, two hundred million imperial gallons. The demands for motor spirits in Canada are increasing from year to year, although at a less annual increasing rate than in the United States, and these requirements are at present met by supplies of foreign origin. Efforts should be made to supply as great a portion of the total as possible from domestic sources, even though the quantity be comparatively small.

This leads to the subject, carbonization of the fuels high in volatile matter and its relation to the development of power.

Carbonization of Fuels and Production of Power

The two main problems with which those inhabiting the "Acute Fuel Area" are concerned, are a steady and assured supply of fuel for domestic purposes and the generation of power on a large scale at the lowest possible cost. With a view to assisting in the solution of the former, the Dominion Fuel Board has conducted and completed an investigation concerning the feasibility of erecting by-product recovery coke oven plants at strategic points in Ontario and Quebec for the purpose of manufacturing a coke suitable for domestic purposes and a gas to replace the town or retort gas now manufactured in practically all the large cities and towns.

The report of this investigation is at the time of writing in the press but the investigating engineer states that the condition for establishing at least two large by-product recovery coke oven plants are very favourable. The governing factor in the establishment of an industry of this kind, is the profitable disposal of the gas generated. If this cannot be profitably disposed of the plant should not be erected.

The logical sources for disposing of the surplus gas would be the existing town gas plants. Most of these manufacture a combination of retort and carburetted water gas while there are plants that manufacture a straight carburetted water gas. Either of the processes employed produce a gas which costs more than coke oven gas. It is natural, therefore, to assume that a by-product recovery coke oven plant and a town gas plant could work in harmony to each other's mutual advantage. But there is another outlet for the surplus gas of such a plant which occurred to the writer, viz: the generation of power. Ontario requires more power and as stated the Hydro-Electric Power Commission of Ontario is considering the erection almost immediately, of a steam power plant of 100,000 h.p. A great deal of interest has already been manifested in the possibilities of low temperature carbonization when employed in conjunction with powdered fuel systems and it is of interest to note that all the possibilities of high temperature carbonization in conjunction with power generation have not been exhausted. The fuel situation in the "Acute Fuel Area" has given rise to conditions which may permit high temperature carbonization to be employed in conjunction with the generation of power, and it appears from the results of the investigation that this may prove successful *whenever* a sufficiently large market for coke exists. J. L. Landt, the engineer, who recently completed the investigation concerning the feasibility of establishing by-product recovery coke ovens in the provinces of Ontario and Quebec, studied, at my request, this special phase of power generation and states his opinions regarding the feasibility of such an undertaking as follows:—

High Temperature Carbonization in conjunction with Power Generation

Of approximately 5,000,000 tons of anthracite coal imported into Canada yearly over 93 per cent is consumed in the "Acute Fuel Area", hence there is a large potential field for the introduction of by-product coke as a domestic fuel, thus assisting Canada to become independent of a high priced fuel, which is becoming scarcer each year, and over which she has no control as to production, quality or price.

Certain assumptions are necessary, and therefore it is hypothecated that it is desired to install a steam electric power plant at or near one of the cities bordering on lake Erie or lake Ontario, where there are adequate facilities for the transportation of coal by rail or water. This plant is to have a rating of 100,000 h.p., or 74,600k.w., and the water rate of the turbo generators is taken at 15 pounds per k.w.hr., the steam pressure at 250 pounds and the degrees superheat 250°.

Figures obtained from reliable sources, indicate that in large installations, a steam power plant using powdered fuel, can be erected at a cost of $75.00 per horse power complete and that one using gas for fuel can be erected for $60.00 per horse power complete.

Then $74,600 \times 15 = 1,120,000$ lbs. steam are required per hour. The total heat in the steam at 250 lbs. and 250° superheat is 1,340.5 B.t.u.'s per lb. therefore:—

$\frac{1340.5 \times 1,120,000}{.80} = 1,875,000,000$ B.t.u.'s are to be supplied from the fuel per hour.

Although higher efficiencies have been shown in practice it is believed that boiler efficiencies of 80 per cent when using powdered fuel or gas are fairly representative of actual practice.

$\frac{1,875,000,000 \times 24}{13,500 \times 2,000}$ = approximately 1,670 tons of fuel required per day when burning powdered coal. One of the claims for powdered fuel is that slack or other inferior grades of coal can be used with highest efficiencies, hence 13,500 B.t.u., per lb. was taken as heating value of the coal.

Assuming that gas is produced with a heating value of 525 B.t.u.'s per cu. ft. then,

$$\frac{1,875,000,000 \times 24}{525} = 86,000,000 \text{ cu. ft. gas is required}$$

per day.

Modern by-product coke oven plant use about 2,000,000 B.t.u.'s to carbonize one ton of coal, and from cheaper grades of coking coals suitable for making good grades of domestic coke, about 8,000 cu. ft., of 525 B.t.u., gas is obtained therefore as surplus,—

$$\frac{86,000,000}{8,000} = \text{approximately } 10,750 \text{ tons of coal to be}$$

carbonized per day to produce sufficient gas to generate the steam required.

The cost of coal for the two systems mentioned is estimated as follows:—

Powdered Fuel		*Coke Oven*
$2.00	Cost of Penn. coal f.o.b. mines	$2.50
2.25	Freight rate to border	2.25
0.40	Duty (average)	....
1.00	Freight rate border to plant	1.00
$5.65	Total	$5.75

Coal for powdered fuel purposes, we assume will be purchased as cheaply as possible and also that coal suitable for domestic coke purposes can be purchased at low prices but that it will cost somewhat more than coal used for steam raising purposes. Freight rates have been assumed to be the same as coals for either purpose can be purchased in same localities in Pennsylvania. Duty is assumed to be 40 cents per ton average for powdered fuel while it is quite probable that there will be no duty in the near future on coal used for making domestic coke.

The cost of producing gas is approximately as follows:—

Coal charged per day	10,750 net dry tons
Commercial coke produced 70 per cent	7,535 net tons
Total operating expense	$1.40
Fixed charges 14.5 per cent	0.48
Cost of dry coal per ton	5.96
Total cost	$7.84
By-product credits	$1.70
70 per cent coke at $8.00 per ton	5.60
Total credits	$7.30
Net cost per ton	0.54
Cost of gas per 1,000 cu. ft.	0.0675
8.0 M. cu. ft. per ton.	

The coke oven plant would consist of six batteries of ovens 60 ovens to the battery, erected at a cost of approximately $12,000,000. Included in 14.5 per cent fixed charges, 7 per cent is taken as cost of money so that the cost of .065 cent per 1,000 cu. ft. is net.

Powdered fuel is usually dried down to 2 per cent water or less before grinding, therefore,—

$\frac{5.65}{0.98}$ = $5.77 cost of coal ready for grinding.

1.00 cost of grinding and preparing fuel.

$6.77 cost of coal ready for firing.

The Cost of Power

Pulverized Fuel		*Coke Oven*
$11,300	Cost of fuel per day	$ 5,800
450	Cost of operation per day	250
2,980	Fixed charges per day	2,380
$14,730	Total	$ 8,430
54.8c.	Cost of steam per 1,000 lbs.	31.3c.
0.823c.	Cost k.w.hr	0.42c.
$49.00	Cost h.p. year (8,000 hrs.)	$28.00

$14,730 — 8,430 = $6,300 × 365 = $2,300,000 annual saving, an amount which will amortize the power plant in about three years and the combined plant in about ten years. Should depreciation reserves of both plants be applied towards paying fixed indebtedness, both plants would be amortized in much less time. The pulverized fuel plant would be of course amortized in about seventeen years on basis shown. This study is most interesting because over 2,750,000 tons of domestic coke would become available to the public in the acute fuel area, or approximately 55 per cent of anthracite could be replaced all by building one plant of this type. Although the question of capital involved may be open to discussion, it does not matter much whether capital figures are changed as the big saving comes in the cost of fuel and the annual saving represents more than 10 per cent on $20,000,000.

By-products Available

The coking of 10,700 short tons of bituminous coal per 24 hours for 365 days would make available the following quantities of:—

Benzol	11,770,000 Imperial gallons.
Tar oils	35,300,000 Imperial gallons.
Ammonia (NH_3)	25,400,000 pounds.

The establishment of a by-product-recovery coking industry on this scale would, first, very materially assist in solving the fuel problem of the "Acute Fuel Area", second, supply sufficient energy to meet the immediate requirements in southern Ontario for additional power, and third, materially augment the supply of motor spirits and liquid fuel. The initial plant would not have to be constructed on a scale sufficiently large to supply gas for a 74,600-k.w., steam-electric plant if the power requirements and the demand for a domestic fuel were not large enough to absorb that fuel and power output.

While the design of the ultimate plant would provide for the installation of six batteries of 60 ovens each and a boiler plant of sufficient capacity to supply steam to four 18,650-k.w., turbo-electric generators, the initial installation might include only one battery of ovens, one turbo-electric generator unit and the required boiler capacity to which additional units could be added as the power and fuel demands increased.

Low temperature Carbonization in conjunction with the Generation of Power

Low temperature carbonization at the time of writing, is not being conducted on a commercial scale, although the erection of a plant for carbonizing bituminous coal at a low temperature at the Ford Motor Works, Walkerville, Ontario is nearing completion. This plant is the outcome of research and development work carried out by V. E. Caracristie and Emil Piron, at Huntington, W. Va., U.S.A., where a demonstration unit with a daily capacity of 25 tons was erected for experimentation and the conducting of tests on coals high in volatile matter.

This method for distilling differs from all others in that pulverized coal is spread in a thin layer on a continuous belt conveyor which floats on a bath of molten lead. The heat for carbonizing or distilling is transmitted from the molten lead to the belt conveyor and coal and is maintained at a temperature of 1,100°F. to 1,200°F. with 1,300°F. as a maximum. The spreading of the coal in pulverized form, in a thin layer ensures rapid heat transmission without the employment of high temperatures. This results in a shortening of the distillation period and corresponding increase in the capacity of oven.

The inventors claim that no lead losses will occur through oxidation due to the gaseous atmosphere maintained and that no change in the lead bath will result through the effect of the sulphur which may exist in that atmosphere.

The molten lead is held, at the desired temperature, in a tank of refractory masonry. Heat is conducted to the lead bath by "U" shaped flues. Plates Nos. B-14 and B-15 which are longitudinal and transverse sections of the ovens, in course of installation at Walkerville, clearly

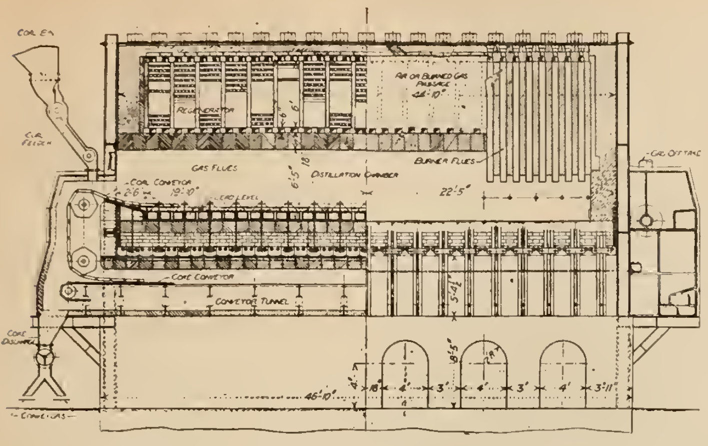


Plate No. B-14.—Longitudinal Section, Piron-Caracristie Carbonizer.

show the method employed for heating the lead bath; the belt conveyor floating on the lead bath; method of feeding and discharging.

Commercial results, it is said, are obtained with a coal layer one-half inch thick and that this distills completely into low temperature coke, (10 per cent to 12 per cent volatile matter), in less than five minutes.

The results of the laboratory and practical research work, as set forth by the inventors indicate that the quantity and kind of by-products per ton of coal carbonized will be:

1. 8,000 to 7,000 cu. ft. 760 to 700 B.t.u. gas.
2. 5 American gallons of motor fuel, directly stripped.
3. Ammonia, in an amount corresponding to 20 lbs. of sulphate of ammonia, stripped from the gas and condensation liquor.
4. 25 to 30 American gallons of light tar oils and the recovery from the latter of:
   1. 5 American gallons motor fuel.
   2. 2½ to 3½ American gallons creosoted oil.
   3. 1½ to 2½ American gallons lubricating oil.
   4. 8 to 12 lbs. of lubricating grease.

The residue is a heavy tar oil which will be suitable for use as fuel oil.

The primary object of carbonizing in this manner, is to obtain a carbonized residue, high in carbon, containing not more than 15 per cent volatile matter; that will burn without smoke and which will be suitable for the following purposes.

1. For the manufacture of domestic briquettes.
2. For burning in furnaces in pulverized form.
3. For burning in chain grate stokers.
4. For grinding and mixing with high volatile coal for the purpose of making metallurgical coke.

Actual operation, under strictly commercial condition, of the plant now in course of erection at the Ford Motor Works, is necessary in order to furnish results upon which an opinion can be based regarding the correctness of the above claim.

The process is, however, of special interest since it is the first attempt made in this country, at least, to generate power in conjunction with carbonization and thus achieve the objective towards which some are striving, viz: of burning coal twice. The operation of this plant will be watched with keen interest and its success or failure will mean much to the advocates of low temperature carbonization and to those who have faith in this method of generating power.

It is interesting, in this connection, to note the opinion hold by the chairman of the low-temperature carbonization section of the Committee on Carbonization of the American Gas Association. He states that:—

"The distillation of coal at low temperature holds a certain fascination for the layman as well as for the chemist and the inventor. It should be said here that there have been no developments which would justify any assumption that the art has passed from the experimental into the commercial field. Distillation of coal at low-temperatures has most certainly not been done on a money-making scale, yielding profits sufficient to carry the operating costs and the capital charges. It has been tried experimentally; and in one case in a full-sized commerc al plant, but none of these attempts has been entirely satisfactory. No process has yet made public any data which would justify the small investor in investing in it, and the development of any process is a matter only for large capitalists. One of the greatest misconceptions held with regard to low temperature carbonization, even on the part of some technical men, is the assumption that the by-product yields from low-temperature processes are so superior in value to those derived from high-temperature processes that the revenue from them would immediately remove low-temperature coke from all fear of competition with by-product coke.

"When low-temperature tar is made in large quantities, and the fractions become available to the industrial arts, a market will undoubtedly arise to absorb them, most authorities agreeing that these tar-oils are potentially more valuable than the secondary tars of the coke-oven. This showing in favor of the low-temperature process, however, is almost balanced, under present conditions, by the much larger quantity of salable gas produced by the coke-oven. Ammonia yields are also in favor of the coke-oven.

"The men who are backing the various processes do not agree with one another as to the nature of the product

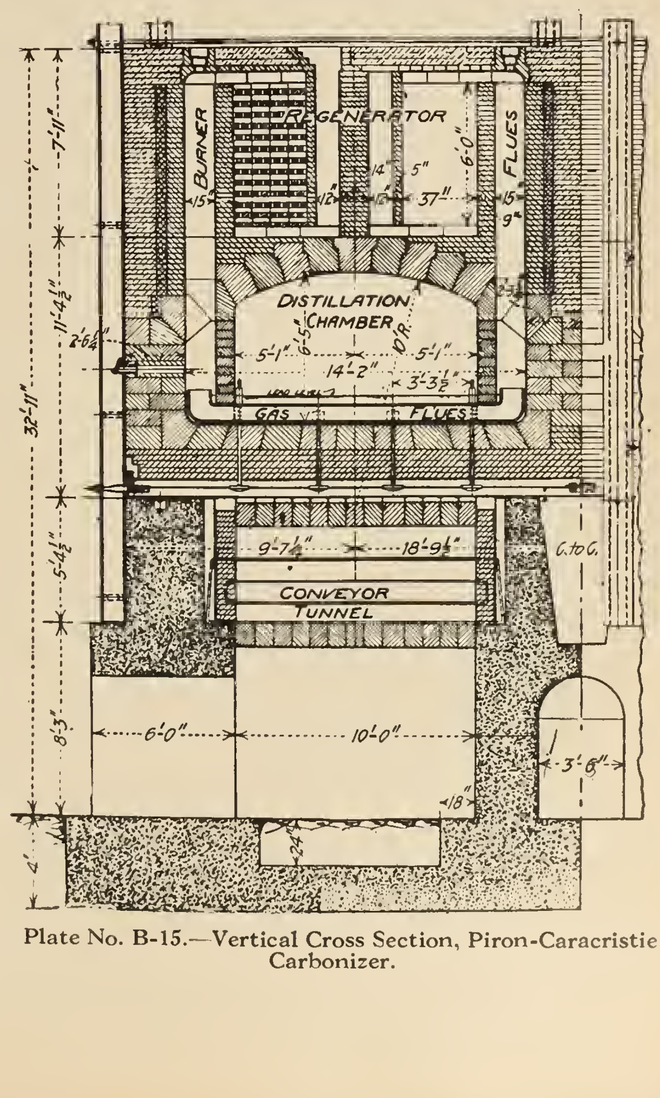


Plate No. B-15.—Vertical Cross Section, Piron-Caracristie Carbonizer.

they are striving to produce. Some are trying to make, in one-stage process, a coke possessing all the excellent physical characteristics of by-product coke plus a relatively high content of volatile matter, to give it free burning qualities; some wish to produce a semi-coke, high in volatiles, porous and soft in structure; others have as their objective a small-sized porous semi-coke which they intend to prepare for the market by briquetting. All are striving to make the ideal smokeless domestic fuel, an anthracite substitute.

"We are not concerned with the definition of the ideal domestic fuel; but we wish to set down the opinion that low-temperature coke is not inherently superior to coke-oven coke unless it is improved physically by briquetting or some other means."

Summary

In this paper the writer has attempted to show:—

1 That Canada has enormous fuel resources of all kinds with the exception of crude oil which at present is produced only in limited quantities.

2 That the requirements for steam and steam power though on a much smaller scale than of those of the more populous and highly industrialized countries, are increasing.

3 That hydro-electric energy has to a very large extent displaced steam power not only in the provinces of Ontario and Quebec but in other portions of the Dominion, although to a much lesser extent, but that the increasing demand for power especially in central Canada, must, to a very large extent, from now on be met by steam generated electric energy.

4 That power plant design and steam boiler installations are modern and provided with combustion apparatus for burning the different grades of coal to the best advantage. It is also shown that more recent steam and steam power installations are equipped with the most complete powdered fuel burning systems, while others are equipped with mechanical stokers of the latest design and of large dimensions.

5 That a field does not appear to exist at the present time, for the carbonizing and briquetting of the lignite coals, but that the solution of the domestic fuel problem of the "Acute Fuel Area" does not appear to lie in the coking of bituminous coal, in the by-product recovery coke oven.

6 That a solution of both the domestic fuel problem and the demand for increased power in central and southern Ontario can be found in the employment of the by-product recovery coke oven on a large scale for the manufacture of a coke for domestic fuel purposes with the recovery of motor spirits, oils, ammonia and the generation of a gas for the development of power.

7 That the first attempt to carbonize coal at low tem perature for the production of first a char suitable for burning in pulverized form for steam generation and second, the maximum recovery of by-products, especially, tar oils, suitable for refining into motor spirits, is actually being made at the Ford Motor Works, Walkerville, Ontario, on a large commercial scale.

Notwithstanding the enormous coal resources of western and eastern Canada, the most highly industrialized and populous portions, viz: the provinces of Ontario and Quebec .are now and will probably continue to be largely dependent on foreign sonrces for a fuel supply for both domestic and industrial purposes. This dependence can be lessened, only by vigorously developing the peat resources which are of large amount in this area. Western Canada on the other hand is capable of producing a much larger quantity, of all kinds, of coal than she can at present dispose of, and the lower grade lignites, therefore, will not, for that reason, be vigorously developed until the population of Saskatchewan and Manitoba, in which the low grade lignites occur, increases sufficiently to warrant their production and processing on a large scale for various purposes.

Canada must be looked upon as the world's store house for future supplies of coal and possibly of oils derived from coal. No country, however, possessed of large quantities of coal, comparatively easy to mine, will seriously consider future supplies of coals so long as the ultimate exhaustion of native sources is not within sight of one's life time. But with crude oil the situation is different, the supplies of this indispensable commodity are far from inexhaustible and if expert opinion is to be accepted, exhaustion will actually occur within the lifetime of living men. To insure not only a supply, but a continually increasing supply, of liquid fuels is the real and most serious problem with which mankind in a short time, will be forced to struggle.

The truth of this statement will be more readily recognized when one considers the quantities of oils of all kinds which are annually required to keep the vast and continually increasing number of internal combustion motors in operation and if one compares the quantity of coals, suitable for distillation, which would have to be carbonized to yield an equivalent quantity of oils. Assuming for the purpose of illustration that ten imperial gallons of motor spirits could be obtained from each ton of coal carbonized, then to supply the demands for motor spirits of Canada, alone, would require the carbonizing of twenty million tons of coal; two thirds of Canada's total fuel requirements. This would not prove so serious a matter if all the carbonized residue could be absorbed for domestic and industrial purposes; but in a country situated like Canada, in which the fuel resources are situated in the eastern and western extremities, three thousand miles apart, this is manifestly impossible.

Mechanical power is the main spring of modern civilization and is the active expression of the latent energy stored in Nature's stupendous fuel resources. The exhaustion of the one implies the exhaustion of the other, and the collapse of our marvellous civilization. To-day mankind is cashing cheques on the fuel reserve of future generations, it is time therefore that we considered means and ways for conserving this, the greatest and least dispensable of Nature's endowments and not content ourselves with the belief, that when these vast stores of potential energy are exhausted and dissipated, new sources and forms will spring into being. Science has made such remarkable progress during the past few decades and discoveries of the most startling character have followed one upon the other in such rapid succession that people have grown to be credulous; as credulous as they were incredulous when science was passing through its childhood days, and credulity may and often does do or cause more harm than incredulity. We should not place our hopes for future supplies of energy in the atom but in our ability to prolong the life of the sources of energy we have learned and know how to use by applying the scientific knowledge, we have attained, in a constructive and not in a destructive manner.

The Generation of Hydro-Electric Power in Canada

The Progress in Canadian Practice in Connection with Hydraulic Power Development.

H. G. Acres, D.Sc., M.E., M.E.I.C., M. Inst. C.E., M. Am. Soc. C.E., M. Am. Inst. E.E.

Chief Hydraulic Engineer, Hydro-Electric Power Commission of Ontario.

In common with all other countries possessing potential water power resources, the nature, extent and utility of Canadian water power is primarily the outgrowth of the purely climatic factors of temperature and precipitation, associated, necessarily with the topographical frame-work of the North American continent.

Extending as it does from the Atlantic to the Pacific ocean, and from the temperate zone to beyond the Arctic Circle, Canada embraces all phases of the temperature factor except the tropical and sub-tropical, and as regards precipitation, also, the range of variation is great. Governed by the third factor of the continental topography, Canada has turbulent rivers heading in the high peaks of the Rocky mountains; huge rivers flowing off the immense central table-land of the mid-west and the Great Lakes basin; and eastward to the Atlantic coast, a multitude of waterways, large and small, draining the slopes of the Laurentian hills, and maintained and regulated by countless lake expansions, many of which have areas ranging from 50 to 1,500 square miles.

It is evident from the general specification above outlined that Canada must of necessity possess water power resources so great in magnitude and so diverse in type, as to afford the widest possible scope for engineering accomplishment and initiative, in the matter of their proper and efficient development and utilization. Furthermore, the development and utilization of Canada's water power resources has been in progress for a great many years, and it would be irrelevant to enter into any extended and more or less historical review of the progress of such development and its co-related engineering and industrial phases. A date has therefore been assumed at which hydro-electric power development, in a modern sense, had its inception in Canada, and from that point to trace the general progress of the art up to the present time, stressing only those phases of the evolutionary process, as governed by primary natural limitations and requirements, which have given Canadian practice a more or less distinct identity.

The history of modern Canadian hydro-electric practice may be said to have had its genesis in 1905 when three vertical turbines, of Swiss design and manufacture, were placed in operation at Niagara Falls. The then outstanding characteristic of these turbines was their great power, and since that time the element of "size" has furnished the main key-note for Canadian advancement in hydro-electric power production, in respect of such features as differ from contemporaneous practice elsewhere.

It is not to be inferred from the above statement that hydro-electric development, as an art, would not have progressed in Canada, or elsewhere, but for the large increase in unit power capacity of modern turbines. The point is, that, as the direct producer of the saleable commodity, the turbine became the focal point from which radiated all essential considerations bearing on electrical and structural design, to the end that the turbine might perform its vital function of revenue production with a maximum of efficiency. The natural reaction to this condition was to throw into conspicuous relief the shortcomings and imperfections of the turbine mechanism itself, and to force engineering thought into channels leading not to the refinement and simplification of then existing standards of design, but to the creation of mechanisms having inherently new and improved characteristics. These improvements and innovations having therefore been devised, from time to time, to keep pace with the special need arising out of heavy investment in large turbines, it was a simple matter, in most cases, to apply these improvements down, as well as up, in the scale of unit turbine capacity, so that Canadian turbine practice, as a whole received ultimately the benefit of an advance in the art which originally grew from the demand for turbines of larger unit capacity than had been called for elsewhere, except in the United States.

The more or less special features of hydro-electric practice, which have originated in Canada or in the United States, fall for the most part under the following headings:—

(1) Waterway Entrance Structures
(2) Open Waterways
(3) Long Pipe Lines
(4) Forebay Structures
(5) Penstocks
(6) Penstock Valves
(7) Governors
(8) Draft Tubes
(9) Turbines
(10) Generators

Canada's progress in the hydro-electric art was primarily attributable to certain underlying natural conditions, coupled with a rapidly growing industrial and domestic demand for power. These factors, besides necessitating the development of the "super-turbine" as previously mentioned, also laid upon the power producing corporations a similarly growing obligation to improve service efficiency. One of the outstanding necessities in connection with this latter requirement is to hold the full plant rating continuously available under winter operating conditions. By reason of this fact Canadian practice has attained a certain individuality through the study of the ice problem, as related to successful hydro-electric plant operation under temperatures frequently ranging as low as 40 to 45 degrees (Fahrenheit) below zero.

If the future trend of water power development in Canada were considered in its relationship to other native power resources, as it properly should be, the scope of discussion would be enlarged far beyond reasonable limits. If, however, the discussion is confined to hydraulic development "per se", it may be stated with a fair degree of assurance that the future holds no prospect of revolutionary advances in the art, such as have taken place in the last twenty years.

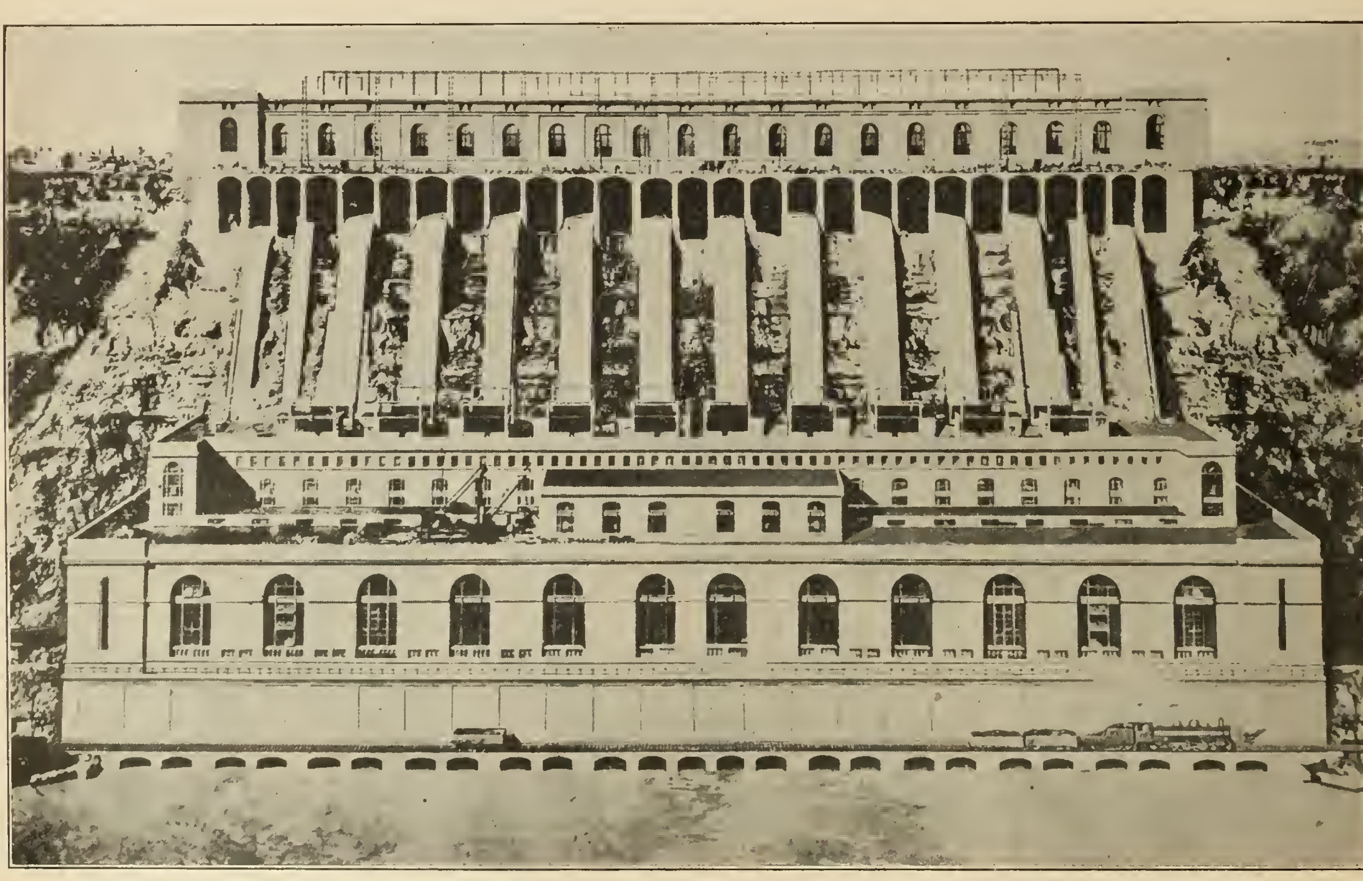
The means of supporting revolving weights, of safely controlling static pressure, and of regulating long water-columns, have been perfected. The Francis turbine and the water-wheel generator have attained a degree of efficiency in energy conversion which leaves little margin for further improvement. The supremacy of concrete as the structural medium for permanent works stands unchallenged. The larger unit capacities now used in Canada are not likely to be greatly exceeded on sound premises, so that the element of mere "size" will not in the future give rise to new problems of design.

The general problem of the future trend of development will therefore be largely governed by two factors; first, the ultimate necessity of developing water powers remotely situated and not favourably endowed by nature, with a resultant tendency toward increased capital and annual cost; and secondly, a general scale of labour and material costs greatly in excess of that which existed previous to the World War.

There may, on the other hand, be a wide field of development in the discovery or development of new materials and new combinations of metals, and it would be rash to state that radical and perhaps even revolutionary advances, along this particular line at least, are not a possibility of the future.

The subject matter of the discussion has been designedly limited to the more interesting and more or less distinctive features of Canadian practice in connection with hydraulic power production, and for an obvious reason. In citing these various features an effort has also been made to summarize, in a general way, the underlying theory involved, and to show that in every instance conformity to natural laws, and a rational comprehension of the phenomena of water in motion, has been the actuating motive.

At the same time, an attempt has been made to convey the impression, more or less by inference, that Canada not only possesses water power resources of enormous extent and value, but has spared no effort to develop them in a manner fully in keeping with their importance as a national asset.



A Canadian Power Development of 600,000 e.h.p. Ultimate Installed Capacity.

Introductory

In common with all other countries possessing potential water power resources, the nature, extent and utility of Canadian water power is primarily the outgrowth of the purely climatic factors of temperature and precipitation, associated, necessarily, with the topographical frame-work of the North American continent.

Extending as it does from the Atlantic to the Pacific ocean, and from the temperate zone to beyond the Arctic Circle, Canada embraces all phases of the temperature factor except the tropical and sub-tropical. As regards precipitation, also, the range of variation is great, with an approximate average range of 60 to 80 inches per annum on the Pacific coast, 40 to 55 inches on the Atlantic coast, 25 to 35 inches in central Canada, to as low as 20 to 25 inches on the mid-western plains. Governed by the third factor of the continental topography, Canada has turbulent rivers heading in the high peaks of the Rocky mountains; huge rivers flowing off the immense central table-land of the mid-west and the Great Lakes basin; and eastward to the Atlantic coast, a multitude of waterways, large and small, draining the slopes of the Laurentian hills, and maintained and regulated by countless lake expansions, many of which have areas ranging from 50 to 1,500 square miles.

It is not within the scope of this discussion to enlarge upon the incentive toward water power development which has existed in Canada by reason of a growing industrial demand and a great variety of natural commodity resources, but granting that such incentive has been, and still is, in existence, it is evident, from the general specification above outlined, that Canada must of necessity possess water power resources so great in magnitude and so diverse in type, as to afford the widest possible scope for engineering accomplishment and initiative, in the matter of their proper and efficient development and utilization. Furthermore, the development and utilization of Canada's water power resources has been in progress for a great many years, and it would probably be irrelevant to, and certainly far beyond the reasonable limits of this discussion, to enter into any extended and more or less historical review of the progress of such development in its co-related engineering and industrial phases. It would seem expedient, therefore, to assume a date at which *hydro-electric* power development, in a *modern* sense, had its inception in Canada, and from that point to trace the general progress of the art up to the present time, stressing only those phases of the evolutionary process, as governed by primary natural limitations and requirements, which have given Canadian practice a more or less distinct identity. "Canadian practice" might of course be more appropriately called "American practice", as the progress of the art in Canada and the United States has been in a large measure contemporaneous, due to the similarity of the primary conditions governing its evolution.

The history of modern Canadian hydro-electric practice may be said to have had its genesis in 1905 when three vertical turbines, of Swiss design and manufacture, were placed in operation at Niagara Falls. These units were of 10,000 h.p., capacity each, and were the largest ever installed up to that time. Following closely on this event, there was installed at Shawinigan Falls a 10,000 h.p., horizontal turbine of American design and manufacture; then again at Niagara Falls a group of 10,000 h.p., horizontal turbines of German design and manufacture; and shortly thereafter at the same point, a group of 12,000 h.p., vertical turbines, designed and built in the United States. The then outstanding characteristic of these turbines was their great power, and since that time

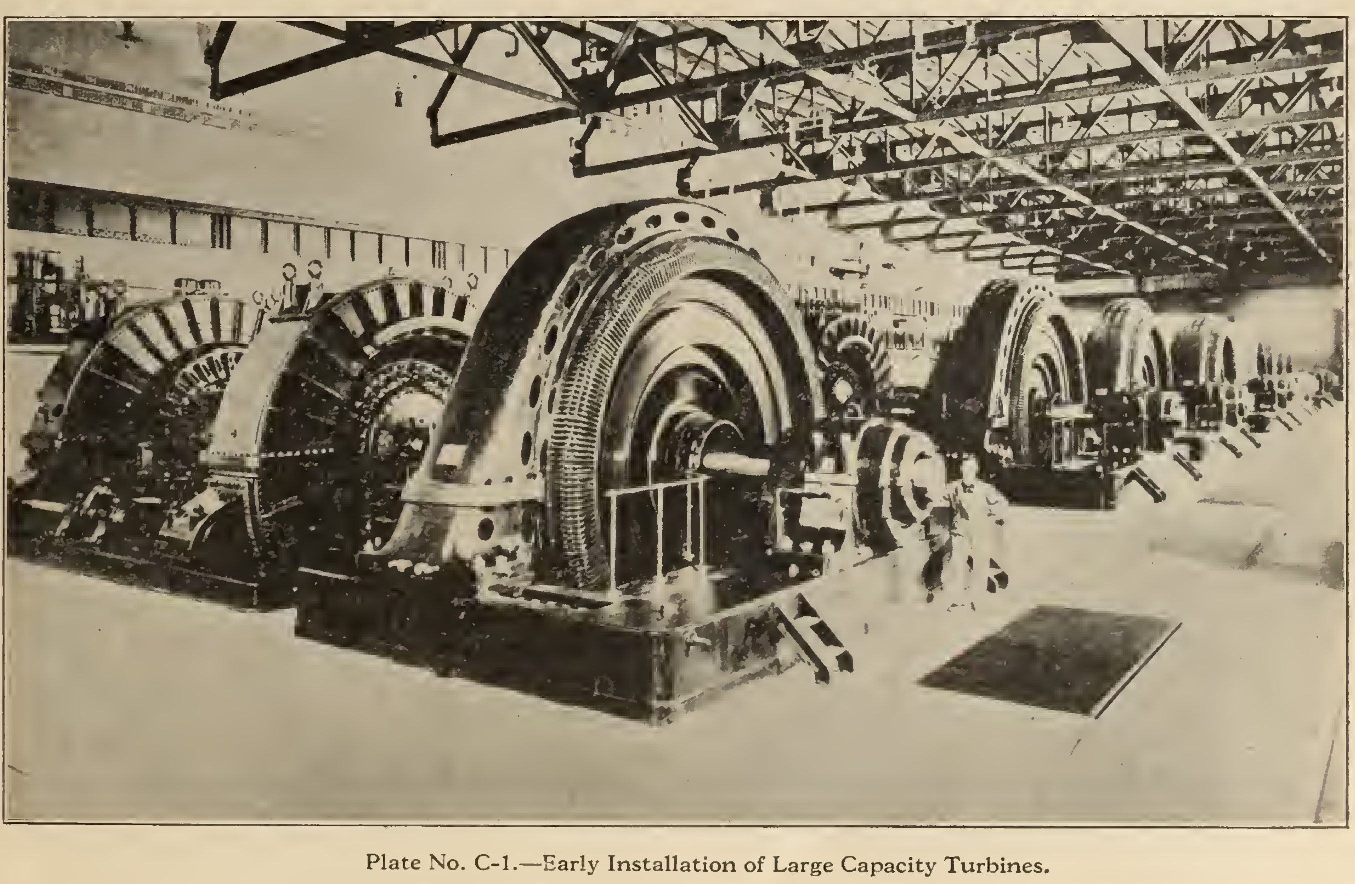


Plate No. C-1.—Early Installation of Large Capacity Turbines.

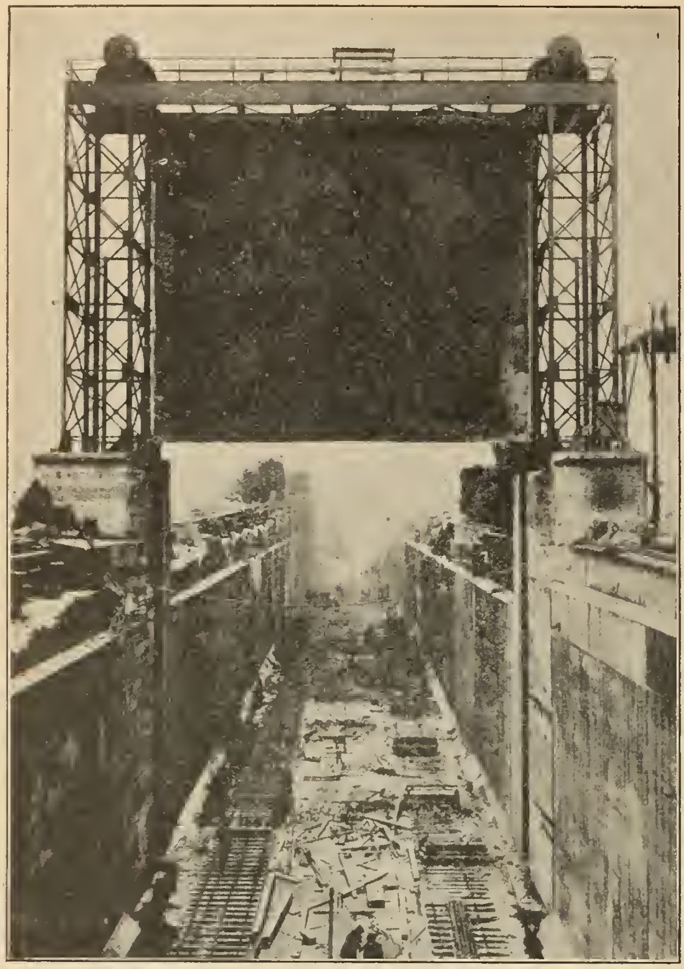


Plate No. C-2.—Stoney Type Control Gate.

the element of "size" has furnished the main key-note for Canadian advancement in hydro-electric power production, in respect of such features as differ from contemporaneous practice elsewhere.

Plate No. C-1 is a view of the German turbines above mentioned. This view is interesting for two reasons; first, on account of the square section of the scroll-case, and second, from the fact that the radial levers of the gate-operating mechanism are clearly in evidence. These turbines were among the first to be equipped with external gate-rigging, a practice which has now become almost universal.

It is not to be inferred from the above statement that hydro-electric development, as an art, would not have progressed in Canada, or elsewhere, but for the large increase in unit power capacity which was inaugurated at Niagara and Shawinigan eighteen years ago. The point is, that, as the direct producer of the saleable commodity, the turbine became the focal point from which radiated all essential considerations bearing on electrical and structural design, to the end that the turbine might perform its vital function of revenue production with a maximum of efficiency. The natural reaction to this condition was to throw into conspicuous relief the shortcomings and imperfections of the turbine mechanism itself, and to force engineering thought into channels leading not only to the refinement and simplification of then existing standards of design, but to the creation of mechanisms having inherently new and improved characteristics. These improvements and innovations having therefore been devised, from time to time, to keep pace with the special need arising out of heavy investment in large turbines, it was a simple matter, in most cases, to apply these improvements down, as well as up, in the scale of unit turbine capacity, so that Canadian turbine practice, as a whole, received ultimately the benefit of an advance in the art which originally grew from the demand for turbines of larger unit capacity than had originally been called for elsewhere.

Before enlarging upon the various phases of modern hydro-electric practice to which the above general observations are applicable, it may be well to state that, particularly as regards turbine and electric machinery, it is not the intention to view the situation from the standpoint of the specialist in any one branch of the art, but rather from the standpoint of one who has had sufficient experience in hydro-electric design, construction, installation and operation to weigh intelligently the present status and future trend of the evolutionary process leading to the ultimate of plant efficiency; this latter being a general term including all of the integral elements of stability, simplification, elimination of losses and reduction of unit costs.

The maximum of hydraulic efficiency is realized when the passage of water, from the point of initial intake to the final point of disposal in the tail-race, is accomplished with a minimum of turbulence and distortion. This provision may or may not result in a maximum of unit cost efficiency, and between these two limits lies a world of compromise which precludes any possibility of fixing the precise meaning of "efficiency" by definition. Efficiency, in the broadest sense, results from the proper co-ordination of simplicity and strength in all hydraulic design.

Simplicity in design is of primary importance. The laws of nature function changelessly and with immutable precision by reason, mainly, of their simplicity, and in no branch of engineering is conformity and obedience to the laws and forces of nature a more vital element of design than in power plant construction.

Strength involves all features of design having to do with the stability and security of structures against the action of the elements, more particularly fire and water, and also shares with simplicity the responsibility for the dependable, precise and unfailing operation of valves, turbines, governors and other mechanical apparatus.

The above generalizations are fundamental, and all the important elements of hydraulic design should conform to them to the greatest possible degree.

It is the intention, if possible, to fix the present status of Canadian practice from this viewpoint.

Features of Present Day Practice

Under this head will be considered various features of Canadian hydro-electric practice, many of which have actually originated in Canada, and do not yet appear to be known, or to have found general acceptance among European designers and builders.

These features fall for the most part under the following headings:—

(1) Waterway Entrance Structures.
(2) Open Waterways.
(3) Long Pipe-Lines.
(4) Forebay Structures.
(5) Penstocks.
(6) Penstock Valves.
(7) Governors.
(8) Draft-tubes.
(9) Turbines.
(10) Generators.

In the introductory chapter it was stated that Canada's progress in the hydro-electric art was primarily attributable to certain underlying natural conditions,

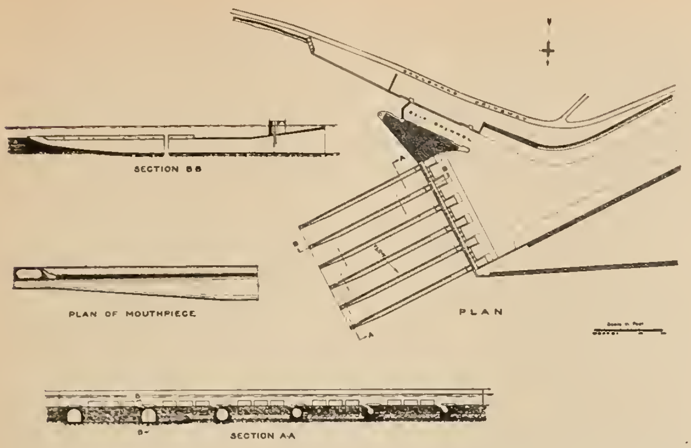


Plate No. C-3.—Waterway Entrance Structure with Gathering Tubes.

coupled with a rapidly growing industrial and domestic demand for power. These factors, besides necessitating the development of the "super-turbine" as previously mentioned, also laid upon the power producing corporations a similarly growing obligation to improve service efficiency. One of the outstanding necessities in connection with this latter requirement is to hold the full plant rating continuously available under winter operating conditions. By reason of this fact Canadian practice has attained a certain individuality through the study of the ice problem, as related to successful hydro-electric plant operation under temperatures frequently ranging as low as 40 to 45 degrees (Fahrenheit) below zero.

Dams

Canadian conditions up to the present time have not given rise to any outstanding features in connection with dam construction, but in the matter of sluice control, Canadian practice has evidenced a decided reluctance toward the adoption of rolling dams, automatic gates and apparatus of a similar nature which appears to be popular in Europe. Where slow regulation only is required, Canadian practice inclines very largely to the use of the simple stop-gate or stop-log, handled by a mechanically or electrically operated winch. Where frequent and rapid changes in flow conditions are involved, counter-weighted gates of the Stoney type have an almost universal vogue. In other words, Canadian practice, in this regard, mainly from consideration of winter operating conditions, has leaned toward simplicity and strength, rather than to complexity of design and precise mechanical functioning.

An interesting installation of the Stoney type is shown on plate No. C-2. This gate, believed to be the largest of its kind, was designed and built in Canada and entirely controls an ultimate flow of 18,000 second-feet in the concrete lined channel in which it is placed. The merit of this single leaf gate is two-fold, in that it obviated a very expensive enlargement in the waterway for the accommodation of piers, while at the same time it saved the head-loss which would have resulted from such enlargement, and from the interposition of the piers.

The structure, as illustrated, has an over-all height of 110 feet and the gate itself weighs approximately 100 tons, being equipped with two hoisting mechanisms and two counter-weights.

Waterway Entrance Structures

This term is used to identify structures located at the initial source of water supply for any hydraulic plant fed through an open canal, pressure tunnel or pressure conduit, and is intended to distinguish such structures from the ordinary forebay and intake structures which are common to all power developments.

In Canadian practice the one controlling factor associated with the design and operation of entrance structures is the protection of the inner system of waterways, whether they be open canals, tunnels or pipe-lines, against the entrance of ice, and, in a secondary degree, of other floating material.

To the above end, the primary general requisite of design for all entrance structures is the fending off of floating matter by an adequate submergence of the entrance passages, coupled with an entrance velocity sufficiently low, not only to prevent vortices, but to be at all times less than the buoyancy impulse of the floating material. The attainment of this objective involves the solution of a complex problem of velocity and draft distribution.

Where the initial source of water supply has an appreciable velocity of its own, any approximation of uniform velocity distribution in the diverted flow through the water passages of the ordinary type of entrance structure is impossible, and any design based on the attainment of such uniformity must inevitably fail. In every such case it will be found that while the average *effective* velocity of entrance may be within the designed limits, there will be regions where the *actual* velocity is so greatly in excess of the assumed average that the structure cannot function according to design, for the two-fold reason that the excessive local velocities destroy the efficacy of the submergence of the entrance passages, and because the resulting turbulence induces hydraulic losses greatly in excess of those calculated from the designed velocity of entrance.

Plate No. C-3 illustrates the plan of a recent type ot entrance structure in which the above elements of design have been very fully developed.

It is evident that the breast-wall portion of this structure is more or less of the conventional type, with rectangular sluice openings controlled by gates, and with deeply submerged curtain-walls.

Between each group of three sluice openings, however, will be seen a still more deeply submerged horse shoe shaped opening through each pier. The transverse and longitudinal sections "*A-A*" and "*B-B*" show that each of these openings is connected, within the breast-wall, to

Plate No. C-4.—Large Scale Model Test of Gathering-Tube Intake.

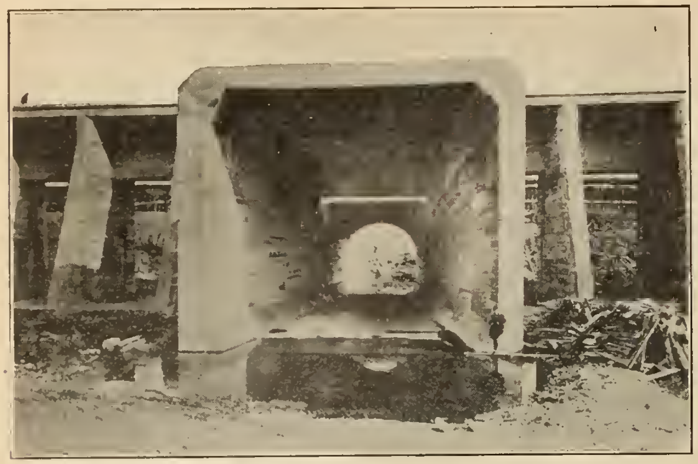


Plate No. C-5.—Intake Structure with Gathering-Tubes.

a diffuser, and outside to a long, deeply submerged tube. The plan of the mouthpiece of this tube shows a clear opening at the tip, and from this point an additional opening in the form of a longitudinal slot in the top of the tube, of gradually decreasing width, and extending back to within a short distance of the breast-wall.

This tube, known as a "gathering" tube, will deliver 2,500 second-feet of water to the mouth of the diffuser with a total head-loss of about four inches. In other words, the six gathering tubes, with the rectangular sluices entirely closed, can deliver a total of 15,000 second-feet to the inner waterway. This would, of course, be a very rare operating condition, as a certain amount of rectangular sluice opening would probably be permissible even under the worst conditions of ice formation and movement, so that the above mentioned head-loss, small as it is, will probably never be realized in practice, and the actual loss will be almost negligible.

The design of these gathering tubes was based upon a rational mathematical analysis, and was also confirmed by large scale model tests. The bath-tub shaped opening at the tip of each tube is designed to produce the initial suction impulse necessary for the functioning of the slot opening. The outer end of each tube is tapered in such a way as to give the axial velocity a constant value, after which the diameter of the tube is maintained uniform, thereby producing an accelerating axial velocity, as additional increments of water are drawn into the shoreward sections. At the same time, the width of the slot decreases shoreward to compensate for the gradually lessening draft capacity of the main stream, and thus maintain the desired rejection ratio, as the tube approaches the shore.

The axial flow in the tube is necessarily induced by a difference of head or head-loss, which initiates and maintains the suction of water through the slot. This head is the resultant of three components; namely, the initial loss in the priming tip; the cumulative induced losses in the tube, at any point, due to distortion of the stream lines in the slot entrance; and the cumulative losses, at any point, due to friction and velocity head-loss in the bore of the tube itself.

One most obvious merit of this gathering tube is, of course, its deep submergence, but the more significant factor of the design is the scientific distribution of draft from the source of supply. Instead of drawing 15,000 second-feet of water from a narrow zone contiguous to the breast-wall, as is customary with structures of this kind, the draft zone is extended, in the case illustrated, over an area of 300,000 square feet, or nearly seven acres. Moreover, this draft, as previously mentioned, is mathematically adjusted to the draft capacity of the source of supply; in other words, the greater quantity of water is drawn through the outer extremities of the tubes, where the supplying flow is a maximum, and lesser quantities are drawn through the slots as this flow gradually decreases shoreward.

On plate No. C-4 is shown a view of the tested model of this structure. This model was constructed to a 20 to 1 scale, and quantities of water up to 100 second-feet were used in the experiments. It was indicated by these experiments that a quantity of water corresponding to 25,000 second-feet as applied to the full scale structure, could be drawn through the tubes, with the sluice openings entirely closed, without materially altering the stream lines of the source of supply, and that floating matter would pass entirely over the tube area without any appreciable reduction of buoyancy, and with little or no dimunition in forward impulse.

Having these facts in mind, it may reasonably be anticipated that an intake of this type will deliver water free of floating debris, even though the surface transportivity of the source of supply may have an extremely low value. Under the extreme condition of a zero value of surface transportivity, floating material would naturally trap over the draft zone, but it could be periodically removed, if necessary, by mechanical means, before its buoyancy impulse had been overcome by suction.

Plate No. C-5 shows a view of this structure from the shore side. The gathering tubes have not yet been built, but the view shows clearly the rectangular sluice openings and the mouth of one of the gathering tube diffusers.

Open Waterways

The discussion under this head is to be limited to open waterways, because Canadian practice at the present time offers no distinctive features, from the structural standpoint, in connection with pressure tunnels, and also because the higher and purely hydraulic characteristics of closed pressure conduits will be discussed later under the head of long pipe-lines.

While the fundamental consideration bearing on the design of an open waterway, of any considerable length, is an economic balance between capital cost and the annual value of lost power, each constitutes an unique problem in itself by reason of the many purely local factors involved, such as right-of-way values, alignment and topography.

In Canadian practice, however, particularly in cases where the system load requires that full plant rating be continuously and instantaneously available, one outstanding factor enters into the consideration of all open waterway design; namely, the maintenance, under extreme low temperature conditions, of a delivery of water sufficient at all times to carry the revenue producing capacity of the turbines up to the limit of their rating. In the general case, a waterway which meets this specification embraces the other elements of efficiency, because the general equation of capital investment against the value of lost power will have been satisfied.

It is therefore necessary to consider the effect of the ice problem on another important element of hydraulic design. In this case, however, the discussion turns mainly on stationary ice cover, rather than ice in motion, because, with the assumption of an adequately designed entrance structure, the problem of moving ice becomes of minor importance, being limited to the comparatively small quantity originating within the area of the waterway itself.

The formation of ice on a waterway of the type under discussion is influenced by variable combinations of air temperature, water temperature, wind, and the relationship which exists, for any fixed volume of flow, between marginal and mid-section velocities. The latter factor is more or less a controllable one, inherent in the design, the others being of climatic origin and therefore uncontrollable.

When ice *formation* on such a waterway is an accomplished fact, the subsequent occurrence of ice *trouble* is governed primarily by the degree of uniformity of mean velocity, and the relationship between width and depth for any fixed area of wetted section.

Where water flows in a regular channel with an appreciable velocity, ice formation always originates in the low velocity portions of the cross-section near the shores. Having secured the shore line for an abutment, this marginal ice builds out, bridge-like, from both shores towards the centre of the stream, the rate of progress being mainly governed by the climatic factors above mentioned. While these marginal ice sheets build outward, they also thicken, and if the climatic factors are such as to cause them to meet in the middle of the stream, the under surface of the sheet is roughly parabolic in form, having a minimum thickness at mid-stream, and a maximum thickness at the haunches abutting the shores.

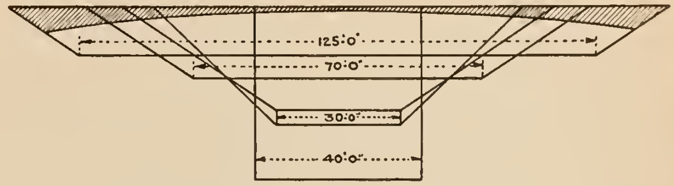
In climates where there are sustained periods of low temperature, as in many parts of Canada, a complete ice cover may be formed in this way and persist for considerable periods, but if the temperature rises sufficiently, the ice sheet at mid-section disappears through the joint action of temperature and erosion, and open water will show. This thread of open water will widen out, or get narrower, or close altogether, in harmony with the variation in the climatic factors. Meanwhile, the haunch ice holds intact and tends to gradually thicken through the agency of ordinary frost action, and also by reason of accretions of slush and frazil which adhere to the lower surface of the ice sheet, as a result of the low transportivity of the shoreward current filaments.

It is therefore evident that in a waterway where the width is great in proportion to the depth, and where the side slopes are flat, the tendency to encourage ice formation is a maximum.

As above mentioned, another primary requisite in reducing the ice hazard in an open waterway is to keep the water flowing, throughout its length, at as uniform a velocity, and with as little disturbance in the gradient and alignment of the current filaments, as possible. This means that all sudden natural expansions and contractions of the cross-section should be obviated to the greatest extent practicable, and that such obstructions to flow and interruptions in gradient as are caused by bridge piers, regulating sluices, drop weirs, etc., should be reduced to a minimum.

The above precautions will not only tend to reduce the thickness of sheet ice cover, but will fulfill the far more important function of reducing the liability of frazil and anchor ice formation at critical temperatures, as the turbulence induced by such structures will cause frazil to form in amounts which will be dependent upon the length and frequency of periods of critical temperature, and which might, during some winter seasons, be frequent enough, and of sufficient duration, to form a hanging dam under the solid ice sheet, of such extent as to seriously restrict the effective discharge section.

The problem of width and depth relationship is simply explained by reference to the diagram shown on



BOTTOM WIDTH	DEPTH FROM UPPER ICE SURFACE	SIDE SLOPES	TOTAL AREA	ICE AREA	NET WATER AREA	PERCENT OF TOTAL AREA OBSTRUCTED BY ICE
125·0	11·87	1·5 To 1	1687·5	433·5	1254·0	25.7
70·0	17·50	"	"	241·8	1445·7	14.3
30·0	25·00	"	"	163·9	1503·6	10·9
30·0	28.70	1 To 1	"	137·6	1549·9	8·2
40·0	42.19	VERTICAL	"	45·4	1642·1	2·8

Plate No. C-6.—Diagrammatic Representation of Width and Depth Ratio.

plate No. C-6. On this diagram are shown a number of typical canal cross-sections all of *equal area* below water or ice level. The discussion of this diagram is based upon the primary assumption that the disparity between marginal and mid-section velocity is a minimum in waterways of deep, narrow section, and a maximum in waterways of wide, shallow section; also, upon acceptance of the secondary proposition that the parabolic form of the lower surface of the ice sheet becomes more pronounced as the disparity between mid-section and marginal velocity increases.

On the basis of the above proposition, a conventional wide, shallow section of the well-known text-book type has been assumed, and a parabolic ice sheet sketched in as above described. The other sections have been derived simply by reducing the width, steepening the slopes, and fixing the respective bottom elevations in such a way that all are of *equal area* below the assumed water or ice line.

Inasmuch as the ice sheet offers a material obstruction to flow through the combined agency of contracted discharge area and surface friction, the significance of the diagram on plate No. C-6 is at once evident.

These theoretical sections are drawn to scale, and it was therefore possible to make a rough computation, shown on plate No. C-6, indicating the relative extent to which the assumed ice sheet contracts the effective discharge area in such case. It is evident that the wide, shallow section offers a maximum of obstruction, and that the deep, rectangular section offers the least.

Assuming that the theory upon which the above conclusions are based is reasonably sound, it follows that the most efficient cross-section for an open waterway should have such a maximum of depth, and minimum of width, as is consistent with the character of the overburden and underlying solid material through which the waterway is to be excavated. This conclusion is furthermore reinforced by two other considerations which are usually involved, the first being that considerable heat is retained in the larger and deeper body of water which usually constitutes the source of initial supply, and this heat will be retained longer in the waterway itself if the section is narrow and deep instead of wide and shallow; the second consideration is that in a wide, shallow section, there is danger of the temperature of the bottom material being at times lower than the water which flows over it, thus offering encouragement to the formation of anchor-ice. On the other hand, if the waterway is deep enough, a converse condition obtains, whereby the underlying

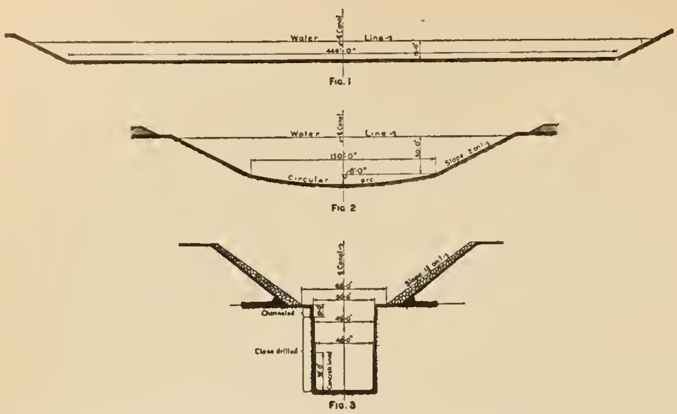


Plate No. C-7.—Typical Open Waterway Cross-sections.

strata will always be warmer than the flowing water, and its ice resisting properties will derive the additional benefit of convection, and variation in density.

Therefore, as regards the type of waterway under discussion, it would appear, from the standpoint of the ice hazard, that the primary factors influencing the design should be:—

(a) To provide as uniform and smooth a surface gradient from intake to forebay as topographical conditions will permit.

(b) To make the depth of the waterway as great in proportion to its width as the natural slope and scouring propensities of the overburden, and underlying solid material, if any, will allow.

More particularly where the channel of the waterway is in earth and the range of permissible velocities thereby limited, an additional manifestation of ice trouble must frequently be considered in the design, having to do with the effect of weekly load-factor on ice cover.

If a power plant, fed through an open waterway, ordinarily operates during the working days of the week under fairly uniform loading, a sustained period of extreme low temperature may cause solid ice cover to form throughout the length of the waterway, transforming it for the time being into a closed conduit subject to surge pressure.

If the above period of uniform plant loading terminates with a more or less sudden week-end shut-down, the induced surge pressures will rupture the ice sheet, and spurting water will flood the surface of the ice and saturate any snow which may have fallen, or drifted in, in the meantime. Subsequent to this occurrence, if the extreme weather continues, and the shut-down covers a period of, say, 36 hours, this surface water and slush will have time to freeze solid and become part of the original ice sheet, having nearly the same specific gravity. Consequently, when load is again pulled on, this thickened ice sheet will fall with the surface gradient and further contract the effective discharge area by an amount roughly corresponding to the increment of thickening. Furthermore, in a wide, shallow section the sheet will adhere to the shores and sag in the middle, and if it takes a freezing set in this position it forms an inverted arch which will greatly intensify the surge pressure, and flooding action, during the next ensuing shut-down period. In a deep, rectangular section the sag factor does not enter into the problem, because the ice sheet shears vertically at the shore lines, and rises and falls bodily with the surface gradient.

It might be assumed from the above description that the sagging ice sheet on a wide, shallow section could alternately flood and freeze until the water supply was shut off completely. This cannot happen where there is any reasonable volume of flow, because there is always a critical point, governed by fortuitous combinations of air and water temperature, at which the tendency of the sheet to thicken is counteracted by the erosive action of the free water, which increases with its velocity, and scours away the lower surface of the ice sheet. This action is necessarily much more rapid and pronounced in a deep, narrow section than in a wide, shallow one, because in the former instance the marginal, as well as the mid-section velocities, are high, and also because the water temperature is usually higher, as previously explained.

This concludes the argument in connection with the formation and resulting phenomena of ice cover, and the consequent significance of the width and depth relationship, and uniformity of flow, as factors in design.

On plate No. C-7 are illustrated several waterway cross-sections illustrative of the above argument.

Figure No. 2, represents the actual section, in earth, of a Canadian power canal, and figure No. 1 shows the shape of a conventional cross-section of the same area of wetted section. Figure No. 3 shows the actual section of the same power canal where the wetted perimeter is wholly in rock.

The above actual and comparative cross-sections show clearly that the width and depth relationship was pushed to the extreme limit of safety and feasibility, as governed by the angle of repose of the slopes in the case of the earth section, and by construction limitations as regards the section in rock.

Plates Nos. C-8 and C-9 are also actual views of the same power canal, and exemplify the development of the theory of velocity uniformity, and of width and depth relationship. On plate No. C-8 the points to note are, (a) the entire absence of any obstruction to stream-line flow, or flow acceleration, (b) the effect of the smooth vertical walls in reducing the disparity between marginal and mid-section velocities to a minimum, and (c) the relationship between the width and depth of the wetted section.

Plate No. C-9 indicates the means devised to overcome an unavoidable topographical feature in the form of a deep transverse ravine, the bottom of which was lower than the bottom elevation of the canal. Here again, cognizance was taken of the width and depth relationship by tilting the side slopes up on a $1\frac{3}{8}$: 1 ratio

Plate No. C-8.—Concrete-lined Power Canal.
Mean Water indicated by White Line.

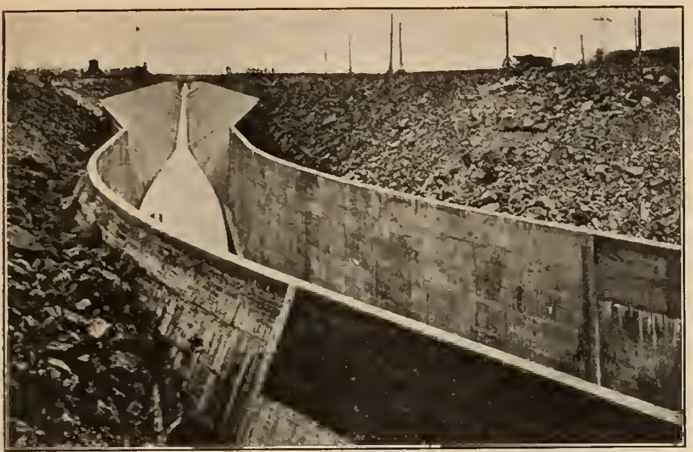


Plate No. C-9.—Curve Construction and Trapezoidal Canal Section over Soft Ground.

and crowding them together till the base width of the trapezoid was only 10 feet. Uniformity of flow and flow acceleration was also provided for, to the greatest extent possible, by determining experimentally the most efficient angles of enlargement and contraction respectively, at each end of the trapezoidal section, this latter feature being more clearly shown on plate No. C-10. The direction of flow in this view is toward the background.

Another interesting feature of recent Canadian practice in connection with open waterways has to do with the design of bends. The theory of this design is more conjectural than mathematically precise, and is briefly to this effect; (a) that the loss induced by the deflection of the stream-lines will be a minimum if the agency producing the disturbance, namely, the curve itself, is made as short as possible, and (b) that the turbulence induced by the change in direction of flow will be reduced and more or less localized if extra lateral space is provided at the seat of disturbance, so that whirls and eddies may be quickly dissipated, instead of being forced forward into the straight section of the waterway. The first requirement is met simply by making the radius of the curve as short as possible, and the second by making the curve equiradial.

A curve of this type is to be seen in the foreground of the views on plates Nos. C-9 and C-10. This curve has a radius of 300 feet, and the radius of curvature is the same on both sides, thus gradually increasing the extra width between walls up to a maximum of about five feet at the middle point of the curve. This expedient has been tested in actual operation and appears to function as anticipated.

Other features of Canadian practice under this head, including such problems as the fixing of economic mean velocity, bottom slope, and surface gradient for non-uniform flow, would require a detailed mathematical analysis for intelligent demonstration, and are therefore not susceptible of the descriptive and general method of treatment adopted throughout this discussion.

Long Pipe-Lines

As related to Canadian practice, it so happens, as in the case of large turbines, that several distinctive features of pipe-line engineering originated at Niagara Falls. Otherwise, Canadian pipe-line installations, in general, offer no unique or special features from the structural standpoint, with the possible exception of those shown on plates Nos. C-11, C-12 and C-13.

Plate No. C-11 is a view of a 6,600-foot reinforced concrete conduit having an area equal to an 18-foot diameter circle. The distinguishing feature of this structure is the oblate cross-section, which shows plainly in the picture, and is derived from an ingenious application of the stress characteristics of the "hydro-static chord", as applied to pipes of large diameter under comparatively low heads; that is, where a large part of the stress in the enveloping membrane is due to the hydrostatic pressure of the fluid contents of the pipe only, as would be the case with a large pipe subjected to a total static head of not more than three times its own diameter.

If a section of this pipe can be imagined as being constructed of some flexible but inextensible material, and stood on end, it is obvious that it would assume a circular shape when filled with water, and also that all portions of the envelope would be in pure tension. If, however, this section of pipe were then bulk-headed and laid on its side, the condition of pure tension would not obtain until a certain amount of the water had been released to compensate for the resultant deformation. In other words, if a hole were pierced in the top of the pipe, and a piezo-meter tube attached, the pressure which resisted deformation would be released, the water would rise in the tube, and the pipe section would bulge laterally until a condition of static equilibrium once more obtained, with the envelope again in pure tension. If the flexible membrane can now be imagined as assuming a state of permanent and practically rigid fixation in this latter position, the basic principle of the design shown on plate No. C-11 will be readily understood. In other words, taking into account the low external head on this pipe, it was found that the envelope would not be in pure tension if a circular section were adopted, and that heavy reinforcement would in such case be necessary to actually prevent the pipe from assuming an oblate form. On the other hand, by adopting the oblate section, a natural law of fluid pressure was taken advantage of instead of being violated, with the result that a very large saving in capital cost was realized by building a pipe designed for tension only, as compared with the cost of a circular section of equivalent strength and serviceability.

Plate No. C-12 shows a view of wood stave pipe construction. Apart from its large diameter, 13½ feet, the matter of interest is the design of the wooden saddles, as shown in detail on plate No. C-13. The feature of this design is the steel tie-rod, which is so placed that the total

Plate No. C-10.—Aeroplane View of Trapezoidal Canal Section with Curve and Transitions.

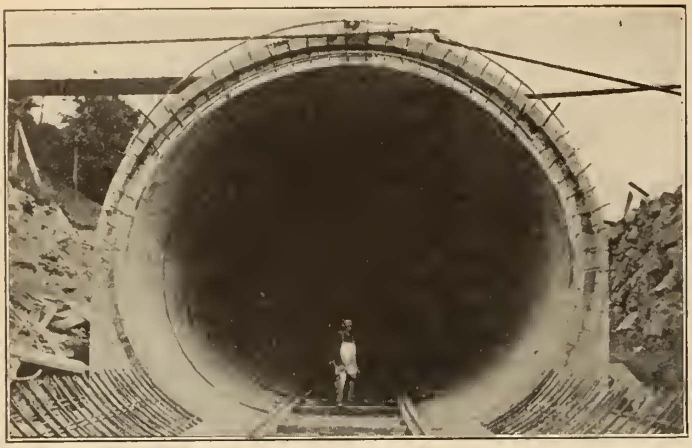


Plate No. C-11.—Reinforced Concrete Pipe of Oblate Section.

weight of the full pipe resists any tendency of the saddle to spread.

Where the development of power involves the use of a closed pressure conduit of any considerable length, certain phenomena become manifest which frequently constitute a serious menace to safe and practicable operation. The continuous rejection and pulling on of load increments, under such a condition, causes recurrent surges throughout the length of the conduit, which, if not damped out or relieved, will sometimes multiply and become super-imposed to such an extent as to cause pressures very greatly in excess of that due to the static head. This condition, in conjunction with the conversion of static pressure into velocity head for acceleration purposes, when a large increment of load is pulled on, will impose a duty in the governors which they are not designed to perform, and where long closed conduits are connected to overgated turbines, which is a far from unusual occurrence, an aggravated condition may obtain which is entirely beyond the regulating range of the governor.

Here, also, it happens that the advent of the "super-turbine" was the primary cause of bringing the above described phenomena into prominence in connection with modern hydraulic design. The reason for this was that the continuously increasing amounts of water to be handled gave rise to serious problems of pipe design, having to do primarily with the heavy capital cost involved in the construction of pipe-lines of constantly increasing diameter, while at the same time adhering to the then accepted limits of feasible peak-draft velocity. This condition naturally led to an intensive study of flow phenomena in closed conduits, the progress of the art under this head being marked by the use of primitive vent-pipe, the more modern stand-pipe, the bursting plate, and various mechanical devices, all aimed at the one possible means of solution; namely, the extending of the limit of feasible peak-draft velocity.

The discussion hereunder has to do with the controlling elements of this problem, and a description of the means of its final solution.

The power-discharge curve for the ordinary turbine will show a maximum production per second-foot at the point of best efficiency, and the first differential of this curve will show a rapidly decreasing rate of production per second-foot from that point to full gate. Consequently, every horse-power pulled on in excess of best efficiency capacity will require a rapidly increasing amount of water to produce it. If, therefore, the turbine is operating at or beyond the point of maximum efficiency, when the system demands a large increment of load, there will be a falling off in power production per unit of water supplied, and coincident therewith, a loss of effective head, due to the absorption of such velocity head as is necessary to accelerate the water-column. During the period when the water-column is accelerating, it is therefore evident that a condition might obtain where the power output is actually falling off while the water input is increasing, the result being that the governor may open the gates full-stroke in response to the falling speed, at which point its controlling function will cease, until either the fly-wheel effect of the system holds the unit, with dropping frequency, for the space necessary for the governor to gradually resume control on rising speed, or until the generator drops the load and the turbine jumps to runaway speed at full gate, with possible disastrous consequences.

Insofar as the control of surge pressure is concerned, it is evident that if no practical limitations be placed upon it, in the matter of diameter and height, the ordinary stand-pipe would be an ideal corrective agency. It is clear, however, that in the case of a large capacity high head installation, unrestricted scope in design is wholly impracticable from the standpoint of both cost and space limitation. On the other hand, a simple stand-pipe, designed and located within reasonable cost and space limitations, may at times actually make more acute the conditions it is designed to correct or alleviate. This is due to the fact that the simple stand-pipe can only passively absorb surge pressure, with its recurrent phases, and for this reason often acts as an agency for superimposing, one upon the other, pressure waves generated by successive changes in load.

Another obvious expedient under this head is to limit the range of velocity change in the conduit by means of a synchronous relief-valve or by-pass, actuated by the governor mechanism. Such a contrivance can be adjusted to prevent the occurrence of disruptive pressures in the conduit, and also to supplement the influence of the system fly-wheel effect, in holding the unit within the regulating range of the governor when the unit is pulling on or rejecting load, but only by reason of the fact that the condition under discussion has not necessarily to do with the maximum conduit velocity at any one time, but with the *range of change* in conduit velocity over a short period of time, and with the absorption and building up of head energy induced by these changes, within their low and high limits.

The synchronous by-pass or relief-valve therefore has a useful function, but in the case of a large high head installation, its usefulness would be largely discounted by its cumbersome dimensions, its waste of water, and an added mechanical complexity which should be avoided whenever possible as a matter of principle.

The discussion under this head has now reached a stage where it is possible to define the specifications of an ideal surge control agency:—

(a) It should have the effectiveness of a simple stand-pipe of very large dimensions, without its cost and space requirements.

(b) It should be capable on the one hand of preventing, or counteracting the effect of, any undue absorption of head energy when load is pulled on, and on the other hand, of preventing or counteracting the effect of, any serious recurrent surge pressures arising from load rejections, whether isolated or successive.

(c) The water surface should be sufficiently active to prevent freezing in ordinary low temperatures, and dimensions should be such as to allow feasible and effective frost protection against extraordinarily low temperatures.
(d) It should operate without wasting water.
(e) It should be mechanically simple with a minimum of moving parts and adjustments.
(f) It should be entirely dissociated from the governor mechanism, leaving the governor free to perform its own peculiar and highly important function, which is to control the speed of the generator, and not the vagaries of the water-column.

This specification has been met with a large degree of effectiveness by the Johnson differential surge-tank, one of the most wholly original and useful contrivances recently developed in the field of hydraulic engineering.

It has been above stated that the incentive which initiated the development of modern pipe-line engineering in Canada was the necessity of extending the limit of feasible peak-draft velocity. This problem, in the first place, involved a realization of the fact that if the old standards of design were adhered to, pipe-line and standpipe construction would soon reach a dimensional limit which would be fixed almost wholly by cost considerations. Furthermore, where large modern turbines are connected to long pipe-lines, the element of mass becomes a major factor in design, as related to the effect of the inertia and momentum of a heavily energized water-column on speed control.

As the two factors, inertia and momentum, are a direct function of velocity, length of pipe, and gross head, it follows that there are possible combinations of these factors, especially if they involve a very low ratio of gross head to length of pipe, where the older methods of design may be entirely inadequate even at prohibitive cost. The unique feature of the differential surge-tank lies not in the fact that it can merely improve and cheapen conditions, which might be met by other means, with an adequate degree of effectiveness, but that it can insure efficient speed control even under the extreme conditions above mentioned. The reason for this will now be explained, after first briefly describing the main structural features.

The structural features of the differential surge-tank are extremely simple and consist of three essential elements; namely, an ordinary tank of diameter and height varying with the conditions to be met; a simple standpipe, or "riser", having about the same diameter as, and connected direct to, the pressure conduit, and also projecting through the bottom of the tank to a height definitely fixed by design; and finally, one or more "ports" or openings, precisely located and proportioned, forming a water connection between the internal riser and the bottom of the surrounding tank.

Plate No. C-12.—Large Wood Stave Pipe Construction.

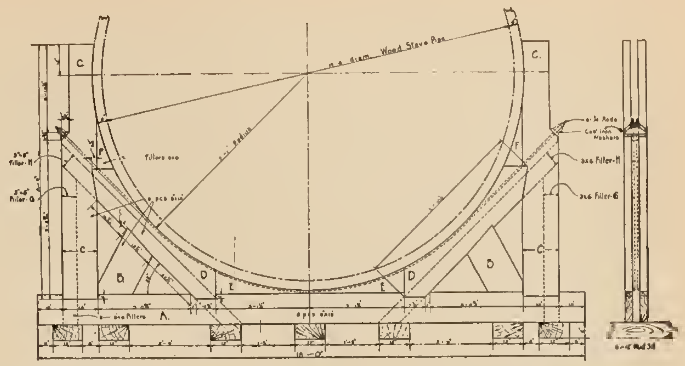


Plate No. C-13.—Detail of Saddle Construction for Wood Stave Pipe.

In the case of an ordinary simple tank, the taking on of an additional increment of load will cause the contents of the tank to fall bodily through a distance which measures the head necessary to accelerate the water-column and meet the demand of the turbines for more water. Conversely, following a rejection of load, the water-column in the simple tank moves bodily upward through a distance which measures the balancing conversion of active energy or velocity head, into potential energy or static head.

The characteristic accompaniment of this cycle of operations is the assumption of a pendulum-like oscillation, synchronous with the period of the pipe-line, and controlled, so far as the inherent capabilities of the simple tank are concerned, solely by friction. It is evident, therefore, that the simple tank has one attribute only which can be utilized for the flow control of a long pipe-line; namely, storage capacity, which in turn is a function of diameter and height, and therefore of capital cost. On the other hand, the differential surge-tank possesses an additional characteristic, distinct from storage capacity, which enables it to function with very much greater effectiveness than a simple tank of similar dimensions or equal cost.

In order to concisely and clearly describe the principle of operation of the differential surge-tank the following hypothetical cycle of plant operation will be assumed:—

(a) Turbines operating on constant gate-opening, with resultant balanced conditions in the system.
(b) A sudden demand for a large increment of power.
(c) Reversion to balanced conditions, after the above demand has been met and maintained.
(d) A sudden rejection of load.

Under condition (a) the respective levels in riser and outer tank must necessarily be the same, with no characteristic different from a simple tank.

Under condition (b) there occurs an immediate and rapid drop in the riser water level to an elevation *below* the hydraulic gradient corresponding to the then existing conduit velocity, thus almost instantaneously communicating to the main conduit the velocity acceleration impulse required for the delivery of an additional supply of water. Coincident with this action in the riser, but at a different and much slower rate, there occurs a drop in the level of the water in the outer tank, which naturally results from the passage of water through the ports into the riser, under the impulse of the lower water level therein. The outer tank therefore has the two-fold function of supplying stored water during the speeding up interval in the main conduit, and of helping to maintain the head on the wheels while the riser water-column is furnishing a maximum of accelerating impulse to the velocity in the main conduit.

Under condition (c) balanced conditions are again assumed, with riser and tank levels equalized at the new hydraulic gradient.

Under condition (d) there conversely occurs an immediate and rapid upward surge in the riser water-column to an elevation *above* the hydraulic gradient corresponding to the then existing conduit velocity, thus immediately communicating a decelerating and damping impulse to the conduit water velocity and to the induced surge pressure. At the same time there occurs a flow from the riser through the ports, to storage in the outer tank, which is necessarily governed in rate and quantity by the difference in levels. This joint functioning on the part of the riser and tank continues until the levels finally equalize on the new running gradient.

The above description of operating regimen should serve to make clear the differential action from which this type of tank takes its name; that is, the function of the active and sensitive water-column in the riser in imparting an appropriate accelerating or decelerating impulse to the conduit water-column, as differentiated from the separate but simultaneous function of the outer tank in making good any short period deficiency in water supply on the one hand, or in storing rejected water on the other. The separating of these two functions, by means of flow back and forth through the ports, has the further effect of destroying the synchronism between the conduit and tank water-columns. Its effectiveness in this connection is so marked that the most extreme and dangerous operating condition possible, where a simple tank is used, cannot obtain; namely, a condition of synchronism between successive load changes on the turbines and the harmonic period of the pipe-line.

The crucial factor of design, in order that the differential surge-tank may have the characteristics above described, is to fix the area of the ports, and the proportions of the outer tank, so that, upon a change of load, the new elevation immediately assumed by the riser water-column shall be maintained throughout the entire period of change in velocity of conduit flow, while at the same time the rate of depletion or replenishment of tank storage, as the case may be, shall be such that the equalization of tank and riser levels will coincide with the resumption of a stable running gradient in the conduit system.

Contrary to the case of the simple tank, the above principle of design is susceptible of such exact mathematical analysis that predicted performance is usually realized in operation within a margin of two per cent maximum error in any part of the cycle, so that, if required, the differential tank may be designed for "dead-beat" action. In the majority of cases, however, this characteristic is not of sufficient importance to justify the extra cost involved, but where the pipe-line is very long and the velocity and friction gradient high, the non-synchronous functioning of this type of tank nevertheless makes it possible, well within the cost limits of a simple tank of adequate dimensions, to design for the "dead-beat" or absolutely non-oscillatory condition, where the range of variation in tank levels is never beyond either the maximum or minimum running gradients of the conduit system, as governed by the characteristics of the connected load.

The initial consideration involved in the design of one of these tanks is the range of load change over which it is intended to function. This in turn involves primary consideration of the nature and characteristics of the system load, but in a scarcely less important degree, the co-related factors of length of unregulated pipe-line, and the fly-wheel effect, whether inherent or externally applied, of the machine installation. There is wide scope for experienced judgment in this connection, and though quite possible, it is not usual to design the tank for perfect functioning under the full range of emergency or accidental load variation, but rather for a range in the neighborhood of 40 to 60 per cent of full load pulled on instantaneously, but making it safe, at the same time, for full load rejected. This latter condition is made possible by the fact that the only abnormal result of a full load rejection is the overflowing of the internal riser, which spills into the outer tank. The volume and impact of this overflow furthermore acts as a direct deterrent to the conduit surge, and thus reduces the amount of water required to be absorbed by tank storage.

Plate No. C-14.—Exterior View of Simple and Differential Surge-tank.

Plate No. C-14 is a view of two surge-tanks forming part of a large Canadian installation. These tanks are connected each to a conduit of identical length and cross-section. The structure on the left is a simple tank, and that on the right is the first differential tank ever designed and built. The conduit connected to the simple tank is of rivetted plate steel construction, while the differential tank is connected to the reinforced concrete conduit shown on plate No. C-11.

Plate No. C-15 is a cross-section through these tanks which clearly shows their distinctive features. It will be seen that the simple tank, on the left, has no function whatever beyond the relieving of surge pressure and the passive acceptance of water rejected by the turbines, to be passed to waste, if necessary, over the crest of a weir into a spiral discharge tunnel. In the other section the elements of the differential surge-tank may be clearly seen, consisting, as indicated, of an outer storage tank, an inner regulating riser, and two sets of connecting ports, one set of overflow ports near the top of the riser, and the other set located between the top of the conduit and the

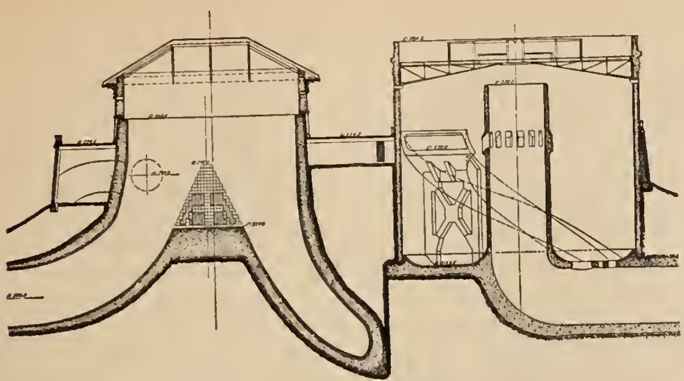


Plate No. C-15.—Cross-sections of Simple and Differential Surge-tanks.

floor of the tank. There is also shown an overflow weir which is not essential to the design. It would probably have been cheaper to have made the tank high enough to impound all rejected water, but certain conditions, quite unrelated to the hydraulic design, made it necessary to restrict the height of the structure at the time it was built. As a matter of fact, a third tank subsequently built in connection with the same installation, was of the non-spilling type. This tank is of steel construction and is shown in section on plate No. C-16. It requires no further explanation beyond calling attention to the fact that the elevation reached by the rejected water, for full load instantaneously thrown off, is indicated on the drawing.

Two interesting features in connection with the tanks shown on plates Nos. C-14 and C-15 are worth mentioning.

As previously mentioned, the conduits connected to each of these tanks are alike in length and cross-section. The maximum allowable peak-draft velocity in the conduit connected to the simple tank is 15 feet per second, and its maximum power capacity is 59,000 e.h.p. On the other hand, the conduit connected to the differential tank can be operated up to a peak-draft velocity of 26 feet per second under perfect conditions of turbine governing, and its resultant power capacity is 97,000 e.h.p., an excess of 38,000 e.h.p., over the other conduit, which condition is jointly due to the solution, by means of the differential tank, of the problem of extending the limit of safe and operable peak-draft velocity, and to the superior hydraulic characteristics of the concrete conduit. If the simple tank were replaced by a differential tank, the maximum power capacity of the steel conduit would be increased to 70,000 e.h.p., or a net gain of 11,000 e.h.p., for which the differential tank is responsible, and a margin of 27,000 e.h.p., due to inherent hydraulic characteristics of the concrete conduit.

The other interesting point is of a purely structural nature. The differential surge-tank shown in section on plate No. C-15 is built of reinforced concrete, and on account of its large diameter, a certain amount of deformation was anticipated under water pressure. This deformation would naturally take the form of an increase in the diameter of the barrel of the tank, thus introducing an extremely complex problem of stress determination and distribution of reinforcement as related to any rigid connection between the barrel and the base of the tank. This problem was finally solved by the unique method of doing away entirely with any such rigid connection, and providing instead a free sliding contact between the base of the tank and the annular area of the barrel. This method of solution is shown in part on the above mentioned cross-section and apparently consists of a low curb of diameter slightly less than the inner diameter of the barrel. The real point of the procedure, however, consisted in providing a smooth finished surface on the annular section of the base under the barrel of the tank, and simply building the barrel on it, after first applying a grout wash. There was thus provided a free sliding contact upon which the tank could swell and contract under pressure, and water-tightness was secured solely through the agency of the weight of the tank.

This tank has been in absolutely uninterrupted service for twelve years, and has been perfectly water-tight from the first day of its operation.

An interesting application of the differential tank is shown on plate No. C-17, where the greater portion of the tank and riser consists of a shaft excavated in solid rock and lined with concrete. This surge-tank regulates two steel conduits 35,000 feet long, and is connected to three units, each of 35,000 e.h.p., capacity, operating under a net head of 857 feet. It is designed to give good regulation for an instantaneous load increase of any amount up to 50 per cent of full load, and to take full load rejection with a small percentage of spill.

Forebay Structures

The general problem under this head is to a large extent analogous with that of entrance structures, in that it primarily involves the adequate protection of the penstock intakes from entrance of, or obstruction by, ice and other floating material, and also because the gravity of the problem is proportional to the percentage of flow diverted from the initial source of supply. The fact also that the forebay structures, which are assumed to include

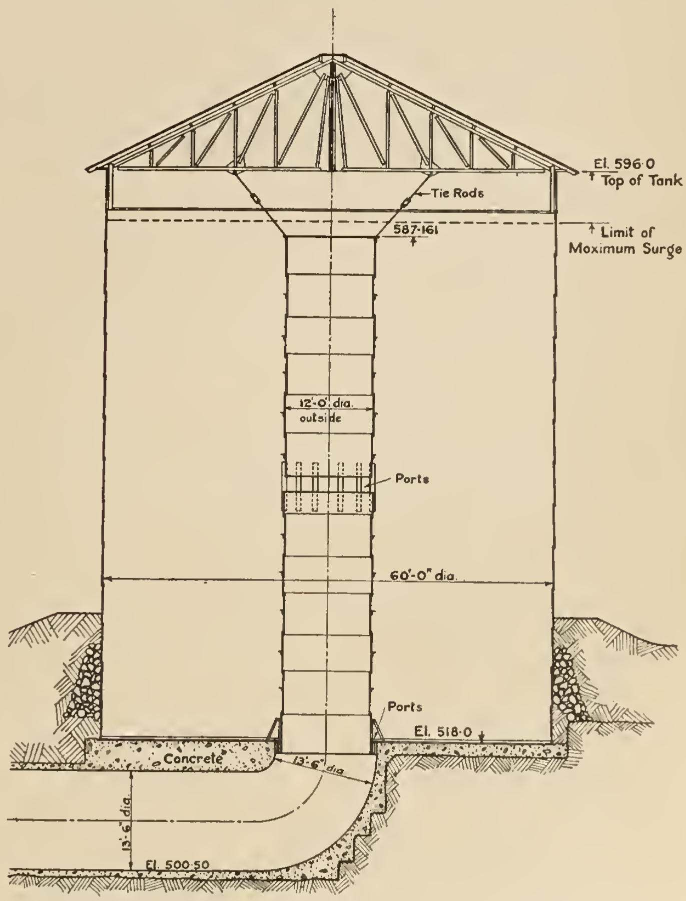


Plate No. C-16.—Cross-section of Surge-tank of Non-spilling Type.

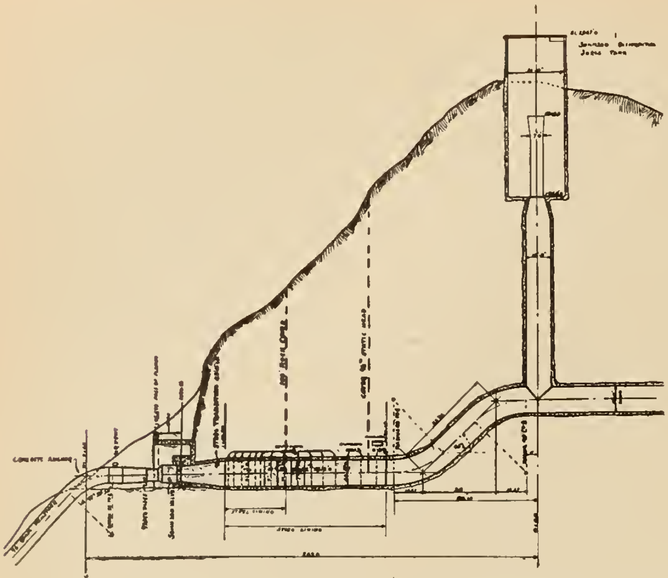


Plate No. C-17.—Differential Surge-tank in Rock.

the racks, constitute the last line of defense before the water enters the wheels, adds materially to their importance from the standpoint of design.

Whether the distance from the forebay to the initial source of water supply be long or short, it is nearly always necessary to reduce the velocity in the feeding waterway before it passes through the racks, thus introducing at once the problems of enlargement loss and draft distribution. Unless the velocity in the feeding waterway is very low, the above conditions manifest themselves in the form of reverse currents and eddies along the margins of the enlargement, because the momentum of the entering stream has a tendency to keep the flow in straight lines instead of diverging with the cross-section, and frequently also tends to form localized vortices in front of the racks or curtain-walls, through defective draft distribution. Besides dissipating otherwise convertible energy, the above conditions have the far more serious effect, previously mentioned, of forming areas where floating material, including ice, will be trapped, or where suction will overcome its buoyancy impulse, and draw it into the racks or penstocks before it can be harmlessly disposed of through ice-weirs or chutes.

Plate No. C-18 shows a view of the forebay and gate-house of a large Canadian installation recently placed in operation. Under ultimate peak-draft conditions, the velocity at the throat of this forebay will be about 12 feet per second, and as the most efficient angle of enlargement could not be adopted on account of the prior requirement of main unit spacing, it was evident that the high momentum of the entering stream would produce very undesirable conditions in the forebay, in the form of defective draft distribution, vortex action, and general turbulence. This condition was remedied by inserting a wedge-shaped diffuser in the throat of the forebay, as shown in the foreground of the above mentioned illustration. The length, shape and critical dimensions of this structure were fixed by experiment, the factor of first importance being the determination of the most efficient angle of flare in the passages on each side of the diffuser, the flare angle of the forebay walls being definitely fixed. The height was so adjusted that the top would be slightly submerged at maximum hydraulic gradient, in order that there would at no time be any available anchorage to encourage ice formation.

The performance of this structure, at loads somewhat in excess of one-half ultimate capacity, has been satisfactory, and indicates that a uniform draft distribution will obtain under all conditions of flow, with the incidental result that nine-tenths of a foot of velocity head will be regained, or about 1,500 e.h.p., of otherwise wasted energy made available under peak-draft conditions.

In another large Canadian plant, a substantially similar problem was solved by the interesting and original method illustrated on plate No. C-19. In this case, as will be seen, the remedy was applied after the water had passed through the racks, instead of in the forebay itself. Two conditions made this procedure expedient; namely, the irregular shape of the forebay, and the importance, in view of the large quantity of water involved, of transmitting the flow from the forebay into a 20-foot diameter tunnel with a practicable minimum of loss. This latter requirement, in turn, called for uniform draft distribution through the racks, and smooth acceleration from that point to the circular tunnel section.

The above result was obtained by means of a design precisely similar in principle to that previously described under "Entrance Structures". As the illustration indicates, this structure consists of a "gathering" tube heading directly into the tunnel, and branching off from it, at an angle of about 35 degrees, are five passages of varying length and cross-section, which emerge abreast at a like number of sluice openings in the gate-house.

The shortest passage enters the gathering tube through an elliptical opening analogous to the "priming tip" in the design previously described, and similarly also, the remaining four passages enter the tube through longitudinal slots of gradually decreasing width, as the illustration shows, and so proportioned as to deliver to the gathering tube a constant increment of flow per unit of axial length. The cross-section of the gathering tube was fixed upon the assumption that the discharge at any point was proportional to the square of the velocity, the dimensional result being a gradually increasing area in the direction of flow, and the hydraulic result, a smooth acceleration of flow up to the junction with the constant tunnel section.

Plate No. C-18.—Forebay Diffuser.

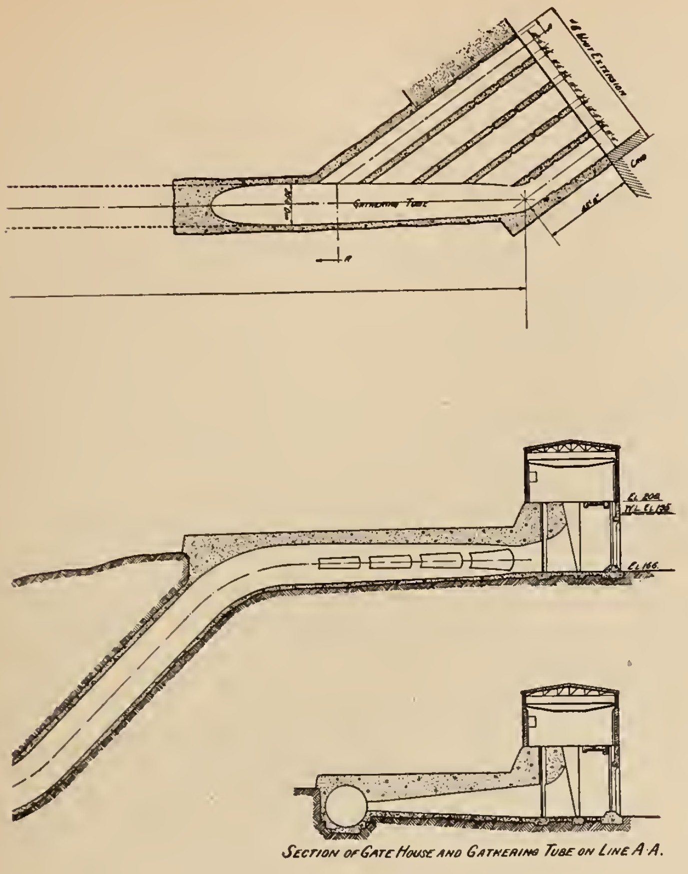


Plate No. C-19.—Forebay Intake with Gathering Tube.

This intake was recently tested under operating conditions, and the degree of uniform draft distribution actually realized was as follows:—

No. 1 or priming sluice	— 20 per cent of total flow
No. 2 sluice	— 21 " " " "
No. 3 sluice	— 22 " " " "
No. 4 sluice	— 20 " " " "
No. 5 sluice (the longest)	— 17 " " " "

The deficiency in respect of No. 5 sluice was considered to be due to a ledge of unexcavated rock immediately in front of it. Such being the case, the above results show such a close agreement between predicted and actual performance, as to constitute a distinct advance in the art.

The primary considerations in gate-house design are, first, the fixing of sill elevations so as to make surface draft a minimum, and to permit a properly proportioned and symmetrical acceleration of intake velocity for the full range of forebay gradients; and second, to completely house in the racks and provide such a curtain-wall seal as will insure frost protection to the above-water portions of the rack structure, and at the same time protect the penstock openings from surface ice and other floating material.

Plates Nos. C-20 and C-21 show a plan and section of a gate-house designed in accordance with these principles. The features of this design are the carefully transitioned intake passage, the deep curtain-wall seal, deep submergence of racks, and a considerable length of rack above water level. All of these features combine to deliver water to the penstocks with a minimum of loss and disturbance and to maintain unimpaired service under winter operating conditions.

The deep curtain-wall seal serves the double purpose of fending off floating material and of protecting the racks from the cold. The superstructure is also built so as to allow any necessary inside temperature to be maintained. The deep submergence of the racks gives the bottom sections the protection of the lower strata of water where the reciprocal effect of density and convection tends to maintain temperatures above freezing point. Similarly, when the interior of the superstructure is heated, the long section of rack above water protects the upper submerged sections through the agency of conduction. Conversely, if the exposed sections of rack are not warmer than the water, a condition may obtain where the racks will absorb heat from the water, with the result that anchor-ice will form on the rack-bars at critical temperatures.

An interesting feature of the design illustrated is that no portion of the rack structure is permanently fixed under water, as the sections are entirely self-supporting between the intake piers, and all metal structures are removable with the exception of the channels lining the grooves. Plate No. C-22 shows the construction of one of these rack sections, which is designed to withstand a pressure corresponding to a static head of 10 feet. For this reason there is little likelihood of the rack structure failing as a result of being clogged with ice or debris.

Penstocks

Nothing of an outstanding nature has developed in Canadian practice under this head, the various types of plate steel, wood stave, reinforced concrete, lock-bar and welded steel penstocks being installed more or less in harmony with the governing factors of static head, length, gradient, size of installation, and climatic conditions. The influence of these factors, in their various combinations, upon the design and type of installation does not require to be enlarged upon at any length for the reason mentioned at the outset.

When extreme low temperature is a factor, it is common practice to house in or bury the penstocks, or to use wood stave pipe, where the other factors permit, on account of its cold resistant properties. As an alternative to the very doubtful expedient of burying steel pipe, the

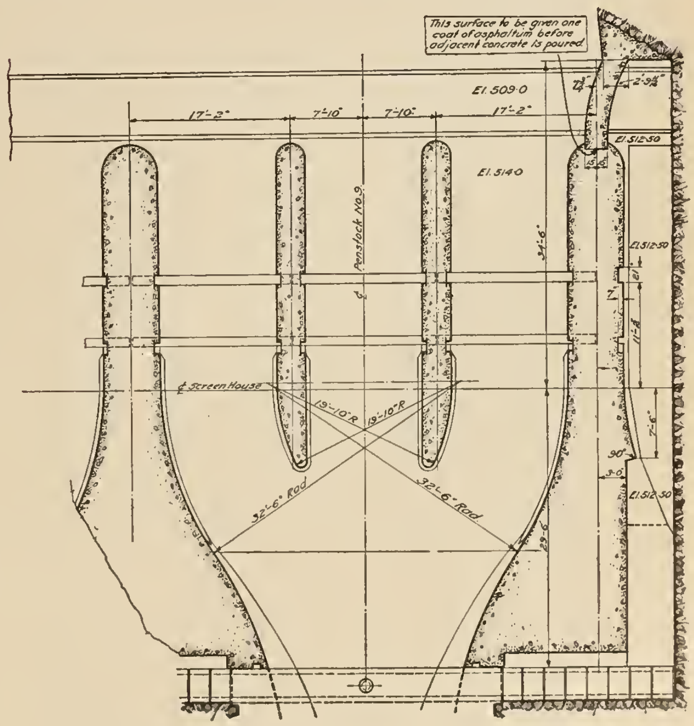
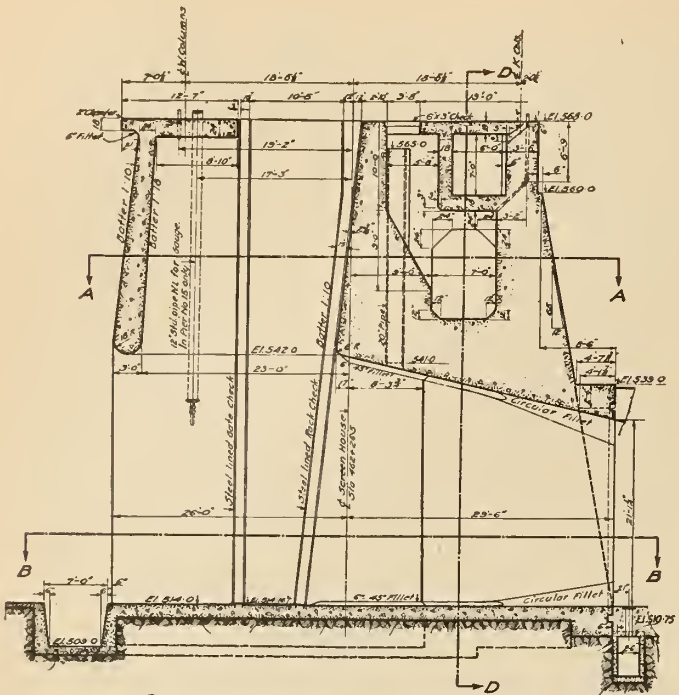


Plate No. C-20.—Plan of Gate-house Substructure.



CROSS SECTION ON ℄ MAIN PENSTOCK.

Plate No. C-21.—Cross-section of Gate-house Substructure.

better method of encasing it in concrete is often employed, and where the distance is short from head-gate to turbine, solid concrete alone is used with the joint object of frost protection and permanence. Plate No. C-23 illustrates this type of design as applied to one of the earlier "super-turbine" installations in Canada, consisting of nine horizontal units each of 20,000 e.h.p., capacity, under an operating head of 83 feet. It will also be noted that the entire substructure assembly, including not only the penstock, but the dam, scroll-case and draft-tube, is monolithic.

Plate No. C-24 illustrates a minor feature of penstock design, of Canadian origin, which is of some interest. The penstock to which this detail was applied is 400 feet long, 16 feet in diameter, and is connected to a 58,000 e.h.p., unit operating under a normal head of 300 feet. Instead of the ordinary lap-joint for the girth seams, a single external strap butt-joint was used to secure the best possible alignment of flow.

The other special feature of this construction was the electric welding of all joints in the interior of the pipe. The drawing reproduced on plate No. C-24 shows how the edges of the butting plates are chamfered, thus forming a V-shaped recess to receive the weld. Plate No. C-25 shows a view of the finished interior construction of this penstock. Six of these penstocks have been placed in service, and upon filling, none of them showed any signs of leakage beyond a small amount of sweating, usually around rivet-heads.

Under the circumstances, it does not appear that any further development in penstock design and construction, of a revolutionary nature, is to be anticipated in the future.

Penstock Valves

As a result of the growth in the size and unit capacity of the turbine, the safe and expeditious control of static pressure finally became the most vital of all the ancillary problems of plant design; simply by reason of the fact that the faulty or uncertain control of a proportionately heavy penstock water-column would otherwise introduce an element of personal and investment risk so serious as to largely discount the value of expensively acquired operating efficiency.

The ordinary gate-valve offers an entirely inadequate solution for the problem where high heads are involved, and even for comparatively low heads, in cases where the penstock is beyond six feet in diameter. Similarly, the butterfly valve, while it has a much wider range of application than the gate-valve, becomes a source of serious operating risk as related to the higher order of unit capacities now becoming prevalent in Canadian practice.

The above limitations have naturally developed to a large extent through the almost unavoidable necessity of placing the penstock valve adjacent to the turbine in the larger modern installation, thus subjecting the valve to the pressure of the full static head. This necessity arises primarily from the fact that a valve, at or near the entrance of a large penstock, cannot protect the plant against a sudden or uncontrolled release of the potential energy of the static water-column, such as might occur in the event of a wheel-case failure, or a failure in governor control. A further advantage arises from the saving in time which would otherwise be lost in draining and filling the wheel-case.

The general specification for a large penstock valve may be written as follows:—

(a) It must be capable of being built in any size necessary to accommodate any conduit, however large.
(b) It must be capable of being designed to operate under any static head, however high.
(c) It must open and close rapidly.
(d) It must be tight under all conditions of service.
(e) Its operation must at all times be safe, sure and positive; in opening under any static pressure, and in closing under the most serious of plant emergencies.
(f) Where very large penstocks are involved, there should also be an automatic closing device.

Obviously, the above specification eliminates the older types of valves, but it has nevertheless been met to a substantial degree, in Canadian practice, by the use of the Johnson automatic plunger valve.

This valve, like the differential surge-tank, is a distinct hydraulic specialty based on simple and inherently sound fundamental principles, and its development has proceeded along lines that should ultimately lead to its exclusive use for the purpose under discussion, if a proper proportion of its comparatively high cost is allocated to the safety insurance which its use makes available to an unusual degree, even under the most onerous conditions of service.

The structural features and operating principle of the Johnson valve are shown diagrammatically on plate No. C-26.

The valve consists of two main elements, one being an outer shell or casing, the larger end of which is connected to the penstock, and the smaller end to the turbine casing. Within this outer shell is a smaller torpedo-shaped structure, the rear end of which, marked *A*, is rigidly attached to the casing, while the forward section, or plunger, telescopes it and can move back and forth within it on a sliding fit. The annular space between the inner and outer element is the main water passage of the valve. It is therefore clear from the diagram that the passage of water through the annular space is entirely controlled by the position of the moveable section of the plunger, which shows fully closed in the diagram.

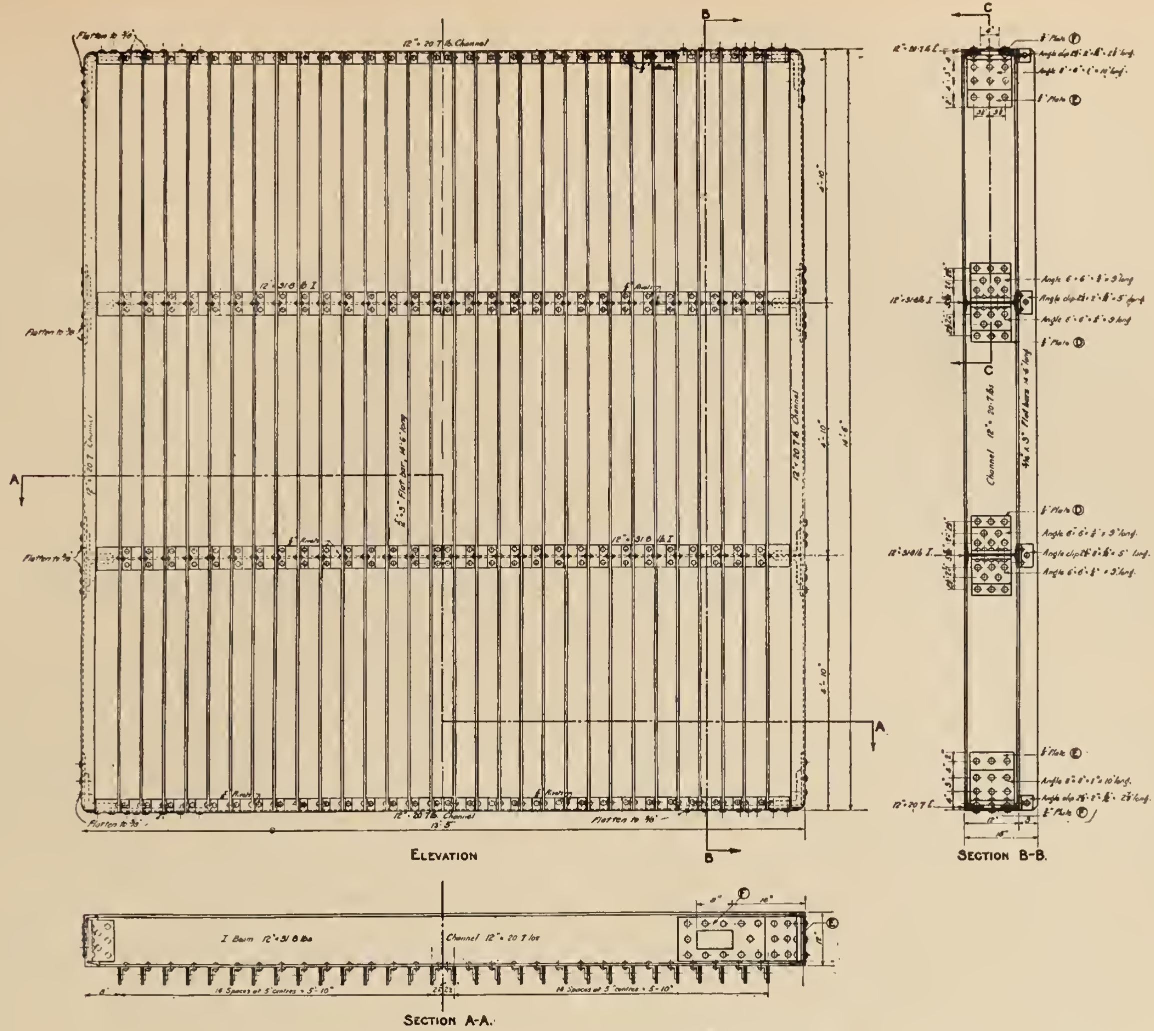


Plate No. C-22.—Self-supporting Rack Section.

Of these several types of control devices used in connection with these valves, that shown on plate No. C-26 is in most common use on large installations, and illustrates a principle of operation common to all. This control is effected by means of three small plunger valves, marked 1, 2 and 3 on the diagram, each of which is actuated by a pilot piston, which in turn is operated by penstock pressure.

As indicated on the diagram, valve 1, (set vertically) is connected direct to the interior of the plunger body, by means of a pipe traversing the main water passage. Valve 2, (set horizontally), connects the main water passage with the inner chamber *A*. Valve 3, (set vertically), is connected direct to the annular chamber, marked *B* on the diagram, which is formed by the difference in diameter between the main body of the plunger and the enlarged rear flange. The pipes shown leading away from valves 1 and 3 discharge to atmosphere.

The valve now being in closed position with no pressure in the turbine casing, it is clear from the diagram, that in order to keep the plunger seated there must be penstock pressure in the chamber *A*. Consequently, valve 2 must be open, and exhaust valve 1 must be closed.

To move the plunger off its seat it is evident, in the first place, that the penstock pressure in chamber *A* must be exhausted to atmosphere, which process is affected by closing valve 2 and opening exhaust valve 1, but as there is no pressure in the turbine casing it is necessary to provide, by other means, the impulse necessary to move the plunger back against the atmospheric pressure in chamber *A*. This impulse is supplied direct by the penstock pressure, which builds up in the annular chamber *B* as soon as valve 3 is closed, through the agency of the priming port 10 and the leakage through the fit.

It is also evident that when the valve has been slightly opened, the initial differential impulse is augmented by the reaction of the free spouting jet on the plunger nosepiece, unless the turbine casing has been previously primed.

In practice, the opening and closing operations are performed by the manipulation of a single reversible hand lever connected to the pilot pistons by a three-way plug valve. When the lever is on the neutral point all three operating valves are normally closed. When the lever is thrown over to the opening position, valve 1 opens immediately, and exhausts the internal chamber to atmosphere, upon which the differential pressure in the annular chamber begins to function and the plunger moves to the open position. The operating lever is then restored to neutral position with all operating valves closed. To close the valve, the operating lever is swung in the opposite direction, thus simultaneously opening valves 2 and 3, with the result that penstock pressure is restored in the inner chamber *A*, and the annular chamber *B* is exhausted to atmosphere, so that the plunger must move to the closed position.

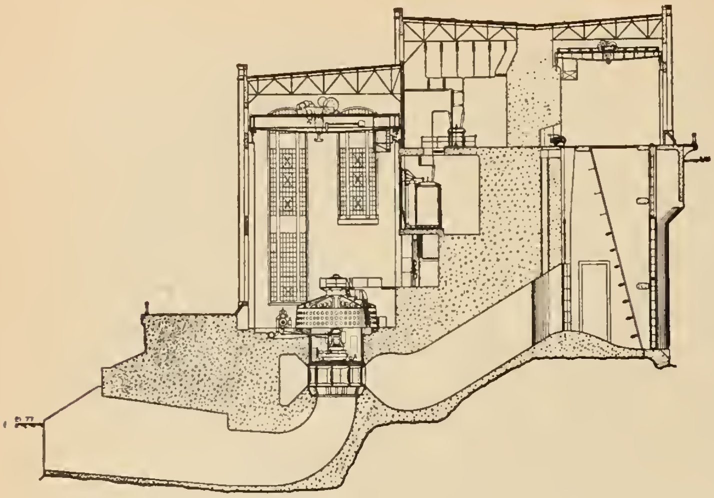


Plate No. C-23.—Typical Concrete Penstock Construction.

In order to obviate any serious pressure rise in the penstock, and to prevent shock in seating, a small pipe is provided at the point 4, which is connected to the control valves; therefore, when the plunger is within about half an inch of closing, the high velocity in the throat causes a reduction of pressure at that point, which reacts on the pilot pistons of valves 2 and 3 and closes them. The result is that the plunger must travel the remaining distance to its seat at a greatly reduced speed, which is directly proportional to the rate at which the water trapped in the annular chamber can escape by leaking through the sliding fit.

The pipe connection at point 4 serves also the purpose of priming the turbine casing during the opening cycle. When the control lever is thrown over to the opening position, and valve 1 opens the inner chamber to atmosphere, the plunger cracks open until the jet velocity causes a sufficient drop in pressure to close valve 1, upon which the plunger immediately moves back to its seat. It opens up again immediately, however, as the control lever is still in the opening position, so that a reciprocating oscillation of the plunger is automatically set up which continues until the turbine casing is primed, after which the plunger moves to its final open position.

Plate No. C-26 also shows the necessary connection for the automatic closing of the valve in the event of a break in the turbino casing of any accident which would result in losing control of the penstock water-column. This result is achieved by the simple expedient of connecting valves 2 and 3 to the turbine casing by means of the pipe indicated at point 5. This connection, as regards the closing stroke, functions in precisely the same manner as the throat connection at point 4.

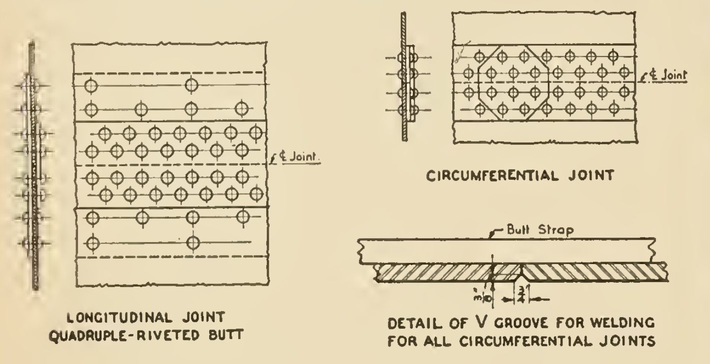


Plate No. C-24.—Detail of Riveted and Welded Penstock Joint.

At point 15 is a valve which controls the automatic closing connection, through the agency of a pair of dogs on the indicator arm. When the plunger is seated this valve is closed, so that the throat connection can function for the priming operation. When the plunger moves open the dog on the indicator arm throws valve 15 open so that the automatic closing feature may function if required.

Plate No. C-27 is a shop assembly view of a 16-foot Johnson valve now installed in a Canadian plant under a 300-foot head, which clearly shows the control mechanism, the control valves numbering 1, 2 and 3 from the left, according to the previous diagram. The vertical valve on the left is the exhaust from the inner chamber, which is also in view on the left. The horizontal valve in the centre is the penstock pressure connection, while the other vertical valve is the exhaust from the annular plunger chamber. At the extreme right is seen the nose-piece of the moving plunger projecting beyond the cast steel housing.

Plate No. C-28 is a view of a 20-foot Johnson valve built in Canada, which is at such a stage of assembly as to show very clearly the main annular water passage and the annular plunger chamber.

The tightness of the Johnson valve is due to the wide angle at which the seat rings meet when in the closed position. There is no dragging of unlubricated surfaces tangentially over each other under heavy pressure, while at the same time the sealing surfaces meet with great pressure intensity, due to the small area of contact, the result necessarily being an extremely tight closure.

Plate No. C-29 is a view of the first Johnson valve ever built. This valve has been operating continuously in a Canadian plant since 1911. It is still in perfect condition, and has had no repairs or maintenance whatever in the interval, beyond an occasional coat of paint

Governors

The development of the art of speed regulation and control in Canada has been materially influenced and simplified by three factors which are complementary to, but not integral with, the governor mechanism itself; namely, the modern methods of controlling the inertia and momentum of long water-columns; the inherent

Plate No. C-25.—Penstock with Welded Joints.

fly-wheel effect of large generators, combined with automatic voltage regulation; and the system fly-wheel effect of the large transmission net-works which absorb the output of the majority of large Canadian installations.

As to the turbine governor itself, the so-called double compensation principle is the accepted basic element of design, together with the utilization of the inherent speed-drop characteristic to maintain stable conditions of synchronism and local distribution on unit groups in parallel, within such normal range of demand as may be fixed by the characteristics of the connected load.

Briefly described, the double compensation principle of speed control, as applied in Canadian practice, involves first the provision of a quick-acting direct primary impulse

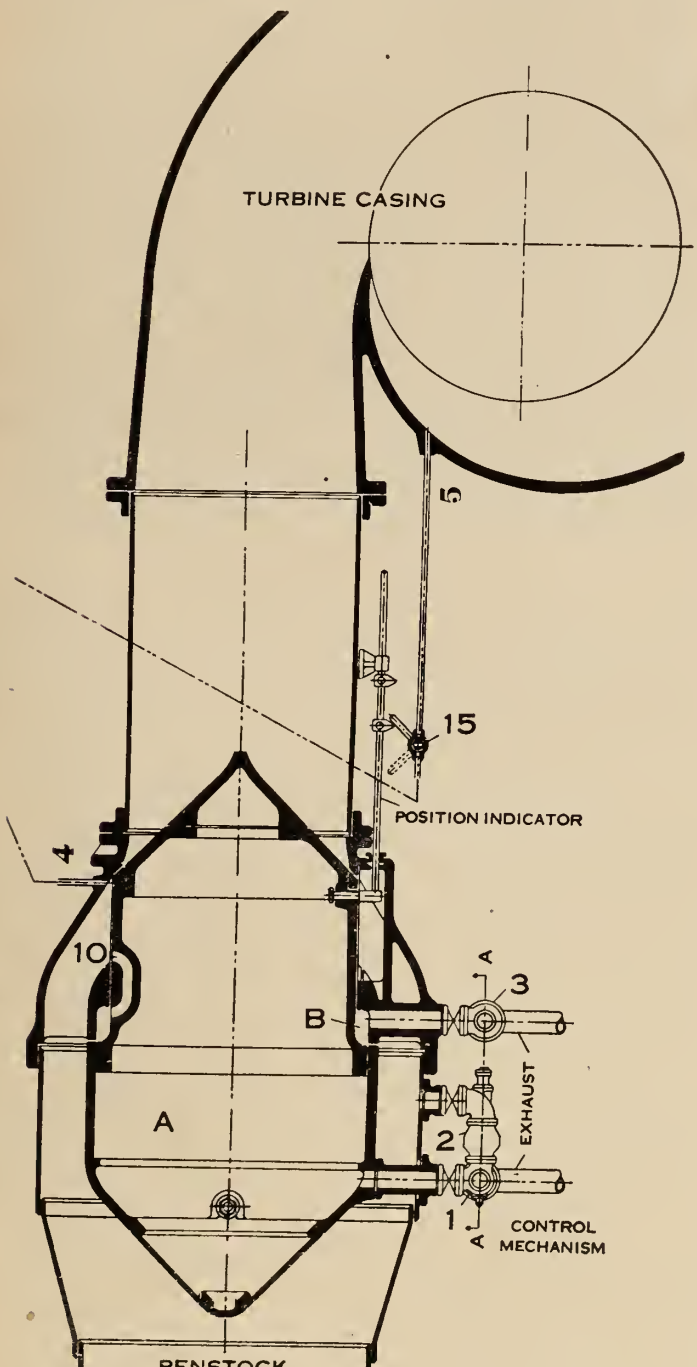


Plate No. C-26.—Diagrammatic Sketch of Johnson Valve.

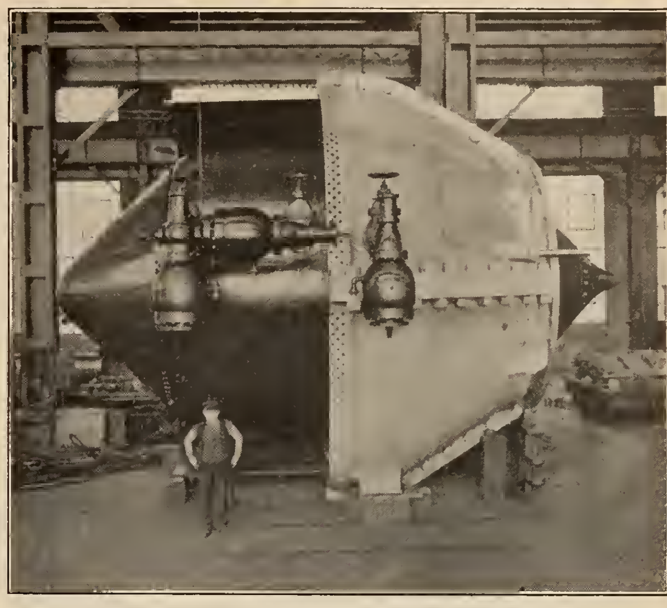


Plate No. C-27.—Shop Assembly of Johnson Valve.

on the turbine gates, which causes an immediate change in their position in response to the initial impulse arising from a change in load, and the consequent tendency toward a change in speed. This primary impulse is effected through a mechanical connection between the centrifugal governor head and a pilot-valve, which in turn releases sufficient governor fluid to enable the servomotors to move the gates. At the same time, there is applied to this initial movement of the gates a primary compensation in the form of a restoring mechanism, which, immediately following the commencement of gate movement, reacts directly upon the pilot-valve, closing its ports, and checking further movement of the gates. As the restoring mechanism is mechanically actuated by the gates themselves, the cycle of primary impulse and primary compensation is entirely self-contained and reciprocal for any one change of speed.

Following the above primary cycle, and coincident with it within a very short interval, a retarded secondary compensation begins to function, usually through the agency of a spring controlled oil dash-pot. This secondary compensation takes control of the gates, and at a greatly reduced rate adjusts them in such a way that normal speed is restored within a small percentage, varying with the magnitude of the load change. This secondary compensation, besides counteracting the hunting tendency induced by the primary impulse on the gates, and which is sometimes only partially offset by the primary compensation, has the further important function of effecting the final gate adjustment in harmony with the amount of absorption or building up of head energy in the penstock, turbine and draft-tube water-column, as induced by load changes, and as related to the normal effective head on the turbine. Therefore, while the primary compensation, in restricting the gate motion, nevertheless allows a considerable amount of initial variation in speed, the secondary compensation overcomes this speed variation at a slower rate, and finally restores the balance between gate opening and load demand, the extent to which the secondary compensation functions being measured jointly by the magnitude of the load change involved, and by the inertia of the water-column. Plate No. C-30 illustrates a governor of the type above described.

At the top of the column is a shrouded centrifugal element to which a double floating lever is connected. One end of this lever is shown connected direct to the pilot-valve, but the pressure pipes leading therefrom to the main governor valve are not in the picture. To the left the restoring rod may be seen passing through the base of the column, and to the right of the restoring rod is the dash-pot connection. Both of these are connected to a secondary floating lever which is suspended at the end of the main lever as shown. To the left of this point of suspension is a spring connection which has an adjustable point of attachment to the secondary lever in order to regulate the movement imparted to the dash-pot by the restoring rod. The fly-ball drive spindle passes up inside the column and is connected to the main shaft by either a belt or a gear drive.

As the primary requirements of governor operation are precision and reliability, the natural trend of development has been in the direction of simplicity in principle, the reduction of lost motion by the use of a minimum of moving parts, and precise shop work. Arising out of these requirements, there have been several recent innovations in design, among the most interesting of which is the direct fly-ball drive, the centrifugal element being mounted direct on the main turbine shaft, thus obviating the complication and uncertainty of a belt or gear drive.

Plate No. C-31 shows a view of one unit of a small Canadian installation equipped with a governor of this type. In the foreground may be seen the essential parts of the centrifugal element, which is mounted on the main shaft within the cylindrical housing, as shown in the view. This view also clearly shows the mechanical connection between the centrifugal element and the pilot-valve.

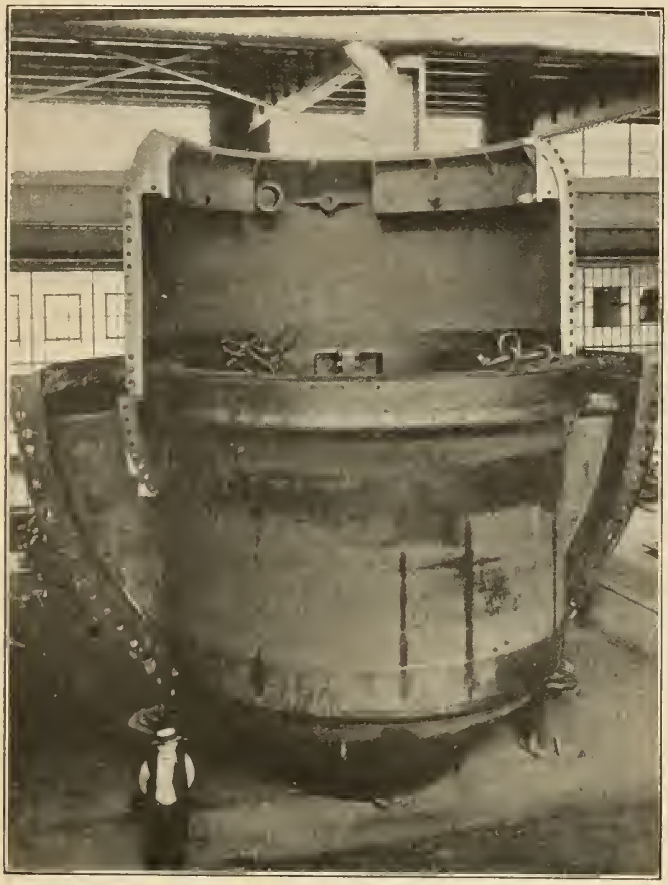


Plate No. C-28.—Shop View of 20-foot Johnson Valve.

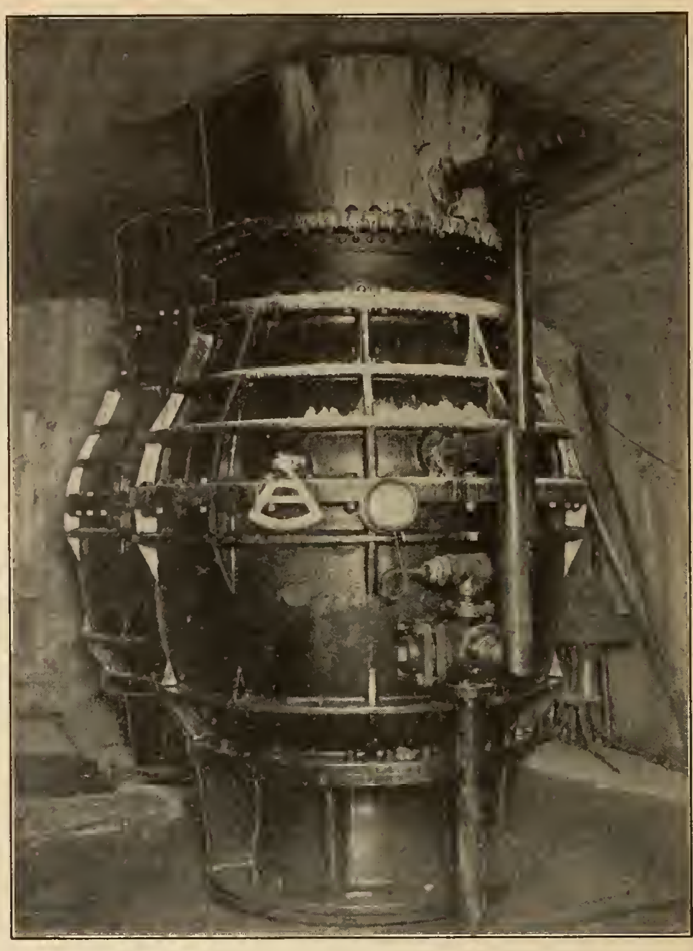


Plate No. C-29.—First Johnson Valve Installed in 1911.

Another recent improvement of great value is the substitution of automatic plunger valves for gate-valves in connection with the control of the governor fluid. This substitution is particularly useful when changing over from governor to hand control. With the older type of control the opening and closing of four to six gate-valves involved not only an expenditure of time that could be ill-spared in an emergency, but a serious hazard due to ignorance or carelessness on the part of the operator. The new type of control, on the other hand, enables the operator to simultaneously close all governor control valves and open all hand control valves, or vice versa, with a single movement of one control lever. This operation can therefore be performed so quickly that there is little or no chance of losing control of the unit, and no chance whatever of varying the proper sequence of procedure.

Remote switchboard control has also developed to such a stage that there is considerable latitude as to the location of the actuator, which is sometimes placed on the machine-room floor, in some cases on the switchboard gallery, and in others directly over the servomotors.

Plate No. C-31 illustrates the latter type of installation. On the other hand, the actuator illustrated on plate No. C-30 is located on the machine-room floor, 40 feet above the servomotors.

As exemplified in the types of governor above described, the double compensation principle, combined with the restoring mechanism, and the load-limiting attachment where necessary, appears to meet all requirements of turbine speed control adequately and safely, and efficient regulation is assured within safe operating limits for all gate movements up to the full stroke of the servomotors.

While the preceding statement is true throughout the full range of hydro-electric plant operation and interconnection, it is not always true where hydro-electric and steam-electric plants are operating in parallel. In many such cases there is a tendency toward unequal distribution of load by reason of the comparatively short time element in governing, and the frequently greater fly-wheel energy, of steam-electric units.

Draft-Tubes

Recent advances in the art under this head, in Canada, are largely attributable to the vogue of the "super-turbine". As the unit capacity of turbine installations increased it was found that the unstable regimen of the water-column in the then existing types of draft-tubes so magnified the effects of vortex action and intermittent vacuum as to cause troublesome and often dangerous operating conditions. These conditions manifested themselves variously in the form of pulsations communicated to the penstock water-column, and in periodic vibratory and resonance effects in the power house superstructure which seriously interfered with operating procedure.

Considerable attention has therefore been given, within the last four or five years, to this phase of hydraulic design, and due to an efficient combination of theoretic and experimental research on the part of American turbine manufacturers and their customers, a very gratifying measure of success has been achieved.

The fundamental truth established by these investigations was that there could be no rational basis upon which the performance of various types of draft-tubes might be compared unless a fixed relationship existed between the specific speed of the runner and its elevation above static tail-water level. In other words, the absolute velocity of the runner discharge has a definite inverse relationship to the elevation of the runner above tail-water, which must be recognized in connection with performance comparisons. With this condition taken cognizance of, or eliminated, a rational analysis of the results of recent important laboratory tests may be attempted with some assurance of reaching correct conclusions.

Of the earlier types of draft-tube, the vertical diffuser was the most efficient, in that it permitted the regaining of an appreciable part of the velocity head of axial flow if properly designed, and if the rail-race were deep enough. However, as the specific speed of the runner increased, the necessary corresponding increase in length of vertical tube and depth of tail-race finally reached a point where capital cost became a controlling factor. This situation was met by an expedient which gave birth to the widely used elbow type draft-tube; namely, the turning upward and outward of the lower section of a vertical diffuser, the result being a hybrid structure of which the upper section was a true draft-tube, and the lower a tail-race, with the junction between the two effected through a quarter turn of such inherent hydraulic characteristics as to largely destroy the respective functions of the other two elements of the structure.

The elbow type draft-tube had a practically exclusive vogue until the specific speed and capacity of the turbine runner had further increased to such an extent that the energy losses in the draft-tube became a matter of serious concern, not alone from the standpoint of efficiency, but by reason of the power and intensity of the disturbances through which these losses became manifest. This condition was of course due to the fact that the tangential or "whirl" component of flow was increasing with the specific speed, and causing a proportionately greater interference with the axial component of flow, as the two traversed the quarter turn into the horizontal or tail-race section of the tube. The result was not only to largely neutralize the benefit of regained axial velocity head in the vertical or diffuser section of the tube, but to restrict the effective waterway area of the tail-race section with vortices and periodic reversals of flow.

The search for a remedy for the above situation led to the development of the so-called "mushroom" type of elbow draft-tube, together with a number of other more or less abnormal variations of the original elbow type, the whole embracing an evolutionary process which found its first rational expression in the White hydraucone.

The White hydraucone is essentially a vertical diffuser so modified as to make it applicable, within feasible dimensional limits, to installations of large unit capacity. This modification is effected by substituting, for the abnormal length of tube and depth of tail-race otherwise required to meet the demand of a constantly increasing specific speed, a horizontal baffle or diaphragm, normal to the axis of the tube, and elevated a short distance above

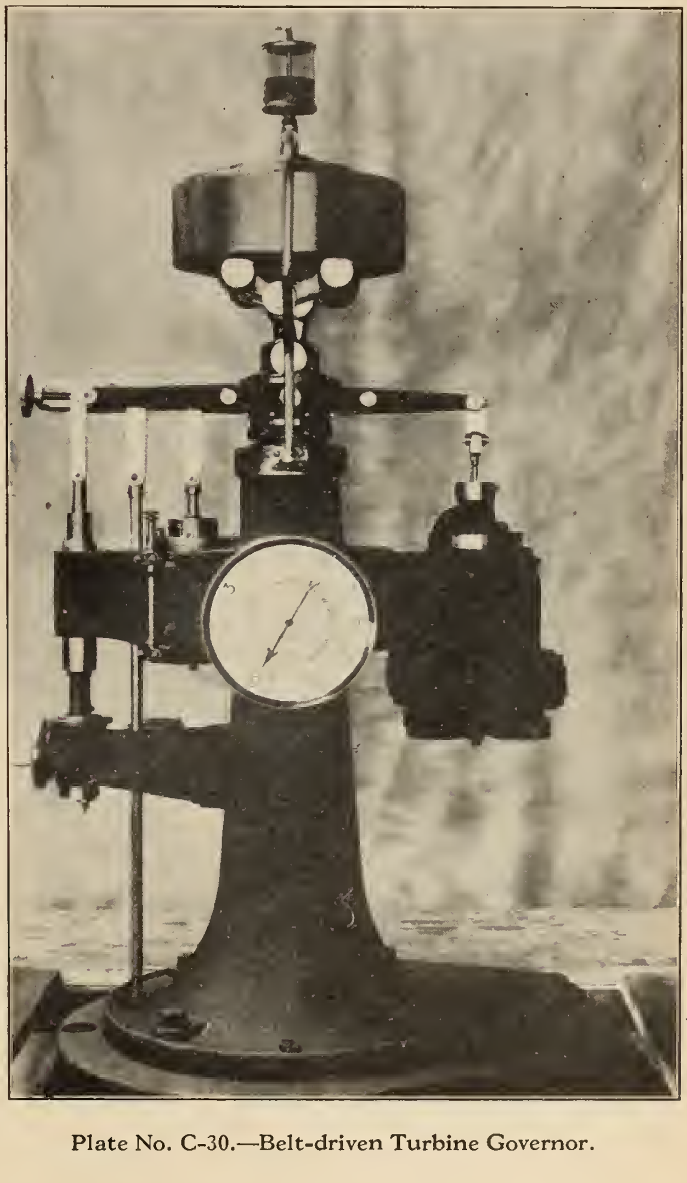


Plate No. C-30.—Belt-driven Turbine Governor.

the invert of the tail-race. The falling water-column impinges on this diaphragm, spills over and around its edges into an expanded lower chamber, from whence the water runs to waste. The function of the diaphragm is to assist the diffuser section in maintaining the integrity of the water-column, or "hydraucone", and to regain velocity head, acting, in an elementary sense, in the same manner as one of the buckets on an impulse wheel. The function of the lower chamber is to carry the "spill" to waste with the assistance of the residual absolute velocity.

The "hydraucone" was a distinct improvement over the elbow type tube, but inasmuch as the discharge from a reaction turbine runner is not purely axial, as in the case of the nozzle of an impulse turbine, the functioning of the "hydraucone", as a velocity head regainer, suffered to an appreciable degree the same disability as the elbow tube, in that it was unable to efficiently reclaim the energy of whirling flow, owing to its inability to control the turbulence of the draft-tube water-column. Nevertheless, the White hydraucone marked the emergence of draft-tube design from a stagnant period during which unsound theory and ill-conceived expediency prevailed, the draft-tube being considered a thing apart from the turbine, except as a convenient means of piping off the runner discharge as quickly and cheaply as possible.

Apart from the incentive arising from a desire for essential rightness of design, a distinctly commercial element has been in a large measure responsible for recent advances in the art of draft-tube design; namely, the fact that the large capacity turbines of the present day permit an appreciable increment of useful power to be reclaimed as the result of a gain of only a fraction of a per cent in overall efficiency.

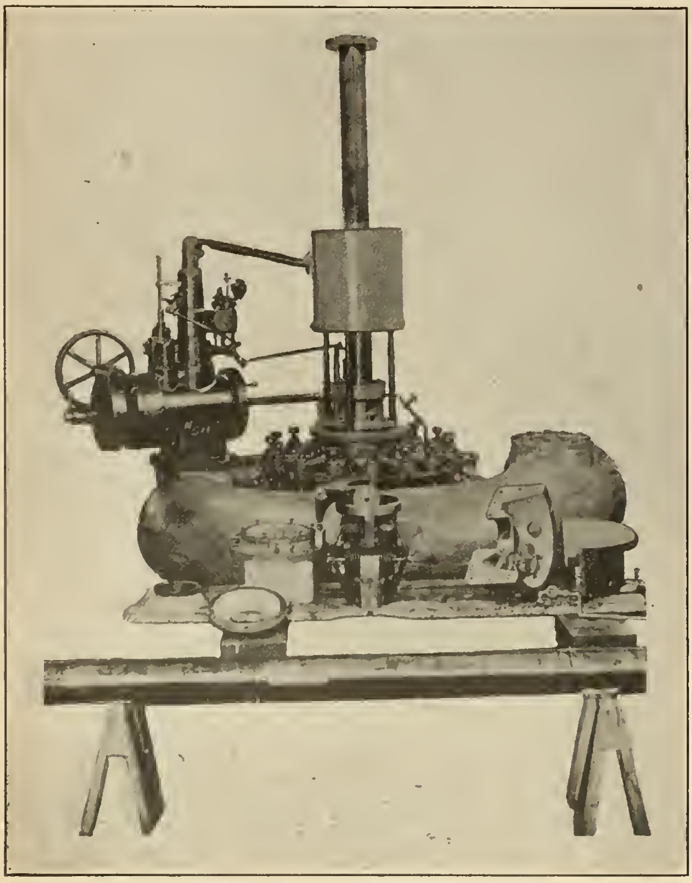


Plate No. C-31.—Turbine with Shaft Fly-ball Governor.

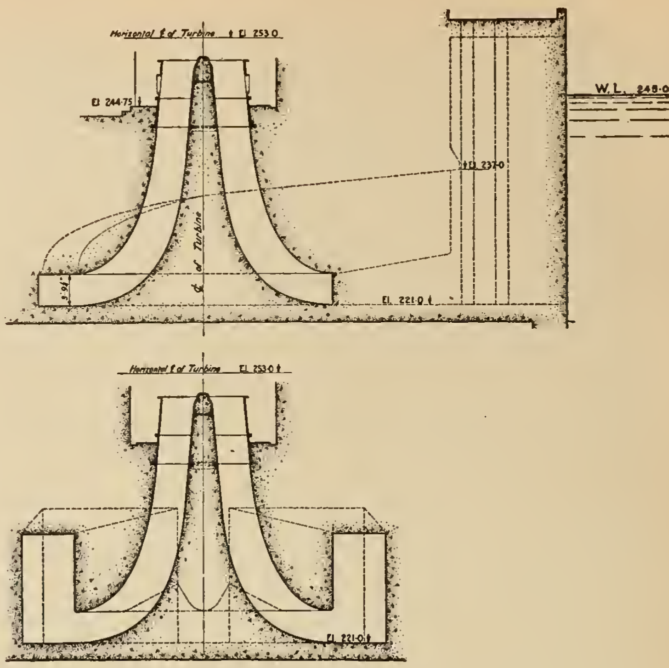


Plate No. C-32.—Moody Type Spreading Draft-tube.

Based therefore, on this double incentive, the object of recent experimental research has been to regain as much as possible, not only of the axial, but of the tangential component of the velocity head of the runner discharge, and to devise means of training the combined axial and whirling flow, through properly shaped water passages, so as to eliminate vibration and transmitted pulsation to the greatest extent possible.

The research work so far accomplished by the principal turbine builders in the United States has demonstrated the faulty basis of conception and relative inadequacy of all forms of the elbow type tube, and, beginning with the "hydraucone", has developed a series of types, more or less co-related, which have given satisfactory results in commercial operation.

Of the later types of draft-tube so developed, that known as the Moody Spreading Draft-tube has found somewhat general acceptance in Canadian practice. The most recent type of Moody tube is illustrated on plate No. C-32, the drawing being sufficiently clear to obviate the necessity of a detailed explanation.

This tube was conceived in theory and experimentally developed on the basis of the following facts and assumptions:—

(a) That the inverse relationship between the specific speed of the runner and its elevation above tail-water is an essential factor in design, and as such must be fixed.

(b) That the draft-tube is as much a part of the turbine mechanism as any of the other water passages.

(c) That in any reaction turbine, tangential or whirling flow is always present in the runner discharge at part-gate and over-gate.

(d) That in reaction turbines of the higher order of specific speeds there is whirling flow at all gate-openings.

The above conditions are more or less a recapitulation of the previous discussion, and recent exhaustive tests have confirmed, respectively, the fact of their existence or

Plate No. C-33.—Spreading Draft-tube with High Concentric Cone.

their justification. The tangible result, as shown on plate No. C-32, is a tube where the annular contour of the runner discharge is preserved intact from the runner to the tail-race invert, by training the combined tangential and axial flow, directly from the point of origin, through a gradually expanding and carefully transitioned sequence of annular areas, until a point is reached where the residual velocity head is required for the disposal of the spent water. Inasmuch as the central cone solidly fills the region of maximum turbulence, it seems reasonable to assume, even without experimental confirmation, that it must be effective in preventing cavitation, and the formation of vortices, with their resultant vibratory effects. Serving this purpose, it also naturally follows that it must effect a useful conversion of hitherto wasted whirl energy in the central zone, realizing thereby a gain in efficiency as well as a betterment in operating conditions.

On plate No. C-33 is shown a partial view of the latest type of spreading draft-tube installed in a Canadian plant, as part of a 58,000 e.h.p. turbine. The view shows one side of the discharge passage leading to the tail-race, and a portion of the lower circumference of the diffuser section surrounding the central cone.

The spreading draft-tube has a very essential function in connection with low head turbines of high specific speed, as it improves efficiency throughout the full range of gate-opening. Used with high head turbines of low specific speed, it is of considerable value as related to part gate efficiencies and overload capacity. In the case of high head turbines of very large capacity it is of material benefit, apart altogether from considerations of efficiency, in largely eliminating the operating hazard which would otherwise obtain through the powerful reactions produced by disturbances in the heavy water-column of the draft-tube.

Turbines

By reason of the limitations imposed in the opening chapter, the scope of the discussion under this head will be limited to the consideration of reaction turbines, as the development of heads in excess of 500 feet has not been sufficiently extensive in Canada, up to the present time, to produce any unusual or distinctive features.

Head conditions requiring the use of impulse turbines are confined almost exclusively to the Pacific coast region, where there are important developments using the widely known Pelton type runner under heads ranging from 400 to 1,820 feet, and in unit capacities as high as 13,000 e.h.p.

While some interesting variations in impulse runner design are now under investigation and test, nothing has as yet transpired to challenge the supremacy of the Pelton type turbine in the high head field, either in Canada or the United States.

In the reaction turbine field, the primary outstanding feature of Canadian practice has been the adoption of the single runner vertical setting for Francis type turbines. While the original incentive toward this type of setting was undoubtedly due to the large unit capacities involved, its popularity subsequently led to its application through a wide range of unit capacities and speeds, until in Canada to-day this type of setting may be regarded as standard practice, with the horizontal double or multi-runner setting an obsolete type, used only in relatively unimportant installations or in connection with the extension of old plants, where the original commitments rendered any radical change in design impracticable or unduly expensive. An extreme case, where the vertical single runner setting was amply justified by operating conditions alone, is illustrated on plate No. C-34, which is a view of a large plant in central Canada, having a total installation of 195,000 e.h.p., in units each of 10,800 to 11,400 e.h.p., capacity, operating at 56 r.p.m., under a normal head of 30 feet. The immense size of the runner is evident from the shop view shown on plate No. C-35. This runner has a lower band diameter of 17½ feet and a finished weight of 175,000 pounds.

Including the feature above mentioned, it may be stated that since the 10,000 h.p., prototype of the modern super-turbine was installed at Niagara eighteen years ago,

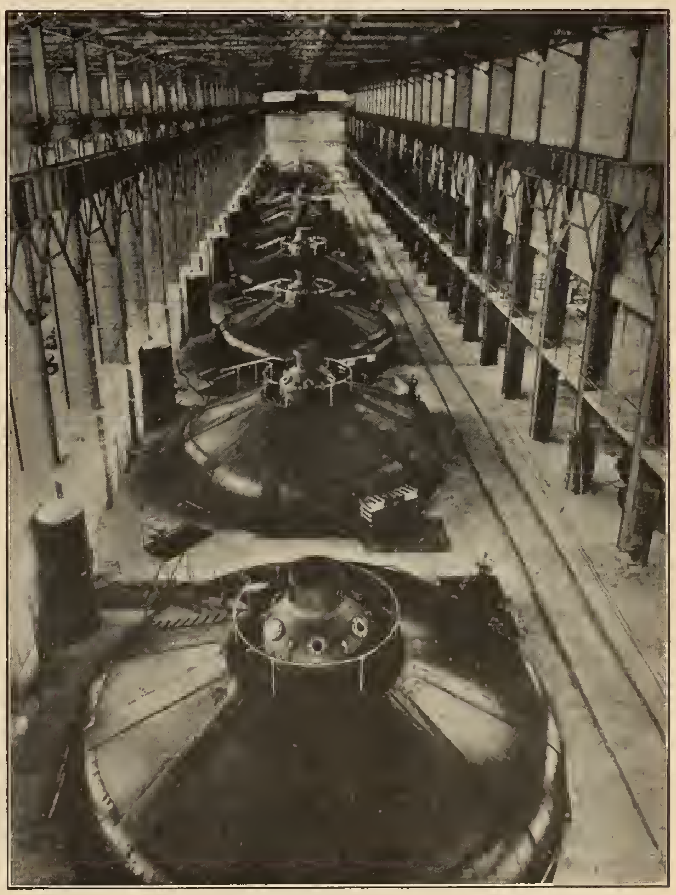


Plate No. C-34.—Large Low Head Vertical Installation.

the subsequent advances in turbine design have been directed toward the improvement of efficiency in the broad sense previously defined, including strength, simplicity, and economy in the use of water. In this connection the spreading draft-tube may be looked upon as a development more or less complementary to the use of the single-runner vertical setting, and may be bracketed with it as a joint primary agency in improving the operating efficiency of large reaction turbines.

In large capacity turbines the question of the stiffness and stability of the scroll-case becomes a matter of importance, depending upon diameter and pressure conditions. As between cast-steel and steel plate scroll-case construction there is no definite field of application, beyond a preference for cast-steel in the larger capacities where the static head is in excess of about 200 feet, as the steel plate construction, under such conditions, is subject to deformation and requires the support of a heavy mass of concrete in the power house substructure, while a cast-steel scroll-case, similarly placed, actually contributes to the stability of the power house foundations.

In the matter of cost, there is usually no material difference between the two types, if due consideration is given to equivalent hydraulic characteristics and to the great saving in time and labour which is realized in the field assembly of the cast-steel, as compared with the steel plate casing. Furthermore, the steel plate casing is not susceptible of a pressure test before final installation, so that perfect workmanship and careful inspection constitute the only assurance that the requirements of the design have been met, and that leakage or other defects will not develop under operating conditions.

Plate No. C-36 shows a shop view of a plate steel scroll-case being built in a Canadian shop for a large installation now under construction in eastern Canada.

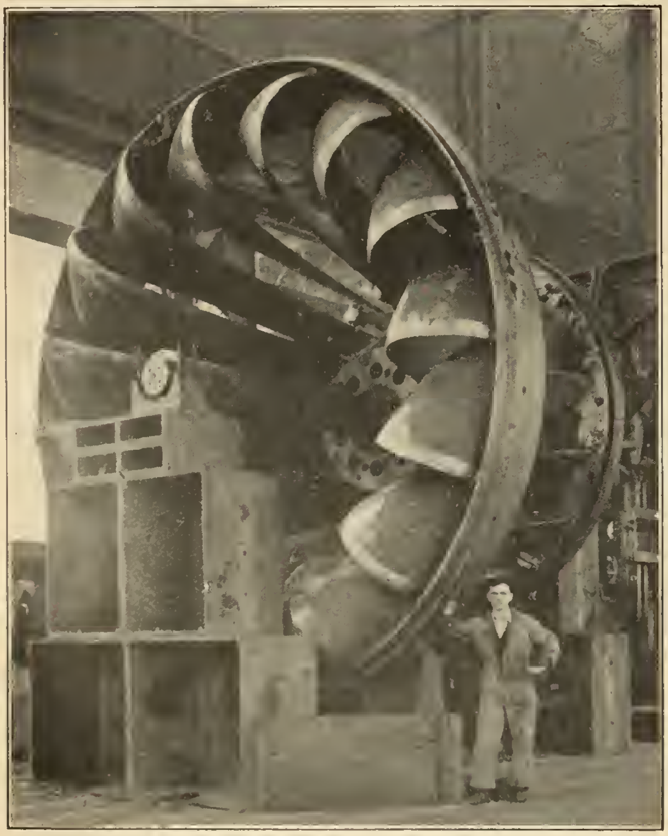


Plate No. C-35.—Large Low Head Runner of 11,400 e.h.p. Capacity.

Plate No. C-36.—Steel Plate Scroll-case under Construction.

This casing has an inlet diameter of 20 feet, and the completed turbine will be one of twelve having a capacity of 40,000 e.h.p., under a 100-foot head.

Plate No. C-37 illustrates a condition which has given trouble in connection with the design of very large cast-steel casings. The figure to the right is an outline of the ordinary type of scroll-case casting with flanged radial sections making a bolted connection with the circumferential flanges of a separately cast speed-ring. It will be seen that the bolt circles of the radial flanges necessarily terminate at the edges of the horizontal flanges of the speed-ring, with the result that the tendency of the casing section to open up under internal pressure causes a cantilever stress in the unsupported section of the radial joint adjacent to the upper and lower speed-ring flanges. In large casings designed for high heads this stress is frequently so great under pressure test as to stress the bolts beyond the elastic limit, and to deform the flanges and bolt-holes, with a resultant serious leakage.

The corresponding figure to the left on plate No. C-37 illustrates the means devised to remedy the conditions above described.

In this type of casing, known as the Taylor sectional spiral casing, each radial section is split transversely, and the speed-ring stay-vanes are cast integral with the small inner section. The transverse joints are staggered, and so located as to permit of heavy flanges and effective bolt spacing, not only in the transverse flanges, but in radial flanges throughout their full length, as the drawing shows.

Plate No. C-38 is a shop view of two radial sections bolted together, which clearly shows the integral stay-vanes, the transverse joint, and the bolt spacing of the radial flange. Plate No. C-39 shows a completely assembled scroll-case of this type ready for the shop pressure test. This casing was the first of the sectional type ever built, and was for a turbine of 58,000 e.h.p., capacity later installed in a plant in central Canada, under a 300-foot head. This casing successfully met a pressure test of 260 pounds per square inch, on the first trial, with no indication of leakage or deformation.

The showing made by the sectional scroll-case under shop pressure test would seem to indicate that no undue risk would be involved in setting very large casings of this type, under heavy operating pressures, entirely in the open, with only such a quantity of surrounding concrete as might be necessary to secure a stable anchorage and freedom from vibration.

Another useful feature incorporated in modern Canadian practice is the Rogers offset lever operating mechanism, as illustrated on plate No. C-40.

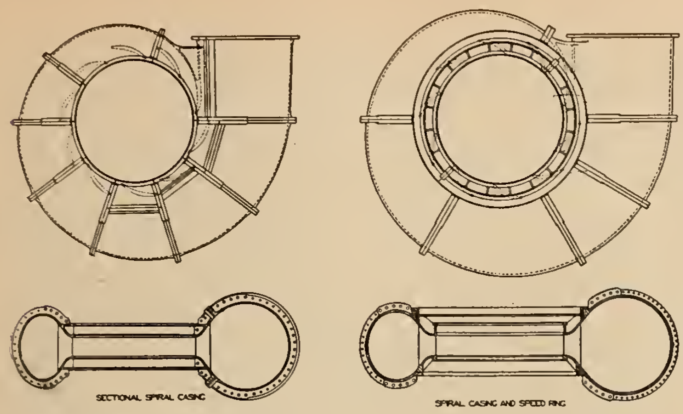


Plate No. C-37.—Comparison of New and Old Designs of Large Scroll-cases.

For efficient speed regulation, any change in speed should correspond to a definite change in load throughout the full loading range of the unit, and most governors are so designed that any such change in speed also gives rise to a correspondingly fixed displacement of the servo-motor piston. The piston displacement, however, cannot produce a continuously proportional gate movement at all stages of load, as the angular movement of the gates must of necessity be governed by the load on the turbine at the time of such movement, and is therefore a function of the shape of the efficiency curve. The advantage claimed for the offset lever mechanism is that it meets the above requirements more efficiently than the ordinary radial lever type.

As the operating ring moves counter-clockwise to close the gates, it is evident that the angular movement of the gates will decrease, for a given piston displacement, as the gates close. This characteristic is advantageous at small gate-openings, as it reduces the amplitude of the piston and pilot-valve oscillation which obtains under such gate-openings by reason of unstable hydraulic conditions.

A further advantage of this type of operating mechanism is that the maximum torque on the gates is exercised when they are in the closed position and thus subjected to the maximum hydraulic load, thus reducing the governor capacity which would otherwise be required.

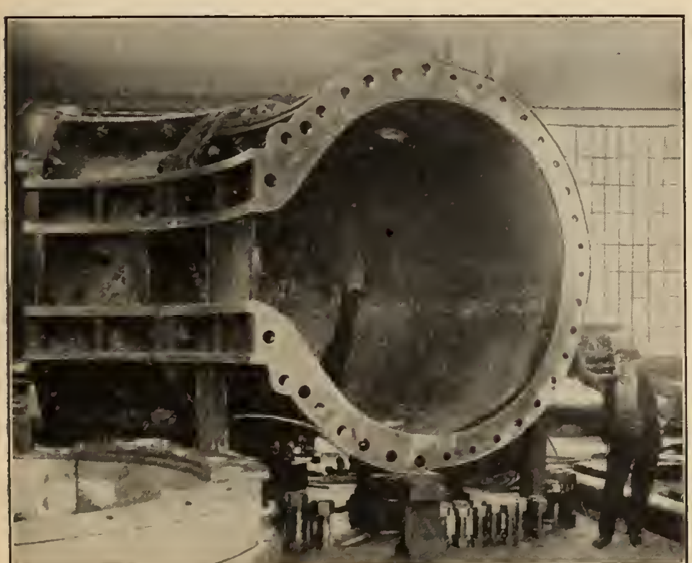


Plate No. C-38.—Two Radial Sections of Sectional Scroll-Case.

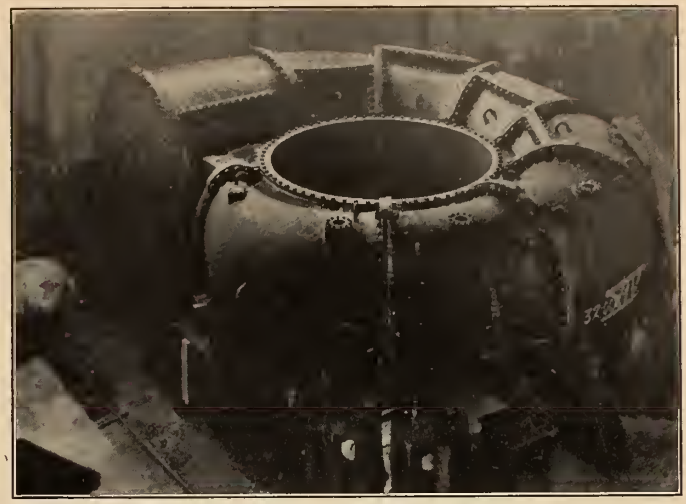


Plate No. C-39.—Assembled Sectional Scroll-Case Under 260-Pound Pressure Test. Three Million Pounds on Head-Cover.

With an efficiency curve of the shape usually traced by the larger turbines used in Canada, the offset lever mechanism preserves a more consistent relationship between piston travel and angular gate movement, up to the point of maximum efficiency, than the radial lever type. Beyond this point the radial lever mechanism has somewhat the advantage. This feature in favour of the radial lever type is largely discounted, however, where economy in the use of water is a material factor in operation.

Plate No. C-40 also illustrates the type of breaking link used with the offset lever mechanism. As clearly shown in the illustration, this link will fail in shear, thus giving consistent protection to the gates and gate-shanks independent of whether they encounter an obstruction on the opening or closing stroke, or whether the link as a whole is consequently in tension or compression at the time of failure.

In high head turbines of large capacity, the great circumferential dimensions introduce a leakage factor which materially effects efficiency where the ordinary type of seal ring and gate shank is used, and more particularly when the clearances have become enlarged through ordinary wear, or the action of silty water. This condition has been met by the use of the so-called "labyrinth seal" and by the "Overn disc", both of these devices having been recently incorporated in the design of large Canadian built turbines.

Instead of the ordinary simple seal consisting of a straight annular passage past the crown of the runner into the space under the head cover, and a similar passage past the runner-band into the draft-tube, the labyrinth seal consists of a series of alternately expanded and contracted passages which destroy the velocity head, and reduce the head on the final free jet to a fraction of its original value. The diagram shown on plate No. C-41 indicates the shape and disposition of the expanded and contracted passages, as well as the direction of flow of the leakage.

The Overn disc consists simply of two annular rings cast integral with the gate-shank, one at each end of the gate proper. These discs are machined, and are so located as to set flush with the upper and lower distributor plates. Therefore, while they do not in any way obstruct the flow through the gates into the runner, they materially

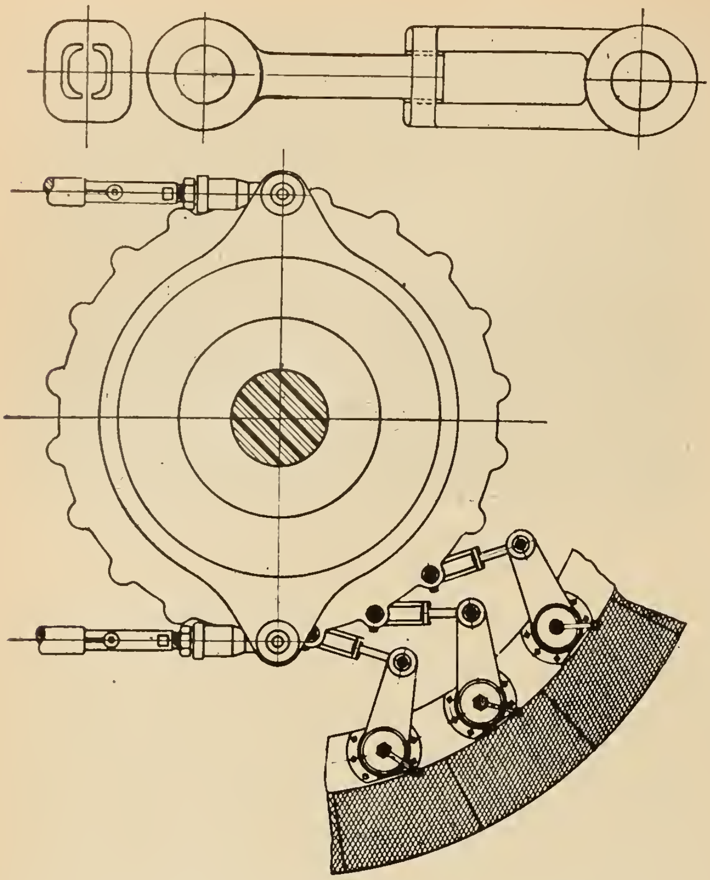


Plate No. C-40.—Offset Lever Mechanism and Breaking-Link.

reduce the leakage through the gate-shank stuffing boxes at all times, and also through the upper and lower gate clearances when the gates are closed. This device also provides a very strong mechanical connection between the shanks and the gate itself. The view on plate No. C-42 clearly illustrates the function of the Overn disc and the manner of its installation, being a complete gate assembly with the upper discs in view at the point of junction of the shanks and vanes.

As in the case of the power development as a whole, the basis of high efficiency in a turbine is the provision of water passages of ample section, with abrupt changes in direction of flow eliminated wherever possible, and where such changes are unavoidable, careful proportioning and transitioning. Secondary, but none the less significant factors are the elimination of leakage and other minor refinements as above described, together with accurate shop work. As related to present Canadian practice, a gain of one per cent in the efficiency of a turbine of 40,000 e.h.p., capacity, as a result of the proper consideration of the above factors in the design, would produce sufficient extra power to supply the requirements of an average community of 2,000 population.

Plate No. C-43 shows a cross-sectional view of a 58,000 e.h.p., unit installed in an operating plant in central Canada, in which the above specified principles of design are to a large extent incorporated. In this view will be noted the carefully designed annular water passage of the Johnson valve at the entrance to the scroll-case, the well-proportioned and transitioned passages through the scroll-case, speed-ring, and draft-tube, and the elimination of one right-angled change in the direction of flow through the use of the vertical setting.

The advantage arising from a proper utilization and co-relation of these factors is exemplified in the efficiency and power discharge curve for the above mentioned unit, as shown on plate No. C-44.

The matters of interest in connection with these curves are as follows:—

(1) The maximum turbine efficiency is 93½ per cent.
(2) The turbine efficiency at full gate is nearly 88 per cent.
(3) The output at full gate is 63,500 e.h.p., under a 305-foot head.
(4) The turbine has a capacity range of 30,000 to 62,500 e.h.p., at efficiencies of 90 per cent or over, and a capacity range of 38,000 to 60,000 e.h.p., at efficiencies of 92 per cent or over.
(5) The maximum overall efficiency at the switchboard, as determined during the period of the above tests, is 91 per cent.

It is believed that the above results constitute the high record for a turbine of any type or capacity, up to the present time. It will be noted, also, that this turbine was equipped with the original low cone type of spreading draft-tube.

A more recent installation, of the same general type, is shown on plate No. C-45, which is a cross-sectional view of a 41,000 e.h.p., unit recently built and installed in central Canada.

On plate No. C-46 is shown an interesting curve representing the first derivative of the power-discharge curve on plate No. C-44. As its name implies, this curve is derived by plotting the amounts of horse-power produced per second-foot of water, in various regions of gate-opening, by a very small additional opening of the gates. In other words, it shows, not the gain, but the rate of gain in power for an increasing rate of water input.

It will be seen that as the gate opening approaches the point of maximum efficiency, the corresponding rate

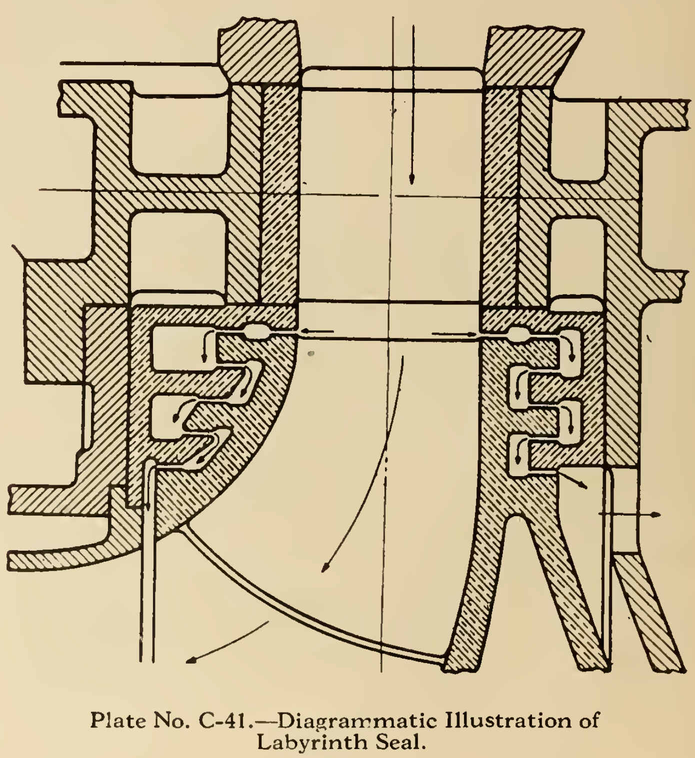


Plate No. C-41.—Diagrammatic Illustration of Labyrinth Seal.

Plate No. C-42.—Gate Assembly Showing Overn Disc.

of gain in power per unit of water input is 34.5 e.h.p., while actually at the point of maximum efficiency, with a water input of 1,500 second-feet, the gain in power for one additional second-foot supplied is about 32 e.h.p. On the other hand, in the vicinity of full gate, where the turbine is taking water to the limit of its capacity, the gain in power for one additional second-foot supplied is only 9 e.h.p.

The two extremes above cited serve to illustrate the significance of previous statements made under the head of flow in long pipe-lines, and also to confirm the truth of the following statement; that under high heads, where the gross potentiality per second foot of water is correspondingly great, it is in the best interests of economy, as well as safety, to operate normally at the point of best efficiency, and to employ the excess capacity of an over-gated turbine for emergency purposes only, and not for routine operation. This statement has an added significance, also, when the water supply is artifically stored.

Furthermore, it is obvious that as the point of maximum efficiency is also the point of minimum hydraulic loss, the rate of runner deterioration at this point must also be a minimum. From this point on, the rate of runner deterioration is an accelerating progression, directly related to the degree of over-gate.

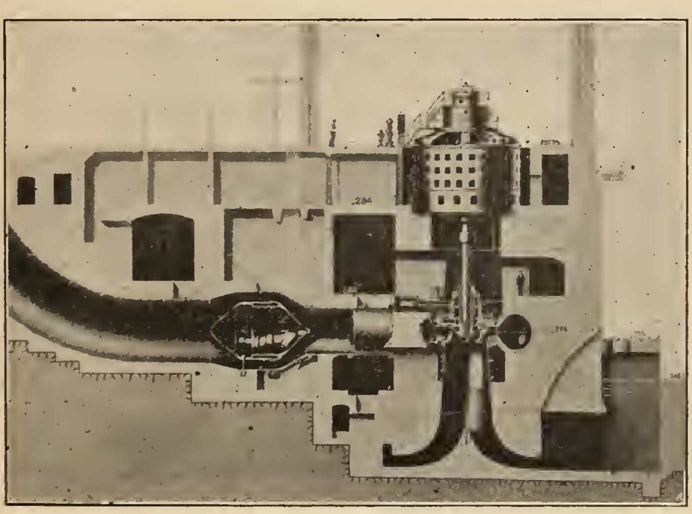


Plate No. C-43.—Cross-section of 58,000-h.p. Unit.

The points in favour of gating the turbine back to the point of best efficiency are: first, safe and efficient operation, particularly where long pressure conduits are involved; second, economy in the use of water under high heads, where the gross potentiality per second-foot of water is great, and where artificial storage is a factor; and third, on account of runner deterioration, particularly in the case of very large turbines, where runner replacement involves a material revenue loss.

The matter of turbine gateage has not, in the past, received the attention it deserves at the hands of the purchaser. It does not particularly interest the manu-

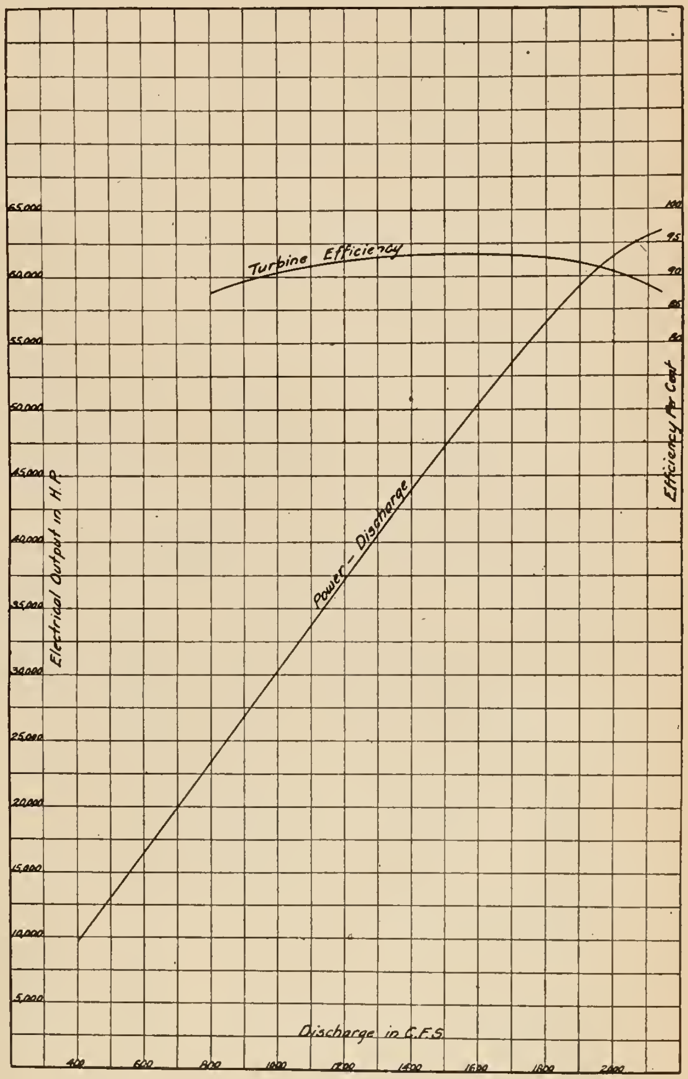


Plate No. C-44.—Turbine Efficiency and Power-Discharge Curve.

facturer, and must be covered, if at all, by the customer's specifications.

With regard to the pitting and erosion of runners, it may be said that super-turbine development has now reached a stage where this condition is no longer primarily a problem of design, but of economics. In other words, if the customer so specifies, the manufacturer can select a specific speed and supply, at a price, a turbine in which the runner will have as long a period of useful life as the other major elements of the installation.

Such a specification on the part of the customer would, of course, involve additional capital expenditure for the generator as well as for the turbine, but, as against this aspect of the situation it must be realized that the modern super-turbine frequently has a capacity which enables it to earn upwards of $2,500.00 every twenty-four hours. Consequently, the lost revenue charge against runner replacement in a fully loaded unit may easily run as high as $25,000.00. If this should happen to be necessary every two years, it would be equivalent, on a 6 per cent basis, to a capital charge of $200,000.00. Such being the case, it is evident that the choice of a proper economic specific speed is a matter deserving the most careful and mature consideration, being a factor of at least equal importance with proper gateage and elevation relative to tail-water.

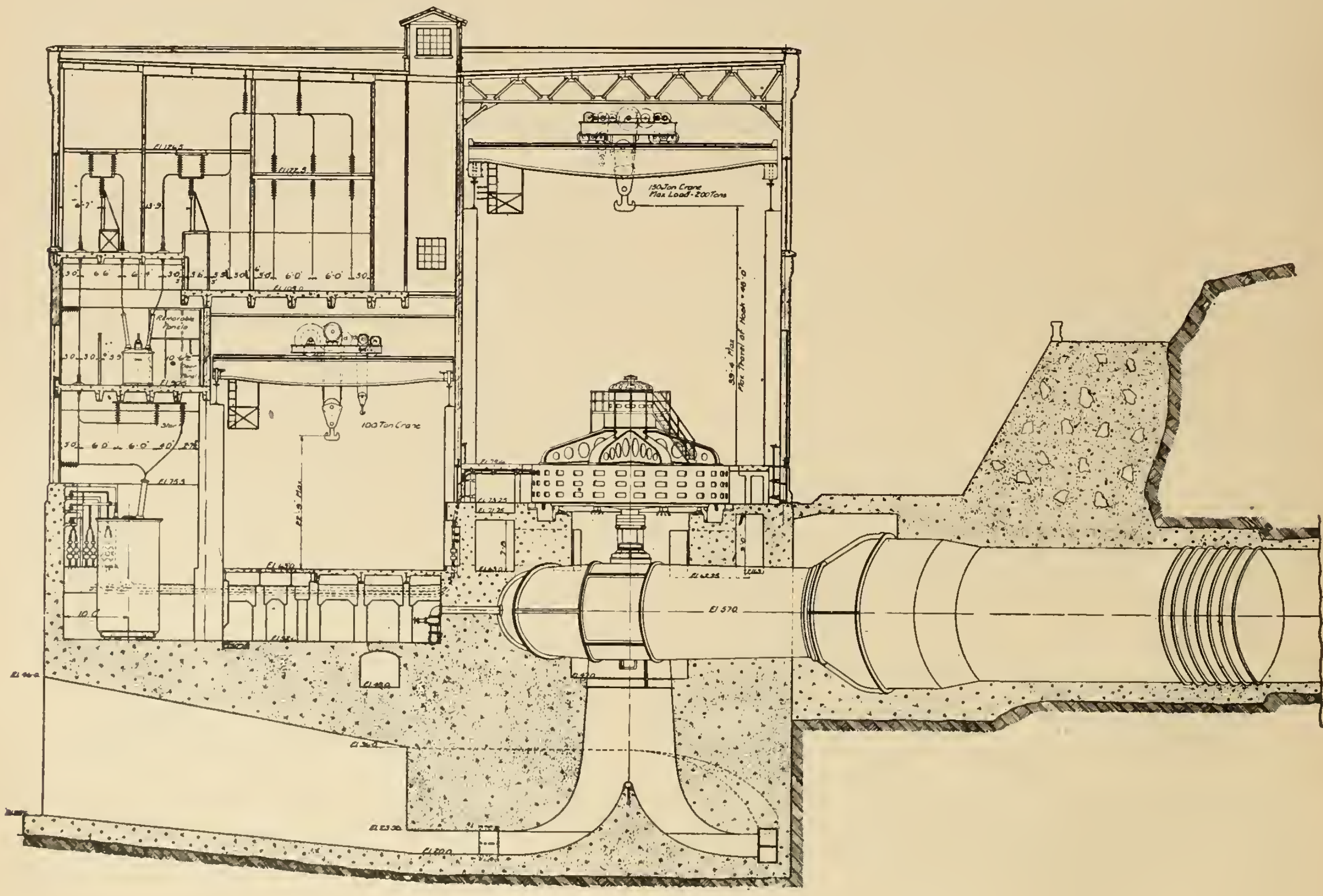
The outstanding fact, in connection with the above discussion, is that the super-turbine of the present day is capable of converting into net mechanical energy all but seven per cent of the gross potentiality of the water supply. Extreme conservatism in the fixing of specific speed, and the combined effect of further small refinements in mechanical design may possibly raise part gate efficiencies to some extent in the future, and thus produce a slightly more advantageous shape of efficiency curve, but it would really appear that the large Francis turbines of the present day embody the ultimate, for any type, in respect of water economy at the point of best efficiency.

The disability of the Francis turbine, in its finally developed form, is its failure to fully meet the coincident requirements of increasing capacity and speed under low and medium heads, in response to a commercial demand for large unit capacities and reduced installation costs. This disability, being inherent in the type, and purely a function of the practicable upper limit of specific speed, was susceptible of only a partial solution by reverting to the objectionable and obsolete multi-runner setting, so that the designers of both hemispheres attacked the problem from the only angle that promised an adequate solution; namely, the development of a new type of runner.

The effort in this direction resulted in the development of the so-called high speed propellor type runner, which, in its various subsidiary types, is now in commercial use, both in Europe and North America. Of these types, the Kaplan (European), and the Nagler (United States), have a closely similar design and method of functioning, the flow through the runner being purely axial. In the Dubs (European) and the Moody (United States) types, the mode of flow through the runner is more nearly analogous to that of the Francis type, with the further distinction, in the case of the Moody runner, that the direction of exit flow is diagonal with respect to the axis of revolution; hence the trade name by which this type of runner is known in Canada and the United States.

As previously intimated, the unique feature of the propellor type runner is the possession of a specific speed, ranging upward to a maximum which has not yet been fixed by inherent limitations or by installation cost, and so far in excess of the Francis type that it bids fair to revolutionize the development of large water-powers under low heads.

The primary elements of design which combine to give the propellor type runner its high speed characteristics are, first, a designedly induced condition of bodily



CROSS SECTION THROUGH ℄ UNIT #6

Plate No. C-45.—Cross-section of 41,000-h.p. Unit.

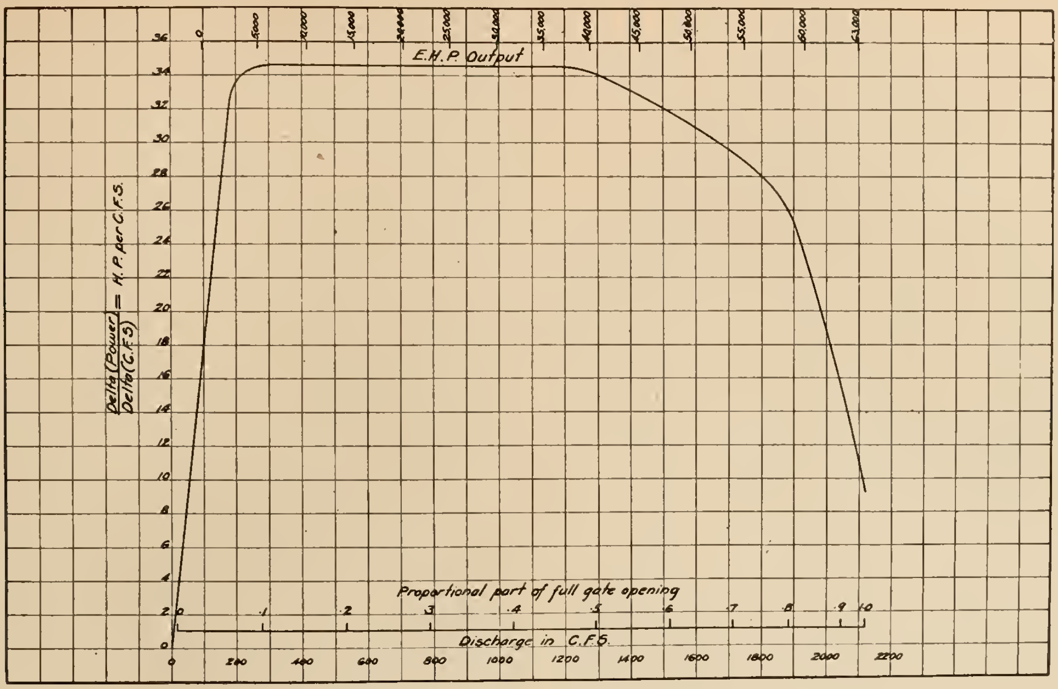


Plate No. C-46.—First Derivative of Power-Discharge Curve.

whirl in the mass of water passing through the speed ring; and second, the use of runner vanes having a greatly reduced length in the direction of flow, in proportion to their pitch, as compared with the Francis type.

The first of the above conditions is more or less common to all types of high speed runners. The second condition is also common in principle, but differs considerably in degree. In the Kaplan and Nagler types, the disparity between the pitch of the vanes and their transverse projected width, and consequently their area, is pushed to such an extreme limit that only four vanes are used, with a clear opening between them nearly equal to half their pitch. In the Moody diagonal type, on the other hand, six vanes are commonly used, and a very greatly increased area and projected width is obtained, for a given runner diameter, by allowing the vanes to overlap; in other words, by making the transverse projected width of the vanes greater than their pitch.

Inasmuch as the torque is a function of the tangential component of the effective difference in pressure between the face and back of the vane, the Kaplan runner tends toward a maximum intensity of pressure difference for any given head, power, and specific speed, as compared with the Moody type. The disability of the Kaplan type therefore, arises from the fact that it realizes this high value of specific speed only at the expense of a correspondingly high value of pressure and vacuum intensity on the vane surfaces, and this condition, in addition to the use of a high absolute exit velocity, imposes a more or less onerous restriction on feasible operating head, from the standpoint of vibration, cavitation, and the elevation of the runner with respect to tail-water level.

In the case of the Moody diagonal runner, the design is such as to avoid excessive pressure increases and reductions on the face and back, respectively, of the vane, without impairing the specific speed, thus eliminating local regions of unduly low absolute pressure behind the vanes, and effecting a resultant gain in range of head application, without the accompaniment of vibratory or unstable draft-tube conditions, or embarrassing restrictions in connection with the relative elevations of runner and tail-water.

The above description covers, in a general way, the basic variation in objective upon which the Kaplan and the Moody types of high speed runner were conceived.

The Kaplan type runner has not as yet been used in Canada, but several installations of the Moody type have

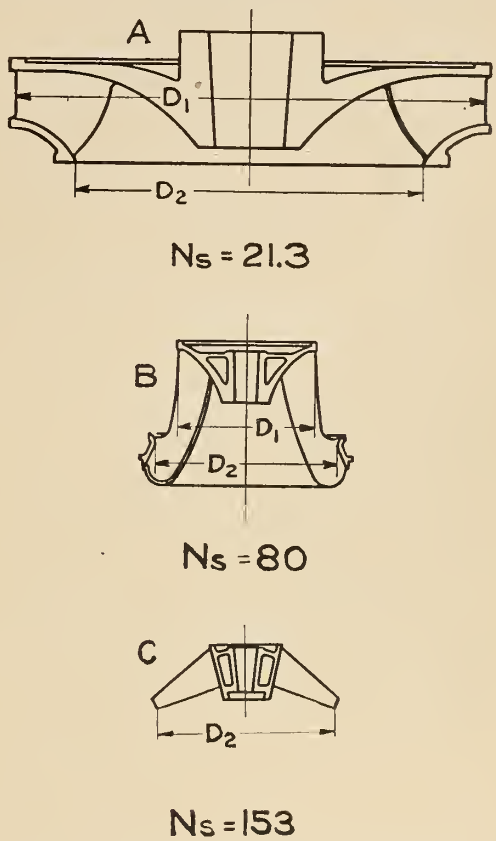


Plate No. C-47.—Comparison of Turbine Runners of Equal Power Capacity.

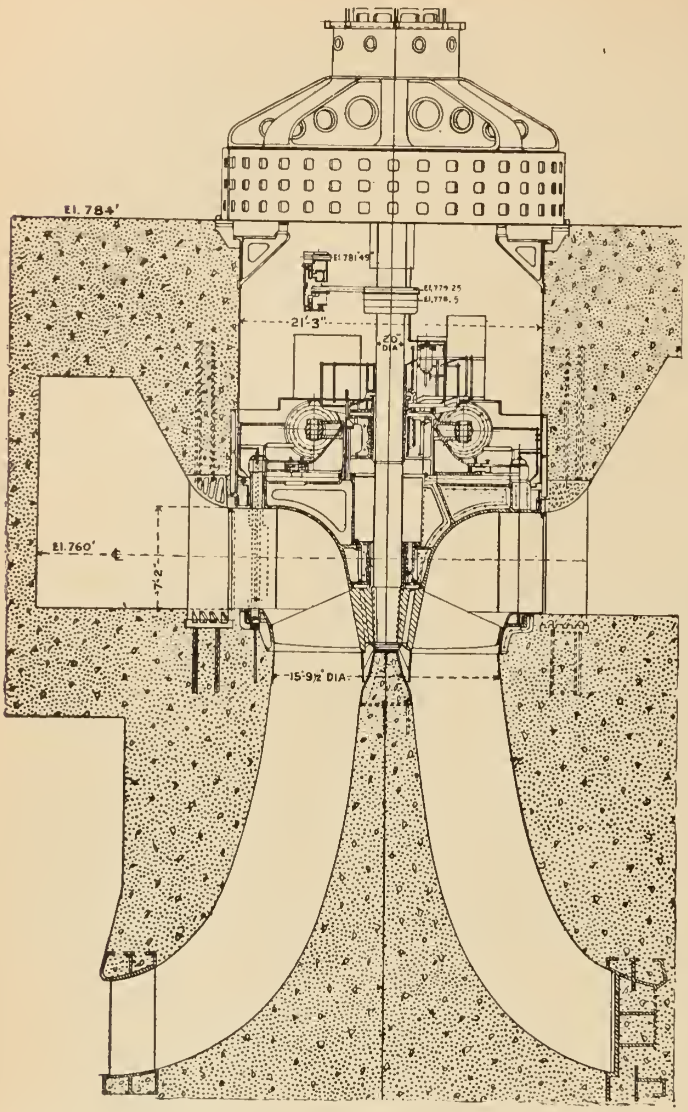


Plate No. C-48.—Cross-section of Diagonal Type Runner Installation.

been completed or are under way. No official tests are yet available in connection with these installations, but tests of a 16-inch model of a recent Canadian installation developed an efficiency of 90.75 per cent, and in the United States an official test efficiency of 90.9 per cent was obtained on a 17,000 e.h.p., diagonal runner unit, having a specific speed of 146 (635 metric).

In the high speed runner, a generally favourable efficiency characteristic is an inverse function of the specific speed. In the case of the Kaplan type all tests showed such a pronounced efficiency peak that economical operation was practically possible only at one gate-opening, for any fixed vane angle, and in order to retain the high specific speed characteristic, it was necessary to have recourse to the only practicable means of obtaining an operable efficiency range; namely, to vary the vane angle synchronously with the gate-opening. This purely automatic expedient is now established as an essential element of the Kaplan turbine mechanism.

In the case of the diagonal type runner, the more moderate range of pressure differences results in a more normal efficiency characteristic, and an appreciable range of economical gate-opening above and below that of maximum efficiency. The question then arises as to whether the efficiency characteristic of the diagonal type runner, with fixed vanes, is such as to permit, under operating conditions, an economy in the use of water comparable with that which may be realized by a Kaplan type runner with adjustable vanes. The answer is in the affirmative if due cognizance is taken of the fact that a maximum of water economy is seldom necessary until the capacity of the installation reaches its ultimate designed limit. Such being the case, an intelligent designer can adjust the capacity of the individual units so that they may operate at all times within the range of economical gate-opening, as indicated by the efficiency contour. This phase of the problem, furthermore, becomes one of elementary simplicity when such an installation is operating in parallel with one or more plants in which Francis type turbines are installed, this being a more or less common condition of Canadian operation.

In future Canadian practice, therefore, it is reasonable to anticipate that dependence will be jointly placed on forethought in the primary elements of plant design and the intelligence of the operating engineer, rather than upon the very material increment of mechanical complexity, and consequent operating hazard, which results from the adoption of any purely automatic corrective agency in turbine design.

Plate No. C-47 illustrates three turbine runners, all drawn to the same dimensional scale, and all developing the same power under the same head, but at an angular velocity corresponding to their respective specific speeds, as shown. Runner *A* is a typical high head runner, runner *B* a typical medium and low head runner, while runner *C* is a diagonal high speed runner capable of operating under heads of the same order as runner *B*.

Plate No. C-49.—Diagonal Type Runner of 28,000 e.h.p. Capacity.

Two points of special interest in connection with this illustration are first, the great power capacity of the diagonal·high speed runner as compared with its physical dimensions; and second, the fact that its discharge diameter, *D2*, is comparable with that of runner *B*, so that in spite of the fact that it has nearly double the specific speed of the Francis runner, the absolute velocity of exit in the case of the diagonal runner is of the same order, and therefore susceptible of the same treatment as regards the limit of draft head.

Among the obvious advantages to be gained by the use of the propellor type runner, the following may be cited in particular:—

(a) A greatly reduced weight of the revolving element of the unit, and consequently a corresponding reduction in cost, not only of the turbine and generator, but of power house superstructure and cranes.

(b) Large water passages, as compared with the Francis type runner, which provide much more favourable conditions for the safe discharge of ice and other foreign material.

(c) Greater mechanical strength, as compared with the Francis type, due to the greatly reduced overhang of the vane from the crown of the runner. In the case of the diagonal type runner, the overlap of the vanes permits a very long connection between the base of the vane and the hub, and a consequent reduction in fibre stress.

Plate No. C-48 shows a cross-section through one unit of a group now in operation in a large plant in western Canada. The runners are of the diagonal high speed type, and develop 28,000 e.h.p., each, under a head of 56 feet, and at a speed of 138.5 r.p.m., or a specific speed of 153 (680 metric).

These units have been in continuous operation for a year, and at the outset a head of only 17 feet was available, instead of the designed head of 56 feet. They nevertheless operated at the designed normal speed, and produced the full corresponding proportion of their normal rating, developing meanwhile a specific speed of 230 (1,020 metric)

Plate No. C-49 is a shop view of the above runner which plainly shows the large vane area and short overlapping pitch, which is characteristic of the diagonal high speed type.

An interesting comparison is afforded by the fact that the Francis type runner illustrated on plate No. C-35 would also develop 28,000 e.h.p., under a 56-foot head. This runner has a throat diameter slightly less than the diagonal runner, but it is 7 feet 4 inches higher, and exceeds it in weight by 108,000 pounds, or considerably more than 100 per cent. The speed of this runner under a 56-foot head would be only 75 r.p.m., as compared with an actual speed of 138.5 r.p.m., for the diagonal runner. This comparison is somewhat illuminating from the general standpoint of cost.

Plate No. C-50 is a cross-sectional view of a diagonal type runner installation now under construction in eastern Canada. These units will develop 30,000 e.h.p., each, under a 60-foot head, and a speed of 120 r.p.m., or a specific speed of 125 (556 metric). This is believed to be the highest limit of head yet reached with a propellor type runner.

It will be noted that both of the above installations use the spreading draft-tube, and in the latter case spiral discharge passages were provided.

Among the minor features of interest, also common to both installations, may be noted the speed-ring stay-vanes, which were cast separately and set in the concrete during the construction of the scroll-cases. Also, the diffuser section of the draft-tube, instead of being held in suspension by a complicated and expensive system of reinforcement, is supported on separately cast stay-vanes, so designed and placed as to offer a minimum of obstruction to the discharge from the runner.

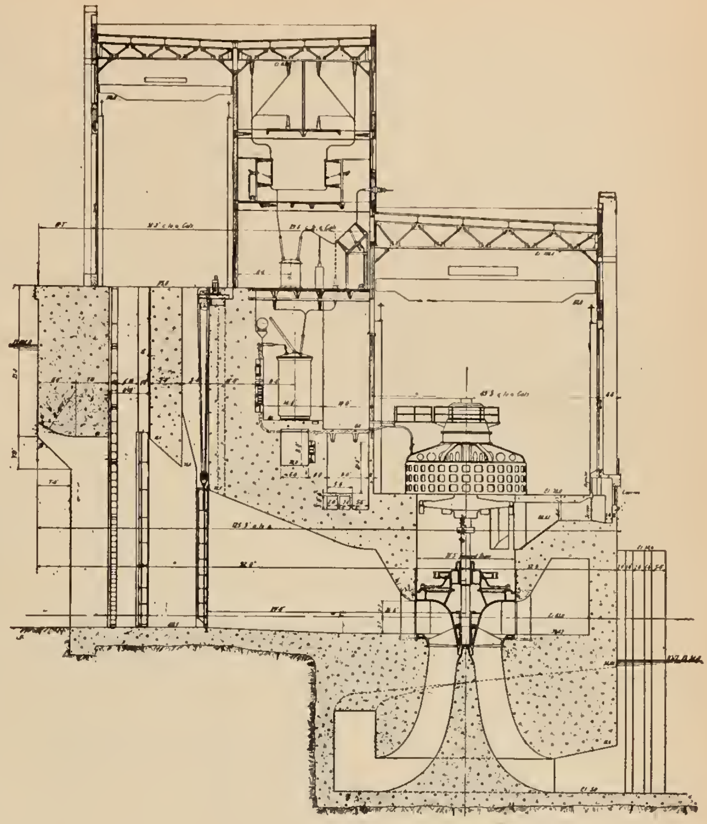


Plate No. C-50.—Cross-section of Diagonal Type Runner Installation.

In addition to the two installations above mentioned, two others of smaller capacity are also in successful operation under heads of 29 and 30 feet, and one is under construction for a head of 9 feet. All are of the diagonal runner type and have been built, as well as installed, in Canada.

Water-Wheel Generators

As in the case of turbines, the most conspicuous feature of Canadian practice in generator construction, apart from size, and in fact largely due to this factor, is necessarily a most pronounced general tendency toward the use of vertical settings, as evidenced by their adoption in most of the more modern installations now operating, as well as those under construction, or projected. The main reasons underlying this phase of the situation having been covered, it is now only necessary to discuss the resultant effect on modern generator practice.

One factor which it is now proper to emphasize, as having contributed in a very essential degree to the vogue of the "super-turbine", and the popularity of vertical settings in general, is the highly perfected status of thrust-bearing construction.

The development of the art in this latter instance exemplifies a condition often met with in the field of engineering, where an inherently sound principle, after having been applied in a primitive way, suffers a period

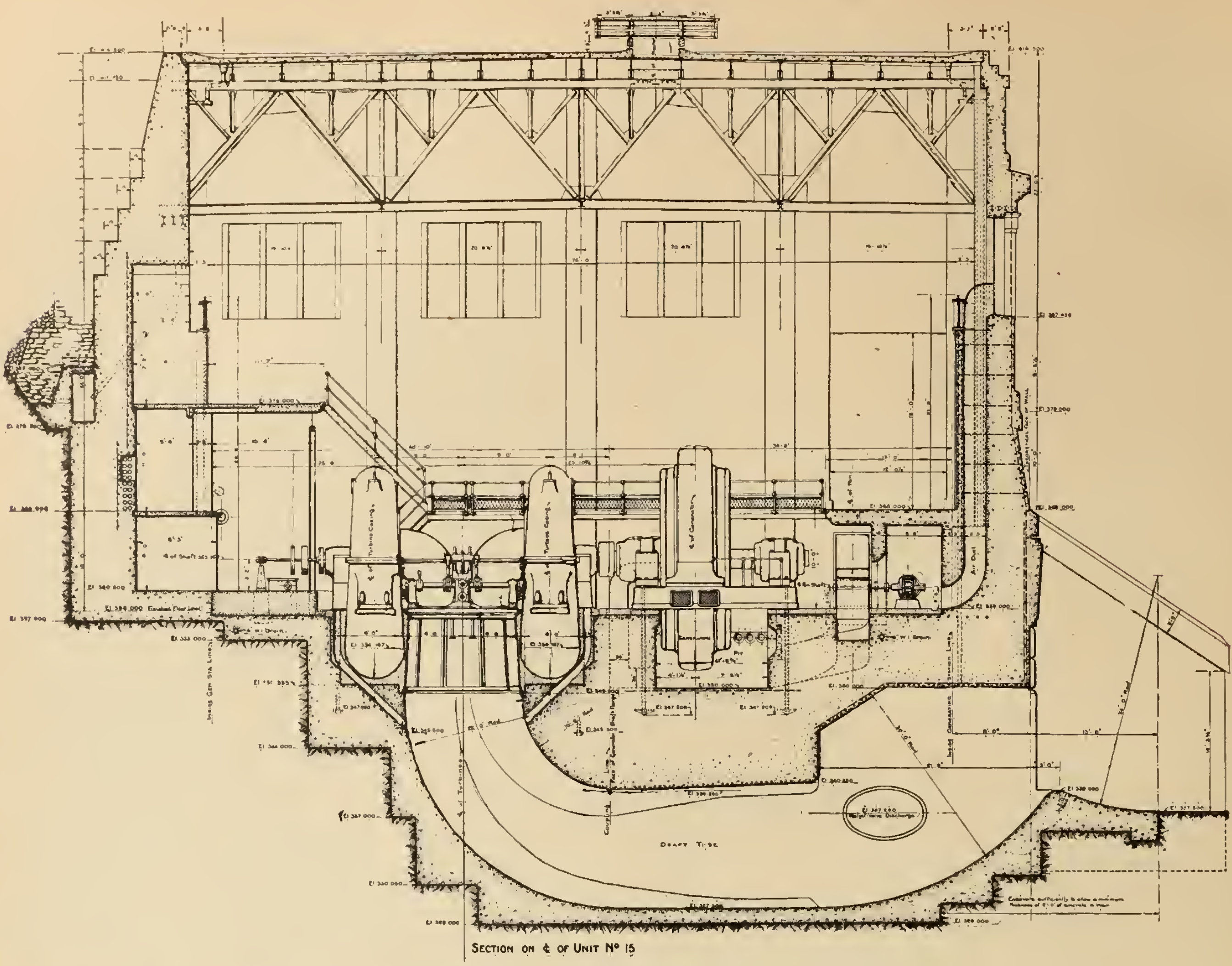


Plate No. C-51.—Horizontal Setting with Large Pillow-blocks Bearings.

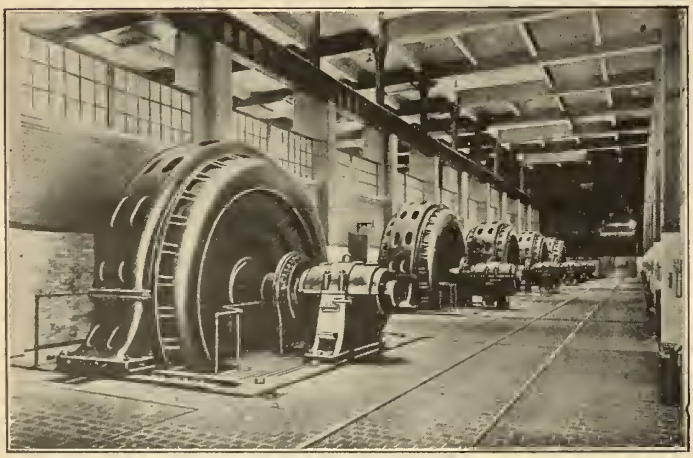


Plate No. C-52.—Typical Installation of Large Capacity Horizontal Units.

of arrested development, and perhaps years afterwards is practically re-discovered, and becomes the basis of the ultimate solution.

In the early days of hydraulic turbine development, the step-bearing, a form of combined thrust and guide bearing located under the runner, was used almost exclusively for the support of the revolving element. The subsequent gradual increase in the speed and capacity of turbine runners then began to introduce problems of pressure intensity, depreciation and accessibility, which the designers of that day solved, not by improving the step-bearing principle, but by abandoning it, and inaugurating, as a result, the era of the horizontal shaft-turbine. This led to advanced development in bearings of the pillow-block type, together with the introduction of marine type thrust bearings to take up unbalanced runner thrust, a double requirement which gave rise to serious problems when the development of electrical generation and transmission called for continuously increasing turbine capacity and speed. The 20,000 h.p., horizontal unit shown on plate No. C-51 fairly represents the climax of this trend of development in Canada, with water-cooled pillow-block bearings of the enormous dimensions necessary to keep bearing pressure within safe limits, and a rotor shaft having a diameter far in excess of torsional requirements, simply to minimize deflection. Plate No. C-52 illustrates another generator of similar type and capacity, as installed in a large Canadian plant.

The original turbines installed in 1896 at Niagara represented the first reversion to the primitive basic principle. They were the super-turbines of that period, and were of the vertical shaft type. The revolving weight of these units was partially suspended from, and partially super-imposed upon, a step-bearing located above the

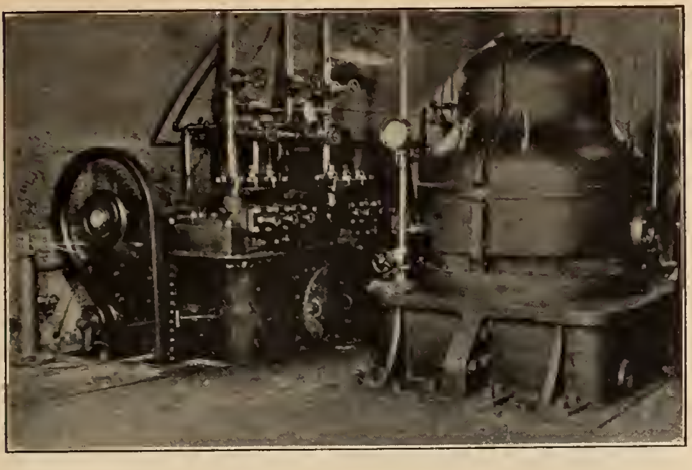


Plate No. C-53.—External Oil Pressure Thrust Bearing of 200 tons Capacity

runner and immediately below the generator, thus removing one of the main disadvantages of this type of bearing, that of inaccessibility. A further important innovation was the application of external pressure to a film of oil which was forced in between the moving and stationary elements of the bearing. This oil was usually supplied by gear driven plunger pumps at pressures varying from 80 to 350 pounds per square inch, and maintained an oil film from two to four-thousandths of an inch thick between the bearing discs. Plate No. C-53 is a view of such a bearing, from a photograph taken in 1905 in a Canadian plant.

The oil pressure thrust bearing had a vogue of many years' duration, and some bearings of this type, such as the one illustrated, are still in operation. Their disabilities are: high investment and maintenance cost, mechanical complexity, and high temperature, resulting in low oil viscosity and high energy losses. Also, even a momentary failure of the pressure oil supply usually results in the loss of the bearing.

Finally, in America, about 1898, the ultimate conception was developed by Professor Kingsbury, as the true embodiment of a basic principle first established by the experiments of Tower in 1863, and afterwards mathematically demonstrated by Professor Reynolds. The Kingsbury principle, as exemplified in the various commercial types now in use in Canada and the United States, constitutes an outstanding example of the simple and efficient application of a natural law.

Briefly, this type of thrust-bearing has the following characteristics which distinguish it from its external oil-pressure prototype, and make it an eminently suitable mechanism for supporting, within comparatively small dimensional limits, the revolving weight of the largest hydro-electric unit.

(a) The source of oil supply is static, and integral with the bearing itself.
(b) The oil supply is "unlimited" in the sense necessary to conform with the laws of viscous fluids, as enunciated by Professor Reynolds.
(c) The formation of the "pressure wedge" is not induced by any external agency, but by the motion of the bearing itself, and by providing for a very slight lack of parallelism between the stationary and moving elements.
(d) The wedge pressure is a direct function of the speed of the moving element, and the thickness of the oil film is a direct function of the fluid temperature, which can be regulated within any desired limits by the simple expedient of water-cooling coils.

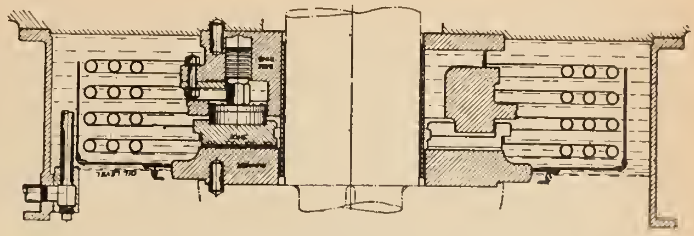


Plate No. C-54.—Cross-section of Thrust-Bearing with Segmental Shoe.

Plate No. C-54 shows a cross-sectional view of a bearing of the latest type, with non-circulating oil supply and water-cooling coil. Plate No. C-55 shows two views of the same bearing, one of the bearing itself partially assembled, and one of the housing and cooling coil. This bearing is guaranteed to carry a load of 1,000,000 pounds, inclusive of estimated maximum runner thrust.

In addition to the rigid segmental shoe type of thrust bearing shown in the above illustrations, Canadian practice also includes the use of a type of bearing in which the stationary element, or shoe, is in one piece, and the slight oscillatory movement necessary for the functioning of the "pressure wedge" is obtained by mounting a shoe of comparatively light cross-section on a multiplicity of springs.

Plate No. C-56 shows a shop assembly of a large bearing of this latter type, of the same loading capacity as that illustrated on plate No. C-55. Both types of bearing are extensively used at the present time, and are giving satisfactory service in one or other of all the more modern Canadian installations.

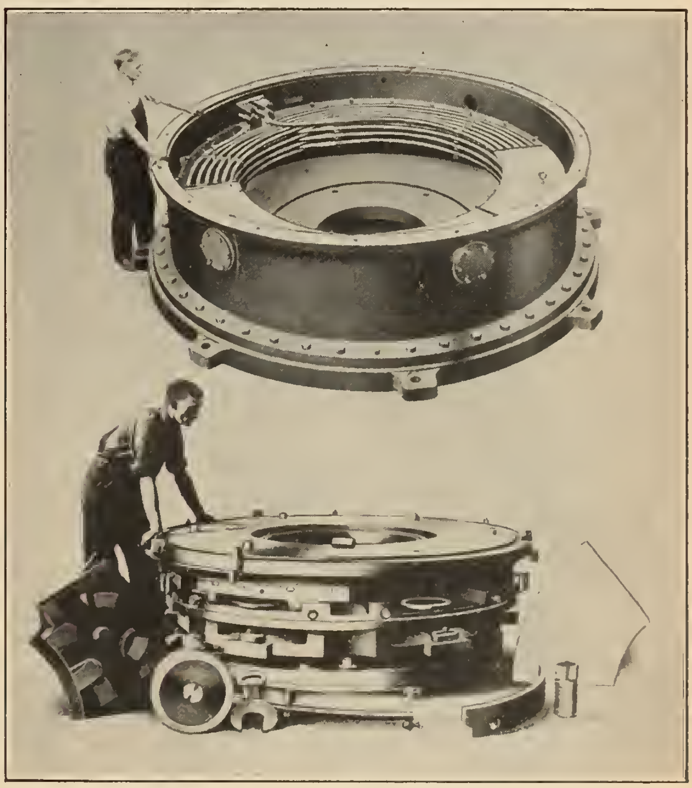


Plate No. C-55.—Thrust Bearing with Rigid Shoe Supports.

In the matter of mechanical simplicity, and therefore dependability, the merit of the Kingsbury type bearing is evident. Also, the now almost universal practice of mounting the bearing over the generator represents the ultimate limit of development as regards accessibility.

The unique feature of the Kingsbury type bearing manifests itself, however, in the fact that unit pressures as high as 500 pounds per square inch can be used with safety. This means that the basis of design does not need to be a predetermined limit of safe unit pressure, but can be, and usually is, predetermined limit of lost power. In other words, the design of this bearing, for any specific installation, is primarily a problem in efficiency economics, and not of mechanical and dimensional limitations as governed by safe bearing stresses. Where units of large capacity are involved, the economic power loss seldom works out in excess of one-tenth of one per cent of the nominal generator rating, the effect of this being immediately reflected in the "speed-no-load" losses of the large modern generator, where the total friction and windage losses are now of the order of one-half of one per cent of rated capacity.

Plate No. C-57 shows one of the most recent installations of this type of bearing, on a 41,000 e.h.p., unit in eastern Canada.

By reason of the fact that the electric generator has for many years been an efficient convertor of energy, no advance, comparable to that made in the case of turbine efficiency, has been effected in Canadian generator practice; nevertheless, the factor of increased unit capacity has resulted in an appreciable improvement in this regard,

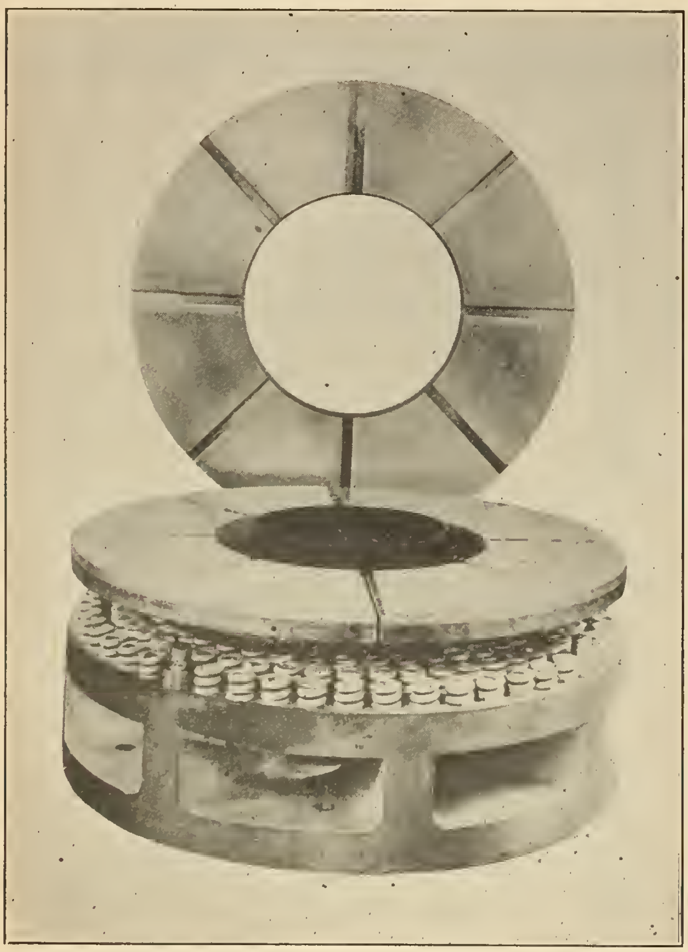


Plate No. C-56.—Thrust Bearing with Spring Supported Shoe.

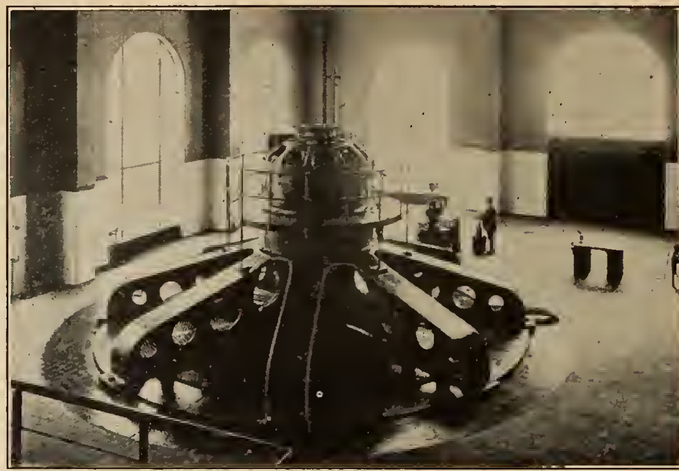


Plate No. C-57.—Large Vertical Unit with Thrust Bearing and Direct Connected Exciter.

to the extent that while 93 per cent is a fair figure for ratings under 2,000 k.w., efficiencies of 96 to 97.5 per cent are now realized, in generators of Canadian design and manufacture, for ratings ranging up from 20,000 k.w. in generators of 11,000 to 12,000 volts, and in cases where the generator voltage is 6,600 or less, a further gain of one-half to three-quarters of one per cent might be obtained.

Probably the most serious problems arising out of the present trend in Canadian practice have been those associated with the purely mechanical features of design. These conditions arose from the necessity of supporting the total revolving weight of the unit from the top of the stator frame; from the use of shafts and circulating oil guide-bearings of large diameter; from the necessity of forced ventilation; and most important of all, from the necessity of maintaining the safety factor in the rotor structure as its weight and cross-sectional mass increased with the generator rating.

As regards this latter problem, Canadian practice embraces the use of two distinct solutions, with the same primary object in view; namely, to overcome, or to offset, the inherent weakness of large masses of steel in the spider casting.

Plates Nos. C-58 and C-59 clearly illustrate the two methods in question. The former view shows a type of construction in which the cast and annealed metal is limited to the hub and spider arms the rim being composed of thin steel laminations dovetailed and wedged into slots in the ends of the spider arms, and held together by through-bolts. The merit claimed for this type of rim construction is that the thin section of the individual steel laminations assures the realization of the calculated safety factor.

Plate No. C-59 shows a type of spider construction in which the necessary requirements as to safety-factor are met by stacking comparatively light rings, cast and annealed separately, and afterwards machined. The comparatively light section of these castings naturally reduces the liability of residual shrinkage strains subsequent to annealing, and the machining furnishes a more or less effective means of detecting lamination, porosity and other internal defects.

Both of the spiders illustrated are for generators of the same capacity, the rotor assembly, with shaft and pole-pieces complete, weighing something over 600,000 pounds in each case.

In the case of the construction shown on plate No. C-59, the upper and the lower rings are inactive electrically, having been added for the purpose of augmenting the fly-wheel effect of the rotor. Also, the horizontal slots shown in this view are for ventilation purposes.

Ventilation is classed as a mechanical problem because, in generators of the class under discussion, it is in almost all cases necessary to dissipate heat by mechanical means. While nothing radical had transpired in Canadian practice under this head, the ventilation of generators has up to the present time definitely progressed as an art by careful attention to detail and gradual refinement of design, as generator ratings increased. It is now being subjected to further intensive study and experimental research from a more or less original viewpoint.

An interesting feature of recent Canadian practice, and closely related to this phase of the discussion, was originated in the design of the installation shown in section on plate No. C-43. In this design, air is drawn at will from within or without the power house superstructure, into a closed chamber beneath the generator, and is discharged through flues passing up through the centre of the building and terminating in louvres on the roof. To make this system of ventilation effective, the main floor of the machine-room is located at the elevation of the top of the stator frame as shown.

The flow of air is primarily actuated by the fans on the generator rotor, and supplemented, as required, by motor driven exhaust-fans located beside the generators in the flues. When these exhaust-fans are in operation, the weight of air passing through each generator, in 2½ hours, is equal to the total weight of the generator itself; namely, 1,400,000 pounds.

The location of the machine-room floor, as above described, had the further advantage of providing ample space for all auxiliary equipment elsewhere than on a main floor, so that the space around the main units is wholly unencumbered except by the governor actuators and control-stands. This floor also has the virtue of materially reducing the unsupported length of the crane columns, and the extra space is provided at the additional cost of the floor only, as the roof clearances are independently governed by the height of the stator frame and the length of the generator shaft.

The cross-section on plate No. C-45 shows a machine-room floor similarly located, and plates Nos. C-57 and C-60 indicate the general appearance of the main floor, with no part of the generator in view below the upper bearing bracket.

From the purely electrical standpoint, the main features arising out of the evolution of Canadian generator practice are, inherent regulation and fly-wheel effect, excitation, core loss, and insulation.

The gradual increase in unit capacity has been accompanied by proportionately smaller frame dimensions, and a much greater percentage of inherent voltage regulation, than was hitherto considered permissible. The primary reason for this trend of development has been the perfecting of the automatic voltage regulator, which is now a standard accessory in all important Canadian installations.

One disadvantage of the smaller frame dimensions is a corresponding reduction in fly-wheel effect, but this condition is more or less offset by the fact that large generators are almost invariably connected to a transmission network, so that in the first place, large percentage load changes are not an ordinary condition of operation, and secondly, their inherent fly-wheel effect is supplemented by the very appreciable fly-wheel effect of the system as a whole.

The fundamental idea in all excitation systems is to use every reasonable means to insure continuity of service. This is usually effected by using two, and sometimes three, independent sources of supply. When the speed of the main units is suitable, it is common practice in Canada to use a direct connected exciter as the ordinary source of excitation. In other cases, particularly where direct connected exciters are not practicable, a central turbine driven service alternator installation, usually in duplicate, is used to drive individual motor-generator sets at each main unit; also, where foreign power is available, it is frequently used as an emergency drive for the motor-generators.

Plate No. C-60 shows a view of the machine-room of a large Canadian station recently constructed. In the

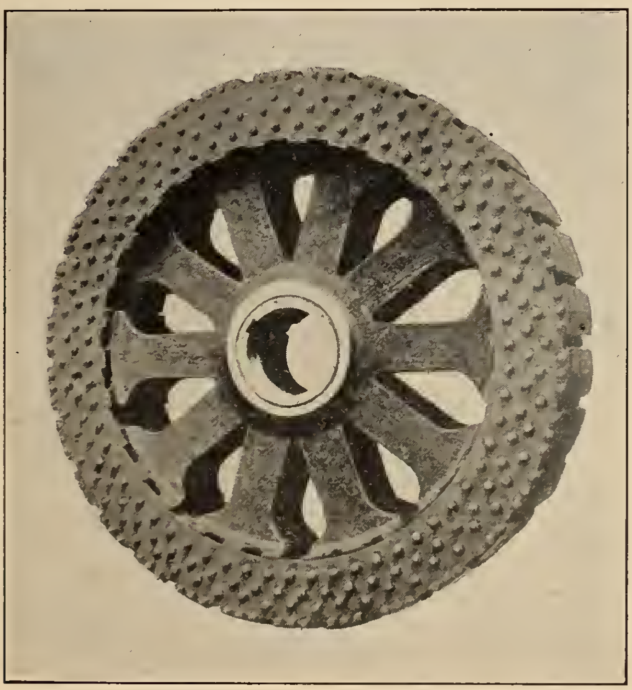


Plate No. C-58.—Generator Spider with Laminated Rim.

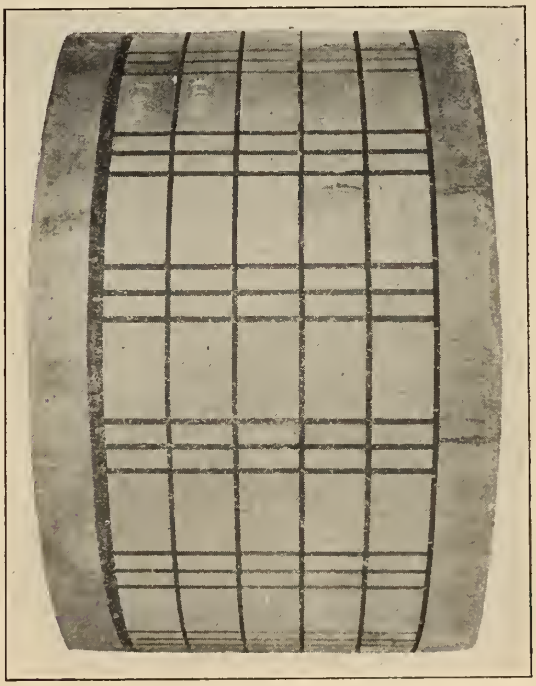


Plate No. C-59.—Generator Spider with Separately Cast Sectional Rings.

background the main units may be seen, each with a direct connected exciter over the thrust-bearing, and in the foreground, one of a pair of 2,500-k.w., turbine-driven service alternators, which supply all power required for the operation of plant auxiliaries. A motor-generator set is also provided as an emergency exciter unit to replace any of the direct connected exciters, if required. This emergency set may be operated from the service units above mentioned, or from a wholly external source of power.

The use of direct connected exciters has been the subject of considerable controversy, and there is still scope for argument in connection with economic dimensional limits, as governed by the speed of the main unit. On the other hand, an appreciable energy saving results from the fact that the direct connected exciter has the benefit of the higher efficiency of the main turbine, while at the same time the advent of the automatic voltage regulator has eliminated its main operating disability; namely, the reaction on field intensity due to inherent speed changes in the main unit, on varying load.

The design of magnetic circuits has of recent years been appreciably improved by the use of low loss medium silicon steel in core construction. In generators of large capacity the reduction in core loss, as compared with

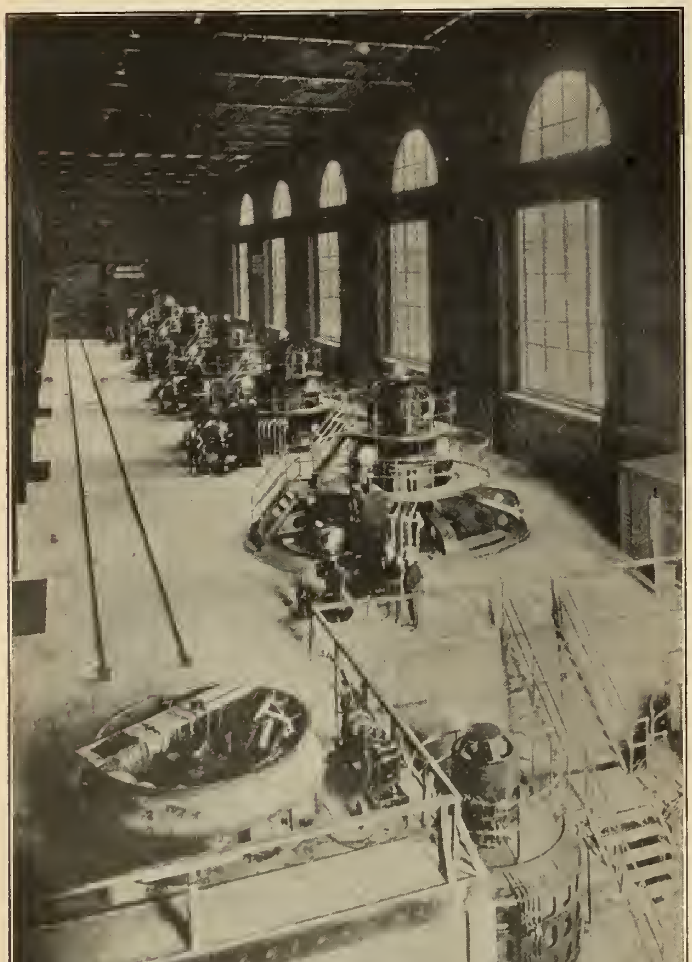


Plate No. C-60.—Machine Room Showing Direct-connected Exciters and Service Units.

previous practice, ranges as high as one-half of one per cent of rated capacity, for this item alone.

A conspicuous feature of Canadian generator design, arising directly out of the vogue of the "super-turbine", has been the development in stator-coil insulation methods, as governed by mechanical considerations, and the use of higher temperature ratings. Here again, as in the case of rotor construction, Canadian practice includes the use of two more or less distinct types.

To differentiate briefly between these two types, which both employ mica as the dialectric base, it may be said that one type provides for a very high degree of heat resistance, but at the expense of flexibility, as the high percentage of sheet mica employed makes the coils stiff and brittle. On the other hand, the second type provides for flexibility and convenience in handling, but at the expense of extreme heat resisting capacity.

There is very evident merit in the use of insulation with extreme heat resisting qualities in some types of motors, where heavy intermittent overloads are a necessary condition of operation, and where the coils are short and stiff, but in large generators, rating upwards from 20,000 k.w., for instance, low temperature performance is a very important economic characteristic of operation, and the necessity for high heat resistance therefore not such a vital consideration. It is for this reason argued that a more equitable balance is attained by providing an insulation which has at once a reasonable and safe margin of heat resistance, with such a degree of flexibility as will permit handling, and a certain amount of distortion, without injury. This argument still leaves open the comparative hazard, as regards these two types of insulation, arising from the possibility of such a break-down as might result from the current rush of a dead short circuit, and it would seem that the ideal solution involves mechanical as well as dialectric considerations. Such being the case, the best insulation will be that having the highest heat resisting properties, even with the inevitable accompaniment of stiffness and brittleness, if at the same time the slot anchorage and the bracing of the end turns can be so designed as to preclude any possibility of coil displacement or flexure.

Shown on plate No. C-61 are two typical generator cross-sections illustrative of the above discussion, particularly as regards methods of rotor construction, thrust-bearing assembly, and bracing of end turns. One cross-section shows a laminated spider rim, a thrust-bearing with rigid shoe supports, and radial end turn bracing applied to high heat resisting insulation. The other cross-section shows a machined sectional spider casting, a thrust-bearing with a one-piece spring-supported shoe, and circumferential band bracing of end turns applied to the flexible type of insulation.

Plate No. C-62 is a view of the stator frame of one of the generators shown in cross-section on plate No. C-61, as assembled in the Canadian shop in which it was built.

The bracing of end turns is a vital factor in the mechanical design of large water-wheel generators, owing to the enormous electrical stresses developed in the event of a dead short circuit. Plate No. C-63 illustrates diagrammatically the so-called circumferential band method of bracing, which consists of two continuous steel bands, of channel section, to which the coils are securely fastened, and which, in turn, are attached to the spider rim by a bolted connection.

Plate No. C-64 is a view of the stator coils of a 55,000 k.v.a., generator in process of assembly. This view shows the radial knee-braces upon which the end turns rest, and

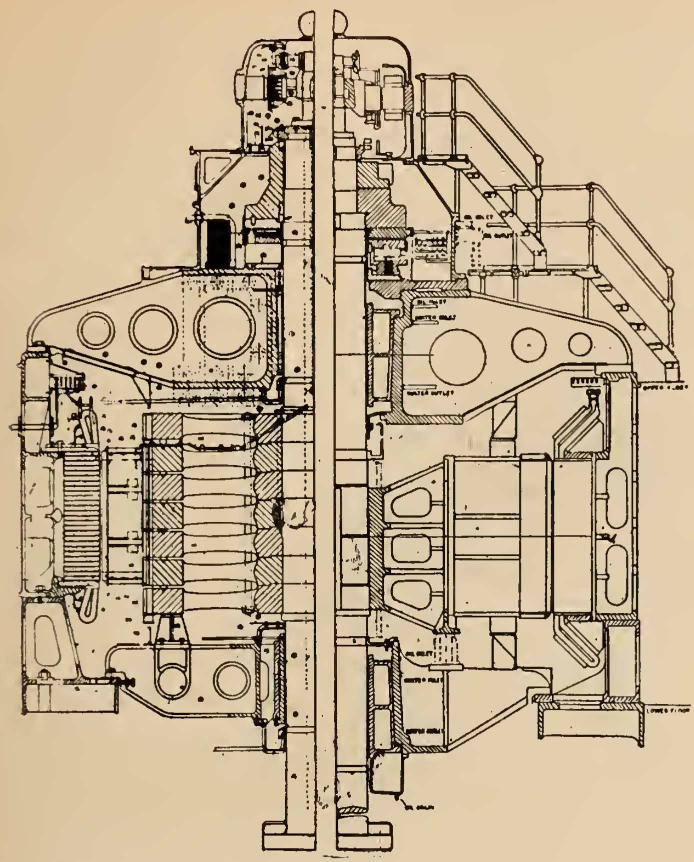


Plate No. C-61.—Typical Large Generator Cross-section.

the hardwood cleats which are through-bolted to the knee-braces to hold the coils rigidly in place.

As in the case of the Francis type turbine, it is reasonably safe to venture the opinion that, as regards economy in energy conversion, the large Canadian built water-wheel generators of the present day are not likely to be demodernized by future advances in the art.

Future Trend of Development

If the future trend of water power development in Canada were considered in its relationship to other native power resources, as it properly should be, the scope of discussion would be enlarged far beyond the limits originally fixed. If, however, the discussion is confined to hydraulic development "per se", it may be stated with a fair degree of assurance that the future holds no prospect of revolutionary advances in the art, such as have taken place in the last twenty years.

The means of supporting revolving weights, of safely controlling static pressure, and of regulating long water-columns, have been perfected. The Francis turbine and the water-wheel generator have attained a degree of efficiency in energy conversion which leaves little margin for further improvement. The supremacy of concrete as the structural medium for permanent works stands unchallenged. The larger unit capacities now used in Canada are not likely to be greatly exceeded on sound premises, so that increased unit power concentrations will not in the future give rise to new problems of design.

It would seem, as a matter of fact, that the one conspicuous exception to the ruling condition is the high speed propellor type turbine, and even this advance in the art, while of a revolutionary nature, is more an actuality of the present than a possibility of the future, its merit as a distinct type having been already tested in commercial operation. In other words, the type has been created, and the future trend of development will be limited to the improvement of mechanical details, and to the more important matter of extending the range of feasible operating heads.

A less conspicuous but nevertheless important subject of future study is the pitting of turbine runners. As stated at a previous stage of the discussion, a means of prevention is fairly well established, but the agency of the actual pitting process is still more or less obscure, and may be due to erosion or corrosion, or a combination of both. If erosion is the controlling agency, then bronze runners should suffer more than those of cast-steel, which is not actually the case. If corrosion is the controlling agency, then cast-steel runners should suffer more than those of bronze, which is in accordance with ascertained facts. If corrosion is for this reason assumed to be the primary cause of the trouble, it follows that there must be some purely local condition, induced in and adjacent to the runner passages, which causes oxidation, otherwise the pitting action might as well occur in the scroll-case or speed-ring, which it does not. Under the circumstances, therefore, it might be reasonable to suppose that high velocity, impact and intermittent vacuum conditions, as induced by part-gate operation, tend to disrupt the molecular structure of the water and entrained air, with the result that sufficient free oxygen is released, in and adjacent to the runner passages, to cause pitting through the agency of corrosion.

A much simpler explanation of pitting action might be to the effect that certain portions of the runner surfaces are alternately wet and dry under operating con-

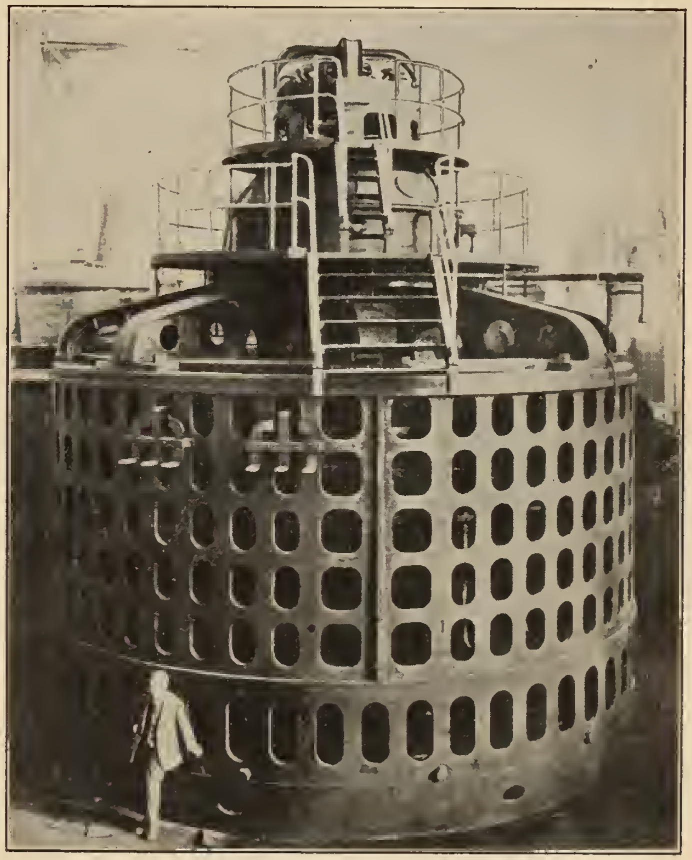


Plate No. C-62.—Shop Assembly of 55,000-kv.a. Generator.

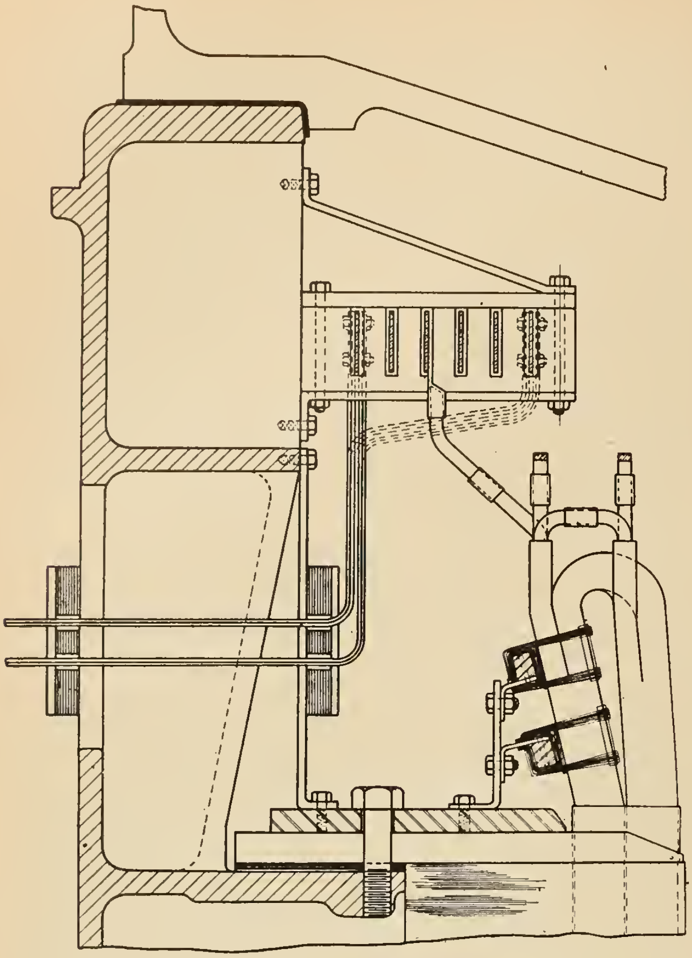


Plate No. C-63.—Diagrammatic Sketch of Circumferential Band Bracing of End-turns.

ditions, due to the fact that the curvature and transitioning of the water passages at any point is only perfect for one critical velocity at that point. If, therefore, such an alternating cycle of conditions persisted continuously for long periods, the oxidation process would function more or less as in the case of an unprotected metal surface in the open air.

The actual cause of corrosion is not, however, essential to the argument, the point being that if the pitting of runners is due to corrosive action in any form whatever, a distinct advance in the art will be achieved if the ideal metal alloy can be evolved; in other words, an alloy possessing the oxidation resisting property of bronze, with the strength and cheapness of cast-steel. The problem would then be solved by reason of the inherent characteristics of the material, rather than by the expensive alternative of low specific speed and low absolute velocities of entrance and exit.

Apart from the specific cases above dealt with, the general problem of the future trend of development will be largely governed by two factors; first, the ultimate necessity of developing water powers remotely situated and not favorably endowed by nature, with a resultant tendency toward increased capital and annual cost; and secondly, a general scale of labor and material costs greatly in excess of that which existed previous to the World War.

If, as previously observed, the above conditions cannot be offset to any appreciable extent by advancing the art from the standpoint of operating efficiency, it follows that future effort must be concentrated on maintaining the present status of efficiency, while at the same time aiming at reduced costs through simplification or revision of the methods and processes by which the present degree of efficiency has been attained.

Under this head, for instance, might be included the use of remote automatic control for low head developments of considerable size, as a means of reducing operating costs; the use of syphonic wheel-pits under low heads, as a means of reducing excavation, unwatering and substructure costs; the use of ejector turbines as a means of reducing the loss of power due to a disproportionate rise in tail-water level during high stages of flow; and finally, by the discovery and substitution of cheaper materials, such, for instance, as a new insulating material for generator coils, which would be cheaper and more workable than mica, and at the same time have equal dialectric efficiency and service-ability. This last possibility is perhaps the most important of all.

As a matter of fact, there may be considerable scope for the advancement of the art in the discovery or development of new materials and new combinations of metals, and it would be rash to state that radical and perhaps even revolutionary advances, along this particular line at least, are not a possibility of the future.

Conclusion

In the opening chapter, the subject matter of this discussion was designedly limited to the more interesting and more or less distinctive features of Canadian practice in connection with hydraulic power production, and for an obvious reason. In citing these various features an effort has also been made to summarize, in a general way, the underlying theory involved, and to show that in every instance conformity to natural laws, and a rational comprehension of the phenomena of water in motion, has been the actuating motive.

At the same time, an attempt has been made to convey the impression, more or less by inference, that Canada not only possesses water power resources of enormous extent and value, but has spared no effort to develop them in a manner fully in keeping with their importance as a national asset.

If, therefore, the subject has been presented in such a way as to properly bring out these facts, and at the same time to impress the reader with the fact that in her proficiency in both the structural and purely engineering phases of the hydraulic art, Canada stands to-day on a par with any other nation in the world, the objective aimed at will have been realized.

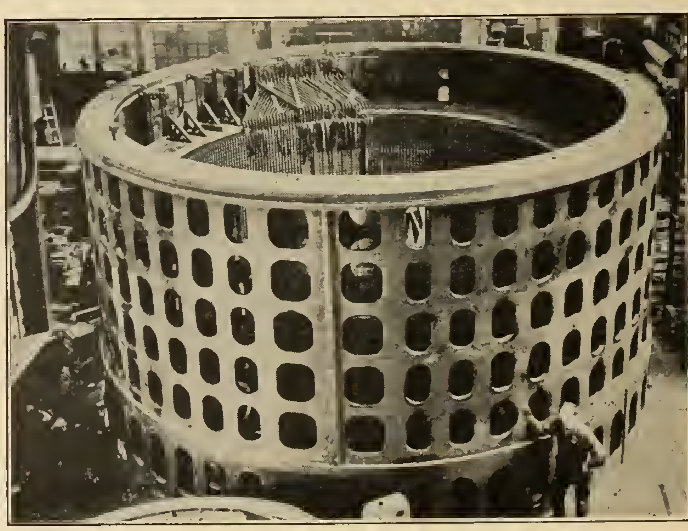


Plate No. C-64.—View Showing Radial Bracing of End-turns.

Electric Power Transmission and Distribution in Canada

Current Practice in the Design and Operation of Electrical Transmission and Distribution Systems in Canada.

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Synopsis of Paper

The authors, in this paper, have endeavoured to describe current practice in the design and operation of electrical transmission and distribution systems in Canada.

The majority of the large water power developments in Canada are located at a considerable distance from the main industrial centres where the power is used. To a considerable extent industries requiring cheap power have been induced to move to the districts near the power developments. This is especially true in the Niagara peninsula in Ontario, but the high freight rates and inaccessibility of many of the power sites have made it impossible to consume more than a small percentage of the power near the source and large transmission systems have been developed to carry the power to the main distribution networks from whence it is supplied to the industries.

The distribution of the water powers is so widespread that exceptionally long transmission lines have not so far been required and 110,000 volts is the highest line voltage at present in use. The development of some of the larger water power sites further from the industrial centres, such as that at lake St. John in Quebec, which is now under construction, will probably lead to an increase in transmission voltage to 150,000 volts or 220,000 volts. Such voltages will also be required on lines interconnecting the transmission systems of Quebec and Ontario.

A number of plates are included showing the main transmission networks of Canada and these indicate that practically every large industrial centre is now supplied with electric power. Two main frequencies are recognized as standard, 25 cycles throughout the Niagara system of the Hydro-Electric Power Commission of Ontario and 60 cycles in practically all of the other systems of Canada. The advantage of making all future developments at 60 cycles is emphasized since this will enable the majority of the systems to be directly interconnected for the exchange of power.

It is pointed out that operating methods are in use on many systems which are not in accord with what is considered the best practice, largely due to the fact that transmission and distribution systems are the result of a gradual growth, separate systems of relatively small magnitude and with small generating capacity, having been interconnected to form the large existing systems. The network of lines in the province of Quebec has connected to it more than fifteen separate generating stations of an aggregate capacity of over 600,000 horse-power and the Niagara system in Ontario is fed from a smaller number of stations of approximately the same combined capacity.

The large voltage drops on many systems are due to the low load power factors and it is shown that the remedy for this condition is to install synchronous condensers in the receiving stations or to place static condensers throughout the distribution systems.

Technical descriptions of apparatus and systems have been omitted except in the case of certain special constructions which are of general interest such as the single-span crossing over the St. Lawrence river.

On some subjects such as lightning protection, relay protection and the use of the grounded neutral on which great differences of opinion exist between the engineers of different systems, an attempt has been made to trace the general tendencies only, realizing that on some systems special considerations may warrant a departure from the suggested procedure.

The necessity for complete co-operation between the engineers of the power and signal companies is considered at some length because it is recognized that only by this means can the unavoidable interference with the operation of the signal systems be reduced to a negligible amount.

Introduction

This paper will endeavour to describe current practice in the design and operation of electrical transmission and distribution systems in Canada, dealing with Canadian conditions as affecting the size, the length and the design of present and future systems.

It must be borne in mind in considering the transmission of power in Canada, that owing to geographical conditions, the majority of the water power developments are situated at a considerable distance from the large industrial centres and the transmission systems are primarily systems connecting the generating stations with the distant distributing systems, but due to interconnection of neighbouring systems vast transmission networks are being developed which will in time cross the country from one end to the other.

The map which accompanies the "National Review of the Water Powers of Canada" shows the principal water powers of the Dominion and indicates that a great part of the water power is located in the provinces of Quebec and Ontario, with Manitoba and British Columbia not far behind, while the other provinces though not so bountifully supplied with water powers, yet have more than sufficient for their present needs and to take care of normal industrial expansion for many years to come. Moreover those provinces which are the poorest in water powers have available vast deposits of coal to compensate for their lack.

The geographical distribution of the population of Canada should also be noted, since of the nine millions of people, representing approximately the present population, the great majority live in the relatively narrow strip of territory adjacent to the St. Lawrence river and the Great Lakes, and in a band about one hundred miles in width close to the southern boundary of Canada, from the head of the Great Lakes to the Pacific coast. Fortunately for Canada most of the water powers lie within transmission distance of the industrial centres, and so the developments which have already been made have not included any transmissions of extraordinary length.

The most important transmission systems of Canada are illustrated by plates Nos. A-6 to A-12, inclusive, accompanying the preceding "National Review of Water Powers of Canada" and plates Nos. D-7 to D-17, inclusive, herewith.* These diagrams show that practically every large industrial centre throughout the Dominion is now served with hydro-electric power, and ample reserves still exist within easy transmission distance.

Canadian transmission systems are characterized more by the large amounts of power transmitted and large size of water wheels involved than by long distance of transmission.

The fact that steam coal is obtainable in Canada to-day at prices ranging from about $6.00 to $15.00 per short ton, according to the distance from the source of supply, limits the price which can be obtained for hydro-electric power in competition with coal fired steam generating plants. There is also competition between electrical systems supplied from hydro-electric developments, and as a result of all these factors, the selling price for bulk electric power in Canada has settled down to such a figure that the investment which can profitably be put into water power developments and the main transmission lines must be limited to approximately $150.00 per kilowatt delivered.

In the development that has taken place in the last ten years in the transmission of large amounts of power, the cost of right-of-way, foundations, structures and insulators has aggregated such a large proportion of the total cost that one of the main factors involved in any transmission system of this type is the amount of power per mile of transmission distance.

A transmission line to deliver 10,000 kilowatts one hundred miles away from the power plant would at present prices cost such a large amount per kilowatt that the power could hardly meet the competition of steam generated power. A transmission line, on the other hand, to deliver 50,000 kilowatts one hundred miles from the power plant would be a much easier economic problem to solve. In dealing therefore, with the elements of design, the amount of power per mile of transmission circuit has a very great bearing and it has resulted in the classification of different types of construction as being suitable for the different conditions that exist.

The discussion of transmission systems will be considered under the two general headings of design and operating characteristics.

*Plates Nos D-7 to D-14 were supplied from the private files of Walter J. Francis and Co., Consulting Engineers, Montreal.

Mechanical Design of Transmission Lines

The general mechanical design of a transmission line can be divided into four parts, the conductors, the insulators, the supporting structures and the foundations.

Conductors

The two principal materials used for conductors for long distance transmission lines are aluminum and copper. In some cases iron wire is used where a small amount of power is to be transmitted. Copper clad steel wire is used to a considerable extent for special crossings where great strength is required. Steel reinforced aluminum cable is coming into more extended use every year. It is very much stronger than copper for the same conductivity and weight. The steel core is relied upon for strength and the aluminum cable furnishes the required conductance.

The following table gives a comparison of some of the more important characteristics of aluminum, copper and the galvanized steel wire used for reinforcing aluminum cables.

Comparison of Aluminum, Copper, and Galvanized Steel Wire

Material	Aluminum	Copper	Galvanized Steel
Specific gravity	2.705	8.890	7.740
Comparative specific gravity	1.00	3.29	2.86
Conductivity in per cent, annealed copper standard	61 (60 to 63)	97 (96 to 100)	
Coef. of linear expansion per degree fahrenheit	12.8×10^{-6}	9.2×10^{-6}	6.2×10^{-6}
Comparative weight for same length and conductivity	1.00	2.07	
Elastic limit pounds per square inch	14.000	30,000	130,000
Ultimate strength, pounds per square inch	24,000 (20,000-30,000)	60,000 (50,000-70,000)	160,000
Modulus of elasticity, pounds per square inch	9,000,000	16,000,000	30,000,000
Comparative safe stresses for same conductance	1.00	1.35	
Comparative safe stress for same weight	1.00	0.65	

For conductors of the same length and conductance the weight of copper is 207 per cent of the weight of aluminum without steel reinforcing. The steel reinforcement commonly used adds about fifty per cent to the weight of the cable.

The comparative safe stress of the copper cable for the same conductance is 135 per cent of that of the pure aluminum, and the steel reinforced aluminum has a comparative safe stress of 220 to 250 per cent, depending upon the percentage of steel reinforcing.

The comparative safe stresses for the same weight of cable in the three cases are aluminum 100 per cent, copper 65 per cent, and aluminum cable steel reinforced about 160 per cent.

When the amount of current to be transmitted is relatively small so that it is permissible to use a size of copper smaller than No. 000 B. & G. gauge, and the line is constructed on steel towers, the span length is usually limited by the strength of the conductor and it is of advantage to use steel reinforced aluminum cable. For wood pole line construction with pin type insulators, the pin is the weak link, and it is not so necessary to use a conductor of very great strength, consequently copper may be used or aluminum cable without reinforcing.

Conductors on steel towers are usually strung so that under the worst conditions the tension will be about 20 per cent below the elastic limit. This limit should not be exceeded, in fact the economical design of towers may require that the conductors shall not be stressed to this extent. On wood pole construction with the heavier sizes of conductors the permissable pull on the pin type insulators or on the pin itself may be less than the maximum allowable tension in the conductor.

Satisfactory joints are more difficult to make with aluminum than with copper, and special care must be taken when making connections between aluminum and copper. The smaller sizes of steel reinforced aluminum can be held by a clamp gripping the aluminum strands tightly, but with larger sizes at dead ends, it is necessary to grip the steel core directly and the aluminum strands must be held separately.

Eighty per cent or more of the conductor material used in the construction of transmission lines in Canada is either pure aluminum or steel reinforced aluminum. The steel reinforced aluminum conductors are used in sizes from No. 2 to 605,000 circular mils.

Insulators

Two widely different types of insulators are in common use, viz: the pin type, used for voltages up to 66,000 volts or in special cases up to 110,000 volts, and the suspension type, for voltages from 66,000 to 220,000 volts.

The early forms of pin type insulators were not designed with sufficient knowledge of the factors involved and the porcelain body was not homogeneous, often it was porous. The shapes were such that excessive dielectric stresses were set up at certain points, besides which mechanical stresses were present in the insulator body which were exaggerated by extreme temperature changes, and the insulators frequently failed in service due to cracking or puncture. The shells were made of thin and brittle material, and when a power arc passed over the insulator following a lightning flashover, the skirts were often broken off and much of the insulating value destroyed. The modern pin type insulator has, however, been very much improved. The material now is homogeneous and non-porous, the parts are so shaped that the dielectric stresses are reduced to a minimum and the initial mechanical stresses are small. The cement binder between shells has been improved so that expansion stresses are reduced, and the various parts of the insulator are of substantial design, and better able to stand a power arc for the short time required by the switches to clear the line. Besides this horns to keep the arc away from the insulator surface are used in many cases and are of advantage. Modern pin type insulators are giving good service on lines up to 66,000 volts and can be used in certain cases for 88,000 to 110,000 volts.

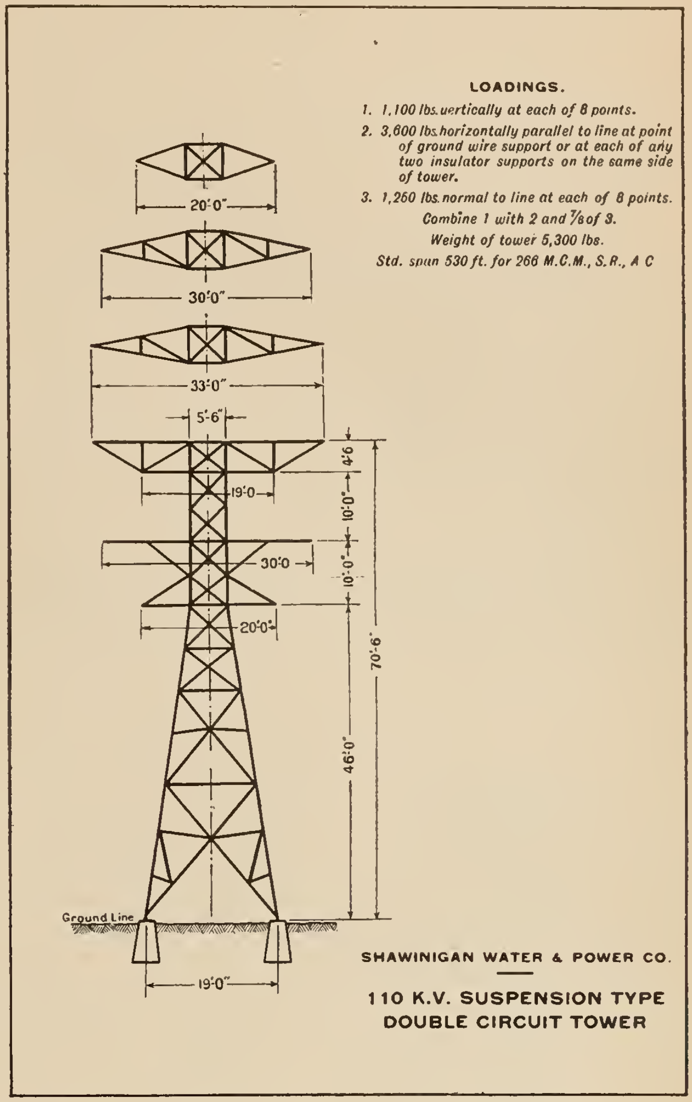

Plate No. D-1, — 110 k.v. Suspension Type Double Circuit Tower.

For higher voltage lines strings of suspension type units are used, one unit for each 10,000 to 12,000 volts to ground. On a 110,000 volt line with 63,500 volts between lines and ground the usual number of units is six or seven. For line voltages of 220,000 volts twelve to fifteen units should be used.

The cemented cap and pin type of suspension unit is the one most commonly used in this country. The link type has not found favour on account of its low ratio between flashover and puncture, and the insulator with the thick porcelain body has not come into general use because of its great weight and the difficulty of connecting and disconnecting the units in the string.

The ordinary 10-inch disc insulator can be constructed for a breaking load of 9,000 or 10,000 pounds, which is quite sufficient for ordinary lines. Where extremely heavy conductors are to be supported the manufacturers can supply heavier discs with a breaking load of 18,000 to 20,000 pounds.

Each suspension unit has a length of about five inches and a string of six units, which will be about 2.5 feet long exclusive of the clamp and the connection to the tower, is suitable for a line voltage of 90,000 to 100,000 volts.

A limitation in the use of long strings of disc insulators has arisen due to the fact that the voltage does not distribute evenly over the various insulators. For instance on strings of five or more units the insulator next to the line takes about 30 per cent of the total voltage. This uneven distribution of voltage is not serious for lines up to 110,000 volts because the factor of safety for dry flashover is still high even on the lowest insulator and in wet weather the voltage distribution over the string becomes more uniform due to water dripping over the discs.

For very long strings of ten or more discs, it is worth while to reduce the voltage across the lowest insulator by means of a shielding ring which ring performs the double function of creating a comparatively uniform voltage distribution over the string and of, at the same time, acting as an arcing ring and thus tending to prevent the destruction of the string by the power arc following a flashover. The shielding ring tends to introduce a complication in tower design as it may seriously reduce the clearance between conductor and tower, when the insulator string swings from the vertical position under excessive wind stresses.

The early types of suspension units failed after a few years of service due to defects both of design and manufacture, and it seemed for a time that the insulator was destined to be a serious limitation in the development of

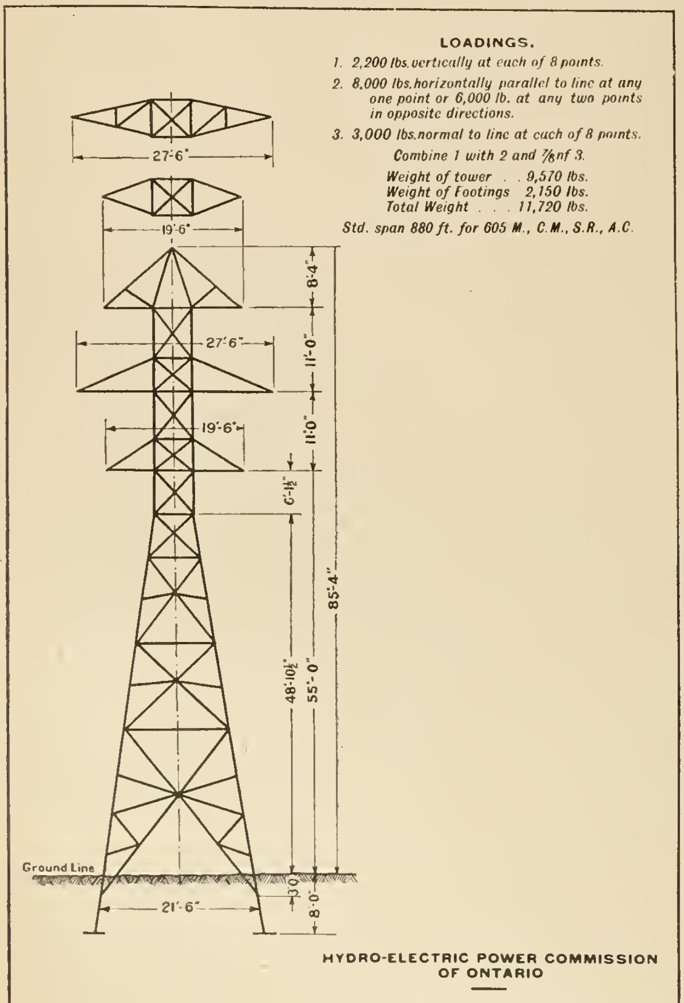

Plate No. D-2, — 110 k.v. 1920 Type Suspension Double Circuit Tower.

high voltage transmission system. Later insulators, however, have given splendid service and with careful inspection of the units before shipment, combined with periodic tests after installation, the danger of interruption of service due to faulty line insulators is very much reduced.

The prevailing practice in trunk line transmission is to provide electrical insulation of the highest possible safety factor against flashover, in an endeavour to eliminate short-circuits caused by lightning. The 90,000-volt pin type trunk line from Niagara Falls to Toronto, which has a very low safety factor against flashover, is in direct contrast to this general practice. This transmission system consists of a double circuit steel tower line of 190,000 circ. mils copper cable with mixed spans of 400 and 600 feet and triangular spacings of 6 feet and 8 feet respectively. The pin type insulators, mounted on steel pins, have a dry flashover of 190,000 volts and a wet flashover of 150,000 volts. The operating voltage at the generating bus varies between 90,000 and 95,000 volts. These lines have been operated successfully at 90,000 volts since October 1918, and the operating results show no indication of any weakness which can be attributed to the low insulation safety factor.

Special Insulation for Dust Areas

In certain parts of the country where there are long dry periods a thick coating of dust collects on insulators. This does not impair the insulation while the dust is dry, but when it becomes damp with dew or fog, the coating becomes conducting and the insulator is liable to flash over with only normal voltage on the line. But as a rule the rain soon washes the dust off and the insulators recover their normal characteristics.

Smoke and the fumes from electro-chemical plants present a more serious problem as they often form a deposit which does not wash off easily with rain and seems at times to be burned into the glaze by the action of the incipient arcs which form, particularly near the conductor. All such deposits tend to collect more particularly in any pockets where the dielectric stress is very high, and so find lodgement beneath the skirts of pin type insulators as well as on top. There does not seem to be any simple solution of this problem except to increase as far as possible the factor of safety of the insulation.

Throughout a part of the asbestos region of Quebec, two 60,000-volt pin type insulators were mounted one on top of the other to insulate a 50,000-volt line, with good results. In another case a 30,000-volt line supplying power to a plant manufacturing calcium carbide was insulated with the same number of suspension units normally used on 100,000 volt lines.

Testing of Insulators after Installation

The improvement in the quality of both suspension and pin type insulators has reduced very largely the interruptions to service due to insulator failures, but it is still necessary to test the insulators on the towers every year or at least every two years to take out those which have become defective and so to reduce the danger of flashover or puncture of the string.

The high range megger has been used very extensively for this inspection but has the disadvantage that at least the section of the line under test must be taken out of service. The method is very slow and even with experienced men many good units are taken off the line and a number of the defective units left.

The "buzz-stick" can be used to test the insulators in a string without taking the line out of service. It takes much less time than the megger test and gives considerably better results. The "buzz-stick" is made up of an insulating rod of dry wood about ten feet long with a U-shaped wire at one end. The prongs of the wire are used to short-circuit successively the insulators of a string. If one prong is held against the line conductor and the second prong is brought into contact with the cap of the lowest insulator and then removed, an arc will be drawn if the unit is good and no arc if it is defective. The remaining units are then tested in the same way.

As a general rule the lowest insulator unit has about 30 per cent of the voltage to ground between its cap and pin and the spark on opening the short-circuit will be long. The lower voltages across the other units are sufficient to draw arcs from one-half to one inch in length if the units are sound and in this way a very large percentage of the defective units can be picked out. These defective units can then be marked in some simple way and removed at any time when the line can be taken out of service conveniently.

The buzz-stick can also be used for testing pin type insulators but the danger of short-circuiting the only good skirt of the insulator and so grounding the line is very much greater than with a string of suspension units. In the majority of cases the head of the pin type insulator fails first and it is a very simple matter to discover the defective heads by short-circuiting the head with a buzz-stick making contact between the conductor and the cement below the head and then removing one point to draw the arc.

Other devices for testing insulators while the line is still in service have been developed during the last few years but as a rule they are more complicated than the buzz-stick and require more expert operators but for testing pin type insulators a testing device which does not short-circuit a part of the insulator is to be preferred to the buzz-stick.

Considerable progress has been made in live line maintenance during the last few years. Apparatus has been developed which makes it possible to change a pin type insulator or a string of suspension insulators or to carry out other operations without taking the line out of service. Such operations, when carried out by skilled crews, are attended by very little risk and while used on only a few Canadian systems will no doubt be employed more extensively when further experience has proved their economy and safety. In the United States live line maintenance is done by contract for a number of companies.

Supporting Structures

The two main types of structures for supporting transmission line conductors are steel towers and wood poles. There are also some lines supported on wood towers and a few on steel poles and concrete poles.

The main trunk lines of the larger power companies are supported on steel towers, either single circuit or two circuit. Most of the lower voltage lines using pin type construction are carried on wood poles but a few are on steel towers. On account of the difficulty of obtaining first class wood poles some companies are making experiments with reinforced concrete poles and they promise to give satisfaction. The first cost and the weight are higher than for wood poles but the life will be very much longer.

Steel Towers

Owing to the great weight and cost of steel towers, the design of these structures has of necessity been carried to a point of high efficiency and the designing engineers make their calculations so that every member of the tower performs its proper functions and the whole tower carries the load for which it was designed without any waste material.

The main factors which must be considered in designing the towers for a transmission line are the following:—

1. Number of circuits to be carried on the tower.
2. Arrangement and spacing of conductors.
3. Length of insulator string.
4. Minimum clearance between conductor and tower members.
5. Minimum clearance from ground.
6. Length of normal span.
7. Size of conductor and maximum tension in conductor.
8. Number and size of ground wires.
9. Assumed ice and wind loads and range of temperature.
10. Dead-ends and transpositions and special crossings and long spans.

Single circuit tower lines are advisable where only two circuits are used to supply an important load, and they should preferably be constructed on separate rights-of-way. When two circuits are carried on one tower occasional interruptions of both circuits are liable to result from direct strokes of lightning or from an arc blowing from one line over to the other or due to a conductor on one circuit breaking and falling across the other circuit. Where four or more circuits are required the double circuit tower line is well justified, especially where the right-of-way is expensive. Plates Nos. D-1 to D-3 show some standard tower constructions.

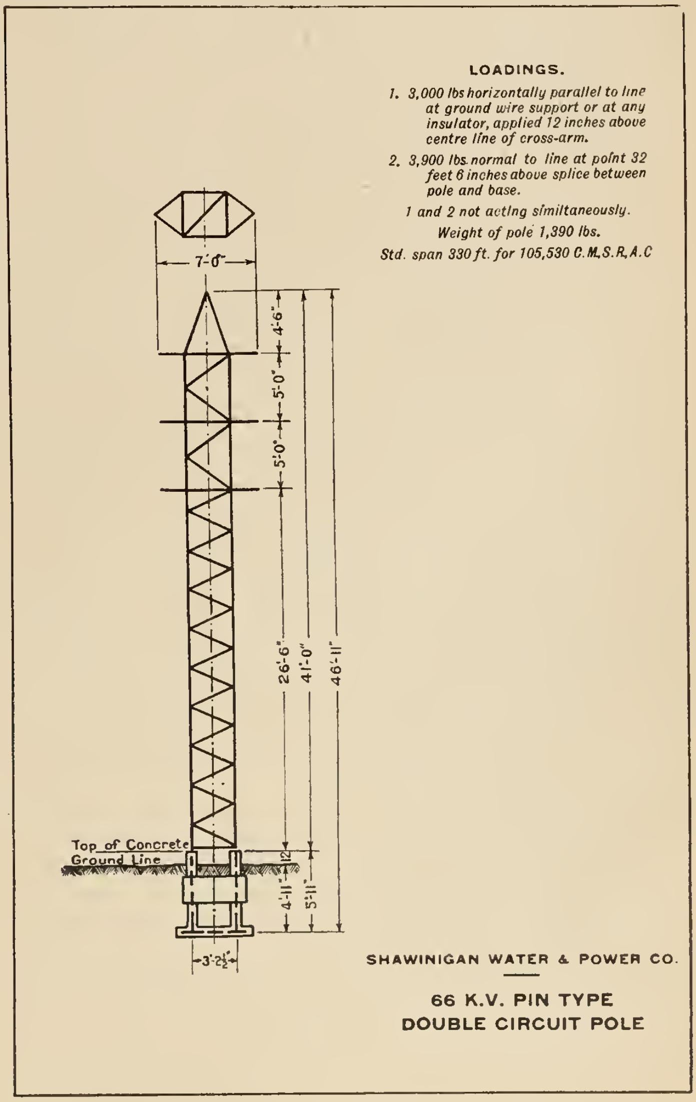

Plate No. D-3, — 66 k.v. Pin Type Double Circuit Pole.

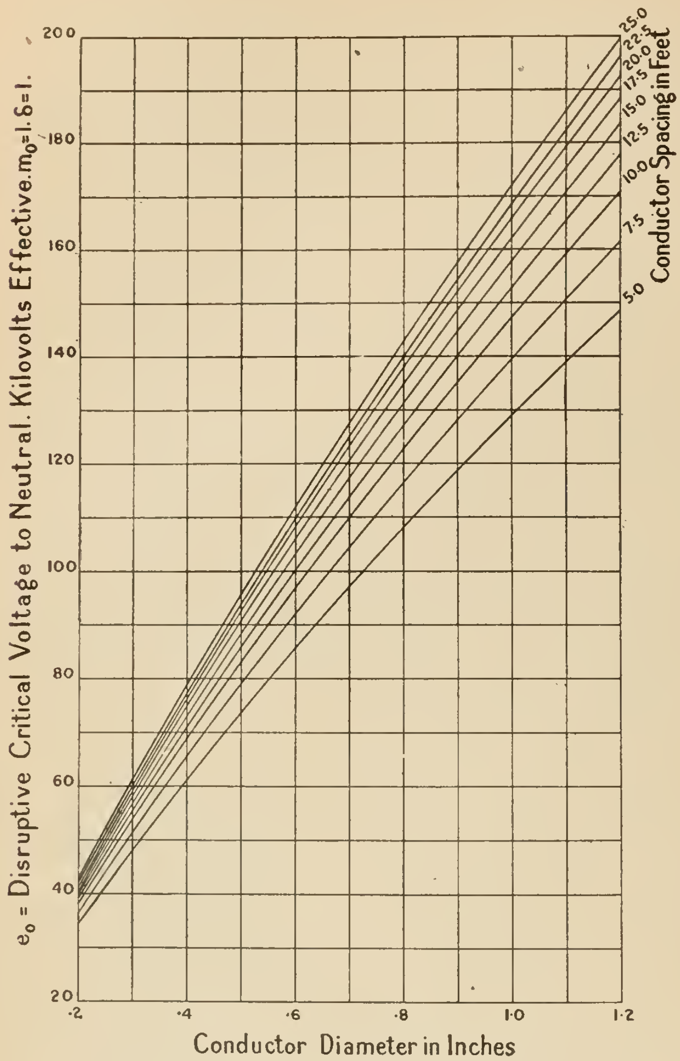

Plate No. D-4, — Disruptive Critical Voltage to Neutral for Various Conductor Spacings.

With single circuit lines the conductors may be arranged in an equilateral triangle or they may be placed in a horizontal plane. With double circuit towers the triangular spacing may be used or a vertical arrangement of the conductors of each circuit. In the latter case it is advisable to set the centre conductor out a short distance as shown in plate No. D-2. This is to prevent the wires coming in contact during sleet storms. If the ice coating should fall from one of the two lower wires in the vertical arrangement before it has fallen from the wire immediately above it, the two wires are liable to swing so close together that an arc will pass between them and interrupt the service. A similar condition may result if the ice load on one of the upper conductors falls off all but one span, since the decreased tensions in the two adjacent spans will allow the loaded span to increase its sag and approach the conductor below it unless it is offset sufficiently.

With two circuits on one tower it is advisable to have the phases symmetrically placed, the two top wires being of one phase, the two middle wires, the second phase and the two bottom wires the third phase, and to maintain this relationship when the lines are transposed. Men working on the lines are less liable to make mistakes if this is done.

Two circuits on a single tower may have five to ten per cent more reactance than if they are carried on separate towers, and this should be taken into consideration in calculating the electrical characteristics of the lines.

Spacing of Conductors

The distance between the centres of conductors should be such that under the worst conditions the voltage required to cause an arc to strike across to an adjacent conductor will be at least twice the normal operating voltage between lines. The usual spacings range from 10 inches to one foot for each 10 kilovolts between lines, with a minimum spacing of about 20 inches. For very long spans greater clearances may be required especially where pure aluminum conductors are used, as these have an excessive sag. For 110,000 volt lines a spacing of 8 feet may be used with a span length of 250 feet, but this should be increased to 10 or 12 feet when the span length is 800 to 1,000 feet.

Extra conductor spacing is not so necessary with steel reinforced aluminum and with copper conductors as with pure aluminum. Smaller spacings may be used with the horizontal arrangements of conductors than with the vertical or triangular arrangement, as the danger of swinging together is less.

In determining the inductive reactance and the capacity reactance of transmission lines, the effective spacing or the equivalent uniform spacing should be used, which is given by the formula:

$$s = \sqrt[3]{s_1 \times s_2 \times s_3}$$

where s is the effective spacing, and s_1, s_2 and s_3 are the actual spacings between pairs of adjacent conductors. When other circuits are located on the same towers accurate determination of the constants of the line requires that the effects of the neighbouring circuits be calculated.

Length of String of Insulators

The length of the insulator string in feet is about 0.4 times the number of units, since each unit of the ordinary cap and pin type occupies a space of about 5 inches, but to this must be added the length of the tower and line fastenings. If the length of the string is so short that it allows the conductor to swing too close to the upper cross-arm under excessive wind stresses, it can be lengthened by making the connection to the cross-arm longer.

The actual arcing distance over the string is usually considerably less than the length of the string when arcing horns are provided to keep the arc away from the insulators when flashover occurs.

Other types of insulators may differ in length from the value given above but the difference will not be very great.

Clearance between Conductor and Tower Members.

The minimum clearance between the conductor and the tower members should be such that an arc will not strike to the tower at a voltage lower than that required to arc over the string of insulators. To meet this condition the minimum clearance should be equal to or greater than the length of the string. In determining the minimum clearance, allowance must be made for the change of the position of the conductor due to wind stresses. With copper or steel reinforced aluminum conductors the insulator string will not usually swing more than 45 degrees from the vertical but with pure aluminum conductors it may swing up 55 or even 60 degrees. The angle of swing from the vertical should be determined for each case based on the assumed ice and wind loadings.

A number of 110,000-volt lines are in operation with a minimum clearance slightly less than the length of the string of insulation, which is normally about 3 feet, and no bad results have been noted, but the added tower expense required to maintain this clearance is not great and would seem to be worth while in the majority of cases.

Minimum Clearance from Ground

The allowable minimum clearance from ground varies in different parts of the country from 22 to 24 feet. This normal distance should not be reduced in agricultural districts but somewhat smaller values may be maintained in uncultivated sections of the country. At special crossings and in the streets of towns and villages the minimum ground clearance of the span may be 30 feet or more and special towers will be required for such locations.

Length of the Normal Span

The length of the normal span for transmission lines varies with the type of supporting structure, and spans up to 880 feet are used with heavy steel towers such as that illustrated in plate No. D-2. There is often a considerable range of span lengths which brings the total cost of the line near to the minimum value, but engineers have hesitated to increase the spans to the maximum to make a small problematical saving fearing the risk of greater operating and maintenance troubles with the extreme span lengths. For 220,000-volt lines it is probable that the most suitable span will be from 800 to 1,000 feet.

Many wood pole lines and some steel tower lines have been designed with too short a span, resulting in a high first cost and excessive maintenance costs. When the time comes to make extensive repairs on such lines it may be good policy to increase the span and in some cases it may pay to replace the wood poles by reinforced concrete poles.

Size of Conductor and the Maximum Tension in the Conductor

The size of the conductor is usually determined to meet the required electrical characteristics of the transmission line. Only where the current to be carried is extremely small will the minimum allowable section of the conductor be fixed by its mechanical strength. For the majority of lines the section is determined from the conductance required to keep the losses below a certain value and Kelvin's law is applied to determine that conductor size which will reduce to a minimum the sum of the interest on the investment in the conductor and the cost of the lost energy.

For very high voltage lines the danger of excessive corona losses on the line in stormy weather may make it advisable to increase the size of the conductor beyond that required by other considerations.

The maximum permissable tension in the conductor depends directly on its section and on the material of which it is made. Conductors should be strung so that under the worst conditions the stress in the conductor will not be greater than 80 per cent of the elastic limit, and since the weight and cost of the towers is directly dependent on the maximum stress in the conductors, it is often found that when the line as a whole is designed for a minimum cost the maximum stress must be kept considerably below 80 per cent of the elastic limit.

Number and Size of Ground Wires

When flexible towers are used, ground wires are necessary as a support for the line and must be designed with sufficient strength for this purpose, but with rigid towers they are of much less value from this point of view. To provide a definite ground for relay protection one ground wire is sufficient but as a protection against lightning two or more wires are more valuable. Many engineers are not convinced that overhead ground wires have any very great value as a protection against lightning and a considerable number of systems are being operated without them. The double circuit tower shown in plate No. D-1 is not equipped with ground wires althouhg the supports are provided. This line parallels an older line on the same right-of-way which is equipped with two ground wires, and it is hoped that a study of the operation of these two lines will add something to the knowledge concerning the adequacy of the protection obtained from overhead ground wires.

Assumed Ice and Wind Loads and Range of Temperature

There is considerable difference of opinion as to what should be taken as the maximum loading in designing a transmission line, but for the majority of lines constructed in Canada the assumption has been made that the ice coating will form uniformly one-half inch thick and that the wind pressure will be eight pounds per square foot of projected area. For some important trunk lines a greater factor of safety has been obtained by considering an ice coating of three-quarters of an inch with a wind pressure of eleven pounds per square foot.

The temperature range varies with the location of the line but it is customary to assume minus 40 degrees fahr. as a minimum and plus 120 degrees as a maximum.

Foundations

There are two main types of foundations for steel towers, structural steel and concrete. The structural steel foundation consists of an angle bolted to each corner of the tower and extending about 6 feet into the ground. To the bottom of these angles is connected a grill of bars or angles and earth is filled in over the grill. This type

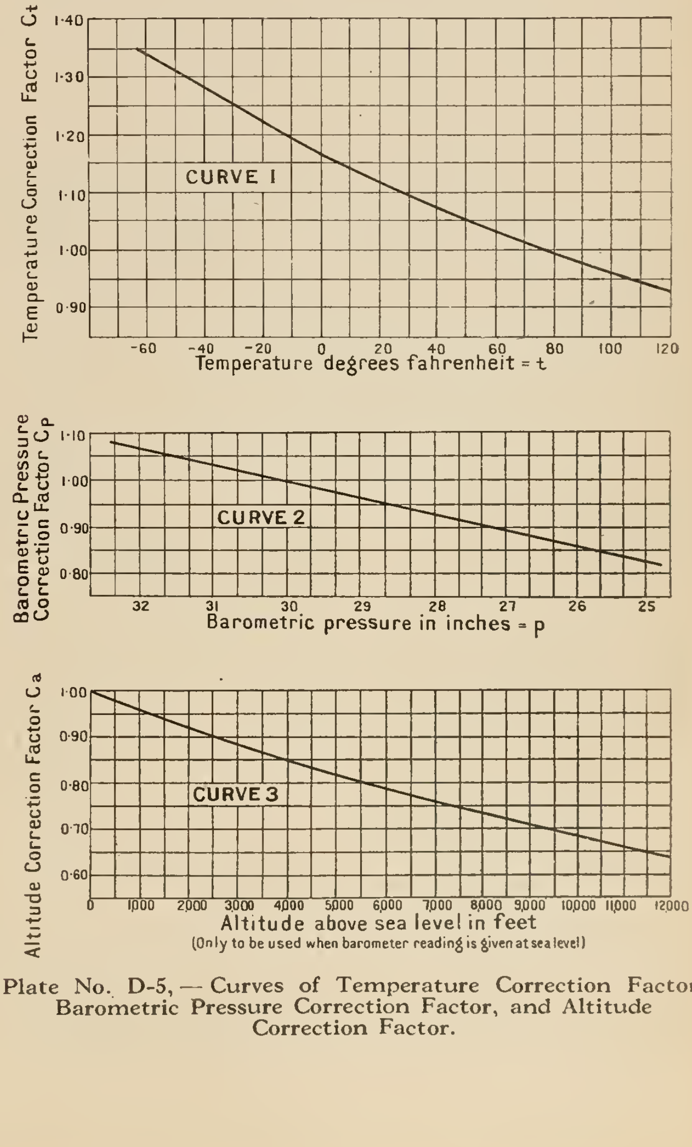

Plate No. D-5, — Curves of Temperature Correction Factor, Barometric Pressure Correction Factor, and Altitude Correction Factor.

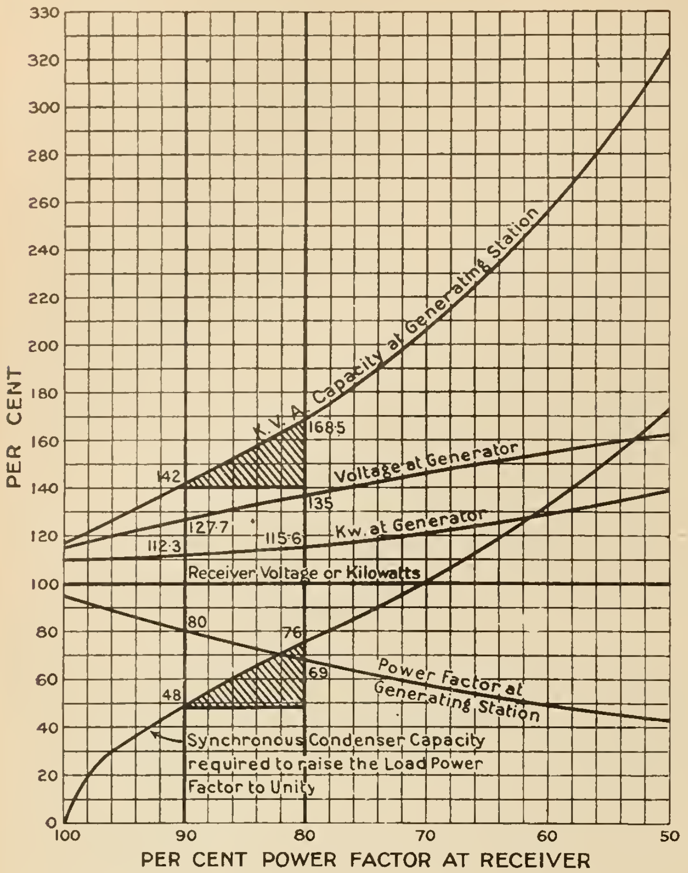

Plate No. D-6, — Effect of Receiver Power Factor.

of foundation is cheap and has been widely used. In good ground no difficulty is experienced with the steel footing but in bad ground the earth is liable to soften and the tower will then pull out of line or tilt over. If the steel which is placed underground is carefully coated with a suitable paint the life of the foundation should be satisfactory.

The second type of foundation consists of a concrete pier either plain or reinforced, containing a heavy foundation bolt to which the corners of the tower are attached. These concrete blocks are built in place by excavating the earth 6 feet below the natural surface and bringing the top of the piers to the proper grade. The concrete foundation has a considerable advantage over the steel footing during erection as it is much easier to line up properly.

Special Towers

On every transmission line a considerable number of special towers are required, anchor towers, angle towers and transposition towers and towers for special spans and crossings. All of these structures are much heavier than the ordinary suspension towers and for economy their number should be kept as low as possible. Some type of tower using insulators in the strain position should be introduced at all points where the angle of the line is in excess of 2 to 5 degrees, and some type of anchor or semi-anchor tower is generally used at least every mile to stiffen the line and to assist in construction.

Single Span Crossing over the St. Lawrence River

The St. Lawrence river, while it provides the main artery for water borne traffic for Montreal and the Great Lakes, is a serious obstacle to the transmission of electric power from the great power developments north of the river to the extensive industrial centres to the south. Above Montreal the river is narrow and there no difficulty was experienced in constructing an overhead crossing, but at Three Rivers and at Quebec the distance was considered too great for a single span and the river was too deep to secure a footing for a tower at the centre. Submarine cables were therefore used at these two points but a great deal of trouble was experienced due to tides and ice injuring the cables.

In 1917 when a larger amount of power was required on the south shore at Victoriaville, it was decided to construct an overhead crossing. The crossing as completed consists of a central span 4,801 feet long and two anchor spans, the north shore span being 571 feet and the south shore span 951 feet long.

There are two towers 350 feet high and 60 feet square at the base, the upstream and downstream faces tapering to a width of 14 feet at the top. A cross arm at the top, 14 feet wide and 100 feet long, carries three double-groove sheaves 50 feet apart over which the anchor cables pass. The tower foundation is made up of four circular reinforced concrete piers, 11 feet in diameter placed at the corners of a 60-foot square. These piers are connected by heavily reinforced concrete beams 4 feet wide by 8 feet deep.

Three steel cables, 50 feet apart, span the river between the two towers. To each end of each centre span cable are yoked two anchor span cables. These are carried over the towers on the main sheaves and then down to a point within 20 feet of the anchors.

It was originally intended to use the main cables as conductors and to insulate them from the towers by means of specially designed insulators but the insulators were not ready at the time of erection and the steel cables have been used as messenger cables only. At first a single No. 0 stranded copper conductor was suspended from each messenger cable, being supported at 250-foot intervals by strings of 8 suspension insulators. Later these copper cables were replaced by two 188,000 circ. mil. steel reinforced aluminum cables suspended from each of the messenger cables but insulated from one another.

The towers were designed for the following loads:—
A vertical load of 530,000 lbs., made up of 350,000 lbs. due to the weight of the tower itself and 180,000 lbs. due to the vertical component of the tension in the cables.
A horizontal load of 26,000 lbs. at the top of the tower normal to the line, due to the wind load on the line.
A wind load on the tower of 400 lbs. per foot of height, or 140,000 lbs. total. The maximum compression on each of the front legs was estimated to be 575,000 lbs. and the maximum uplift on the rear legs was estimated to be 233,000 lbs. per leg.

The cables are 1.375 inches in diameter, of galvanized plough steel, made up of six strands of 19 wires each and a stranded steel core of 30 wires with a small hemp centre. Tests showed the average yield point of the individual wires to be 221,000 lbs. per square inch and the average breaking strength to be 258,000 lbs. per square inch. The yield point of the completed cable was found to be 158,500 lbs., and the ultimate strength 186,400 lbs., which correspond to 193,000 lbs. per square inch and 227,000 lbs. per square inch respectively.

The cables as originally strung allowed the following clearances between the conductor and the average water level during the season of navigation; downstream 172.5 feet, centre 178.8 feet and upstream 180.6 feet. This crossing has given satisfactory service for more than six years and so far has not developed any weaknesses.

General Design

In laying out a new transmission line it is necessary to give careful attention to various features which decide the route, such as the accessibility of the line from existing railroads and highways, the physical characteristics of the country and the cost of right-of-way. It is very desirable that the line should follow existing railroads as this reduces the cost of transporting materials and is of very great advantage in patrolling the lines and making repairs. There is, however, a disadvantage in that telegraph and telephone lines on the railroad right-of-way are susceptible to interference from the power circuit and the transmission line must be constructed so as to cause as little interference as possible. More transpositions of the power wires will be required than when the line is remote from the railroad. Lower voltage lines, up to 50,000 volts, may be carried on the railroad right-of-way on the side remote from the signal wires, if the two circuits are properly co-ordinated, without causing serious interference, but higher voltage lines should be constructed at least 150 to 250 feet from signal circuits.

It is very undesirable for a line to be carried over the crests of hills, on account of the increased liability of trouble from lightning in such localities. A line should not be built across swampy ground as it may be almost impossible to inspect it and make necessary repairs, and any interruptions will therefore be of greater duration and maintenance costs will be higher.

Forests affect the cost of transmission lines very seriously. It is desirable to cut through a forest an opening from 300 to 600 feet wide to make room for two tower lines. In high winds there is a large amount of flying material in the air and small branches of trees are apt to be blown against the wires. There is also the more serious danger of forest fires which would destroy the line completely. The cost of clearing a right-of-way through a heavily wooded country is very great and may reach a figure of $100.00 per acre or even more.

In laying out a new line it is important that accurate information and maps be obtained showing the exact profiles of the proposed route, and giving sufficient information so that the location of every tower can be predetermined and profiles drawn up to show the position of the conductors, both at minimum and maximum sags, for every span throughout the line.

The right-of-way where purchased outright varies in cost from $25.00 per acre for barren lands to $250.00 per acre for well cultivated farm lands, and to $2,000.00 or $3,000.00 per acre for lands near a large city. When pole sites or tower sites are leased for a term of years, instead of being purchased outright, careful consideration must be given to the probable future of the district or at the end of the term the line may have to be abandoned because the value of the land has increased to such an extent that the cost of renewing the lease is too great. If two separate rights-of-way can be purchased instead of a single right-of-way for two tower lines at only a slight additional cost, the increased cost will usually be warranted in view of the increased security from total interruptions of service due to severe lightning storms or wind storms.

Electrical Characteristics of Transmission Lines

Frequency

Two frequencies are standard in Canada, 25 cycles, including the frequency of 31.25 cycles used on part of

Plate No. D-7. — General Map of Location of Generating Stations, Transformer Stations and Transmission Lines, of the Hydro-Electric Power Commission of Ontario.

the system of The Shawinigan Water and Power Company, and 60 cycles, including the frequency of 62.5 cycles used in the Montreal district. The original developments at Niagara Falls were made with a frequency of 25 cycles and this frequency was so firmly intrenched in the Niagara district that the Hydro-Electric Power Commission of Ontario carried out the development of Queenston at the same frequency. A considerable amount of 60-cycle power is developed and consumed in Ontario, and where necessary interconnection is made between the two systems by means of frequency converters.

Practically all other developments in Canada are producing 60-cycle power. The original development at Shawinigan Falls was made at 30 cycles but no additional power will be developed at this frequency and as conditions warrant this frequency will gradually be eliminated from the province of Quebec.

There is little doubt that in the light of present knowledge the frequency of 60 cycles is considered more suitable than the lower frequency of 25 cycles, but the investment in 25-cycle apparatus throughout the province of Ontario is too great to be interfered with. It seems very desirable that future developments in Ontario outside the Niagara district be made at 60 cycles as a uniform frequency throughout Canada will in the future greatly assist the interchange of power between systems.

Voltage

No serious attempt has been made to standardize transmission voltage in Canada as there is no standard of allowable line regulation and the voltages at the two ends of a transmission line may differ by as much as twenty-five or thirty per cent. This is very largely due to the fact that the load power factors are of the order of 80 per cent to 85 per cent or even lower, resulting in a very large line drop. This condition is being very greatly improved by the installation of synchronous motor drives in large industrial establishments and in many cases by the addition of synchronous condensers to the other voltage regulating equipment in the receiving station. This makes it possible to operate lines at more nearly their theoretical maximum capacity and at the same time improve the voltage regulation.

The majority of the transmission systems of Canada fall under the voltage classes of:—

22,000 volts (20,000 to 25,000 volts)
44,000 volts (40,000 to 50,000 volts)
66,000 volts (60,000 to 70,000 volts)
110,000 volts (100,000 to 120,000 volts)

The 110,000 volt range is the highest voltage at present used in Canada but it is probable that the near future will see 165,000 volt and 220,000 volt systems in operation.

The change from 66,000 volts to 110,000 volts is coincident with the change from pin type insulators to suspension insulators, although as already stated there are a few cases of successful operation of pin type lines at 90,000 volts and 110,000 volts.

Losses and Efficiency

Kelvin's law can be applied to determine the most economical size of conductor to be used in a particular case, as when a known load at a definite voltage and power factor is to be delivered over a radial line from a generating station of known capacity. But all of the above conditions are not generally known at the time of construction of the line, and even if they are known conditions will probably change in the future and make the exact calculation of less value. For instance the voltage may be raised: the regulation may be improved by the installation of synchronous condensers, resulting in an increase in the capacity of the line; loads may be taken from the line at some intermediate point or the line may be connected in as part of a network; and further it is difficult to attach a definite value to the losses, since the power lost has a value varying between the power cost at the generating station and that at the terminals of the line. In the average case probably an efficiency at full load of about 90 per cent should be aimed at with a difference in voltage between the two ends of the line of from 10 to 20 per cent. To meet these conditions the full load power factor should not be allowed to fall below 90 per cent. In the case of extra high voltage lines, conditions will probably be much more definitely known and the line voltage at the generating station may be fixed as well as that at the receiving station and the two may not be allowed to differ by more than 5 to 10 per cent. This can only be accomplished by the use of large synchronous condensers, and the power losses in this controlling apparatus must be added to the line losses.

On many lines supplying power at low load factor and on which the peaks are of short duration, the all-day efficiency is of as much importance as the efficiency at maximum load, and it may be advisable to accept a larger power loss at the peak and save the extra investment in the conductor, since the average efficiency will still be high.

When a line serves as a tie line between two generating stations and may be called upon to carry power in either direction, depending on the division of the load, it may not be necessary to provide a conductor with more capacity than that required to carry the transfer current, and the losses may be unimportant. The safe current carrying capacity may then determine the size of the conductor.

Corona Loss on Transmission Lines

In the design of high voltage lines, it is of great importance to know the factors affecting the formation of corona and to be able to estimate with reasonable accuracy the critical voltage at which the corona loss begins and the resulting power loss, on various types of conductors and under different conditions of temperature, pressure and altitude, and in both fair weather and stormy weather.

The critical voltage and the loss of power may be calculated from the following formulae, if the regularity factor of the conductor be known and the state of the weather.

Let — e = effective value of kilovolts to neutral.
t = temperature in deg. fahr.
p = barometric pressure in inches.
δ = specific gravity of air.
$g_o = 53.6$ = disruptive critical gradient for air, in kilovolts per inch, effective value, at a temperature of 77 deg. fahr. and at a barometric pressure of 29.9 inches.
r = radius of conductor in inches.
s = distance between conductor centres in inches.
f = frequency in cycles per second.

Then the disruptive critical voltage or the effective value of voltage to neutral at which corona loss begins is,—

$$e_c = 2.302\ m_o\ g_o\ \delta\ r \log_{10}\frac{s}{r} = m_o\ \delta\ e_o$$

where m_o is the regularity factor for conductors and has approximately the following values:—

m_o = 1 for polished wires.
= 0.98 to 0.93 for roughened or weathered wires.
= 0.87 to 0.83 for seven strand cables.
= 0.90, approximately, for large cables with more than 7 strands.

The usual tables of disruptive critical voltages are not easy to apply and the curves plate No. D-4 have been plotted with critical voltage to neutral in kilovolts e_o on a base of conductor diameter in inches for various conductor spacings for the condition represented by $m_o = 1$ and $\delta = 1$ and the equation of these curves is:—

$$e_o = 123.5\ r \log_{10}\frac{s}{r}$$

The values of e_o obtained from these curves should be multiplied by the proper value of δ as corrected for a change of temperature or barometric pressure or altitude and by the value of m_o representing the condition of the conductor surface, before being substituted in the equation to determine the losses.

The air density $= \delta = \frac{17.9\ p}{459 + t}$ = specific gravity of air referred to air at 77 deg. fahr. and 29.9 inches barometric pressure when it has the value 1.00.

C_t the correction factor to be applied to δ for temperature changes is plotted in curve 1, plate No. D-5.

The equation of this curve is $C_t = \frac{17.9 \times 29.9}{459 + t} = \frac{536}{459 + t}$

C_p the correction factor to be applied to δ for changes of barometric pressure is plotted in curve 2, plate No. D-5.

The equation of this curve is $C_{p_a} = \frac{17.9\ p}{459 + 77} = \frac{17.9\ p}{536}$

C_a the altitude correction factor, curve 3, plate No. D-5, is the ratio of the barometric pressure at the given altitude to the barometric pressure at sea level. It should be applied to δ only if the barometer reading is taken at sea level and the line operated at some other level.

The value of δ to be used in the corona voltage and corona loss equations is $= C_t \times C_p \times C_a \times 1.00$; t being the temperature along the line, p the barometric pressure at sea level, and a being the altitude above sea level.

If the pressure reading is taken at the level of the line the factor C_a is omitted.

The power loss in fair weather, in kilowatts per mile of single conductor is,—

$$P_f = \frac{390}{\delta}(f + 25)\sqrt{\frac{r}{s}}(e - e_c)^2\ 10^{-5}$$

In stormy weather the critical voltage is lowered about 20 per cent, and the power loss in stormy weather in kilowatts per mile of single conductor, may be taken as

$$P_s = \frac{390}{\delta}(f + 25)\sqrt{\frac{r}{s}}(e - 0.8\ e_c)^2\ 10^{-5}$$

In calculating the corona loss it must be remembered that the line is not all at the same voltage since there is usually a drop of 5 or 10 per cent at least between the generating station and the receiving station. The above formulae are based on the assumption that the conductors are uniformly spaced in an equilateral triangle. If the vertical or horizontal arrangement is used corona forms on the middle wire before it forms on the two outer wires. The equivalent uniform spacing may be used without serious error. It is,—

$$s = \sqrt[3]{s_1 \times s_2 \times s_3}$$

where s_1, s_2 and s_3 are the actual distances between the various pairs of conductors.

It is not advisable to operate a line above the critical voltage in fair weather or the loss in stormy weather may be excessive. It is very unlikely, however, that a storm will extend over the whole line at one time. The corona loss on a transmission line will vary from day to day due to differences in temperature and weather conditions, it has a tendency to be lower in winter due to the low temperature. If a line is operated near the disruptive critical voltage any surge appearing as a high voltage on the line will tend to dissipate part of its energy in corona loss, and to this extent the corona will serve as a protection to the terminal apparatus.

The formation of corona changes the apparent capacity of the transmission line and the charging current and introduces a power component of current to supply the loss. It has been shown that a third harmonic of considerable magnitude flows when corona forms and this may interfere with the operation of signal systems.

As an example, determine the corona loss in both fair and stormy weather at a temperature of 32 deg. Fahr.

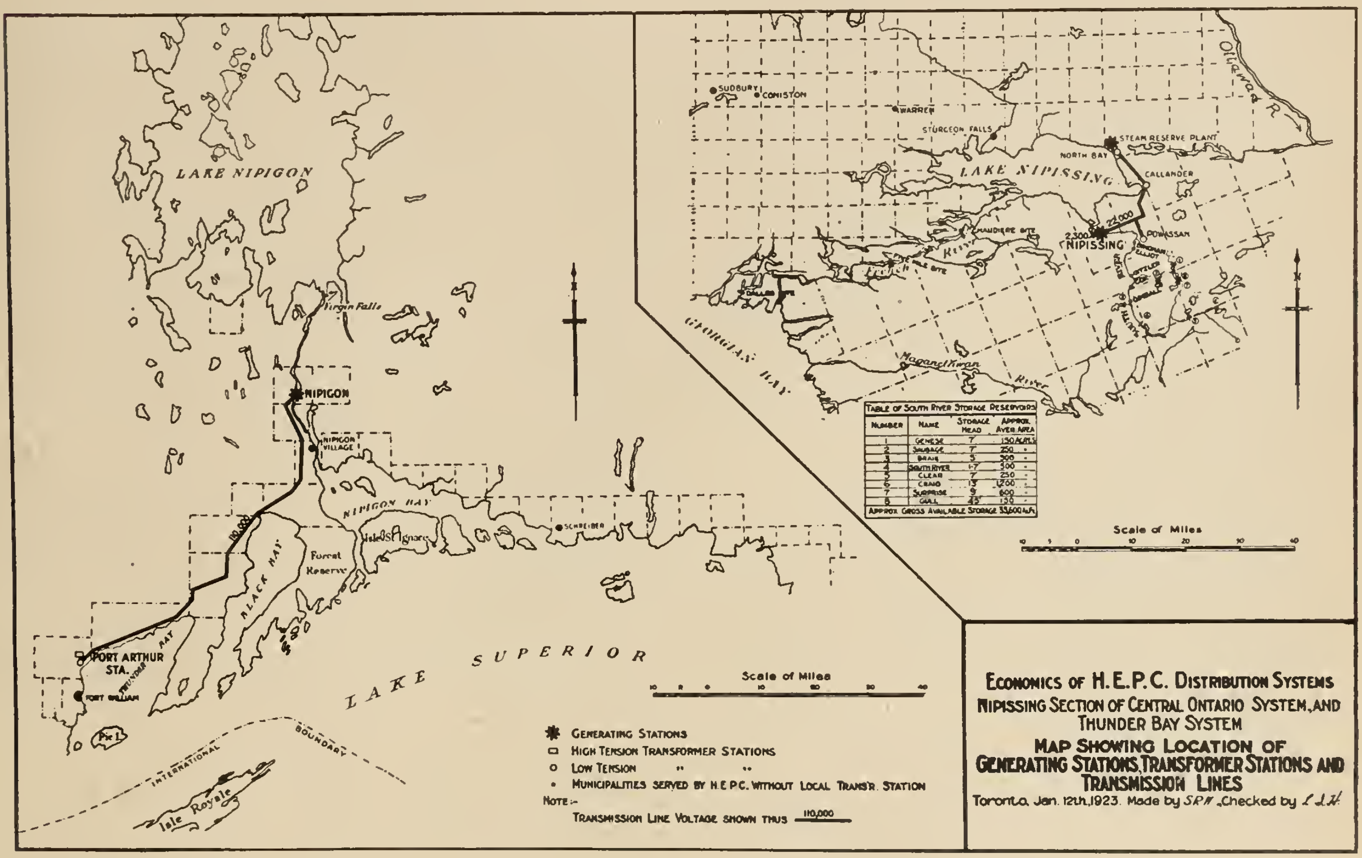

Plate No. D-8, — Location of Generating Stations, Transformer Stations and Transmission Lines, Nipissing Section of Central Ontario System, and Thunder Bay System.

and at an altitude of 500 feet above sea level on a line consisting of three conductors of 500,000 circular mils steel reinforced aluminum, uniformly spaced 15 feet apart and operating at 200,000 volts between lines and at a frequency of 60 cycles per second. This conductor is made up of 30 strands of aluminum over 19 strands of steel and has a diameter of 0.904 inch and may be considered as having a regularity factor of $m_0 = 0.9$.

The temperature correction factor for δ is 0.96 and the altitude correction factor for δ is 1.09.

Assuming normal barometric pressure at sea level the value of δ is $1.00 \times 0.96 \times 1.09 = 1.05$

The disruptive critical voltage obtained from the curve for this spacing is 145 kilovolts and applying the factors above, the disruptive critical voltage under the assumed conditions is,—

$e_c = 1.05 \times 0.9 \times 145 = 137$ kilovolts to neutral.

The operating voltage between conductors and neutral is,—

$$e = \frac{200}{\sqrt{3}} = 115.5 \text{ kilovolts,}$$

and there would therefore be no corona loss in fair weather.

In stormy weather the loss would be,—

$$3P_s = 3 \times \frac{390}{1.05} (60 + 25) \sqrt{\frac{0.452}{15 \times 12}} (115.5 - 0.8 \times 137)^2 \times 10^{-5}$$
$$= 1.65 \text{ kilowatts per mile of line.}$$

This is a negligible loss and even at 220,000 volts the loss would only be 14.25 kilowatts per mile in stormy weather.

Voltage Regulation

The various methods of computing the regulation of transmission lines will not be treated here in detail. For lines up to 50,000 volts the effect of the line capacity may be neglected in the majority of cases, as the line charging current is largely offset by the magnetizing current required for the transformers. The resistance and reactance of the step-up and step-down transformers should always be added to the line resistance and reactance, since in the case of many short lines the impedance voltage drop in the transformers is of the same order as that in the line.

For higher voltage lines up to 100,000 volts, and up to about 100 miles in length, the line capacity may be considered as concentrated at the centre of the line. In the case of still higher voltage and longer lines, calculations involving the use of hyperbolic functions should be employed. They give the exact results with very little more work than the simplified methods.

The drop of voltage in the line and transformer impedance depends to a very great extent on the power factor of the load. A short transmission line may deliver power at 80 per cent power factor without an excessive line drop but when power is delivered at the end of a long line it should be delivered only at power factors of 90 per cent and over.

The diagram, plate No. D-6, illustrates the effect of low load power factor in increasing the voltage regulation of transmission lines of moderate length, and in increasing the required kv.a., capacity of the generators and transformers in the power station. The line in question was assumed to have a 10 per cent resistance drop and a 30 per cent reactance drop, and the effects of the line capacity and the magnetizing current of the sub-station transformers were neglected as they tend to neutralize one another.

With a load of 100 per cent delivered at a voltage of 100 per cent and at a power factor of 90 per cent the line loss is 12.3 per cent, the voltage at the generator is 127.7 per cent of the receiver voltage, the kv.a., at the generating station is 142 per cent of the kilowatts delivered and the generator power factor is 80 per cent.

With the load power factor reduced to 80 per cent and the same load in kilowatts delivered at the same voltage, the line loss is 15.6 per cent, the voltage at the generating station is 135 per cent, the kv.a. capacity required in the generating station is 168.5 per cent and the generator power factor is 69 per cent.

Conditions may be improved by installing synchronous condensers at the substation end of the line to produce at least a part of the lagging current required for the load at this point instead of transmitting all of it through the reactance of the transmission lines.

The load power factor can be increased from 80 to 90 per cent by installing synchronous condensers in the substation of a capacity of 27 per cent of the kilowatts delivered. This reduces the kv.a. capacity required in the generating station by approximately an equal amount and at the same time improves the efficiency of the transmission, as indicated above. A loss of 3 to 4 per cent of the capacity of the synchronous condensers must be added to the line losses.

When considering the transmission of very large amounts of power at voltages of 165,000 volts or 220,000 volts, line drops of 20 to 25 per cent cannot usually be considered, as the line must be constructed and insulated for the highest voltage at any point on it, and the regulation should normally be limited to from 5 to 10 per cent. This may require the installation of synchronous condensers with a rating of 60 to 70 per cent of the kilowatts delivered at full load.

If sufficient synchronous capacity is installed the line can be operated at constant voltage at both the generator and the receiver ends or in the extreme case with the same voltage at the two ends. If it is desired to operate a line 300 or 400 miles in length at the maximum capacity, it may be necessary to place part of the synchronous capacity at the centre of the line to prevent a decrease of the voltage there.

Synchronous Condensers

The term "synchronous condenser" is applied to synchronous motors when they are used primarily for power factor correction or voltage regulation. Such machines are essential on large power systems for the regulation of voltage at the receiving station. At times of heavy load the condensers are over-excited and they can then be considered as drawing leading current over the lines, thus holding up the receiver voltage, or as supplying part or all of the lagging current required for the load. At times of light load they are under excited and draw a lagging current from the lines, which combines with the lagging current required by the reduced load and holds down the receiver voltage to its normal value. It is not practicable to design a synchronous condenser to operate at full capacity lagging, but 60 to 75 per cent capacity lagging can be obtained.

If both the generator voltage and the receiver voltage are to be held constant under all load conditions and are not to differ by more than five or ten per cent the synchronous condenser capacity in kv.a. must be of the order of 60 to 70 per cent of the load kilowatts, or approximately the amount required to raise the load power factor to unity. The generator voltage is held constant by means of automatic voltage regulators and the condensers with automatic voltage regulators operating on their exciters hold the receiver voltage constant at a somewhat lower value.

On the majority of systems at present in operation in Canada, synchronous condensers are being used to only a limited extent to improve the load power factor and to control the receiver voltage, the generator voltage being varied to suit the load conditions. On one system in Manitoba synchronous condensers have been in operation for about ten years and the results have been very satisfactory. A number of synchronous condensers have been installed at various points on the transmission network of the Hydro-Electric Power Commission of Ontario to reduce the amount of lagging current transmitted over the lines to the main centres. Some other large systems have hesitated to connect synchronous condensers of large capacity to their systems fearing that the increase in current fed to short circuits would tax the present circuit breaker equipment beyond its safe capacity.

In the early stages of operation of a transmission system the use of synchronous capacity is not often warranted but when the load increases to the point where new lines are necessary, the installation of condensers should be carefully considered. If the extra lines are required as insurance against interruptions of service as well as to improve the efficiency and regulation, the installation of condensers may not be justified. If, however, it is only a question of increasing the capacity of existing circuits the synchronous condensers will enable this to be done with the minimum of expense. To increase the capacity to the same extent by raising the voltage of the lines would probably cost more, and the improvement in regulation would not be so great.

There is no doubt that the near future will see a great increase in the use of such machines, but it is much better practice for a large distributing system to place synchronous condensers at various points throughout its network, where they will relieve the underground cables of large components of lagging current and so increase the capacity of the system and will at the same time raise the power factor of the load supplied over the main transmission lines. The synchronous condensers installed in the receiving station will then be of much smaller capacity and the danger of excessive short circuit currents will be decreased.

The losses in modern synchronous condensers are very low and vary from about 4 per cent in condensers of 5,000 kv.a. capacity to 2 per cent in those of 30,000 kv.a. capacity. Since they can be constructed as high speed machines the cost is very reasonable and their electrical characteristics are good.

For some years it has been evident to the transmission companies that the power factors of many of the large industrial loads were lower than necessary and they have been insisting on the installation of synchronous motors for driving at least a considerable portion of the machines, with sufficient exciter capacity so that the total load power factor can be kept at 90 per cent or above. It seems reasonable that the transmission companies should not sell power in large blocks below 90 or 95 per cent power factor and that a great portion of the synchronous capacity should be placed on the distributing systems or in the customers premises.

Power Factor Correction on Distributing Systems

Practically all large distribution systems, as well as the transmission systems supplying them, are suffering from troubles due to low power factor or due to the large components of reactive lagging current flowing in their circuits.

These lagging currents are required as magnetizing currents for transformers and induction motors and to produce the magnetic fields surrounding all the circuits, but in the majority of systems they may be considerably reduced by improvement in the connected apparatus and by the application of proper motor types and sizes to the various loads. The two most serious effects of the lagging currents are the impairment of the voltage regulation and the increase of the line losses, both result in

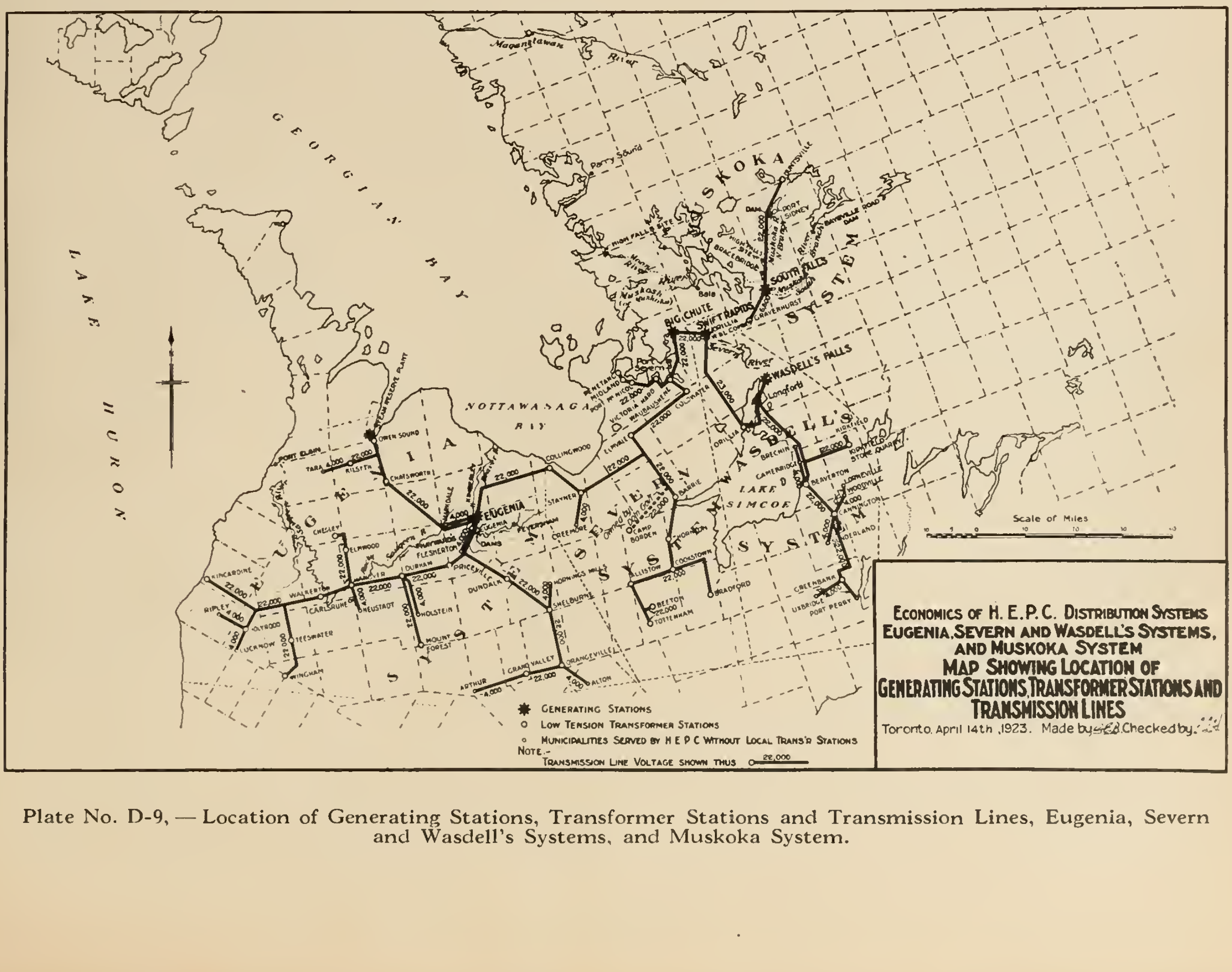

Plate No. D-9, — Location of Generating Stations, Transformer Stations and Transmission Lines, Eugenia, Severn and Wasdell's Systems, and Muskoka System.

reducing the power capacity of the various transformers and circuits.

It is possible to relieve, to a large extent at least, the transformers and the lines of these objectionable lagging currents if the magnetizing current is produced near the point where it is required. Over-excited synchronous motors or static condensers can be used to supply magnetizing current to induction motors on the same circuits and so relieve the supply line. In the substation synchronous condensers or static condensers may be installed to act as generators of lagging current and they will then relieve the cables feeding the substations and will increase their capacity.

The advantages to be gained from the installation of static condensers to reduce the lagging current flowing in the lower voltage circuits are becoming more apparent as the economy of distribution is studied and up to the present time over 8,000 kv.a. of static condensers have been installed on the various distribution systems throughout Canada. For large capacities and for use on the high voltage circuits, the synchronous condenser is more suitable as it can be operated lagging as well as leading to improve voltage regulat'on, while the static condenser can only draw leading current to improve the power factor. When the voltage of the system decreases the synchronous condenser draws an increased leading current and so tends to limit the voltage drop while the corrective effect of the static condenser decreases with the decrease of voltage.

The static condenser has very low losses, these being less than one-half of one per cent. Its operating and maintenance costs are small and it does not add to the short circuit currents on the system. Its first cost is a little greater than the synchronous condenser, except in the very small sizes, and it requires more floor space, but it has the great advantage that it can be subdivided into its individual units and placed at the points on the system where it will show the greatest economy. The condensers for power circuits are made in units for 600-volt service but these can be connected in series for operation on circuits up to 3,000 volts and, when the demand arises, they can be supplied for 6,600-volt circuits.

Any synchronous capacity or electrostatic capacity added to the distributing system not only relieves the distribution circuits of the excess lagging currents but also relieves the transmission lines at the same time and reduces the amount of synchronous capacity required in the terminal station to maintain satisfactory voltage regulation.

Alternating Current Generators and Transformers

Alternating Current Generators

Alternating current generators are in operation in Canada in sizes up to 55,000 kv.a., 25 cycles, 12,000 volts on the system of the Hydro-Electric Power Commission of Ontario and up to 40,000 kv.a., 60 cycles, 11,000 volts at Shawinigan Falls, Que. These machines are all three-phase, star connected machines.

The majority of the smaller generators are rated at 6,600 volts. For capacities below 10,000 to 15,000 kv.a. the armature currents are not excessive and the lower voltage is more economical, but machines of very large capacity will require a number of armature circuits in multiple and the terminals and cables will be very heavy and when the capacity is over 25,000 kv.a. the higher voltage will be warranted in the majority of cases. The increase of voltage limits the mechanical stresses on bus bars and this may be of considerable importance in stations of large capacity.

The short-circuit currents from generators of the later designs are proportionally much smaller than those from machines built eight or ten years ago. The increase in the allowable operating temperatures has resulted in an increase in the permissible rating of a given machine and this has been accompanied by an almost equal increase in the per cent reactance drop and a corresponding reduction in both the instantaneous and the sustained short-circuit currents.

The 40,000 kv.a., 60-cycle, 11,000-volt generator mentioned above has a sustained short-circuit current with normal excitation of about 2.5 times full load current and an instantaneous short-circuit current of less than 3.3 times full load current. Such large internal reactances increase the per cent regulation and extend the range required in automatic voltage regulators but do not seem to present any operating difficulties. This particular machine when short circuited under light load conditions, when the excitation is low, delivers less than full load current to a short-circuit and this has made necessary some changes in the ordinary relay protection.

Step-up transformer banks are being operated as part of the generators in an increasing number of stations and the generators are not paralleled on the low voltage side. The generator bus bars and circuit breakers may then be omitted and the station layout very much simplified.

Transformers

The design of alternating current transformers has more than kept pace with the increase of transmission voltage and it is evident that transformer voltages can be increased to values as high as will be required for economical transmission.

Transformers of both the core and shell types have been built for 220,000-volt service and are now in operation in the United States. The core type seems theoretically to have certain advantages under short-circuit stresses on account of the shape of the coils and for the very high voltages since it is easier to provide the requisite insulation between the high voltage and low voltage windings. For the lower voltages the operating records of both types when built by reliable manufacturers are so good that a choice between the two types is largely a matter of individual preference.

One change in design which has been introduced with the 220,000-volt transformer and which may be copied on some lower voltage designs in the future is the use of only one high voltage bushing, the other end of the high voltage winding being grounded to the core and tank. This arrangement allows the designer to grade the insulation of the high voltage winding from a maximum at the line end to a minimum at the neutral point and so saves a considerable expenditure without reducing the factor of safety.

The later power transformers are being designed with a much larger per cent reactance drop than was the case a few years ago and from 8 to 10 per cent reactance drop on new 60-cycle transformers is common. This large reactance reduces the destructive effects of short circuits. The largest 25-cycle transformers so far built are the new 18,330-kv.a., single-phase units for the Queenston plant in Ontario. They are of the shell type and three of these connected delta-star are used to step up the generator voltage from 12,000 to 110,000 volts, which will later be increased to 132,000 volts.

The largest 60-cycle transformers in operation in Canada are at Shawinigan Falls and are rated at 15,000 kv.a., they also are of the shell type and are connected delta-star for operation at 115,000 volts but they are designed so that when the full high voltage winding is used the line voltage can be raised to 155,000 volts. The fact that both of these transformer banks are constructed to operate later at an increased voltage, illustrates one of the difficulties of transmission line design where load conditions change with great rapidity. Provision must be made in many cases to increase the capacity of lines by an increase of voltage. In some cases this is accomplished by operating transformers delta-delta in the earlier stages, and later changing over to delta-star. On 110,000-volt lines this gives too great an increase of voltage to be taken care of without reconstruction of the line

Three-phase transformers are used in sizes up to 14,000 kv.a., but in the majority of installations of large capacity three single phase units are preferred. In the smaller sizes they are used to a very considerable extent particularly in outdoor pole type transformer stations.

Oil conservator tanks have been installed with a great many of the later power transformers and they are of value in reducing the deterioration of the oil, but many engineers fear that serious damage may result from arcs causing explosions in tanks which have no air to act as a cushion. An attempt has been made to overcome this objection, and at the same time to prevent sludging of the oil, by the development of a breather which will extract all the moisture and oxygen from the air and allow only nitrogen to pass into the transformer tank. The inert gas acts as a cushion to relieve stresses set up by arcs n the oil, and a further safeguard is provided by attaching the manhole cover by springs and placing below it an air-tight diaphram which will rupture under excessive stresses. This new equipment has been provided with the large 25-cycle transformers for the Queenston plant but some years of operating experience will be required to determine its merits.

Three types of bushing are in common use for transformers and oil circuit breakers, the compound filled type, the condenser type and the oil filled type. The compound filled bushing and the condenser bushing have both given very satisfactory service on apparatus up to 110,000 volts but for higher voltages the condenser type and the oil filled type are more suitable. For indoor service the condenser bushing has a smaller diameter than the other bushing which makes it more suitable for use with bushing type current transformers. In outdoor service some troubles have been experienced due to the breakdown of the compound filling the space between the bushing proper and the porcelain sleeve. The oil filled bushing has been used to only a very limited extent in Canada. It has the disadvantage of requiring occasional inspection to test the oil and to replace any which has leaked out.

Since bushings for the higher voltages are so expensive it is of advantage to have them designed to be interchangeable between transformers and circuit breakers to reduce the number of spare bushings carried in stock.

Transformer Connections

The large generators used in modern hydro-electric developments may be either star or delta connected but the majority are star-connected and the neutral is either solidly grounded or grounded through a resistance suited to the requirements of the protective apparatus.

The step-up transformers are more and more being considered as a part of the generator. The standard connection of the transformer banks at the generating station is delta-star and the star neutral is usually solidly grounded. The delta connection is required to give a path for the third harmonic magnetizing current as otherwise the secondary voltage wave will be distorted.

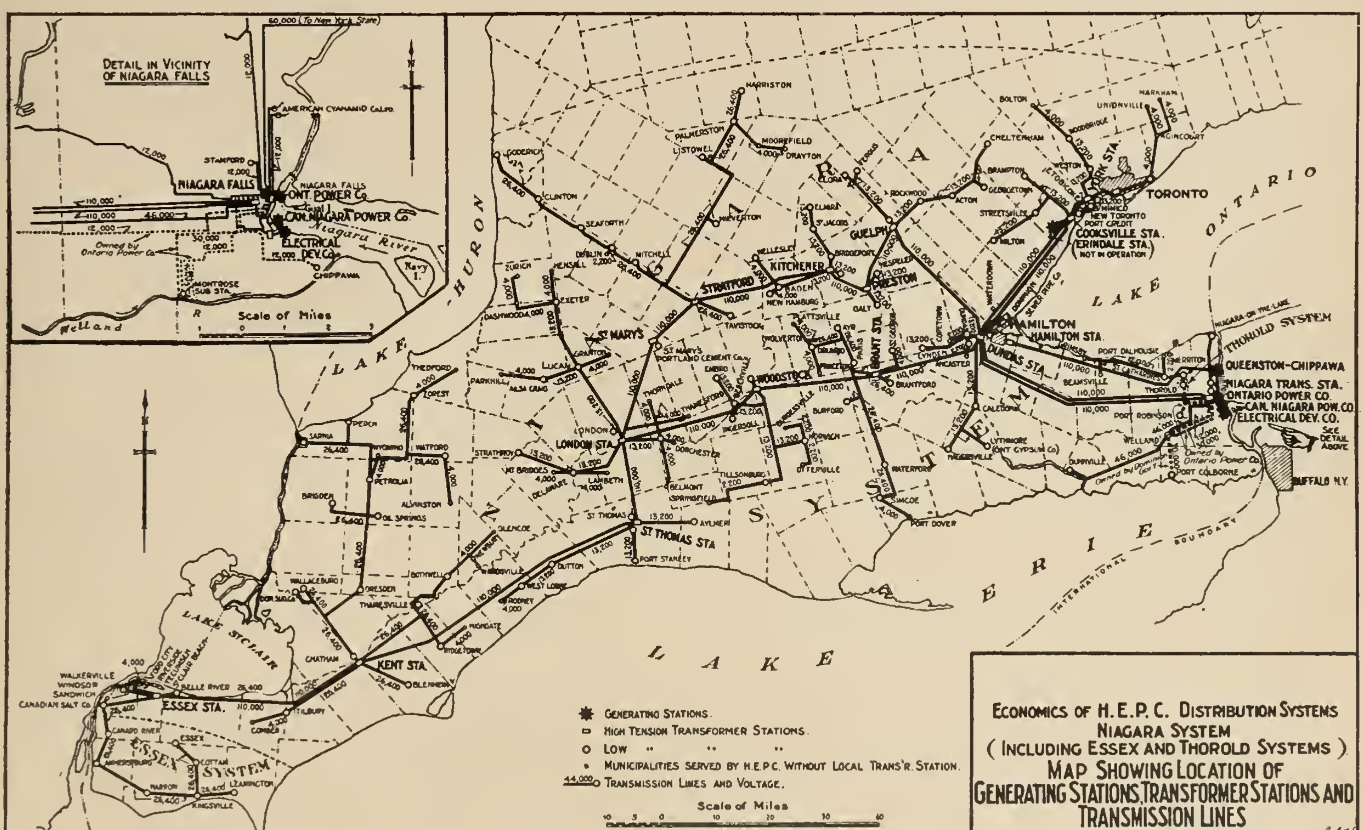

Plate No. D-10, — Location of Generating Stations, Transformer Stations and Transmission Lines, Including Essex and Thorold Systems

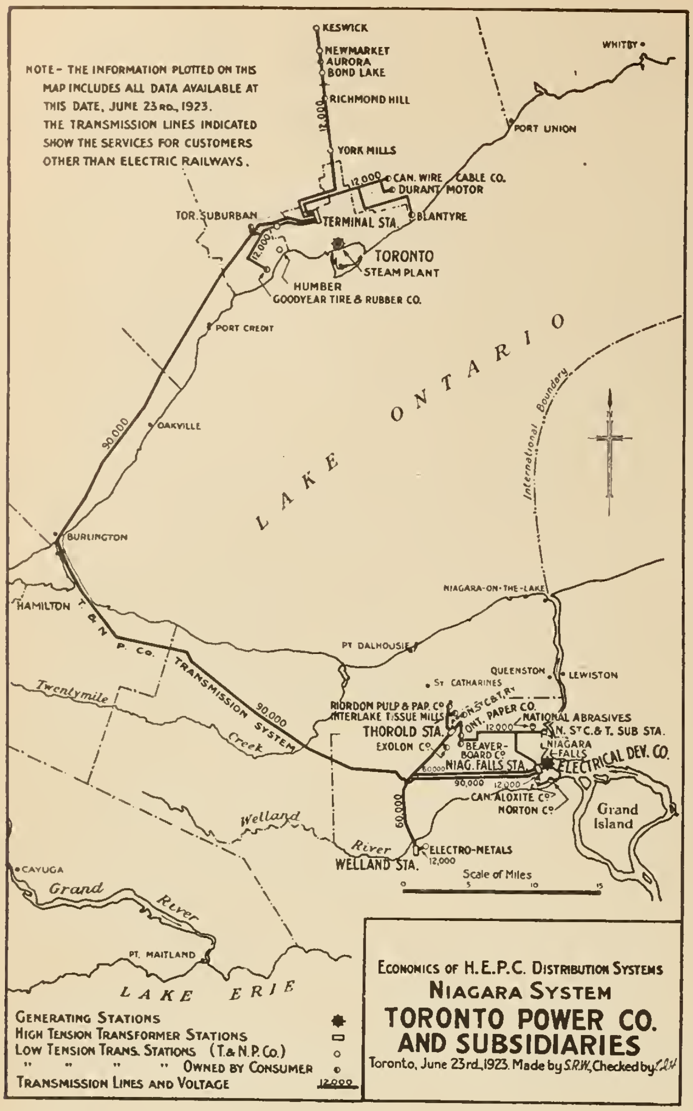

Plate No. D-11, — Location of Generating Station, Transformer Stations, and Transmission Lines, Toronto Power Company and Subsidiaries, Niagara System.

A star-star connection can be used if both the generator and transformer neutrals are solidly grounded but such a connection is not advisable since the third harmonic magnetizing current for the step-up transformers circulates through the generator and transformer neutrals and there is a triple frequency pulsation of the generator leads to ground. The delta-delta connection can also be used if it is not necessary to ground the neutral on the high voltage side.

Passing to the substation end of the line the transformers may be connected star-delta and the high voltage neutral either grounded or isolated. If it is grounded, a part of the third harmonic magnetizing current for the step-down transformers passes over the three line conductors in multiple and returns through the neutrals. This tends to cause a triple frequency induction in neighbouring signal circuits but the closed delta on the secondary side presents an alternative path for this current and interference is not usually serious. If the neutral is not grounded the third harmonic current does not pass over the lines but is confined to the delta. The star-star connection is not advisable as there is no path except the line for the third harmonic current and interference with signal circuits would be serious. This can be partially eliminated by placing a tertiary winding on the transformers to provide the required path for the magnetizing current. Tertiary windings add considerably to the cost of transformers and have not been used in Canada up to the present. Where the tertiary winding can at the same time fulfil some other function such as providing a circuit from which to operate synchronous condensers for voltage control of transmission lines it may become more popular. It will then be quite possible to use the star-star connection of transformers at the substation end of transmission lines.

Where it is not considered necessary to ground the neutral on the line side at the substation the delta-star connection may be used, which has the advantage of providing a neutral on the low voltage distributing system which may be grounded. This of course requires that the transformers should be designed for the full line voltage which makes them considerably more expensive than the corresponding star-delta connected transformers. For 165,000- and 220,000-volt lines the neutrals at both ends of the high voltage lines will be solidly grounded to reduce insulation stresses, and also to permit the use of a single high voltage bushing. In such a case the secondary might well be a star connected 12,000-volt circuit with grounded neutral for secondary distribution and a tertiary winding would be added both to provide a path for the magnetizing current and to supply the proper voltage for operation of the synchronous condensers.

Relay Protection

Since the function of an electric power company is to make electric power available for its customers at all times, and since any even momentary interruption of the service may result in serious loss to the customers, the designing engineer must give the most careful consideration to all means available as insurance against interruption of the power supply. The necessary spare equipment and duplicate lines must be provided and an adequate system of relay protection must be installed.

Relays cannot give perfect protection from interruptions of service but the various types developed and improved during the last ten years give the engineer an opportunity to reduce the number of interruptions due to defective circuits.

It is not possible here to enter into a technical discussion of the problems of relay protection but only to point out the benefits obtained by those companies which have had the faith to spend time and money in developing protective systems to reduce the interruptions to service due to insulation failures or other abnormal operating conditions.

For small systems, with only single lines, overload relays must disconnect the faulty line at the power station before serious permanent damage results and the customer must wait for repairs to be made to the line before his service is resumed.

When duplicate lines are provided and a ground or short circuit occurs on one of them, the protective relays must disconnect the faulty line at both ends with the least disturbance to the other line or lines and without causing any interruption of the service. Such a protective system developed for some of the largest systems in Canada and giving most satisfactory results is briefly described in the following pages.

Differential Current Scheme for the Protection of Two Parallel Lines

With generators at both ends of a double circuit line, such as a double circuit tie line between two power houses, or with generators at one end and synchronous condensers or synchronous motors at the other, a very rapid clearing of a faulty line is required to keep the synchronous machines from falling out of step and to prevent serious power arc destruction of insulators.

On such a system, discriminating protection, requiring only current elements was applied based on the fact that when a ground or short-circuit occurs on one line it will manifest itself by drawing more current than the good line. This will hold true for a short circuit at any point between stations, and a relay, actuated by the excess current, to trip the faulty line and to simultaneously prevent the sound line from tripping, can select and clear the faulty line without affecting the service over the other line. It is essential that the trip circuit of the sound line be blocked before the faulty line is cleared. A protective scheme based on this principle has been in successful operation for the last six years.

Differential Current System for the Protection of Three or More Parallel Lines

For the protection of a system of three or more parallel lines, discriminating action can be obtained by the use of relays energized from current transformers alone. The successful functioning of such a system of protection is based on the fact that the current of a line becomes unbalanced relative to the same phases of other parallel lines when a fault occurs on it, whereas the current in the other parallel lines will remain balanced with respect to each other. This will hold true for a short circuit at any point on a system of three or more parallel lines provided their characteristics are similar.

An arrangement of differential relays coupling one feeder with the other parallel feeders, and having the trip circuits of these relays interconnected in such a way that their joint action will trip the circuit breaker in the unbalanced feeder, will be able to select and clear such a faulty feeder without disturbing the remainder of the system. The faulty feeder will either be disconnected at the two ends simultaneously or in succession depending on the location of the fault.

For the protection of three parallel lines only three differential relays are required, each relay having two independent trip contacts, each contact being inserted in one of the trip circuits of the two lines from which the relay is energized. Only one current transformer is required for each line.

The same principle can also be applied for any system of more than three parallel lines. Each feeder may then be coupled up with two other feeders only or it may be coupled up with all the parallel feeders. The latter arrangement will require more relays but has the advantage in operation that it permits any line to be disconnected without disturbing the effectiveness of the protection so long as three lines remain in service. When two lines only are left in service, the protection will open both lines without discrimination when a fault occurs on one of them.

This differential current system has been in use for a number of years on two of the largest transmission systems in the country and has given very satisfactory results.

Relay Protection for Radial Transmission and Distribution Systems

The ordinary method of protecting a radial distributing system is to provide excess current relays with selective time adjustments. It is based on the assumption that under any short-circuit condition the current in the faulty line will exceed full load current, and this excess current is used to actuate a current relay, which in turn

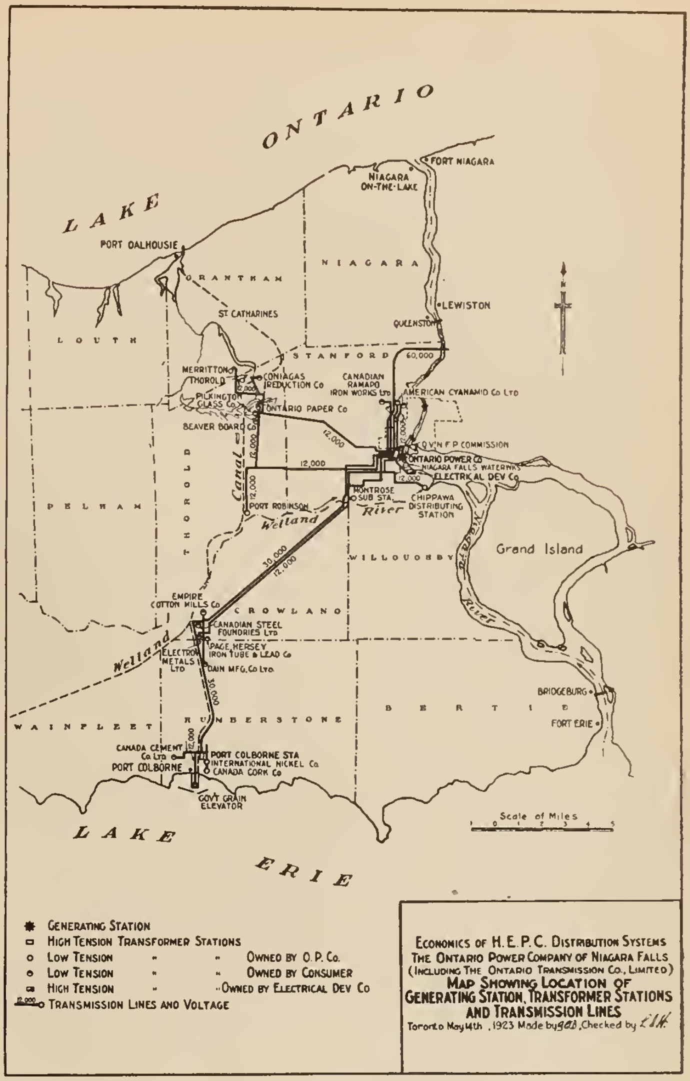

Plate No. D-12, — Location of Generating Station, Transformer Stations, and Transmission Lines, of the Ontario Power Company, Including the Ontario Transmission Company, Limited.

trips the line circuit breaker, thus disconnecting the faulty line. Systems with several substations in series have a time delay feature on the current relays of the various stations. This time delay is made shortest on the distant feeders and is gradually increased towards the generating station and reaches the highest time setting at the generating station. Such a system of time settings will give distant feeders a chance to clear, when in trouble, ahead of main feeders closer to the generating station, even if the short circuit current should be sufficient to start to actuate the excess current relays of the main feeders.

The excess current is used to indicate the abnormal condition of the line due to short circuit, while selectiveness of tripping is obtained by time delay differences on the relays of switches located in series to each other between the point of fault and the generating station. This principle of protection while satisfactory on some systems is found to be inadequate for transmission systems where the whole output of the generators is fed out over a few long lines, since, due to the large reactances in the lines, transformers and generators, the short circuit current after the first instant may fall below normal full load current and the excess current principle therefore fails in this case. However, by making use of the fact that a short circuit manifests itself not only by excess current but also by low voltage a different system of relay protection has been developed for such systems and has had some years of successful operation on one of the largest systems in the Province of Quebec.

In the new system selectiveness of switches placed in series to one another is obtained not only by a time selective setting but by the use of a relay which will respond only if it is close enough to the short circuit to be affected also by the resultant voltage drop.

A differential relay is used, having a beam actuated at one end by a current coil fed from the line and at the other by a voltage coil fed from the station busbars. The operation of the relay depends on the relation between current and voltage regardless of their actual magnitudes and is therefore equally effective at all loads and with all values of generator capacity.

Ground Selector

When a system is operated with the neutral grounded, a ground occurring on any conductor develops immediately into a short circuit of that phase and overload relays will at once disconnect the defective line. Since on circuits over 60,000 volts and also on many of lower voltage, grounding the neutral is the usual practice, grounds developing on such circuits can be very easily cleared and the operation of the rest of the system continued.

A ground, occurring on a non-grounded transmission or distribution system will be felt over the whole system. There is normally no means available of locating the faulty line except by successively disconnecting individual sections of the system until the grounded section is found. Such a method is slow and always necessitates the momentary interruption of a larger part of the system than necessary, since many sound feeders may be disconnected before the faulty feeder is finally located. The ground will cause a 73 per cent increase of voltage on the two sound phases to ground and if left on for any length of time may cause the breakdown of another weak spot at an entirely different part of the system.

To reduce to a minimum the disturbing effect of a ground, it is essential to provide means to disconnect the grounded section within the shortest possible time. This is the function of the ground selector. The fundamental idea of the ground selector is to produce a short circuit immediately after a ground appears on the system. This is accomplished by automatically grounding one of the sound phases at the main station bus by closing an oil switch to ground immediately after the ground appears. Thus a complete phase-to-phase short circuit is produced and as a result overload current will flow into the faulty line and the ordinary overload protection will act and disconnect it. As soon as the line is cleared the ground switch will open automatically and restore the remainder of the system to normal.

Grounding the Neutral of Power Transmission Systems

In the early days of power transmission there was little operating experience available to demonstrate the advantages and disadvantages of operating systems with grounded or with isolated neutrals.

At the present time transmission voltages have increased far beyond those used in the earlier systems and the necessity of grounding the neutral of such systems to avoid excessive insulation strains and in order to provide a more definite method of clearing lines in trouble has been demonstrated. It is now standard practice to ground the neutrals of lines operating at 66,000 volts or higher, although there are still some exceptions due to special circumstances. In the case of overhead systems of 13,200 to 66,000 volts the objections to the isolated neutral are not so great and many of the lower voltage systems are operated in this way.

It is further necessary to consider the character of the ground to be placed on the system, whether the neutral is to be solidly grounded or is to be grounded through a resistance, whether the neutrals of all generators or transformer banks are to be grounded, or only some or even only one of them. A ground through a resistance on each bank of transformers may be more effective or may offer a lower total impedance to the flow of ground current than a solid ground on only one transformer bank.

Sufficient operating experience has now been collected and published to enable engineers on new installations to give a reasoned judgment on the question of grounding and unless some special circumstances are to be considered, the best practice is to ground the neutral of transmission lines solidly at the generating station using delta-star connected transformers.

There is still a difference of opinion as to whether transmission lines should have their neutrals grounded at the substation as well as at the generating station. Part at least of the third harmonic magnetizing current for the substation transformers will flow out along the three line conductors in multiple, and back through the neutral connections. This may affect nearby signal circuits, but the induced voltages do not appear to be serious. If it is not considered necessary to ground the neutral on the high voltage side at the substation, the delta-star connection of step-down transformers may be used, and it establishes a neutral point at the source of power for the secondary network.

The main arguments in favour of the isolated neutral system especially with delta-delta connection of transformers, are discussed below:—

(1) A single broken insulator causing a ground would not result in a short circuit, and consequent interruption of service, but service could be maintained until it was convenient to disconnect and repair the faulty line. To continue operation under such circumstances cannot be considered good engineering practice, as the whole system is endangered. Insulation breakdowns may occur at widely scattered points on the system. If the ground originally formed is an arcing ground, very dangerous high frequency surges will be produced in the circuits which are very destructive. Both of these conditions will cause severe induced voltages to appear in neighbouring signal circuits, and for this reason, if for no other, such operating conditions cannot be tolerated.

(2) With transformers connected delta-delta it is possible to continue operation at reduced capacity when one transformer is damaged and out of service. Such open delta operation of transformers offers some economies in the early stages of a small transmission scheme, but results in a slight voltage unbalance which is objectionable. When a system is operated delta-delta in the early stages, when the load is comparatively light, with the intention of later increasing the line voltage by changing to the delta-star connection, the original operation with isolated neutral may be justified.

When a ground appears on an isolated neutral system there is normally no means available to locate the faulty line except by disconnecting successively individual sections of the system, and observing when the ground disappears. Such a cut-and-try method is very slow and causes momentary interruption of a larger part of the system than necessary. To reduce to a minimum the damaging effect of a ground it is essential to provide means to select and cut out the grounded section within the least possible time.

Systems designed with isolated neutrals may be changed to grounded neutral systems by the use of grounding transformers, but to obtain the equivalent of a solid ground the grounding transformer must have a large capacity and will be expensive. Ground resistances for high voltage systems must likewise be designed with large current capacity and must be thoroughly insulated. They are usually expensive and take up a large amount of space. At a number of points on the system of the Hydro-Electric Power Commission of Ontario, grounding resistances consisting of a number of barrels of water, mounted on insulators and connected in series, are used and they function satisfactorily.

Grounding of Cable Systems

The practice followed in grounding underground cable systems is somewhat different from that employed on overhead lines. The majority of such systems are operated with the neutral grounded, but very few are solidly grounded. One of the main reasons is that the reactance in such systems tending to limit the flow of current to a fault, is much less proportionally than in the case of overhead lines, since the extent of the systems is so much smaller, and at the same time the concentration of power in the underground network is of the same order as that in the transmission system. The safest practice is to operate with a resistance in the ground connection and only reduce or remove it when operation of the system has clearly demonstrated that such a procedure is warranted. If sufficient current limiting reactances are placed in the feeder circuits the ground resistance may not be required.

Lightning Arresters

The primary object of a transmission company is to sell and deliver power and the interruptions of the supply must be brought as close to the irreducible minimum as is possible by economical design and by the installation of the proper protective apparatus.

Lightning arresters are designed to protect the insulation of apparatus and particularly end coil insulation from puncture at or very close to the points where the arresters are installed. If they, at the same time, protect the service it is only a consequence of the protection afforded to the insulation.

On wood pole lines the most prolific cause of interruptions to service is arc-over of insulators due to lightning at points distant from the arresters, and the lightning arrester has no power to prevent such an occurrence. The ground wire however tends to reduce the number and severity of such arc-overs and also reduces the duty of the lightning arrester in relieving such disturbances when they occur near the station.

Lightning arresters may be dispensed with if there are no lightning storms and no severe surges on the lines, if the insulation of the power transforming apparatus has a higher factor of safety than the line insulation, or if the protected apparatus is of such small kilowatt capacity that the relatively high cost of the arrester cannot be justified economically.

There are very few systems which are free from lightning disturbances and surges. Some originally well designed lines have weak line insulation due to the fact that the line operating voltage has been raised above that originally contemplated without a corresponding change in insulation. Such a condition, while not

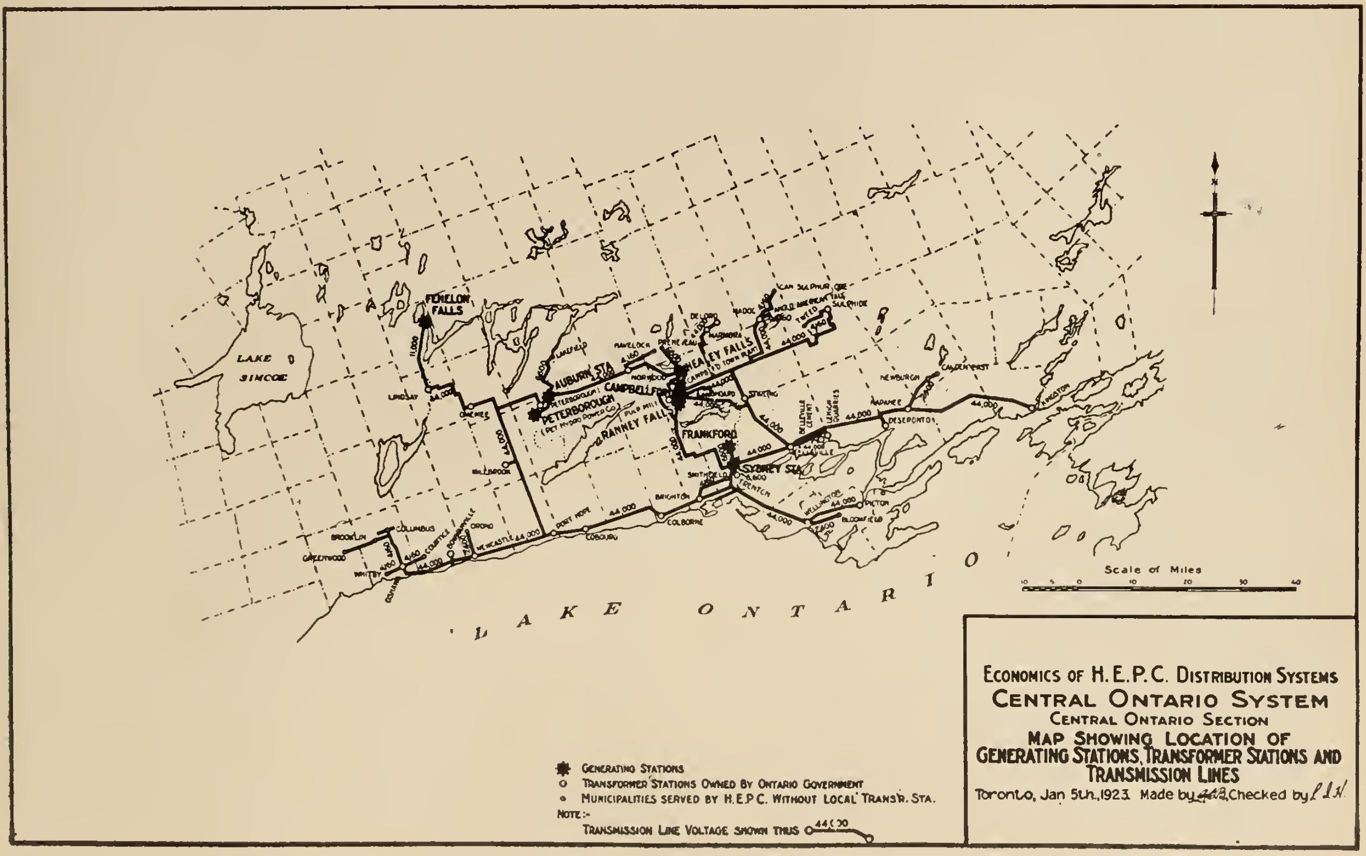

Plate No. D-13, — Location of Generating Stations, Transformer Stations and Transmission Lines, Central Ontario System.

representative of good practice may be of rather frequent occurrence in the development stages of large high voltage systems and networks, and the elimination of lightning arresters in these cases is only a temporary measure of economy. Properly designed relay protection of such lines can reduce to a minimum the time of interruption of service but the insulators on the lines must be provided with some sort of arcing horn so that the power arc following the lightning arc-over will not destroy the insulator and cause a prolonged shut-down. The supply of small amounts of power from transmission lines, particularly in rural districts, has been very much handicapped by the lack of a suitable cheap lightning arrester to protect the customers apparatus. It seems likely that some form of oxide film arrester or similar device will soon relieve this condition.

Types of Arresters in Service on Transmission Lines

Horn gap arresters, with high series resistance with discharge rates of only a few amperes, are still in service on many systems but they have practically no protective value. If the series resistance is reduced and the discharge rate thereby increased, the amount of protection is increased but the cost of the series resistance becomes high. With no series resistance the large arcs formed may be blown against other circuits and extend the damage, and the service is inevitably interrupted. Where efficient relay protection is provided and the momentary disconnecting of a circuit is not serious, the horn gap with low series resistance or without any series resistance may be used, but its protective value is small. Heavy discharges are liable to destroy the ground connection and very careful inspection is necessary to prevent danger to operators.

The development of the electrolytic or aluminum cell lightning arrester making use of the electric valve action overcame many of the objections to the horn gap arrester. When provided with a series gap, there is no discharge at normal line voltage, but at abnormal voltages the discharge current rises to several hundred amperes and relieves the system of the abnormal condition. As the current wave passes through zero the arc is extinguished and the normal line insulation is restored and prevents the power current from following the ground. Unless the disturbance is extremely severe, there is no interruption to service.

Until two or three years ago the installation of aluminum cell arresters was standard practice on all transmission circuits where the cost of their installation was relatively not too great, but experience has shown that they have certain objections; the presence of oil causes a certain fire hazard; they require expert maintenance as daily charging is necessary and careful inspection of the stacks is required to determine their condition, and furthermore the surge set up in the lines when charging the arresters causes considerable annoyance to the operators on neighbouring telephone lines.

The oxide film arrester is rapidly taking the place of the aluminum cell arrester on new installations especially for lines of 60,000 volts and under. It gets rid of the oil and electrolyte and avoids the necessity of daily charging while fundamentally it has characteristics similar to those of the aluminum cell arrester. It depends for its operation on the electric valve action and has but a few milliamperes of discharge current at normal line voltage but at abnormal voltages has the same discharge rate as the aluminum cell. It has the same capacity as the aluminum cell arrester to take care of arcing grounds and, on account of the absence of electrolyte, it can be placed out of doors in the coldest climates.

For low voltage primary distribution circuits such as 2,300 to 13,200 volts and more particularly for the protection of smaller apparatus such as lighting transformers, the standard forms of aluminum cell and oxide film arresters are not economical in view of the relatively low cost of the apparatus requiring protection. This difficulty has been solved by the development of the pellet type of oxide film arrester which brings good protection to the lower voltage circuits at a reasonable cost.

Multigap arresters of the graded resistance type are still used quite extensively on circuits under 11,000 volts.

The autovalve type and the water column surge arrester are new developments, but have not yet had a sufficient length of service to make possible definite conclusions with regard to their efficiency.

Since it seems to be impossible economically to provide sufficient insulation on circuits of 110,000 volts and lower to prevent all lightning trouble, it has become standard practice to use a reasonable amount of insulation and to employ lightning arresters on such circuits. For the higher voltages of 165,000 volts and 220,000 volts, some engineers are inclined to the belief that the insulation of the connected apparatus should be designed with a sufficient factor of safety to take care of any excess voltages. Years of operating experience with the higher voltage systems will be required before any definite conclusions can be drawn with regard to this matter, but if the lightning arresters are omitted, two or more overhead grounded wires should be installed to reduce the danger of disturbances originating at some distance from the stations being carried into the terminal apparatus.

When lines are normally operated near the disruptive critical voltage any surge producing a high voltage on the line will tend to cause corona to form about the conductors and the energy in the disturbance will be to some extent dissipated in this way.

Surge Protection on a Distribution System

The distribution system of the Montreal Light, Heat and Power Company, in Montreal, Que., is supplied from five hydro-electric plants. It consists of a network of approximately eighty miles of 12,000-volt underground cable and seventy-six miles of 12,000-volt overhead tie and distribution lines. The neutral of the system is isolated.

To protect the cables from high frequency surges due to lightning, switching, charging aluminum arresters and other causes, a surge absorber, consisting of a condenser in series with a resistance, is connected to ground on each phase. The condensers have a capacity of 0.007 microfarads and the series resistances are 600 ohms each.

This surge absorber acts as a valve allowing only high frequency currents to pass, and to make it effective for low frequency disturbances, the condenser is shunted by a horn gap. When the frequency of the disturbance is low the voltage across the condenser is sufficiently high to cause the gap to discharge and the discharge current passes to ground through the resistance. The gap setting used corresponds to 15,000 volts. Since the installation of the surge absorbers the number of failures on the 12,000-volt system has decreased materially.

Overhead Grounded Wires

The protective value of overhead grounded wires is difficult to determine quantitatively, but there is little doubt that when properly installed, they are a most effective and most valuable protective device. They tend to keep high voltage disturbances out of the system and by their action as a short circuited secondary they greatly increase the energy dissipation of a travelling

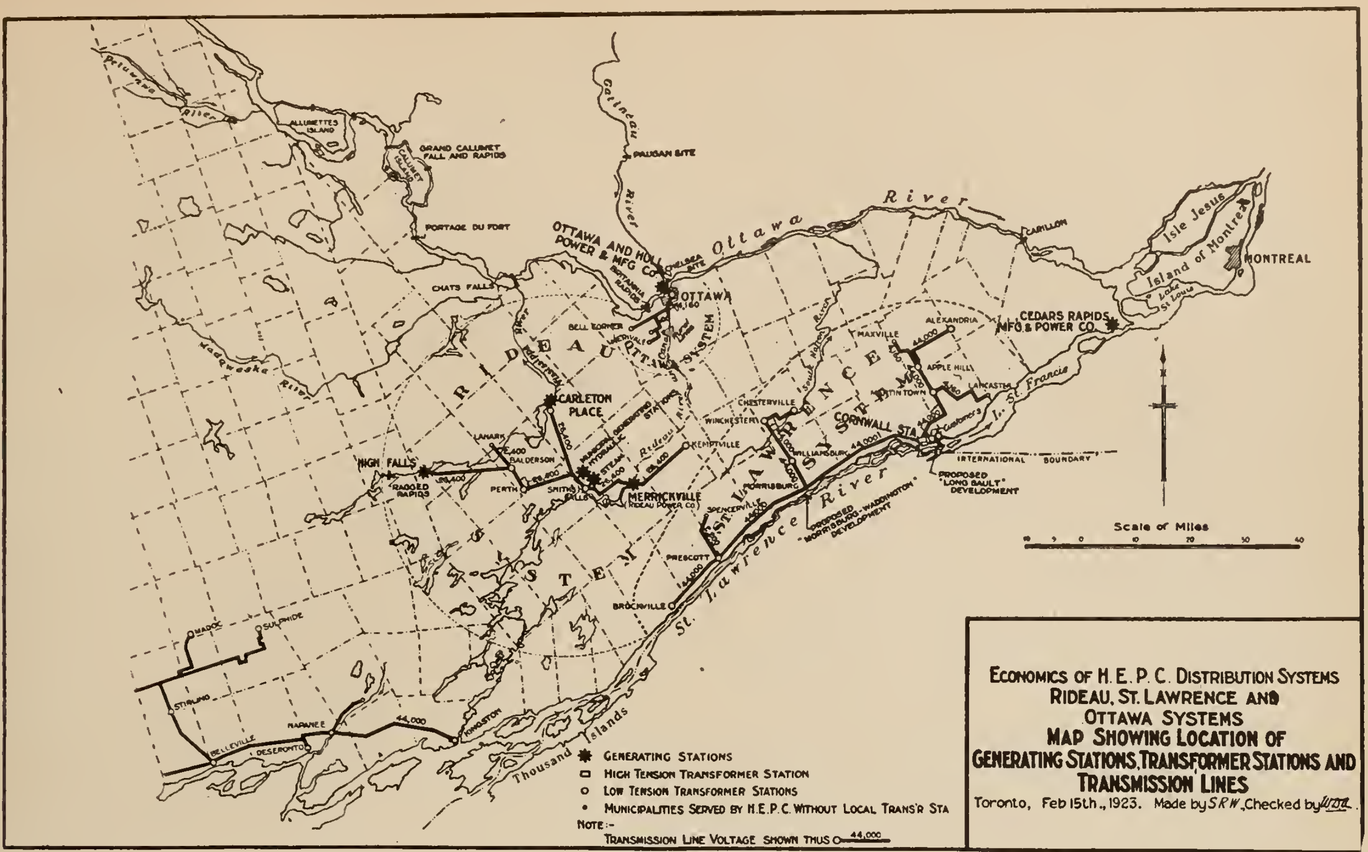

Plate No. D-14, — Location of Generating Stations, Transformer Stations and Transmission Lines, Rideau, St. Lawrence and Ottawa Systems.

wave and are therefore very effective in reducing disturbances originating at a considerable distance from the station. They are also of great value in providing a definite ground for relay protection of the lines and in the case of the grounded neutral systems the ground wires should be connected to the station neutral.

The overhead ground wires tend to lessen the stray electric field which extends out from the power lines to neighbouring communication circuits and therefore tend to reduce the voltages induced in these circuits and the consequent interference with their normal functioning. The overhead grounded wire on wooden pole lines can probably not be justified economically unless it is grounded at every pole and it may even be a detriment unless the pins and crossarms are also grounded.

When the overhead ground wire is not used, the vertical ground wire on each pole is still advisable to prevent burning or shattering of the poles when arc-over occurs. Grounded metal pins are to be recommended for systems above 30,000 volts rather than wooden pins which are liable to be eaten away by the silent discharge, especially at the higher operating voltages.

In the case of extra high voltage lines where the safety factor for flashover of the insulator string is very high and where, therefore, the induced lightning voltage assumes relatively less dangerous proportions and where for economical reasons the line is operated near the critical voltage of corona formation, the protective functions of the grounded wire are not so important as the energy of the travelling wave will be dissipated by the corona loss.

The valuable functions discussed above would appear to justify a properly installed overhead ground wire on the majority of long distance transmission circuits, if not on all of them. However, this is one of the questions which can be settled only by careful study of operating records. Parallel circuits are being operated, only one of which is equipped with overhead ground wires and it is hoped that the comparative records of these lines after a few years of operation will help to a definite solution of the question.

Inductive Co-ordination between Power and Signal Circuits

Where it is necessary to construct power and signal circuits near to one another, both systems must be designed so that the transfer of energy from one to the other will be as small as possible. This will result in a minimum interference with the operation of the signal circuit.

Inductive interference may be defined as the impairment of the serviceability of communication circuits resulting from the transference of energy into them from nearby power circuits or resulting from their absorption of energy from the electric field of the neighbouring power circuits. To reduce interference the power circuit must be designed so that its influence on the signal circuit will be small and the signal circuit must be designed so that it will not be unduly sensitive to the influence of the power circuit.

The normal power circuit frequencies of 25 cycles and 60 cycles cause interference with telegraph circuits, while the higher harmonics of the power circuits are responsible for the greater part of the interference with telephone circuits. Under abnormal conditions of operation the inductive disturbances may be very greatly increased and momentary impulses may be sufficient to cause a physical hazard, to operate protective devices or to cause severe acoustic shocks to the signal circuit operators. Such conditions occur when energizing or de-energizing lines, opening short circuits, charging electrolytic lightning arresters, or when arcing grounds are formed.

It is necessary to distinguish between the voltage induced in the signal circuit by the electrostatic field, which is proportional to the voltage of the power circuit, and the voltage produced by the magnetic field, which is proportional to the current in the power circuit. The one is called electrostatic induction and the other magnetic induction. Induction, whether electrostatic or magnetic, is classified as transverse or longitudinal, depending on whether it tends to produce a current flowing from one signal wire to the other, or to produce currents along the two signal wires in multiple to ground.

In analyzing inductive affects it is necessary to divide the power circuit voltages and currents into two general classes, balanced and residual. Balanced current components in the several conductors of a power circuit are such that their algebraic sum at any instant is zero. The algebraic sum of all currents in the conductors of the power circuit is the residual current. Similarly, the balanced voltages of the several conductors, (balanced with respect to the earth as neutral conductor or point of reference) are such that their algebraic sum at any instant is zero, while the algebraic sum of the several voltages to ground is the residual voltage.

The remedies for induction from balanced and residual voltages and currents are often fundamentally different. Transposition of the power circuit reduces induction from balanced currents but scarcely affects induction from residual currents, while transposition of the telephone circuit will reduce induction from both the balanced and residual components.

Causes of Residuals

Inequality between the capacities to ground of the several conductors of a power circuit causes residuals of the frequencies present in the voltage between conductors.

Unbalanced capacities are caused by differences in the distances of the conductors above ground and from other conductors or ground wires. Transposing the conductors of the power circuit tends to equalize both their capacities and also their inductive reactances. Of common configurations, the equilateral triangle is the most nearly balanced, the unsymmetrical horizontal arrangement is the worst.

If one conductor of a three-phase line, without grounded neutral, becomes grounded, a residual voltage of three times normal voltage appears and a large residual charging current flows.

Defective line insulation will cause leakage currents to flow which are residual currents.

In a delta-star, star-delta connected transmission line with neutrals grounded at both ends, parts of the third harmonic magnetizing currents for the receiver transformers are in phase in the three lines and return through ground. The remainder of the third harmonic current flows in the closed receiver delta.

When transformers are connected star-star at both ends, the residual currents are much greater and this connection should not be used on account of its bad effect on signal circuits unless a low impedance tertiary winding is provided to carry the third harmonic magnetizing current.

Very high voltage transmission lines on which corona forms will carry third harmonic corona forming currents which will be in phase in the three conductors and will be residual currents.

Unbalanced loads will cause residual currents and voltages in the supply lines.

All abnormal operating conditions which set up transient currents and voltages produce very large residual effects.

Causes of Harmonics

The detrimental effect in a telephone receiver varies almost directly as the induced current and it increases roughly as the square of the frequency up to about 1,000 cycles per second. To reduce induction it is necessary to eliminate as far as possible all harmonics from the power circuit. These higher harmonics which appear as irregularities in the voltage and current waves may result from a number of causes:—

(1) The shape of the pole face may result in the introduction of third and fifth harmonics in the voltage wave.

(2) Open slots on the armature cause high frequency ripples on the generated voltage wave which are called tooth harmonics. A long air gap and proper design of the pole face will reduce these tooth harmonics to very small values but more complete elimination may be obtained by skewing the armature slots or by distributing the armature winding in a fractional number of slots per phase per pole.

(3) The operation of transformers at very high densities causes distortion of the current and voltage waves. If the impressed voltage is a sine wave the flux must be a sine wave, but due to magnetic saturation the exciting current cannot be a sine wave but contains prominent third, fifth and higher harmonics.

(4) The presence of an arcing ground or an arc due to a loose switch contact may cause very serious high frequency induction.

Transpositions

One of the most valuable methods of reducing inductive interference under normal operating conditions is to transpose the conductors of each circuit so as to equalize their relations to all other circuits and to earth.

Transpositions of a power circuit tend to equalize the capacitances of its conductors to ground, thereby removing a source of residuals, and to cause the inductive effects from the balanced currents and voltages to neutralize one another in successive lengths of the parallel telephone line. Transposition of a power circuit does not reduce induction from residuals except insofar as it reduces the residuals themselves.

Transpositions of a telephone circuit tend to equalize the capacitance of its conductors to ground, to equalize the inductive effects on the two sides of the circuits due to nearby power circuits and to lessen the induction among the several telephone circuits in the group, but they do not affect the voltages induced between the circuit as a whole and ground, called the longitudinal induction. To be of any value transpositions of the telephone circuit must be very carefully located so that the induction in adjacent sections will be the same and the transpositions in the two classes of circuits must be co-ordinated.

Electric waves take a finite (though very short) time to travel along conductors and the electrical conditions at a given instant will be different at different points along the lines. They will be practically opposite at points one half wave length apart. The length of a barrel or complete transposition of a power circuit should be short compared to the wave lengths for the frequencies under consideration.

Principles to be Applied to Prevent Serious Interference Between Power and Signal Circuits

(1) Avoidance of close proximity to a circuit of the other class. This is the only way to completely prevent interference but can only be applied in isolated cases. It is not a final solution. When the two types of circuits are located on the same highway or railroad right-of-way, they should be placed on opposite sides of it. When the power circuit is on a separate right-of-way it should be kept at least 150 to 250 feet from the signal circuit whenever this is possible.

(2) Co-ordination of the transposition schemes of the two circuits. This is a very effective method of reducing interference.

On the part of the power company

(3) Elimination or suppression of harmonics by proper design and methods of operation of the power apparatus.

(4) Limitation of residuals by proper balance of circuits and loads.

(5) Proper arrangement of conductors of the transmission lines.

(6) Limitation of abnormal conditions by high grade construction and care in maintenance and operation.

On the part of the signal company.

(7) Careful balance of the circuits by high grade construction and maintenance.

(8) Limitation of susceptibility of systems.

A carelessly designed and maintained power system may be a menace to nearby signal circuits, but on the other hand, a highly susceptible signal system or one which is not properly maintained may be a nuisance to a power circuit which is blamed for unwarranted interference.

The signal companies have developed a very ingenious meter, called the "telephone interference factor meter", which indicates the amount of interference which any power circuit will cause to a neighbouring signal circuit. A study of the remedial measures required to reduce the interference to a reasonable amount can then be made.

This meter can be used in testing a generator and will give a direct indication of the amount of interference to be expected due to harmonics in the generator voltage wave. This is one of the standard tests to be applied to new installations.

In Canada the very closest co-operation has existed between the power companies and the signal companies for some years past and all possible precautions have been taken to prevent interference, and it is well understood that inductive co-ordination is purely a technical problem only to be satisfactorily solved by sympathetic co-operation between the engineers of the power and signal companies both before and after new developments and extensions are carried out. It is entirely a question of compromise and should at all cost be kept out of the courts of law.

Both services must be made available conveniently and economically. The highways, in many cases, are the natural location of both services but they must only be used by circuits which are neither too influential nor too susceptible to prevent other circuits being placed on the same highway.

Interconnection of Transmission Lines

The economic value of interconnecting power generating systems is sometimes very great on account of the difference in the characteristics of the rivers on which the developments are located and of the loads supplied from them. Great economies may likewise often be made by interconnecting steam and hydro-electric generating stations.

Developments located near to each other on the same river should, for the best results, not only be interconnected electrically but should be operated under one control so that the water can be used to the best advantage in the combined plants.

When two generating stations are located on different rivers, one of which has a low head, large volume of water and very little storage capacity, while the second has a high head, smaller volume of water and a comparatively large storage capacity, the advantage of interconnection is obvious. By pooling the power of the two systems the low head plant with its continuous flow can be operated continuously at its maximum capacity while the water in the high head plant is stored up to be used to carry the peak load. The interconnection will be of special value at times of low water.

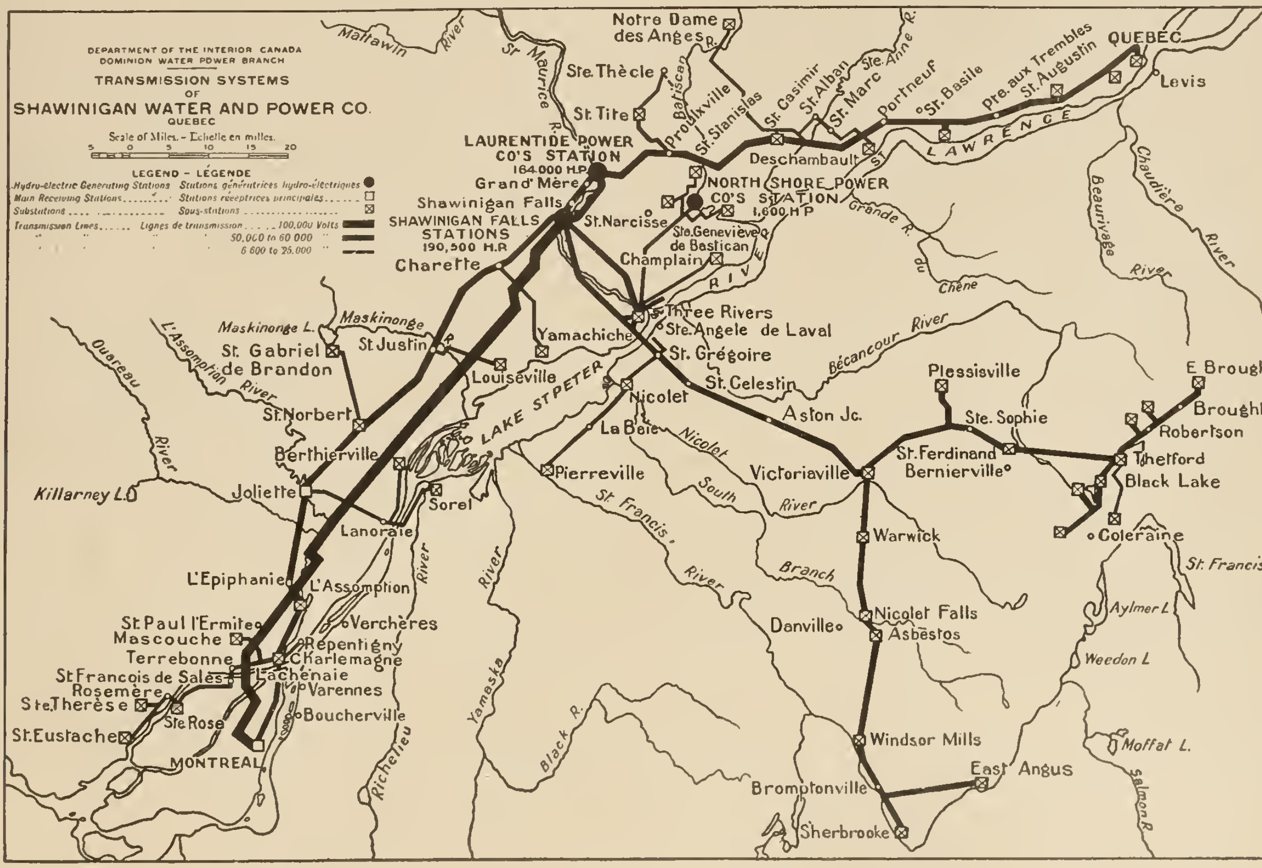

Plate No. D-15, — Shawinigan Water and Power Company,—Transmission Systems.

Interconnection between plants on different water-sheds often enables a development with large natural or artificial storage to help other plants over their low water periods. To get the best results in many cases steam reserve plants should be provided to take care of the peaks and to help out at periods of low water and in emergencies.

The advantages of interconnection have been realized in many of the Canadian systems. The Niagara System of the Hydro-Electric Power Commission of Ontario has a network of 110,000-volt lines and 12,000-volt circuits which are normally fed from generating stations aggregating over 600,000 horse power. These are the Queenston station, the Ontario Power Company and the Electrical Development Company, and when required power can also be supplied to this system from the Canadian Niagara Power Company, and the Niagara Falls Power Company on the American side of the river.

In the province of Quebec, the Cedars Rapids development supplies power to Massena in the United States and to the St. Lawrence System of the Hydro-Electric Power Commission of Ontario in the eastern part of Ontario. It also delivers power to Montreal, and through the 12,000-volt distribution system of Montreal is connected to the lines of the Shawinigan Water and Power Company which extend to the east nearly 200 miles to Quebec where they link up with the system of the Quebec Power Company, which, in turn is connected to the lines of the Laurentian Power Company. The Shawinigan 30-cycle system on the south side of the St. Lawrence river is connected through frequency changers to the system of the Southern Canada Power Company. More than fifteen power developments, some of them more than 200 miles apart, are connected into this Quebec system and the total present capacity is about 600,000 horse power, which will be increased when the new development of the St. Maurice Power Company is put into operation during the present year.

Up to the present time very little steam power has been developed in Canada as a standby for the hydro-electric stations but plans are being made in Ontario to supplement the output of the hydro-electric plants by the construction of one or two large steam plants, and there is no doubt that in the near future additional steam generating stations will be required in some of the largest industrial centres in the province of Quebec. When the load factor of an important load centre is below 60 to 70 per cent the installation of steam stations to take care of peak loads will usually be found to be economical.

Short Circuit Currents

As the concentration of power in a network of lines is increased short circuits become more and more destructive in their effects.

In many cases a small system has operated satisfactorily so long as it was isolated from other systems; the short circuit currents flowing to fau ts were not excessive and the switches were able to handle them without difficulty. The stresses on low voltage busbars were small and no special precautions were required to prevent mechanical damage to the structures. The addition to such a system of more generating capacity or of synchronous condenser capacity or synchronous motors at the receiving end of the line or even the addition of extra transmission lines may reduce the impedance in the path of currents flowing to a short circuit to such an extent that the switches will be stressed beyond their capacity and be destroyed. Or a short circuit on the low voltage bus may result in such a large current flow that the bus structure will be destroyed.

If all the generators in a power station are paralleled on the low voltage bus the greatest concentration of energy will occur when a short circuit occurs on this bus. Switches which were adequate to handle the short circuit currents when only three or four generators were installed are entirely inadequate when the number has been increased to ten or twelve. The severity of a short circuit on the low voltage bus can be reduced by sectionalizing the bus and either operating the sections entirely separate or connected only through bus bar reactances. A greater reduction can be obtained by eliminating the low voltage bus altogether and paralleling only on the high voltage bus. In this case the step-up transformer bank is operated as part of the generator and the two can be designed with the most suitable combined impedance.

The modern generators and transformers are designed with much larger reactances than those of a few years ago and this has largely reduced the amount of current they can feed into a short circuit. When studying the operation of oil switches in clearing short circuits the sustained value of the generator short circuit current is the one to be considered as the current will have fallen to this value before the switch opens the circuit, but to determine the maximum stresses on bus bars or on parts of switches, the instantaneous current must be used and the worst condition assumed which is when the short circuit occurs at the zero point of the generated voltage wave.

At the receiver end of the line, the short circuit currents are usually much smaller than at the generator end as they are limited by the line impedance. If, however, large synchronous condensers or synchronous motors are operated on the low voltage bus they will feed current into the short circuit.

When a number of systems are interconnected they all feed current to any short circuit on the network and the smaller capacity switches on the low powered systems are liable to be destroyed unless care is taken to so arrange the circuits that sufficient impedance either of lines or transformers is in the path of any short circuit.

A few years ago on one of the largest Canadian networks of lines, supplying a load of approximately 300,000 kilowatts, the maximum estimated short circuit kv.a. was 2,000,000, but by re-arrangement of the generators and lines and the insertion of reactances in the low voltage busbars, the estimated short circuit kv.a. has been reduced to 650,000, notwithstanding that in the meantime the load on the system has increased to about 500,000 kilowatts.

Extra High Voltage Lines

Provision has been made in the design of a number of systems in Canada for future operation at voltages up to 150,000 volts, but at the present time no lines are actually in operation above 125,000 volts. Some new developments which are now in the first stages of construction or are projected for the near future will require the use of voltage much higher than those at present in use in order to transmit the large amounts of power, which will be developed, to the distant markets.

It appears probable that transmission at 220,000 volts will only differ in degree from transmission at lower voltages as no new or startling effects are to be expected. The economical amount of power to be carried per circuit will probably be of the order of 75,000 to 100,000 kilowatts and the generator capacity required to charge the lines will be very great. The duty of circuit breakers will be somewhat heavier but this may be kept down by proper arrangements of circuits, and probably switching will be much less frequent.

Conductors of large diameter must be used with very wide spacing, to reduce the corona loss under storm conditions. Conductors of about one inch diameter spaced from 15 to 18 feet apart will probably give satisfactory results. Steel reinforced aluminum will give the required diameter at a lower cost than copper and will have sufficient conductance unless considerably more than 100,000 kilowatts is to be carried per circuit or the line is of extreme length.

It must be remembered in constructing extra high voltage lines, that the maximum voltage at any point on the line is the one that must be considered. A line delivering power to a receiving station at 200,000 volts but having a rise of 25 per cent in voltage at the generating station, is not a 200,000-volt line but is a 250,000-volt line. Since apparatus and insulation costs increase rapidly with increase of voltage it is apparent that the large voltage drops commonly allowed on some of the lower voltage systems will not in general be economical on the 220,000-volt lines, and probably the regulation should be limited to 5 to 10 per cent, except in special cases. If the normal load power factor is not above 85 per cent the synchronous capacity required for such close regulation will be of the order of 50 to 60 per cent of the load kilowatts. When the load reaches very high values such as 150,000 to 200,000 kilowatts per circuit it may be found economical to install more synchronous capacity and to operate at approximately the same fixed voltage at both ends. This would be a very extreme case and if the line were over 200 to 250 miles in length there would probably be a considerable voltage drop at the centre which should be corrected by placing part of the synchronous capacity there. Copper conductors may be used on circuits designed to be operated at such extreme loads, to reduce the line losses.

It is necessary to distinguish between systems supplying large blocks of power to terminal stations at a great distance from the generating stations without any intermediate taps, and the system acting as a main trunk line crossing a network of existing lines and connected into it at a number of points.

The first type of system would suit conditions in the province of Quebec, where the main industrial centres lie along the river St. Lawrence or south of this river, while the principal water power sites, except the group on the St. Lawrence, lie two or three hundred miles north of the river, estimating distance as the probable transmission distance to the markets, the country between being relatively undeveloped industrially. The main transmission lines will be operated at 200,000 to 250,000 volts without taps and a drop of voltage of 15 to 20 per cent may be allowed in the lines, the generator voltage being changed through perhaps a 10 per cent range to suit load conditions. Power should be sold to the main distributing companies at 90 to 95 per cent power factor and only enough synchronous capacity installed in the terminal stations to regulate the voltage and to limit the line drop to the value assumed. Synchronous capacity of 25 to 30 per cent of the load kilowatts should meet these conditions.

The second type of system will probably be more suitable for the province of Ontario. The proposed power

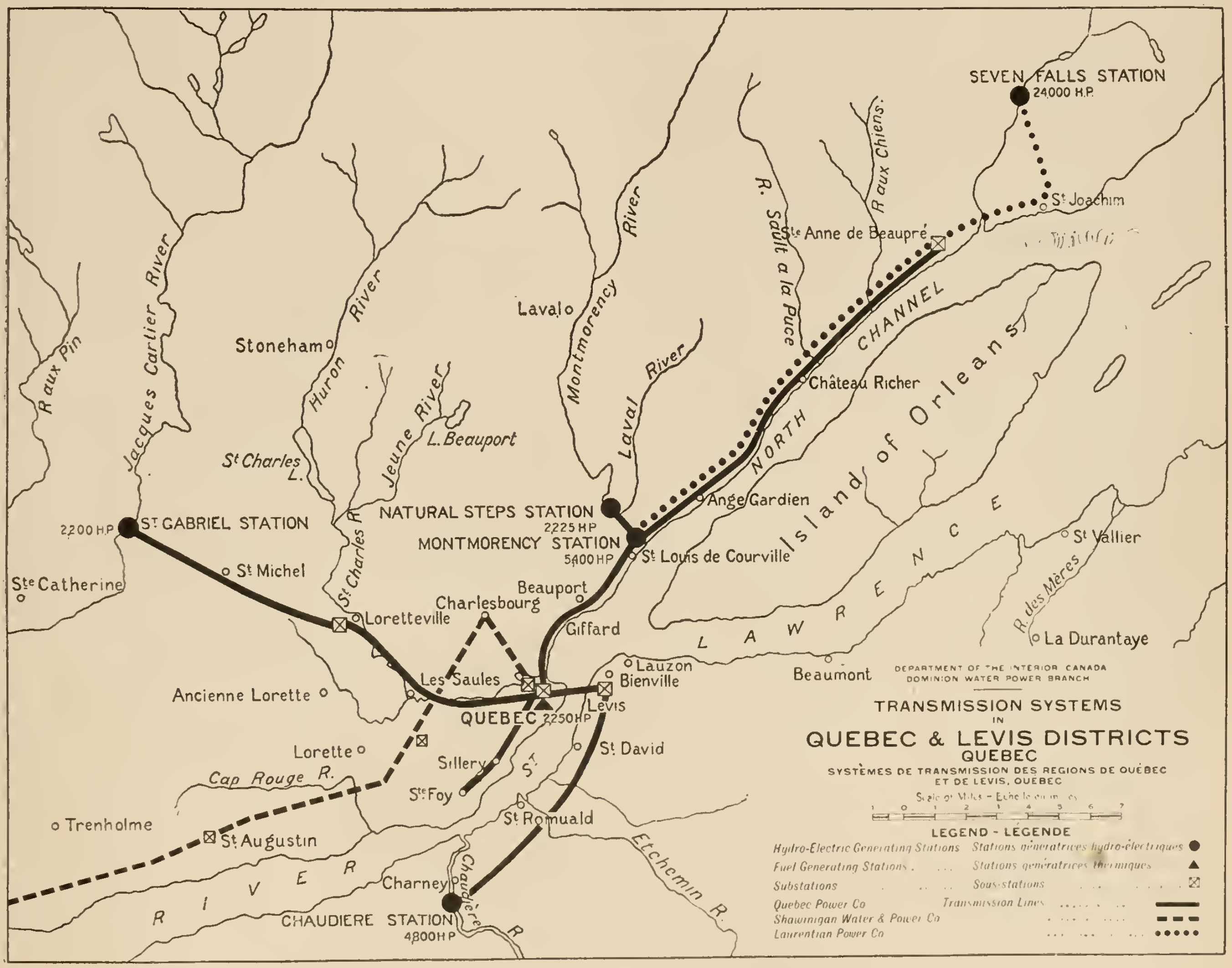

Plate No. D-16, — Quebec and Levis Districts Transmission Systems.

developments on the St. Lawrence river will be linked up with the various developments at Niagara Falls and with any large steam stations located at strategic points through the system of the Hydro-Electric Power Commission of Ontario. Probably 220,000-volt trunk lines will be constructed crossing Ontario from the north-east to the south-west, tapped at the main load centres and linking up all the main sources of power so that the greatest economy may be obtained for the complete system. These lines will be operated of necessity at a fixed voltage throughout and large amounts of synchronous capacity will be required at the load centres to hold the voltage constant.

The objection to the first type of system with its comparatively large voltage drop is that at the generator end the transformers and lines must be constructed for 240,000 to 250,000 volts while the receiver voltage is only 200,000 volts. There will however be no difficulty in obtaining transformers for 250,000-volt operation and if necessary spacings up to 25 feet can be used without any great increase in tower costs. The system will not then differ except in size from the transmission systems of to-day.

The extremely large synchronous condenser capacity required for the second type of system will probably increase the operating difficulties more than the small increase in the voltage at the generating station assumed in the first case. The short circuit currents will be increased and there is danger that the synchronous machines will fall out of step, when serious disturbances occur.

The present is a time of great activity in the field of water power development as the rehabilitation and growth of the industries of the country is in very large measure dependent on an increasing supply of dependable and cheap power. Many available power sites, of a capacity of 50,000 to 100,000 horse power, near the industrial centres are still undeveloped but attention has been turned to some of the larger developments, among which may be noted the Queenston plant of the Hydro-Electric Power Commission of Ontario, which has already a capacity of 350,000 horse power which will probably be increased to 500,000 or 600,000 horse power; the large development on the Saguenay river where nearly 1,000,000 horse power will ultimately be available, and the international developments on the St. Lawrence river.

To market the power from the Saguenay development and from the St. Lawrence stations, higher voltages will be required than those at present in use and this will be accompanied by an extension of the present networks of lines and probably by an interconnection of the systems of Ontario and Quebec.

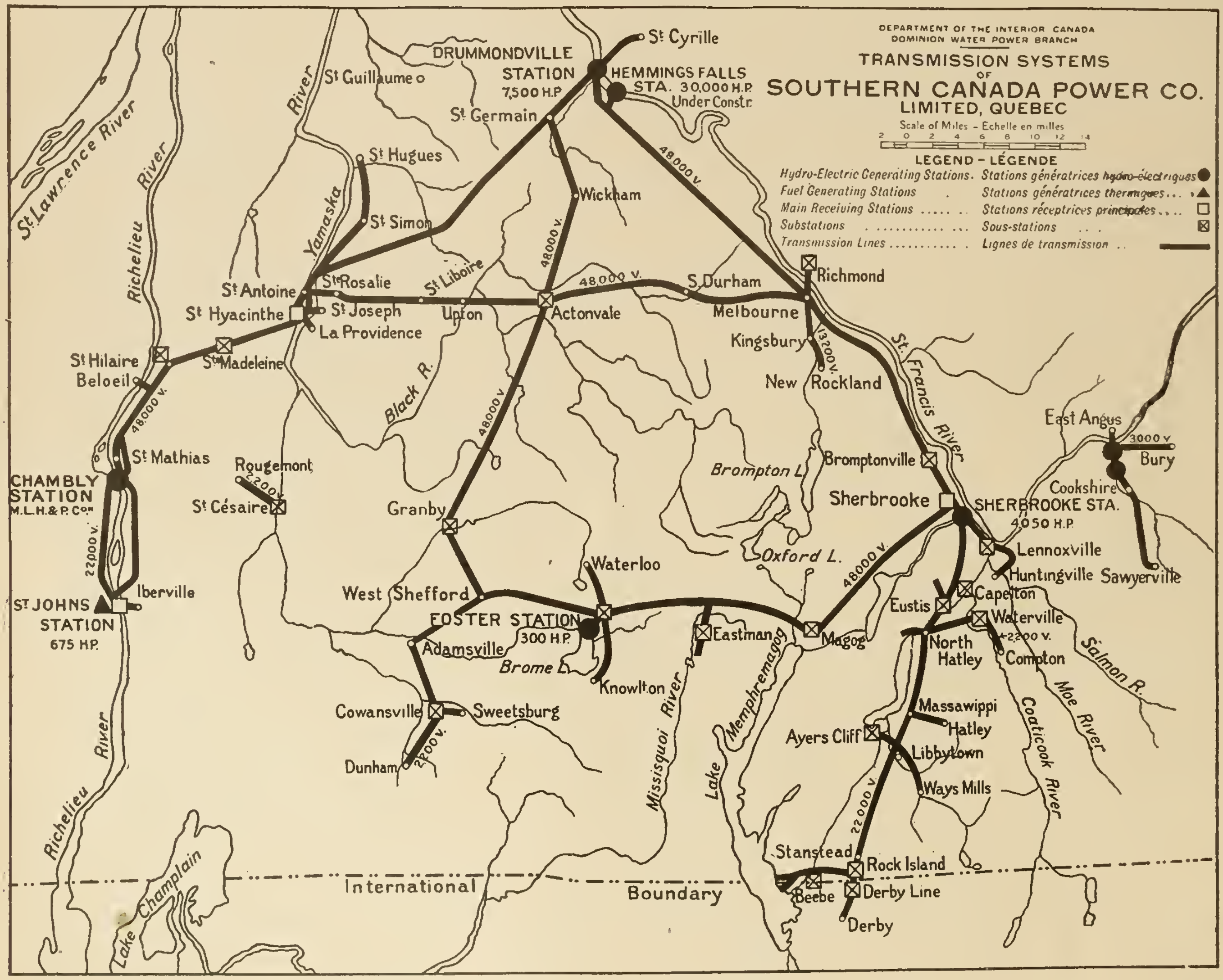

Plate No. D-17, — Southern Canada Power Company, Limited, Quebec, Transmission Systems.

Utilization of Power

Introductory Statement to Symposium Collated by

P. T. Davies, A.M.I.E.E.

President, Canadian Electrical Association

The term "Utilization of Power", as here used, is the official title of a group of papers on various aspects of power utilization and the purpose of the present remarks is to introduce the twelve Canadian papers on this subject and to briefly summarize the total use of power for all purposes in Canada.

Elsewhere in Canada's contribution to papers for the World Power Conference, her great resources of both water and fuel power have been set forth in detail. Briefly stated, the, at present, recorded water power resources are for maximum commercial development, over 32,000,000 h.p., and the amount now developed is nearly 3,250,000 h.p., a figure which shows Canada to have the second largest utilization of water power of any country in the world, the first being the United States, which however has much less developed water power per capita than Canada. In coal, Canada possesses over 15 per cent of the world's known coal reserve and there are large producing fields of natural gas.

No section of the Dominion is without ample power resources and no section has failed to utilize them. Manufacturing and mining industries are distributed practically throughout the Dominion. Ontario and Quebec are the main centres of manufacturing industry, but the fourth manufacturing city, Winnipeg, is in the centre of the Dominion, and the fifth, Vancouver, is on the Pacific coast.

In Canada the water power is distributed so that it is available at, or near, all centres of population from coast to coast, with the exception of comparatively small areas in the south of Alberta and Saskatchewan, where, however, there are enormous resources of coal. Throughout the Dominion fuel power has now been largely replaced by water power, the present division of power for all purposes except steam railroads, being 70 per cent water power, 30 per cent fuel power.

In Canada the growth of the central station industry has been a marked factor in the power situation, over 70 per cent of all developed water power being in central stations and 98 per cent of the output of central stations being from water power.

The use of power in industry is therefore mainly represented by the growth of water power development and a general view may be obtained from the following table:—

Growth of Manufactures and Power

	Population		Capital Invested in Manufactures		Developed Water Power	
	Total	Increase per cent	Total	Increase per cent	Turbine h.p.	Increase per cent
1900	5,322,000		$ 446,900,000		157,200	
1910	6,917,000	48.7	1,247,600,000	197	965,000	514
1920	8,631,000	24.8	3,443,300,000	176	2,482,000	157
1900 to 1920		57		670		1480

The above table does not include mining and the treatment of ores, and the apparent excess of water power developed is due to its use in this, in the supplanting of fuel power and in a general extension of domestic and other uses. So great however has been the growth of manufactures that the value of product thereof now exceeds that of agriculture and live stock.

Ontario and Quebec, which contain over 60 per cent of the total population and nearly 80 per cent of the total manufacturing development, possess no native coal, and it is clear that the great manufacturing development could not have taken place without the aid of water power.

Reducing the above table to a per capita basis gives the following:—

Capital and Power per 1,000 of Population

	Capital Invested in Manufactures	Water Power Developed h.p.
1900	$ 84	29
1910	180	139
1920	387	288
1924	—	353

Diversified Use in Industries

The widely diversified use of electric energy in industries is well exemplified by the inventories of power users in appendices I, II and III. The first two cover the two largest cities, Montreal and Toronto. The figures for Toronto are based upon the actual tested load being paid for by the customer. For Montreal they are based upon the connected load and a study of several thousand tests has shown that the average load is 65 to 70 per cent of the connected load. Montreal figures include street railway load, and Toronto figures do not.

The third covers a rural territory in the province of Quebec, some 10,000 square miles in area and containing a population of some 69,000, and is of special interest as illustrating the distribution of electric energy over a wide area including a number of towns and villages.

Uses of Central Station Power

In 1922 the uses of central electric station power for the whole of Canada were approximately as follows:—

Lighting and small motors	30.0	per cent
Electric railways	8.0	"
Mining and treatment of ores	10.0	"
Pulp and paper	13.0	"
Electro-chemical and metallurgical	5.0	"
Other manufactures and power	25.0	"
Electric energy exported	9.0	"
	100.0	per cent

The total power in use for all purposes as at January 1st, 1923, was estimated by the Dominion Water Power Branch as follows:—

Water power		2,673,000	45 per cent
Fuel power, Industrial	1,142,000		
Steam railroads	2,130,000		
		3,272,000	55 per cent
		5,945,000	100 per cent

Excluding railroads, the proportion, as before stated, was water power 70 per cent, fuel power 30 per cent. The largest use of power in any single industry in Canada is that in pulp and paper manufacture, over 725,000 h.p.

General Use of Electric Energy

It has been shown that Canada has the largest actual amount of water power developed of any country in the world except the United States. In actual utilization of electric energy Canada exceeds any other country without exception. The following figures are from a table of the "Consumption of Electrical Energy by the Various Nations of the World" published by the *Electrical World*, January 6th, 1923, except those for Canada which are actual census results:—

Kilowatt Hours per Capita 1920

Canada	729
Switzerland	700
Norway	493
United States	472
Sweden	364
France	147
Germany	141

The official figures for Canada in 1922 show that this had then increased to 820 k.w.hrs. per capita.

Dwellers in Electrically Lighted Abodes

The following are also taken from the same source quoted above, the figures being in percentage of the total population:—

Canada	38.3
United States	36.8
New Zealand	30.8
Japan	29.9
Denmark and Iceland	29.8
Switzerland	25.9
Norway	21.3
Sweden	17.0

Size of Distribution Systems

The energy and enterprise that have been shown in the generation and distribution of power in Canada are strikingly illustrated by a United States compilation* of 110 of the largest power generating systems in North America. In annual output the system of the Hydro-Electric Power Commission of Ontario heads the list, and in order of magnitude Canadian systems stand thus:—

1. Hydro-Electric Power Commission of Ontario, (as in 1922).
6. Shawinigan Water and Power Company, (as in 1922).
11. Montreal Light Heat and Power Consolidated, (as in 1923).
15. Ontario Power Company, (as in 1923).

This is the more striking when it is remembered that the population of the United States is about twelve times as large as that of Canada.

Conditions of Distribution

All organizations supplying electric energy throughout the Dominion are alive to the necessity of giving adequate service to all users; this service originally included the free renewal of their lamps but this practice is now being discontinued. The service to-day however does cover the free attention of trouble-men for the purpose of replacing fuses and making minor repairs in the home, the carrying on of electric stores where almost every electrical appliance is obtainable on long term payments, the carrying of a wiring staff, and finally, for industries, free engineering service upon all subjects dealing with the supply given, and continuous advice on the possibilities of its increased use.

*Electrical World, April 12, 1924.

Distribution Voltage

The general distribution voltage from sub-stations is 2,200 volts, with some at 4,000 volts, 3-phase, 4-wire, grounded neutral installations. The secondary service from local transformers is at 110/115 volts, single-phase, for lighting ordinary residences, for larger customers, for lighting and cooking and for multiple street lighting it is usually 110/220 volts, 3-wire. Power is usually supplied at 550 volts, 3-phase, with larger units at 2,200 volts, and units of 3 h.p., or under at 110 volts, single-phase.

There is a little direct current generated for limited distribution, more particularly for passenger elevators in the large cities of Montreal, Toronto and Winnipeg; such service is also available for lighting in some cases in Toronto and Winnipeg.

Frequencies

The principal frequencies of alternating current in use are 25 cycles on the Niagara system of the Hydro-Electric Power Commission of Ontario, 30 cycles in the territory south of the St. Lawrence between Sorel and Levis, and 60 cycles in practically all other parts of Canada.

Construction

In the past most of the construction of distribution systems has been carried on wooden poles and cross arms, the necessary transformers also being hung on the poles where required; some of this construction, especially at corners, was not as trim as it might have been and more modern construction now does away with crossarms, iron brackets and hooks supporting insulators close to the poles with vertical instead of horizontal spacing between the wires becoming more general. The use of concrete poles has also been tried and a considerable installation of these made in Toronto. In the centres of large communities all services are almost invariably underground; duct systems being used with transformer manholes and distribution ducts, usually under the side-walk. No particular difficulties have been found in operating these underground systems even in places where a very heavy snow fall is encountered.

Wiring and Fittings

All wiring and fittings must be approved before electric service can be obtained. In Ontario the approval of the Hydro-Electric Power Commission's laboratories on wiring, fittings and appliances, must be obtained before any material can be placed in service. In the balance of Canada the rules of the Canadian Board of Fire Underwriters, which approximate to the National Electric Code of the U.S.A., must be followed, and all wiring fittings and fixtures approved before their use is permitted. Many disappointments have been caused British and other manufacturers, it not being known that such certificates and approval are required for all material for use in customers' premises in Canada.

Rates

Rates in Canada vary according to the density of population, and in some cases the distance from the power source. Where hydro-electric power is available the rates are usually considerably lower than would be possible through steam generation, especially where an industry has a high load factor.

Contracts

Contracts with customers are generally made on a one-year basis for domestic business, and for some longer period, generally five years, for power service. Customers are required to finance some part of the cost of any necessary extension when business is temporary or the return on the investment necessary too low to permit a profit. Meter rent is not charged, although all meters have to be sealed by the government once every six years, at a cost of 60 cents per seal.

Canada is singularly fortunate in the amount and well distributed availability of its power resources. In spite of the extensive development that has already been made it is estimated that only about eight per cent of its readily available water power has been utilized to date. It stands ready, therefore, to provide for the industrial and domestic needs of a population many times the size of its present one.

The resources of power are ample and development is capable of immediate expansion as required; the whole of the materials needed for such development are produced within its borders, its water powers are being freely developed under favourable laws securing stability of investment, and, as has been shown in the foregoing remarks, Canada stands in the very forefront in the science and practice of power utilization.

Appendix I

Classification of Power Users in Montreal

Kind of Business	Number	Connected load in h.p.	K.w.hrs. per annum
Asylums and institutions	10	978.5	670,738
Air compressors	100	3,550.0	3,120,000
Artificial stone manufacturer	1	422.5	356,640
Automatic typewriter	1	.58	980
Auto accessories dealer	11	63	62,000
Artificial limbs dealer	1	3	551
Asbestos works	2	337	260,000
Automobile manufacturing	1	209	79,500
Aerated water manufacturing	7	181	155,022
Battery chargers	55	950	1,060,000
Broom manufacturing	2	5	1,728
Biscuit manufacturing	8	165	91,254
Bag manufacturing (jute)	2	241.5	146,849
Blue printing machine	4	190	506,000
Bottling machine	22	134	216,500
Barrel manufacturing	4	40	52,000
Bread manufacturing	19	634	421,000
Boiler works	3	28	13,339
Buffers	6	14	1,106
Belt manufacturing	2	27.5	6,706
Bed and mattress making	5	94	141,500
Bed manufacturing	2	992.5	800,268
Bone cutter	2	2	66
Brush manufacturing	5	18.5	32,000
Button making	5	19	25,900
Braiding machine	3	29	39,000
Brass finishing machine	8	69	67,600
Bell ringers	8	38	1,925
Brewery machinery	4	1,446	2,945,187
Brick manufacturing	2	3,835	5,760,960
Butcher machinery	4	9	6,963
Cotton goods manufacturing	3	225	138,000
Cake mixer	8	14	2,500
Confectionery machinery	27	943.75	1,390,767
Cigar manufacturing	6	174	46,000
Caramel making (coloring)	1	16	10,458
Chemical works	51	1,040	364,200
Cleaning and dyeing	27	212	122,200
Chocolate manufacturing	4	1,101	911,724
Cocoanut machine	1	4	1,310
Cash carriers	14	22	440
Coppersmiths	2	2	1,962
Canning machines	2	20	3,179
Can manufacturing	2	412.5	321,993
Cloth cutter	4	8	5,200
Cranes (travelling)	3	165	5,360
Carriage making	20	148	26,400
Coffee grinders	6	5	2,000
Coffee grinder (large mill)	1	80	40,000
Cement mixer	8	58	62,600
Cigar box manufacturing	2	70.75	91,000
Cigarette manufacturing	2	45.5	5,358
Creamery machinery	2	23	4,702
Cement works	1	11,290	54,329,903
Cork cutter	2	5	472
Conveyor (letter)	1	5	3,590
Cheese manufacturing	1	85	55,899
Candy making	3	9.5	2,423
Coal handling machinery	25	697	875,000
Canal gates	1	240	14,400
Cordage manufacturing	1	528.5	743,143
Car puller	1	12	6,530
Celluloid manufacturing	1	81	132,600
Drug supplies	1	12	11,772
Dye making	2	18	11,700
Dough mixer	66	379	52,800
Dairy machinery	19	372	216,000
Drop hammer	1	2	159
Dental machinery	5	12	3,780
Electric distribution systems	4	7,407	5,470,000
Electric heating	9	8,048	3,647,224
Elevators (passenger)	278	10,421.5	19,950,000
Elevators (freight)	740	5,065	935,000
Electric railway systems	2	35,030.6	30,600,000
Embroidery machine	5	21.25	27,816
Engraving machine	5	70.3	6,885
Envelope manufacturing	3	8	13,000
Electrical repair shop	2	11	480
Electric appliances manufacturing	2	260	430,000
Electric testing	11	460	9,912
Feather cleaning	1	2	241
Floor finishing machines	23	67	8,500
Feed mill machinery	14	126.5	24,454
Fleshing (hide)	1	15	2,202
Fur dressing machinery	14	184	136,000
Flour mill machinery	7	5,381	16,750,000
Foundry machinery	23	9,267	9,300,000
Fans	60	678	270,000
Fountain pen manufacturing	1	125	148,840
Grain elevators	12	5,126.5	4,476,047
Gramaphone works	2	442	429,076
Gas works	3	5,050	4,995,743
Glass manufacturing	11	2,103	8,250,000
Glove manufacturing	3	45	37,000
Horse cleaner	2	9.5	163
Ice Cream freezer	97	308	169,500
Ink manufacturing	23	14	11,000
Iron works	8	72	27,700
Ice making machinery	2	534	1,907,200
Jewellery machinery	17	273.25	199,292
Knitting machines	16	245	121,000
Lime treating	2	68.5	16,080
Laundry machinery	50	590	497,000
Linseed oil mill	2	442	645,526
Locomotive works	1	8,170	8,522,218
Lumber mills	5	513	279,000
Lamps manufacturing (electric)	2	104.9	103,005
Leather goods manufacturing	6	317	198,000
Motion picture machines	51	728	542,000
Malt manufacturing	2	75.5	36,693
Machine products and saw manufacturing	4	1,096	1,305,000
Machine shops	358	6,756	6,840,000
Mattress making	2	33	12,342
Meat extracts	1	34	2,360
Meat choppers	26	69	10,650
Macaroni manufacturing	2	391	562,510
Metal works	1	102.5	65,330
Marble works	11	452	390,000
Optician machinery	10	23	13,410
Organ blower	70	261	42,900
Oil refinery	1	20	7,350
Oats crusher	13	43	5,350
Oxygen products	1	350	994,800

Kind of Business	Number	Connected load in h.p.	K.w.hrs. per annum
Oil pumps	9	68	23,400
Oilcloth manufacturing	2	1,579	2,134,950
Pipe treading machinery	1	5	3,265
Printing machinery	223	3,683	3,640,000
Piano manufacturing	2	55	82,500
Paint manufacturing	16	1,970	3,100,000
Plumber's supplies	4	360	157,400
Paper box manufacturing	14	305	160,000
Packing plant machinery	5	1,337.8	3,645,217
Paper goods manufacturing	5	752	3,450,000
Plaster mill	1	30	39,270
Pins manufacturing (metal)	1	130	31,460
Quarry machinery	16	5,926	2,685,000
Roofing manufacturing	4	320	185,610
Refrigerating machinery	237	7,322	16,880,000
Rubber goods manufacturing	7	27.8	33,694
Rubber manufacturing	3	5,625	5,759,252
Railway station equipment	2	1,420.9	8,379,400
Rolling mills	2	2,800	3,100,000
Railway crossing gates	1	6.3	2.000
Railway signal tower	2	17.28	8,800
Railway signal manufacturing	1	29.5	7.443
Railway cars manufacturing and repairing	2	10,356.75	13,958,400
Sponging works	5	15	14,700
Sealing machine manufacturing	1	46.5	45,616
Safety razor manufacturing	2	376.2	615,512
Starch mill machinery	1	12	3,741
Shoe shine machine	1	2	1,300
Sewing machines	649	2,003	1,412,000
Shoe manufacturing	60	2,480	2,061,000
Straw goods manufacturing	1	7	11,460
Spool cotton machinery	2	1,113	392,997
Shipbuilding plant	1	4,680	3,576,127
Sausage making machinery	10	60	38,800
Sausage casings manufacturing	1	15	1,920
Sheet metal products	1	40	22,380
Steel mill machinery	6	2,230	5,395,000
Stove manufacturing	5	70	24,500
Steel foundries	3	3,845	9,448,800
Sugar refineries	3	1,840	3,730,000
Silk manufacturing	2	398.5	484,500
Stone cutter	10	486	324,000
Tanneries	2	235.25	204,197
Trunk manufacturing	1	117.5	200,220
Ticket cutter	1	2.8	231
Tobacco cutter	6	215	961
Tobacco manufacturing	7	295.1	155,858
Textile mills machinery	6	7,670	20,141,190
Tea blenders	8	64	7,010
Tire repairing machinery	3	9.5	786
Umbrella manufacturing	1	47	46,100
Varnish manufacturing	3	137	160,000
Vacuum cleaners	55	248	69,700
Ventilating fans	89	1,519.4	1,024,000
Wire and cable manufacturing	6	1,377.8	1,582,256
Wadding making	1	90	147,300
Waste manufacturing	7	185	81,500
Washing machines	21	92	11,700
Wood saw	242	1,257	2 49,000
Woodworking machinery	190	3,080	2,140,000
Water pumps	136	20,665.5	36,750,000
Welding equipment	12	95.8	9,350
Wall paper manufacturing	1	30	58,800
X-ray machines	16	163	7,860
Grand total	4,806	252,135	364,623,037

Appendix II

Classification of Power Users in Toronto

Kind of Business	Number	Actual Tested Load in h.p.	K.w.hrs. per annum
Abattoirs, meat products, animal by-products, glue, fertilizer	15	4,734.5	22,381,884
Bakery, candy, chocolates, ice cream, gum	97	4,028.5	8,539,344
Bottling works, brewing, distilling, vinegar	25	418	715,128
Brick, tile, sewer pipe, pottery, lime, sandstone	14	724.7	2,034,756
Canning, preserving, pickling	3	31.5	26,256
Cleaning and dyeing	29	377.5	565,752
Cloth manufacturing, clothing, dresses, fancy goods, elastic goods, hats, bedding, awnings, pleating, umbrellas, spats, tailoring, overalls	410	2,849	2,697,900
Contractors, builders, carpenters, temporary service	29	617.5	670,260
Dairies, ice cream	51	1,395	3,695,364
Docks, stations, freight sheds	12	812.5	778,668
Drugs, chemicals, extracts — toilet preparations	46	895	1,262,172
Elevators (only)	187	2,947	1,278,552
Foundries, smelters	24	1,452.5	2,383,812
Furniture, frames, gramophone wood, vehicle, boats, wood turning, trunks, caskets	57	1,338.5	1,410,084
Glass, cut glass, optical glass	25	482	811,764
Jewellers, silverware, pleating, cutlery, scales, electric appliances	68	1,389	3,158,268
Laundries	49	469.5	486,960
Leather goods, shoes, gloves, harness, luggage, auto tops	58	1,080	1,253,688
Machinery manufacturing, machine shop, welding, implements, autos, bicycles, motors, cream separators, etc.	195	7,261.5	13,519,944
Metal goods, sheet metal, wire fixture, boxes, beds, kitchenware, meters, hardware, batteries, roofing	121	4,377	6,112,224
Mills for grinding food products	30	1,489.5	5,105,892
Municipal and government service	—	26,269.2	71,988,732
Oil refineries, gas plants	8	191	177,288
Paints, varnish, ink, asphalt, tar, shoe polish	30	1,037	1,357,584
Paper mills, goods, boxes, wall paper, window-blinds, cardboard, imitation of leather	56	2,261	6,301,236
Plumbing and steam supplies, stoves	28	1,578.5	2,982,336
Printing, bookbinding, engraving, books	240	3,888.5	4,006,488
Refrigerating plants, ice, cold storage	26	1,564	7,006,248
Rubber goods	19	4,985	9,121,212
Smallwares, buttons, notions, novelties, features, cork products, celluloid, French ivory, toys	31	486	536,760
Soap	8	996.5	3,043,272
Stone, marble, monument, artificial stone, cement blocks	32	1,156	1,034,688
Structural works, bridges, boilers, blacksmiths, shipbuilding	34	1,265.5	1,757,940
Sundry, small power service	2,015	40,013.2	38,020,608
Tanneries, hides, skins, raw furs, tallow	23	254.5	210,936
Textile mills, carpets, oilcloth, yard, cord, shoddy, jute bags, wool	47	2,294.5	3,548,532
Tobacco products	4	49	46,176
Warehouses	180	2,196	3,066,588
Wood specialties, patterns, brushes, brooms, baskets, wickerware, picture frames	63	941.5	1,051,236
Woodworking shops, lumber, doors, boxes, ladders	38	1,254.7	1,219,056
Yards, — coal, wood, builders supplies, misc, materials, stock yards, sand, gravel, junk and waste	95	2,532	3,048,024
Total	4,702	134,382	238,413,612

Appendix III

Classification of Power Customers—Rural Territory

See description in introduction to this paper.

Kind of Business	Number	Connected load in h.p.	Kind of Business	Number	Connected load in h.p.
Bakers	24	84	Lumber	7	539
Biscuit factory	2	45	Loose leaf ledgers	1	53
Bottling works	5	14	Machine shop	9	201
Box manufacture	2	38	Maple sugar manufacture	1	5
Bridge (operate swing)	2	32.5	Mattress factory	2	23.5
Brass furnace	1	100	Mesh bag	1	5
Broom factory	1	5	Mines	1	1,300
Butcher shop	7	14.75	Moving pictures	5	49.25
Butter factory	17	144	Municipality pumping service	14	1,723.5
Canning	1	15	Organ blower	6	11.75
Carriage factory	1	12.5	Organ manufacture	2	20
Celluloid goods	2	30	Overall factory	15	67
Cement mixer	1	5	Plumbing works	1	30
Cable manufacture	1	36.5	Pottery	4	110.5
Chair factory	2	55	Printing shop	13	63
Chemical plant	1	180	Pumping (private)	6	70.5
Clay products	2	240	Quarries	6	518
Coffee grinder	1	0.25	Refrigerators	6	80
Collar manufacture	1	114	Rope manufacture	1	18
Corset manufacture	2	33	Rubber goods	3	1,098
Clothing	2	10	Rural light and power	4	190
Detonators	1	15	Sash and door factory	4	100
Distillery	1	40	Shoe last factory	1	93.5
Dust wax manufacture	1	5	Shoe manufacture	2	328.5
Dyers	1	174	Shoe repair shop	5	12
Elastic fabrics	1	54.25	Silk factory	3	708.75
Electric heater manufacture	1	36	Silk goods	1	103
Elevators	15	92.5	Steel tool manufacture	1	498⅓
Explosives	1	810	Stone mason	21	1,351.5
Farm service	6	22	Suspenders	1	1
Felt factory	2	191.5	School furniture	1	232
Footwear findings	1	13	Storage battery charging	2	12
Foundries	7	326	Storage battery manufacture	1	178.5
Fur dressing	1	82.5	Straw hats manufacture	1	10
Garage	24	96.75	Tannery	1	308.75
Garments	3	15	Telephone and telegraph	4	10
Glove manufacture	1	13	Tobacco factory	4	290.5
Gramophone	1	58.5	Textile mills	5	7,100
Grip nut manufacture	1	87.5	Vacuum cleaner	1	3.5
Grist mill	32	1,053.5	Veneer works	2	516
Handle factory	1	300	Water works (private owners)	3	31
Harness factory	1	5	Whip manufacture	1	30
Hay cutting	1	3	Wire goods	1	30.5
Herb and root grinding	1	7.5	Woodworking shops	35	615
Hoisting ice	3	20	Woodyard	8	58.5
Hosiery factory	2	71	Wool mills	3	523.75
Laundries	11	80.75			
Leather goods	1	2.5	Total	420	24.200.58

Electricity in the Canadian Home

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"Do It Electrically," "The Electric Home," and "Electrify Your Home", have become very common phrases in comparatively recent years. In some parts of Canada especially, they are perhaps of greater significance than anywhere else.

The extent and methods of utilization of electricity in the homes of any country are, of course, partially dependent on the local conditions prevailing in that country. A brief outline of conditions in Canada as they effect this question of electricity in the home is necessary if this discussion is to be of value in enabling delegates to decide to what extent the results achieved in Canada are possible of attainment in other countries.

In general, the Canadian climate is moderately hot in summer and decidedly cold in winter. The houses are almost invariably heated by means of a central heating furnace located in the basement, and electricity in some cases is used for heat only as an auxiliary. Apart from other considerations, the severity of the winters precludes the possibility of using electricity for heating, exclusively, at reasonable cost.

Canada is fortunate in having very large resources of water power in proportion to her population, and these have been developed to a remarkable degree. To such an extent is this true in most parts of the country that over 90 per cent of the central-station power in Canada is derived from hydro-electric sources. It is believed that the per capita development of hydro-electric power is greater in Canada than in any other country of the world. The development of power on

Plate No. 1,—Two Storey Residence Electrically Lighted and equipped for Electric Service.

this large scale has resulted in an unusually low unit cost of producing and distributing electrical energy.

The expansion of the household use of electricity has been encouraged, in general, by the electric supply authorities, through the adoption of rate schedules with low secondary or follow-up rates. For instance, in Ontario alone there are over 300 municipalities where the follow-up rate for domestic service is 1.8 cent or less per kilowatt-hour. In many of the larger towns and cities of Ontario the follow-up rate is 0.9 cent net per kilowatt-hour.

Domestic help in many parts of Canada is relatively scarce and expensive. Wherever possible the Canadian housewife, with the help of electrical appliances, does her own work, unassisted by servants. In households whose means permit the employment of servants, the use of electrical appliances is also found to be of great benefit, as the electrically equipped home attracts servants of a better class and enables fewer servants to perform the duties required.

These factors have reacted upon each other, low rates encouraging the use of electricity, and extended use making possible still lower rates. In most municipalities throughout Canada the average family may take advantage of the cleanliness, convenience and safety of electric lighting at a cost of about one dollar per month or less, while for a small additional charge, electric irons, toasters, vacuum cleaners, washing machines, fans and certain classes of light cooking appliances may be utilized. Cooking by electricity is rapidly becoming popular. At the present time it is not unusual, in some parts of Canada, to find electric bills for residential service showing a consumption of from 200 to 1,000 kilowatt-hours per month. The following table is presented with the object of indicating the great amount of electrical service which can be obtained for a relatively small cost at the low rates for electrical energy which now prevail in large sections of Canada.

With reference to the above table it is of interest to note that in all applications of electricity to domestic appliances driven by electric motors, even those of larger size such as washing machines, the current consumption per month is relatively so small that their use would be justified and economical even in communities where much higher rates are charged for current. On the other hand electric cooking and auxiliary heating can only economically be employed where the rates for current are relatively low.

Extent of Use of Electrical Energy for Household Purposes

The great expansion of the use of electrical energy for residential purposes is of comparatively recent date.

Table No. 1, — Number of Hours Electrical Appliances may be Operated for an Energy Cost of Ten Cents in the Majority of Canadian Municipalities*

Appliance	Capacity	Hours of operation for 10 cents
Curling iron	20 watts	555 to 278
Warming pad	40 "	278 " 139
Sewing machine	60 "	185 " 92
Vibrator	60 "	185 " 92
Vacuum cleaner	100 "	111 " 55
Washing machine	200 "	55 " 28
Ten 40-watt lamps	400 "	28 " 14
Percolator	400 "	28 " 14
Hair dryer	440 "	24 " 12
Toaster	550 "	20 " 10
Iron	660 "	17 " 8
Air heater	660 "	17 " 8
Grill	660 "	17 " 8
Water heater	1,000 "	11 " 6
Grate	2,000 "	6 " 3
Range	3,000 "	3⅓ " 2
Ironing machine	3,000 "	3⅓ " 2

*These figures are based on the secondary or follow-up rate, it being assumed that the consumer uses, in addition to the requirements of these appliances, 30 to 90 kilowatt-hours per month for lighting and other primary purposes, depending on the size of the residence.

It is within the memory of the present generation when the first carbon-filament lamps began to replace the kerosene lamps and gas light formerly in use. With the introduction of the more efficient tungsten and gas-filled lamps and the growing realization on the part of the public of the economies and comforts to be derived from the use of electrical appliances, the last decade has seen tremendous strides in the domestic, as well as in the industrial, applications of electric power in Canada.

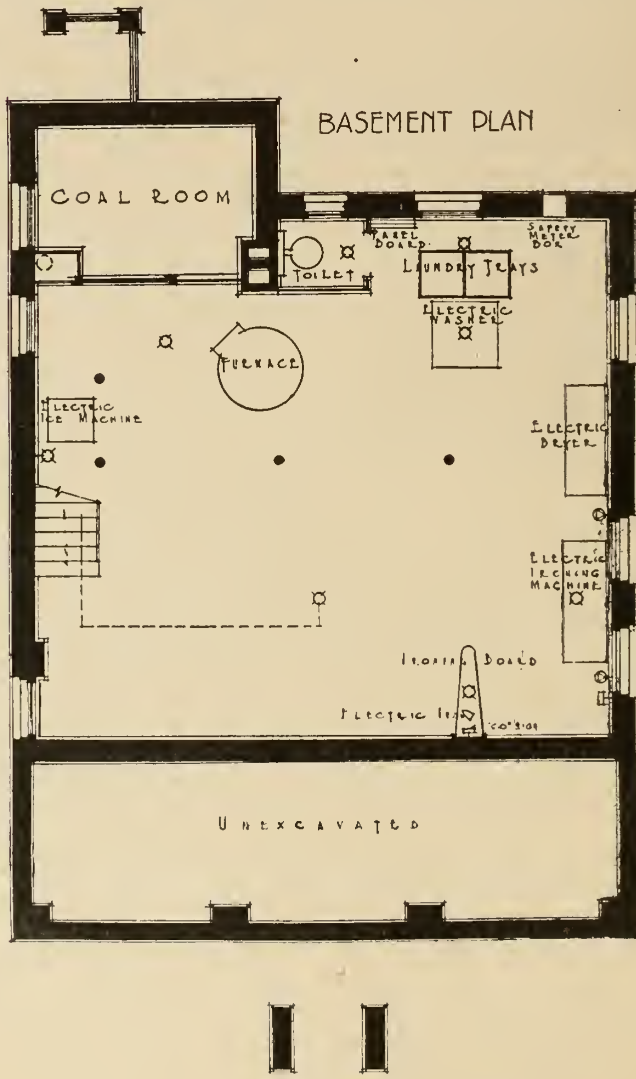


Plate No. 2,—Wiring Diagram for Basement.

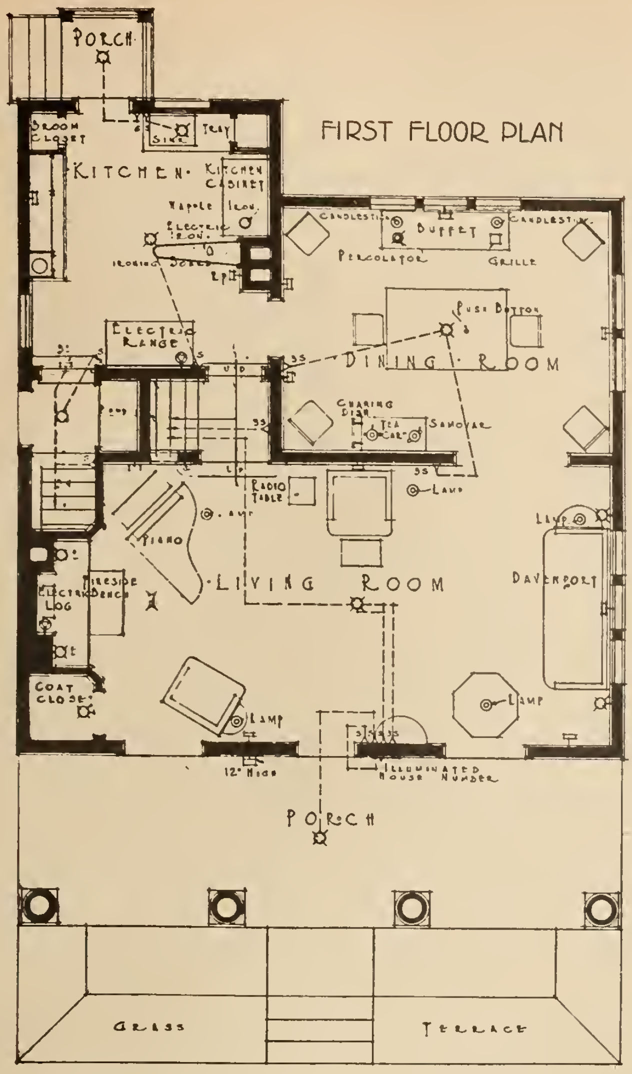


Plate No. 3,—Wiring Diagram of First Floor.

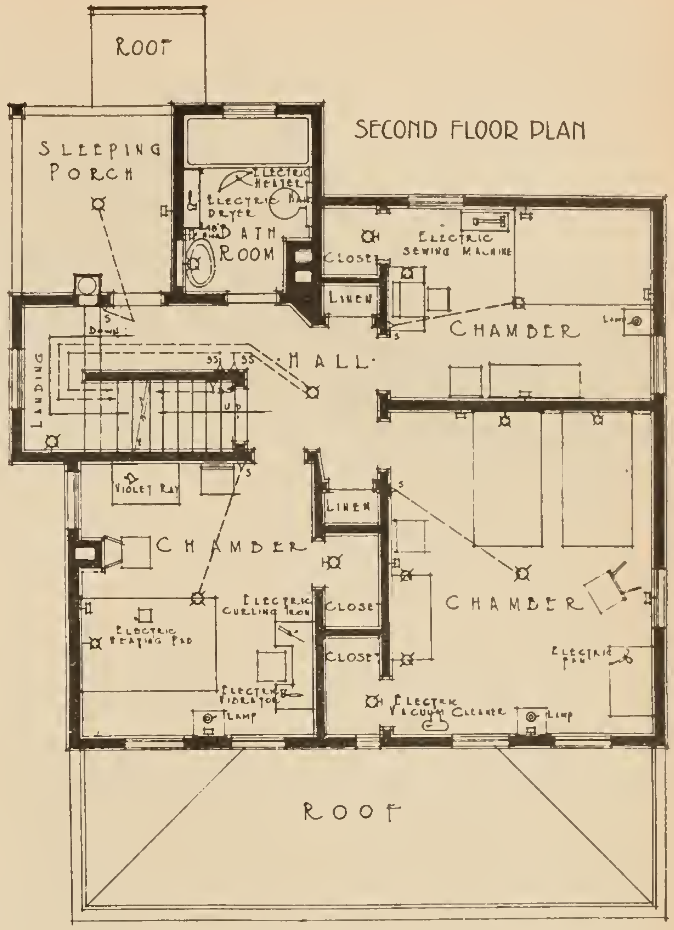


Plate No. 4,—Wiring Diagram of Second Floor.

This can, perhaps, be most clearly illustrated by extracts from the records of the supply authorities in a

Table No. 2, — Electrical Supply Statistics of some Representative Canadian Municipalities.

Municipality	Population	Years	Domestic consumption k.w. hr.	Domestic revenue	Domestic consumers	Average monthly k.w. hr.	Average monthly bill	Net cost per k.w. hr.
							$ c.	c.
Toronto	530,000	1913*	4,220,000	$ 190,370	16,500	25	1.25	4.4
		1917*	15,341,000	414,040	41,400	34	0.91	2.7
		1920*	33,568,000	729,365	57,700	51	1.11	2.2
		1923	84,345,000	1,817,900	102,040	74	1.36	2.1
Ottawa	113,000	1914*	1,376,000	68,767	6,400	19	0.95	4.5
		1917*	2,376,000	81,506	8,600	24	0.82	3.4
		1920*	5,960,000	109,800	9,500	53	0.97	1.8
		1923*	16,200,000	186,000	11,100	126	1.44	1.15
London	60,000	1914	1,192,000	57,500	5,200	18	0.83	4.8
		1917	3,300,000	86,500	9,000	31	0.83	2.6
		1920	6,610,000	144,000	12,400	44	0.97	2.2
		1923	16,000,000	267,100	15,000	92	1.53	1.8
Niagara Falls	16,000	1917	868,000	22,600	2,300	31	0.99	2.6
		1920	2,380,000	46,900	2,900	68	1.34	2.0
		1923	6,200,000	82,400	3,350	160	2.10	1.4
Mimico	4,500	1914	91,200	5,100	460	17	0.90	5.4
		1917	178,000	7,400	700	21	0.93	4.2
		1920	508,000	12,300	850	50	1.22	2.4
		1923	1,470,000	23,000	1,200	110	1.71	1.7
Waterford	1,100	1917	17,500	1,370	100	15	1.14	7.8
		1920	50,000	2,500	171	21	1.30	5.0
		1923	103,000	3,630	260	35	1.24	3.6
Baden	600	1914	7,000	1,250	52	7	0.75	10.0
		1917	10,000	842	60	12	0.98	8.4
		1920	18,200	1,350	73	27	1.00	4.2
		1923	53,400	1,370	89	51	1.30	2.6

*Statistics for these years, except populations, refer to one supply authority only and not the whole city.

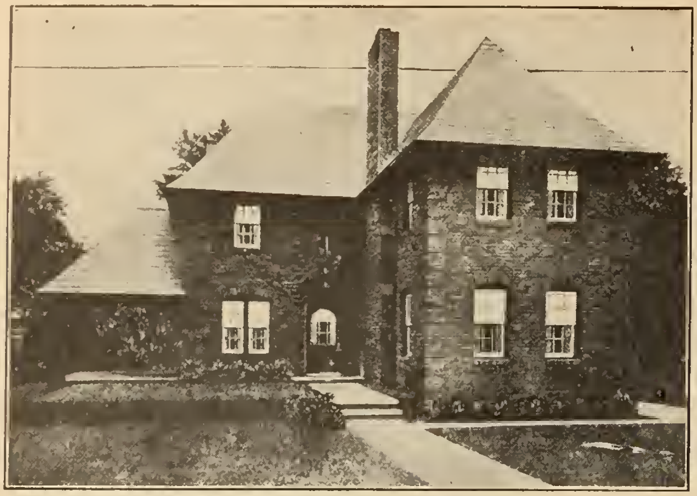


Plate No. 5, — Two Storey Residence Electrically Lighted and Equipped for Electric Service.

few representative municipalities, which are given in table No. 2.

It will be noted that in these municipalities the number of residential services now averages about one to every five inhabitants, — in other words, practically every home is served; in nine years the energy consumption per consumer has increased by from 200 to 600 per cent, and the net average cost per kilowatt-hour has decreased by from 50 to 75 per cent, in spite of the effect of the War in raising prices of practically all other commodities.

Popularity of Electrical Appliances

In the larger proportion of the cities and towns of Canada, the energy used by appliances in the average home now greatly exceeds that used for lighting.

While no survey has ever been made of the number of appliances in use in any or all communities, it is safe to assume that with a great many appliances at least, the point of saturation is being approached very rapidly. A survey recently made of the number of electric ranges in use in some of the larger communities in Ontario show the following results:—

City	Population	Wired homes	Number of ranges	Percentage saturation
Barrie	7,000	1,700	170	10%
Brantford	32,000	5,000	1,400	28%
Chatham	16,000	3,600	660	18%
Galt	14,000	3,200	1,100	34%
Kitchener	22,000	4,400	660	15%
London	61,000	14,000	4,000	29%
Ottawa	113,000	25,000	3,700	15%
Niagara Falls	16,000	3,200	900	28%
Stratford	18,000	3,600	1,500	41%
St. Catharines	20,000	4,500	900	20%
Windsor	43,000	11,000	4,000	36%
Winnipeg	200,000	33,882*	6,621	20%

*Municipal plant only.

It is safe to say that the more popular appliances, such as the iron, toaster, grill, vacuum cleaner, washing machine, and the electric fan, will show much higher percentages than do the ranges in all of these communities, were the figures available for the purpose.

The Canadian home is well equipped electrically. In the 1,000,000 wired homes there are in use over 500,000 irons and toasters; over 100,000 electric ranges, and, in addition thereto, a large number of other appliances, such as are mentioned in this article.

Modes of Utilization of Electricity in the Home

In describing the manner in which electricity is used in the Canadian home, attention will be directed to the principles now being applied in the more modern residences. The equipment and its arrangement in the house will first be dealt with, then the wiring by means of which energy is supplied from the public mains to the individual current-consuming devices, and finally the means adopted to render both the equipment and the wiring free from personal and fire hazards.

As regards the current-consuming equipment, methods of electric lighting will first be considered, after which labour-saving appliances will be briefly discussed.

Lighting the Home

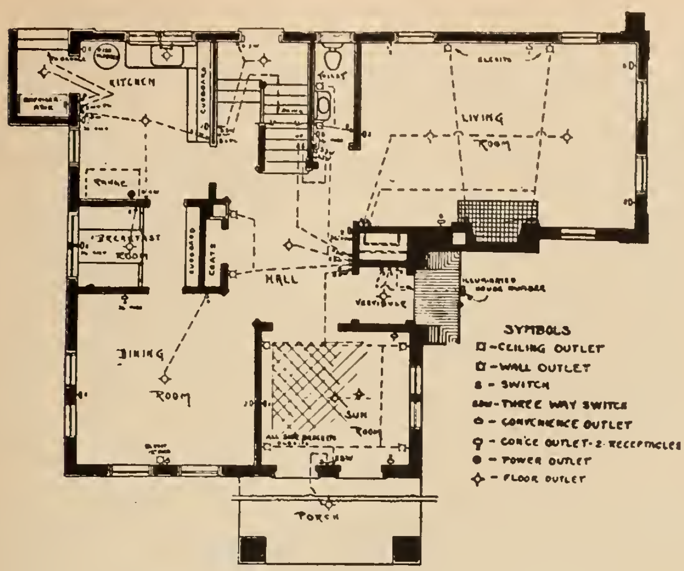
The possibilities of adding to the attractiveness of a home by means of suitable electric lighting are even yet not fully realized by the public. It is upon the guidance of those who manufacture, sell and install outlets and fixtures, who, in turn, are influenced by the advice of experts in illumination, that householders must rely more fully if the greatest benefit is to be secured from the resources at hand.

Without entering too fully into the scientific aspects of illumination, it may be said that there are important hygienic advantages associated with the use of electricity for lighting the home, but its greater service is rendered through making the home cheerful and attractive. In planning the lighting of a home there are certain fundamental principles which should be followed. For exampie, the filaments of incandescent lamps should never be vlsible when the lamps are in the normal direction of vision; such a condition is harmful to the eyes, and detracts greatly from the beauty and comfort of the home.

That light is useful light which falls upon the objects to be seen; bright light, shining in the eye, is not useful light. The layman often confuses glare with overlight. Investigation of places which are said to be overlighted has frequently shown that they are greatly underlighted. As an indication of the greatly varying degrees of light intensity to which the eye can adapt itself it may be stated that upon test, sunlight in an open field measures about 8,000 foot-candles; in a street between buildings,

BASEMENT PLAN

Plate No. 6, — Wiring Diagram for Basement



FIRST FLOOR PLAN

Plate No. 7, — Wiring Diagram for First Floor

3,000 foot-candles; shade in a street between buildings measures 300 foot-candles; under a tree in the open, 500 foot-candles. Light on a table close to a south window has an intensity of 110 foot-candles; on a table 10 feet from a window, 70 foot-candles; and on one 18 feet from a window 50 foot-candles. It is interesting to note that the artificial illumination for homes, as generally recommended, seldom exceeds 10 foot-candles. It is a mistake to have an inadequate number of electric luminaires* and lamps in any room of the home, or to use unshaded glare-creating lamps. Where lamps can be only partly shaded from view, they should have diffusing bulbs, and large lamps with very bright filaments can be used to best advantage in fixtures which shade them completely, diffusing the light, among which may be mentioned the semi-direct fixtures and semi-direct luminaires provided with decorative shades.

The modern smaller Canadian home usually contains an entrance hall, a living-room, a dining-room and a kitchen on the ground floor, and three or four bedrooms and a bathroom on the floor above. To accommodate the central heating plant a basement is provided and this usually extends under the whole of the ground floor. The height of the basement from the concrete floor to the under side of the ground-floor beams is usually from six feet six inches to seven feet six inches. This basement is often divided to provide a separate room for the laundry and frequently a portion is partitioned off to form a storage room for food supplies. Most houses are provided with a verandah or porch at the front. A sun-room is frequently added to many houses. Inasmuch as the various rooms in a house present different lighting problems, they will be dealt with separately.

Lighting the Living-Room

The home is, or should be, the centre of family life. The lighting of the living-room, especially, should be capable of adaptation to the various activities and social affairs which take place in this room. The activities range from those of a quiet, restful nature, such as reading and studying, to those of the joyous occasion, as when Christmas or other festive celebrations are in progress.

*Luminaires — Used here to indicate a light source whether consisting of one lamp or several lamps enclosed in a common shade.

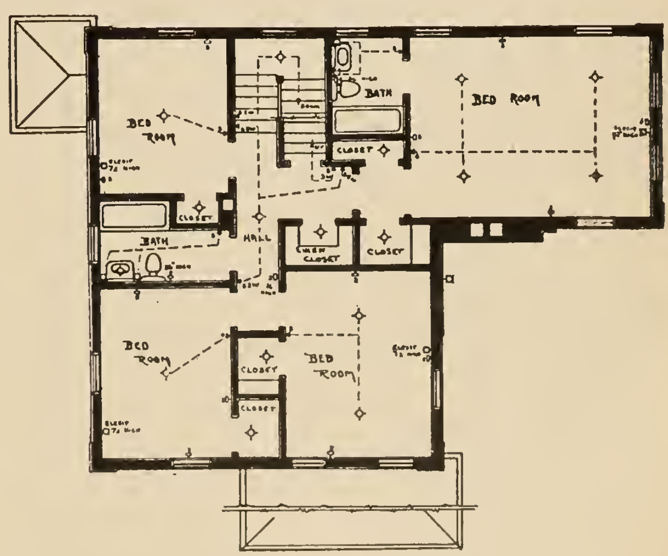
The provision so frequently made for only one central lighting effect, limits the possibilities of illumination and tends towards monotony. At present fixtures and lamps are available in such variety that a number of effects can be obtained without difficulty, if the wiring has been carefully planned. A flood of light is desirable when there is a social occasion, but for quiet evenings, with reading and study, local lighting is best; a table-lamp on the study table, or a floor-lamp beside an easy chair. For reading at a library table, with illumination from a well-designed table-lamp or portable floor-lamp, the visual field surrounding the book may be of medium brightness if desired, but if the remainder of the room is in semi-darkness, the psychological effect is usually conducive to concentrated attention, and the semi-darkness provides a place towards which the eyes may be directed occasionally, for the purpose of resting them.

The living-room, therefore, should, in addition to a powerful source of general illumination, contain floor-lamps and table-lamps. Many pleasing restful and artistic effects are also obtainable by the use of wall brackets, with either tinted or shaded lights.

The Dining-Room

The problem of lighting the dining-room is more definite than that of the living-room. The table is usually confined to a fixed position, and as it may be considered the most important object in the room, it should also be the most intensely illuminated object. Certainly there is a cheerfulness about a well-illuminated table, hemmed in by a semi-darkness.

If in lighting the dining-room, the so-called semi-indirect unit is used, it ordinarily floods the entire room with light, and the table is not always the most highly illuminated spot in the room. Semi-indirect lighting is often unable to fill the requirements for best lighting in the dining-room, and while, to some extent, it is a matter of taste, in modern practice it is usually replaced by a unit which directs dominant light to the table area. This modern unit may be a shower luminaire, with a number of lamps hanging downward, shaded with long dense glass shades, or a large dome suspended from above the table, low enough to shield the eyes from the lamps themselves, yet sufficiently high to permit an unobstructed view across the table.



SECOND FLOOR PLAN

Plate No. 8, — Wiring Diagram for Second Floor

In large dining-rooms, the semi-darkness around the walls is often softly illuminated by the use of shaded and decorative wall-bracket lights, with very pleasing effect.

The Bedrooms

The chief function of light in the bedroom is to facilitate making the toilet; two wall-brackets, one on each side of the dresser or dressing-table, provide the best solution of this problem. Light from a central fixture does not fill the requirements, because the light should fall upon the front of the person facing the mirror, and therefore the light should be on the wall. A light source consisting of one or several small luminaires, each hidden in a dense inverted bowl, provides a useful and pleasing general illumination. In addition, portable decorative and reading lamps may be provided for the bedside table and other situations, or for attaching to the bed itself.

Halls, Closets and Porches

The diversity of the layout of halls and closets makes it difficult to generalize with respect to the best methods of lighting, but the following suggestions may be helpful.

While it is not essential to have very high illumination in the hall, its appearance can be greatly improved by installing an attractive ceiling luminaire, supplemented by well-designed wall brackets.

A light within a clothes closet, arranged to be switched on automatically when the door is opened, or controlled by a pull-chain switch, with a radium-bead attachment, is a convenience which greatly facilitates selection of garments.

The sun-room should be equipped with decorative ceiling lamps, and portable lamps. The modern closed-in sun-room is finished much like an interior room, and, with suitable lighting, forms one of the most delightful parts of the modern residence; the lighting arrangements in the modern sun-room should be similar to those of the modern living-room, because it is virtually a summer living-room.

Bathroom

A satisfactory solution of the lighting problem in the bathroom is to provide a wall-bracket on each side of the mirror controlled by a switch at the door. The man who shaves himself will appreciate this arrangement, and there are many other reasons for such a method of lighting. In large bathrooms, the addition of a single overhead unit may be necessary, and it often adds to the general appearance of the room. This unit should be enclosed in an opalescent globe, and it should be of attractive design, in keeping with the other fixtures installed.

Kitchen

As the average housewife spends a great deal of her time in the kitchen, it is essential and very desirable that the kitchen be particularly well-lighted. A well-chosen location and design for a dwelling provides for proper natural illumination of the kitchen during the daylight hours, but it is too often found that this very important requirement has been sacrificed to other considerations of less value and a great many kitchens must depend for adequate illumination, even in the day-time, upon artificial sources. The efficient kitchen, therefore, must be flooded with light, and, in addition, lights over the kitchen table, and over the sink, so shaded as to prevent glare, are often desirable. A central lighting unit of ample size placed close to the ceiling, and enclosed in a diffusing globe to prevent the casting of sharply-defined shadows will provide a satisfactory general illumination.

Laundry

The basement, where the laundry of the Canadian home is usually located, is frequently one of the neglected parts of the house so far as lighting is concerned, and many essential requirements are often overlooked. The laundry should be provided with sufficient light to illuminate the sections in which the chief operations are carried on. Owing to the relatively small headroom available, it is frequently impossible to install a central lighting unit that will satisfactorily light the tubs, the washing machine, and the ironing machine, and therefore, individual lights placed over these various appliances are often more satisfactory. The proper illumination of the laundry is of direct benefit, not only because of the greater ease in performing many laundry duties, but also in the better results obtained.

Colour Lighting

The effective use of colour in decorative and lighting schemes is a most important consideration in a modern home. Recently the use of coloured lights has been developed as an aid to produce certain effects. They should, however, be used sparingly and with discretion.

References in ancient myths and in early history reveal the fact that mankind has always been sensitive to colour impressions. Colour is a medium by means of which pleasant sensations may be created, and this fact should stimulate the lighting specialist to utilize its power in the home. To those who realize the fact that in many ways lighting should be considered more from a psychological, than from a mechanical standpoint, no plea for utilizing colour effects in residential lighting is necessary.

There are certain fundamental reactions of various colours upon the human organism, common to nearly all individuals, and a knowledge of these may be used by lighting specialists to secure decorative and artistic effects.

Equipping the Home with Labour-Saving Devices

In the foregoing paragraphs an endeavour has been made to outline briefly the lighting equipment suitable for an average modern Canadian home. Even more, however, might be written respecting the equipment of the Canadian home with electric appliances. Before the introduction of modern labour-saving appliances into the home, the housewife's work was much more laborious than at present.

In Canada, electrical appliances are freely used in the home to perform a multiplicity of tasks formerly done in more laborious ways. Certain appliances, such as the *electric flat iron*, are found in almost every home where electrical service is available. Other appliances are introduced from time to time as means permit. A brief reference will be made to the more important electrical appliances which are utilized in a fully-equipped "electric home".

The electric vacuum cleaner is too well known to require description. It can be used in almost every room of the house to remove loose dirt from floors and rugs.

Electric floor-polisher: Many modern Canadian homes have waxed and polished hardwood floors throughout. Where large areas have to be polished regularly the electric floor-polisher is of great assistance.

The electric fan, whose main function in summer is to provide cool comfort, has a number of other uses. It can, for example, be used for drying clothes indoors, drawing cool air into the bedroom, exhausting the cooking odors from the kitchen, drying fruit and vegetables, improving the operation of the central heating system by increasing the heat radiation of a radiator or by improving the circulation of air in a room.

The electric range or cooking-stove has, in the past few years, become exceedingly popular in Canada. This is an appliance that can only economically be used where the rates for current are moderate. Briefly summarized, the advantages of the electric range are better cooking results, a cooler kitchen, an even, controlled heat which eliminates guess-work and supplies in its place an accuracy not hitherto possible with fuel ranges. The electric oven, free from gases that contaminate the food and carry off fine flavours, produces better results; meats are juicier and richer, with less loss of weight in cooking. bread is moister and stays fresh longer, cakes are more delightful in flavour, and biscuits are beautifully brown. Moreover, the same temperature conditions that are found to produce good results at one time can be duplicated on subsequent occasions.

The electric dish-washer is not yet in very general use. In large families where there are a great number of dishes to be washed, it will probably become more popular as it becomes better known.

The electric hand-iron, probably the most universally used of all electric appliances, needs no description.

Other devices frequently found in the modern kitchen include *electric refrigerators, electric fans* to exhaust cooking odors and *electric utility motors* for polishing silverware, grinding cutlery, etc.

The electric washing-machine is, perhaps, the most useful of the larger devices found in the modern home. It saves more labour than any other device.

The electric ironing-machine together with the washing-machine in many cases enables the housewife to dispense with the services of a laundress. Modern ironing-machines can handle over 90 per cent of the laundry of the average home.

The electric clothes-dryer is of use in city dwellings where backyard space is limited and unfit for drying clothes.

Supplementing the electric range is the *electric water-heater.* In some sections of Canada, the use of electric water-heaters has been made economical by the introduction of flat rates, which encourage the employment of low-capacity immersion heaters, used constantly. With heat-insulated hot-water tanks, the cost of hot water on this system is very moderate, and in many localities electric water-heaters are becoming popular. The comfort of having an abundant supply of hot water for washing, shaving, bathing, dishwashing and laundry purposes constantly available in winter and summer is greatly appreciated.

Electric heaters: The *electric log or fire-place* provides useful auxiliary heat in the living-room. As contrasted with the open fire, it is very cleanly, being sootless and smokeless and free from fumes and fine ash. Where provision for a grate or log does not exist, the *portable electric heater* is found useful and can be carried from room to room as required.

In the dining-room, a number of miscellaneous cooking appliances are frequently employed. The best known of these is the *electric toaster.* Small portable *grills, percolators, waffle-irons, chafing-dishes* and *egg-boilers* are among the other appliances frequently used in the dining-room. Many of these are also useful in preparing light meals such as afternoon tea in the living-room or sun-room.

Electrical appliances for the bedroom and the bathroom include such devices as *curling-irons, violet ray, electric vibrator* and *hair-dryer,* also *immersion heaters* for heating shaving-water or warming the infant's milk. The *electric warming-pad* is another useful article, especially in cases of sickness. It is more satisfactory than the hot-water bottle, because of its even heat and because it can be adjusted to any desired temperature.

One other most useful piece of electrical equipment is the electric *sewing-machine.* Sometimes a small independent "general-utility" motor is used which, when not required for driving the sewing-machine, will operate a small fan, a small emery wheel for sharpening tools, or a cream-whipping apparatus, etc. Motors are sold with attachments for performing these various functions.

Wiring of the Home

The necessity of providing adequate wiring for the home when it is built cannot be too strongly emphasized; obviously, the beautifying and labour-saving possibilities of modern electrical equipment cannot be realized in full measure unless the outlets are conveniently located and in sufficient number, and the wires serving them are of ample current-carrying capacity. In Canada, until recently, there was an unfortunate tendency on the part of designers and builders of homes to neglect wiring requirements, and as a consequence many householders have been put to unnecessary expense in making the required alterations, while others are still prevented from taking full advantage of electrical service.

Popular demand, however, now insists that the electric wiring of homes shall be ample for all present or future requirements, and in modern house construction the electric wiring is much improved. Provision is made in each room for all the fixtures and appliances likely to be used at any time in that room. Most important of all, the service wires entering the house are installed of capacity sufficient to serve the maximum requirements of the house as a whole, considering both initial and probable future needs.

Wired furniture is coming greatly into vogue in modern homes, and many are the provisions made in the manufacture of this furniture for the convenient use of portable domestic electrical equipment. Dining tables, buffets, and tea-wagons in the dining room, dressers, dressing-tables and beds in the bedroom, and tables for use in various parts of the house are among the pieces of furniture provided with wiring and outlets for the portable appliances to be used in conjunction with them.

In installing wiring for lighting throughout the home, control switches at the entrance to all rooms are indispensable, and switches which will control the lights on one floor from another floor are generally installed and found very convenient.

Electrical Inspection

The average householder, unfamiliar with the technical aspects of electricity, is not in a position to judge of the safety and desirability of electrical wiring and appliances, and it is essential in the public interest that some qualified body pass upon electrical equipment before its use is permitted. Without supervision, unscrupulous wiring contractors and appliance manufacturers would take advantage of householders, installing and selling poorly designed wiring and equipment, with consequent inconvenience and not infrequent damage by fire to the householders property and in some cases even loss of life.

In some provinces of Canada the Fire Underwriters' Association appoints a body to supervise electrical work. This body formulates and revises from time to time a code of rules for wiring, and inspects all installations. In Ontario the code of rules is issued by the Hydro-Electric Power Commission on behalf of the government, guided by the advice of a joint committee representing the electrical manufacturers, jobbers, wiring contractors, insurance underwriters, central stations and the provincial fire marshal, and the observance of the rules is enforced by a system of wiring permits and inspection administered by the Hydro-Electric Power Commission of Ontario. No wiring can be done without a permit, and no central station may energize a circuit until it has been inspected and approved, without incurring heavy penalties.

Periodical testing of samples of electrical devices is conducted by the Hydro-Electric Power Commission of Ontario. Each device, if approved, is given an approval number, which is stamped on the article by the manufacturer and only devices so stamped may be used or sold in the province. This system of inspection and test has, it is believed, almost entirely eliminated the fire and personal hazards which would otherwise be quite appreciable in a country like Canada where electricity is used so extensively in the home.

Electrical Service for Rural Districts

As Provided by The Hydro-Electric Power Commission of Ontario.

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In the province of Ontario there has been an extensive application of electrical energy throughout many rural and agricultural districts. In order rightly to appraise the remarkable results which have been achieved in this sphere of activity, it is necessary to recognize the fact that settlement, even in the older portions of the province, is spread over relatively large tracts of land, especially as contrasted with settlement in European countries. This fact is of special significance because it implies longer transmission lines and special and more costly physical equipment to serve agricultural customers in the province of Ontario than would be the case if the farmers were grouped along the main highways and their buildings were closer together than is the case. Notwithstanding such difficulties, the growth in agricultural electrical service in the province has been remarkable, and all indications point to a much greater development.

In presenting a statement of what has been accomplished in connection with the furnishing of electrical service throughout portions of the province of Ontario, it will add to the understanding of the statements made if it is explained that the province of Ontario extends from the Great Lakes northwards to James bay and Hudson bay. Of this vast area of 400,000 square miles, the southerly portion in which most of the population is settled is commonly referred to as "Old Ontario", and the newer northerly portions as "Northern Ontario". "Old Ontario" extends from about the head of lake Huron to the Ottawa river and southwards to lakes Erie and Ontario and the St. Lawrence river. In this territory, there is an assessed area of approximately 40,000 square miles. In "Old Ontario" the assessed area in townships is about 24,000,000 acres, of which about 15,000,000 acres is cleared area. According to the census in 1922 as determined for purposes of assessment the population consists of 1,056,238 rural, 549,915 urban, and 1,186,329 in cities, a total of 2,792,482.

Before entering into a description of the special features of the application of electrical energy to agricultural areas in the province of Ontario, brief mention should be made of the chief agency by which all these activities are devised, constructed and operated.

Early Efforts

About the year 1900 a number of leading Ontario manufacturers gave public expression to their opinion that investigation should be made to determine if hydro-electrical energy at rates cheaper than the cost at which power could be generated locally from coal, gas or oil, could be obtained from the extensive water powers of the Niagara river. It was pointed out that the wholesale distribution of electrical energy throughout the more populous portions of Ontario would substantially reduce the importations of coal which the citizens of this province were compelled to obtain from the Pennsylvania and other coal fields in the United States. Special interest in Ontario's power problem was thus aroused and was further greatly stimulated by means of public meetings and by discussions in the press.

It had further been suggested that it might be possible for municipalities to co-operate to secure low-cost electrical energy and distribute it to the citizens of their municipalities just as readily as it had previously been found possible for individuals or corporations to combine in order to secure by common action a desirable end.

Appeals were made to the provincial government for legislation to enable municipalities to take action and finally as a result of the general movement on behalf of cheaper hydro-electrical energy the government of the province of Ontario, in 1903, provided the means by which a commission could be appointed by interested municipalities to investigate the supply and distribution of hydro-electrical energy. The authority thus granted resulted in the appointment by the municipalities of Toronto, London, Brantford, Stratford, Woodstock, Ingersoll and Guelph of the Ontario Power Commission, which, after a thorough investigation, published in 1906 a comprehensive report. In this report the availability and costs of power from various prime sources were set forth, also data respecting the consumption and estimated future requirements of power in the districts concerned, the cost of the development of electrical energy at Niagara and other relevant matters.

When the results of this investigation became known to those interested, the provincial government in 1906 provided by special Act for the creation of the Hydro-Electric Power Commission of Ontario. This commission was empowered by the legislature of the province to act as trustee and agent for such municipalities in the province as desired to co-operate for the securing of electrical energy. The commission was later empowered to harmonize the various requirements and co-ordinate the municipalities into suitable groups or districts. It has been through the instrumentality of the Hydro-Electric

Plate No. 1,—Power Service to a Farm in Ontario

Three-phase rural power service, showing the distribution lines along the road, the service to the farm and the 110,000-volt line in the background.

Power Commission of Ontario that the application of electricity in the agricultural districts has been initiated and carried forward to its present stage of development.

The commission, acting as trustee and agent for the municipalities, exercises both administrative and constructive functions and has evolved a well defined and working policy for the transmission and the distribution of electrical power under municipal ownership. The fundamental basis of the undertaking is a partnership of municipalities formed to obtain electrical energy for its citizens *at cost*. Cost, so far as "hydro" power is concerned, includes all charges arising from the generation, transmission and delivery of power to the municipalities. These charges include for each municipality its proper share of the interest and sinking fund for the cost of lands, stations and equipment required for supplying the power, as well as a proportionate part of administration, operation, maintenance, taxes, renewal and reserve, and of all other costs entering into the business of supplying electricity.

The first distribution of electrical energy by the commission was in the year 1910, and by the end of 1910 it was supplying power to about ten urban municipalities. The small initial load of less than 1,000 horse power increased until in 1920 it was 356,000 horse power. The commission is now, in 1924, distributing about 750,000 horse power. It has under construction in what is known as the Queenston-Chippawa development on the Niagara river, the largest individual water power plant in the world with an ultimate capacity of about 600,000 horse power. This power, it is expected, will all be in use by 1926.

At the present time, the commission operates electrical power undertakings which, when fully developed, will have a potentiality of over 1,000,000 horse power. At the end of fifteen years of its work, the commission finds itself distributing electrical energy throughout practically all of the more populous portions of the province of Ontario. It has main transmission lines totalling 4,000 miles in length, including about 600 miles of 110,000-volt line. The greatest length of continuous 110,000-volt line, is that between Niagara Falls and Windsor, a distance of approximately 250 miles.

When it is appreciated that the co-operating municipalities of the province of Ontario supply power and light to half the population of the province; supplying over 380 municipalities, including cities, towns, villages, police villages and townships, involving in all an investment in connection with the general transmission and distribution of electrical energy of $250,000,000; a better understanding will be had of the auspices under which electrical service to agricultural and rural communities has been established.

Without this brief description of the work of the co-operating municipalities of Ontario through the instrumentality of their Hydro-Electric Power Commission it would be impossible to understand the special

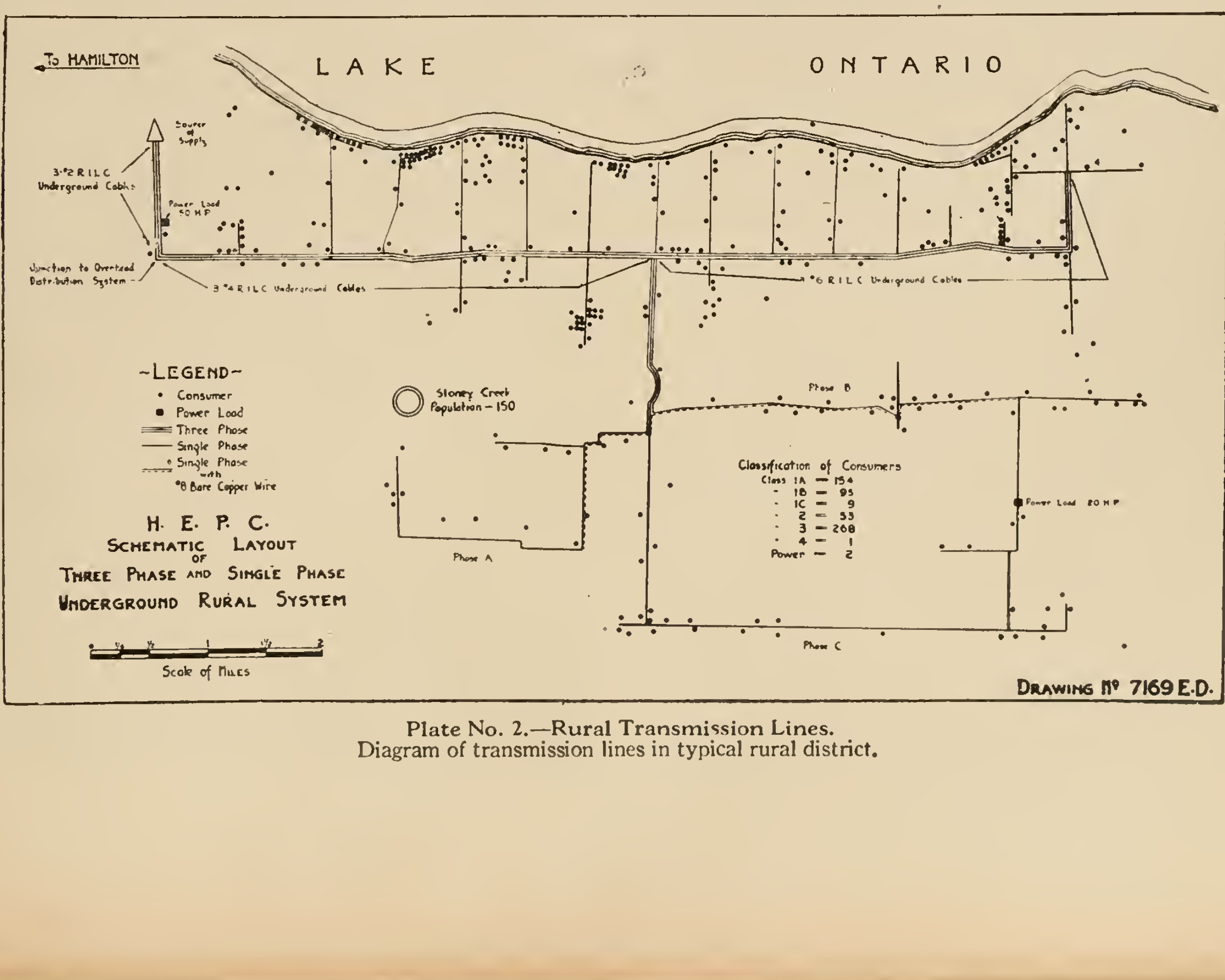


Plate No. 2.—Rural Transmission Lines.
Diagram of transmission lines in typical rural district.

aspects of the problems which the commission's officers have been called upon to solve in their work on behalf of rural communities. It was, in fact, the success of the work of electrical distribution in the cities, towns and other community centres which induced the agriculturists to seek a means of co-ordinating their efforts to the end that they might, in turn, receive like benefits to those which they saw operative in their adjacent municipal centres.

The Hydro-Electric Power Commission has already formed one hundred and seventeen "Rural Power Districts" with definite boundaries, and service has already been given fifty-five of these districts. A typical rural district covers about one hundred square miles. Approximately 55 per cent of the constructional work for these services has been performed within the past two years.

Reaching the Rural Population

The distribution of electrical energy to country districts is a problem which has engaged the earnest attention of the national governments of various countries in Europe and in North America. This attention has been greatly stimulated by the serious shortage of farm labour brought about by the Great War. The governments of France, Denmark and Sweden have assisted rural districts to obtain electrical service either by granting long-term loans to companies composed of farmers or by actually bonusing such companies. In the United States, the Department of Agriculture is at present working in co-operation with a large electrical association with a similar objective.

The number of rural customers using electricity in European countries was greatly increased during the War owing chiefly to the fact that the supply of fuel for internal combustion engines, which were so extensively used, was either radically restricted or entirely cut off. It has been stated that in one of the European countries the number of rural electrical customers increased since the War commenced from 1,200 to 35,000.

It is believed that the Hydro-Electric Power Commission of Ontario is the first organization transmitting and distributing electrical energy in a wholesale way to undertake the delivery of electrical energy direct to the individuals of rural power districts. The method of governmental procedure in other countries, as is also the case in the United States, has been along the line of the delivery of electricity from a general centre *en bloc* to a receiving centre from which the distribution is taken care of by a private organization or distribution company, the personnel of which is made up of consumers.

In the course of the present discussion, it is proposed to outline the problem of electrical rural distribution as it exists in the province of Ontario, the means employed to deal with the problem, the success which has been attained, and the general prospects for the future.

Generally speaking, the difficulties of electrification of country districts appear to be the same, or nearly the same, in all parts of the world. There is, however, one important difference which should be borne in mind, namely, that in many countries of the old world the rural districts have their buildings assembled in a group as in a village, with their small farms around it, while in newer areas, like the province of Ontario, a farm consists of a section of land in one block with the buildings usually situated on a high spot somewhere on the farm, often in the centre, in consequence of which the distance from the set of buildings on one farm to those on the next farm is, on an average, about one-third of a mile. Obviously, with only three possible farm electrical service per mile; as is the average in most Ontario districts, the problem of economical electrical distribution calls for special study, the result of which is not always favourable to proceeding with the work of furnishing the electrical service desired.

Again, Canada, unlike some of the countries of Europe, has available supplies of gasoline and oil at fairly reasonable prices and, therefore, in some sections, electrical power for farm service and other purposes, has a competitor in the internal combustion engine. However, the electrical service from a central station has many points of superiority over an individual lighting plant driven by an internal combustion engine.

Rural settlements spread over extensive areas, as is the case in the province of Ontario, present unusual economic difficulties as a field for the distribution of electrical energy. Except in districts where the requirements for power are considerably larger than the average found in rural districts, or where the service is to areas under intensive cultivation, or to areas adjacent to existing transmission lines, private power companies usually will not extend their lines for rural service. The difficulties of electrification of country districts are universally recognized. Only a small return can be secured from any capital invested; the operating costs, due to the distances to be covered, are excessive; the load per mile of distribution system is small; the load factor is low and the demand irregular, being controlled, in part, by weather conditions which affect most farmers in a given locality in a similar manner.

In spite of the handicaps inherent in rural distribution of electrical energy, the Hydro-Electric Power Commission has, in this department of its activities, made substantial progress and although the aggregate load distributed to the rural dwellers is, and must always be, but a relatively small proportion of the total energy distributed by the commission, its influence upon the economic life of the province of Ontario is already a factor of importance.

Legislation for Rural Service

Having thus noted some of the outstanding general features of electrical rural distribution, it will be interesting to review the legislative enactments which were required in order to initiate and further electrical rural distribution in Ontario.

Farmers in Ontario knew that the high-voltage lines from the generating stations of the Hydro-Electric Power Commission to the high-tension stations and from the latter to the cities, towns and villages of the province were conveying electrical energy which was building up these central communities as well as easing household burdens. It was not long, therefore, before the farmers began to desire for themselves the benefits which they perceived were being enjoyed by their friends in the adjacent cities and towns.

In 1911, — and this was just shortly after the main transmission lines of the commission were made alive, — requests from prospective rural consumers for estimates of cost for electrical service were received by the commission from areas adjacent to the cities and towns served, but as no provision for dealing with such matters had been made in the original Power Commission Act, it became necessary to pass an amendment to the Act providing for the supplying of hydro-electrical service to one or more ratepayers of a township where proper request was made for such service. Under this amendment, the petitioners who wished to obtain a supply of electrical energy might sign a petition to their township

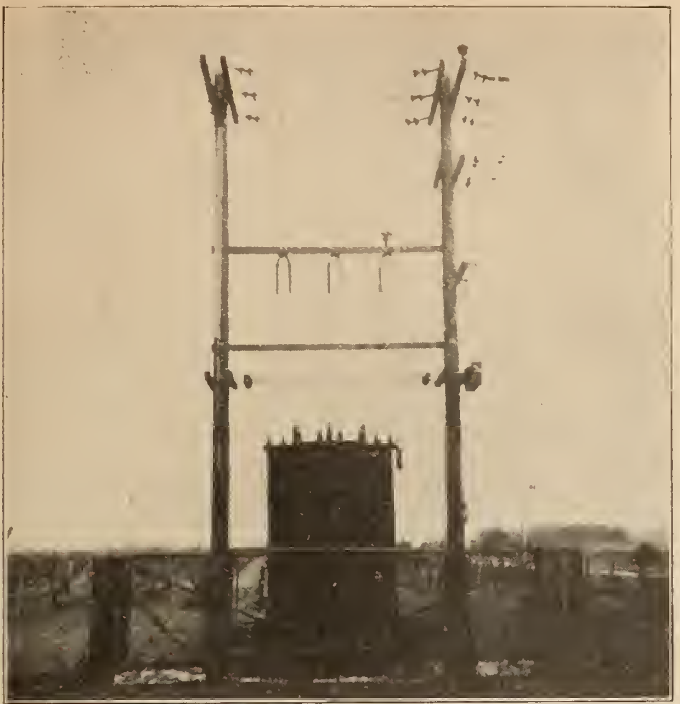


Plate No. 3a,—Rural Transformer Station and overhead Construction.
Outdoor substation serving rural district, primary voltage 12,000, secondary voltage 4,000/2,300.

requesting it to secure from the Hydro-Electric Power Commission an estimate by the commission of the cost of supplying electrical energy for their needs. After such an estimate of the cost and the rates which would apply had been supplied to, and considered by, the petitioners, they could then each enter into a contract with the township for the amount of power individually required. The township would then enter into a contract with the commission for the power necessary to supply the aggregate amount of energy required by the petitioners. This Amending Act also provided for the addition of further power subscribers. The contract would be for the period of the debentures issued for payment of the cost of constructing such lines with their necessary equipment.

About 1920, it was found that the legislation passed in 1911 was resulting in giving service to the more densely populated areas adjacent to towns and cities already receiving service while the rural citizens on the back concession lines were still being more or less excluded from the benefits which it was the desire of the provincial legislature should, so far as possible, flow to all citizens. The legislature, therefore, passed a further amendment providing for the distribution of electrical energy to rural consumers in special districts or zones. The conception underlying this amendment differs from the 1911 arrangement in that the districts supplied are not limited by the geographical boundary lines of the townships, but provision is made for the extension from the distribution centre of a city, town or village receiving electrical energy from the commission or from a centre to be created. Such extension from a distribution centre is limited only by the economic soundness of the extensions. The legislation also provides for the supplying of power for the lighting of streets or roads in townships.

In 1921, another amendment was made to the Power Commission Act whereby primary lines would be bonused by the provincial government up to fifty per cent of their cost. Under this arrangement, transformers and meters are considered as secondary equipment; that is to say, they are excluded from participating in the government bonus.

The Hydro-Electric Power Commission has had requests from many countries for information respecting the legislation under which its rural operations are conducted, and as this is so important a feature of the subject under discussion, an epitome of the commission's legislation as amended and in force at the present time, is, for reference purposes, submitted at the end of this paper.

Initiating the Work

From the standpoint of the Hydro-Electric Power Commission, the supplying of the electrical needs of rural citizens must be initiated and carried forward on a basis that is economically sound. Before authorizing any project, the commission must look well ahead to ensure future, as well as present, requirements of the district under consideration. Any project must absolutely pay its way, including the repayment of all moneys employed for the purchase and installation of the necessary equipment to provide the rural service; the consumers provide their own individual equipment and motors, etc., including the wiring for same. The commission only carries its construction to the entrance to the consumers' premises.

Rural Uses for Power

The conception which many rural residents have of their needs in the way of electrical service is usually confined at first to the providing for lighting requirements, but later it is realized that the greater service is rendered in the form of convenient power, because it is in connection with power service that the farmer effects his chief saving in labour. The experience of the commission enables it to appraise the whole situation so that the selection of equipment, the method of installation and other features, will be such as to ensure the required service at a minimum of cost.

Wherever possible, the load factor of systems is improved by the commission co-operating with manufacturers to secure the development of a better class of farm power-using machinery, with perhaps smaller capacities, thus decreasing the individual demand for power. The effort is made to have smaller motors employed for the driving of such machinery as is required under average present-day farm conditions. As rural distribution of power extends, machinery for power purposes will be employed with increasing regularity. The shortage of farm labour is, to a noticeable extent, being overcome by the employment of mechanical milkers, automatic water systems, and other machinery conveniently arranged to lessen the handling of farm produce. Once power-driven machinery is employed on the farm, its use generally suggests other adaptations. In the sphere of the domestic application of electricity, the cooking range and other appliances found in the homes in urban centres are already being used in farm houses resulting in a great saving of labour and time to the housewife. In numerous cases the farmer employs electrical power for cutting wood for fuel, and in some instances the fuel is sold in the adjacent town and from the money obtained the farmer himself purchases the electrical energy by which his own meals are cooked. These and other uses are shown in the accompanying illustrations.

It is very interesting to observe the rapidity with which industrial uses for electrical energy multiply once an electrical supply is available. In almost every rural power district there are some industries using power such as brickyards, tile yards, cheese and butter factories, gravel plants, stone plants, quarries, chopping mills and flour mills. Such industries thrive and develop under electrical service while such service also attracts new industries. There have been several old-fashioned portable saw mills supplied with electricity, the slabs of wood and sawdust being now sold for other purposes instead of being used, as formerly, for fuel for a steam plant employed to supply the power.

The providing by the commission of the distribution lines and equipment necessary for conveying the electrical energy from the nearest available power centre to the consumers' premises is the chief element of cost determining whether or not rural power service can be furnished on a satisfactory economical basis. Owing, therefore, to the importance of the factor of the distribution system, the commission has bestowed a great deal of effort to determine the best means to employ in order to provide distribution lines and equipment which, from the standpoint of electrical and physical requirements, would be satisfactory and at the same time of a minimum cost. It will be of special interest, therefore, to those considering the problem of electrical rural distribution to have before them a brief review of the features which the commission has employed in the construction of its rural distribution lines.

The Rural Primary Distribution Circuit

The standard circuit for distribution from the substation is 4-wire, 3-phase, 4,000/2,300-volt, star-connected, with the neutral wire grounded; the frequency is 25 or 60 cycles according to that of the generating system. One, or more if required, of these 3-phase circuits, is taken out of the substation and carried into the rural district.

The extent of the 3-phase circuit in any direction is determined by the amount of power to be distributed in that section. It is extended as far as is required to secure the desired voltage regulation, and no further. This limitation of the 3-phase circuit, with resultant economy, is feasible because 3-phase service is not offered to the individual consumer except for exceptionally large loads. In practice, the 3-phase circuit forms approximately one-third of the total length of circuit; located along the main highway it constitutes the backbone of the distribution system and from it, at each intersecting cross-road, are carried single-phase, 2,300-volt branch circuit, connected alternately to the three phases of the main circuit. One conductor of the single-phase circuit is grounded. Connections to the ground are made at the substation and at each service transformer; these being required on the average at about one-quarter of a mile apart.

The Rural Secondary or Service Circuit

Adjacent to or on the property of the consumer, a transformer is installed in order to reduce the voltage from the 2,300-volts of the primary circuit to the 220 or 110 volts for the service circuit. For safety it is found desirable to avoid carrying the 2,300-volt circuit on to the property of the consumer and, therefore, this circuit is confined to the highway unless the consumers' buildings are located at an unusually great distance from the highway.

Single-phase, 110-volt service is supplied for the use of consumers having an average lighting load; 220/110-volt, 3-wire, single-phase service is supplied for consumers with electric cooking ranges or motors of 2, 3 or 5 horse power. Upon the average farm larger demands are uncommon, although occasionally it is found advisable to provide 3-phase, 220-volt service and in exceptional cases, 3-phase, 550-volt service.

Design of Overhead Distribution System

Low First Cost Essential

The distances between consumers along the highway in the country is, of course, much greater than in the cities, and consequently the length and therefore the cost of line per consumer and also the cost of operation and maintenance is likewise greater.

Being familiar with the town service rates, and not always appreciating the extent to which the above-named factors affect the cost of rural power, the rural consumer does not at first take kindly to the necessarily higher rates. It is, therefore, essential to install a type of construction having low capital cost in order to obtain such rates as will be attractive to the farmer. On the other hand, the construction must be mechanically strong for safety in order to avoid interruptions to service and to keep down maintenance costs. The electrical characteristics of the conductors and equipment must be ample because the farmer will not be content with a quality of operating service inferior to that supplied in the towns. All such conditions have been given due consideration in the design and construction of the lines standardized by the Hydro-Electric Power Commission of Ontario. To a

Plate No. 3b,—Rural Transformer Station and Overhead Construction.

Junction between underground cables and overhead constructors; middle cross arm supports fused disconnecting switches, lower cross arm supports cable terminals for two 3-phase underground circuits. Note lightning arresters on top of adjacent pole.

large extent, the commission's experienced construction force is supplemented by local labour, thus reducing the cost of transporting labourers from place to place and the cost of the lost time involved in so doing. The farmers themselves are willing to engage in the work, appreciating the fact that a reduction in the cost will be reflected in the rates, because the power is sold *at cost*. Competitive tenders also are received from contractors and much of the rural work is done on contract basis.

Lines are Built on the Highways

Farm dwellings and barns are usually located reasonably close to the highway and lines on the highway are therefore conveniently situated for the connections to the farm buildings. Trees form perhaps the greatest obstacle to these lines, although telegraph and telephone poles are commonly encountered. The use of the telephone is very general in rural districts in Ontario and telephone lines are frequently found on both sides of the highway. In a few cases arrangements have been made for the joint use of poles for telephone and power wires. Where the poles of a power transmission circuit of higher voltage have already been erected along the highway, such poles are used for the support of the conductors of the rural circuit, thereby avoiding duplication of poles.

Poles, Pole Spacing, Crossarms and Other Pole Fittings

The standard pole used is of eastern Canada cedar and is 30 feet in length, with a diameter at the top of 6 inches. These poles are set 5 feet, 6 inches in the ground on tangents and 6 inches deeper at curves, corners or terminals. Poles of greater height are occasionally required to provide clearance from trees and foreign pole lines. At railway crossings, the poles are required to be of 7-inch diameter at the top and of sufficient height to permit clearance of 30 feet between the rails and the power wires. The maximum spacing between poles is 160 feet, and this spacing is commonly obtained. It is, however, reduced at curves in the road and in spans adjacent to corners, as well as in terminal spans. At consumer's premises, also, poles must be located for convenient connection to the consumer's buildings. For these reasons the average span may be considerably less than 160 feet. Where necessary, guys of stranded galvanized steel are installed. Where the four wires of the 4,000/2,300-volt circuit are to be supported, crossarms are used, the dimensions of which are 3¾ inches by 4¾ inches by 6 feet 4 inches. The material is British Columbia fir. The spacing on the crossarm between the outer and the adjacent conductors is 18 inches with 30 inches between the two conductors adjacent to the pole. The crossarm is secured to the pole by a ⅝-inch machine bolt and by two flat steel braces 30 inches in length. Where only two conductors are required for the 2,300-volt, single-phase circuit, crossarms are not used. The ungrounded conductor is carried on a steel pin projecting above the top of the pole and the grounded conductor on a steel bracket on the side of the pole. Two feet vertical separation is maintained between the two conductors. All hardware used is galvanized. Porcelain insulators are used to insulate the ungrounded conductors and the grounded conductor is supported on glass insulator.

Conductors

For the primary circuit, hard-drawn copper is used, the cross section of which must not be less than No. 6 B. & S. gauge. This minimum is determined for reasons of mechanical strength and not on account of electrical conductivity. Joints in this conductor are made with copper sleeves, twisted. To a small extent, a stranded aluminum conductor with steel core has been used for the primary circuit. Bare wires are the rule for all primary wires in rural districts. Where the primary circuit is 3-phase, the fourth or neutral wire usually consists of ¼-inch steel, stranded and galvanized. In hamlets and occasionally even in the country itself two or more consumers may be found located favourably so that they may be served economically from one transformer. For such cases the 3-wire secondary circuit (220/110 volts) required along the highway is supported in a vertical arrangement on a steel bracket fastened to the side of the pole. The neutral conductor is placed above the others to provide greater safety in the event of a primary wire falling across the secondary circuit. The neutral wire is bare and the other two are provided with a double braid weatherproof covering. The wires of this circuit are, without exception, medium hard-drawn copper and all joints are soldered. No. 6 B. & S. gauge is the minimum size used. For connections from the pole on the highway to the consumer's premises, medium hard-drawn copper conductors are used, all conductors having a double braid weatherproof covering and being not less in cross section than No. 8 B. & S. gauge. All conductors carried over railroads are required to have a strength not less than that of No. 4 B. & S. gauge copper, and to be stranded. This applies to the conductors in the crossing span and the adjacent span on either side of the crossing.

Transformers and Meters

Due to the fact that the average number of consumers per service transformer is small, little advantage is obtained in diversity of the load on the individual transformer. The transformer must be capable of carrying the maximum load which is usually of short duration. On the other hand the number of transformers connected to one feeder is large, due to the relatively small average transformer and also due to the fact that there is a high diversity in the transformer demands on the feeder. At the time of peak load on the rural feeder there is, therefore, a large number of transformers from which the consumers are drawing little or no current, and these lightly loaded transformers result in a low power factor for the load on the feeder, which is of course undesirable. To ameliorate this condition, particular care has been taken in specifying that transformers shall have low exciting current. In other respects, the transformers are similar to those used in urban systems. The rated voltage is 2,200/220-110. The minimum size used is of 2 kv.a. capacity and there is more demand for the 3 kv.a. than for any other size. Each service transformer on the overhead lines is protected by a lightning arrester and fuse cutout. Watthour meters are used for measuring the consumers' power consumption. These are placed inside the consumer's house or barn, or infrequently in a wooden housing on a pole on the consumer's property. The ratings of the meters commonly required are 10-ampere, 2-wire, 110-volt and 15-ampere, 3-wire, 220/110 volts and for either 25 or 60 cycles.

Underground Cable Construction

The increase in cost of labour and material, one of the conditions resulting from the Great War, made itself evident in the building of power lines as in other classes of construction. This led the Commission's engineers to investigate the possibilities of underground construction in rural districts. It is unnecessary to state that the use of cables laid underground is a well-established practice, but it may be of interest to note that their use

Plate No. 4a,—Underground Rural Transmission Lines.
Tractor excavation trench for underground cable.

antedated the use of pole lines. In the year 1843, Morse attempted to lay cables underground for his telegraph system but, due to difficulty in obtaining a proper cable and troubles in connection with his trenching equipment, he abandoned this type of construction and turned to wood poles for the support of his conductors.

The extensive application of underground cables to rural service is however, we believe, quite new, and the methods of installation and the design of material and equipment were given comprehensive study. At the present time the commission has approximately 125 miles of cable installed with 35 miles additional now under construction.

The standard cable is described briefly as follows: Single-conductor, No. 6 B. & S. gauge, 7-strand, tinned copper, insulated with 30 per cent para rubber 3/32 inch in thickness, laid over with a rubber-filled, insulating tape and covered over all with a sheath of pure lead 1/16 inch in thickness. No steel wire or tape or other protective covering is put on the cable. The cable is rated nominally at 2,500 volts and is given a factory test for 7,000 volts for 5 minutes. It is furnished in uniform lengths each of one third of a mile.

In general, the cable is laid close to the fence line and between the fence and the traversed portion of the highway. In some cases, it has been found advisable to lay it immediately inside the fence on private property. A trench is made of from 15 to 18 inches in depth and the cable placed therein without other protection than that afforded by the refilled soil, except at hazardous locations such as road crossings. At such points the trench is made deeper and a creosoted plank is placed above the cable after a few inches of the excavated soil has been replaced.

At advantageous points the location of the buried cable is indicated by a stake of creosoted wood 4 inches by 4 inches by 5 feet long, set 2 feet in the ground. On this stake is placed an embossed aluminum plate with the designation "Hydro Cable" and a space thereon for marking details of location.

Two methods have been employed in making the trench. A plough of exceptional strength, drawn by a gasoline driven caterpillar tractor was originally used and for the greater part of the mileage now installed. The same tractor was used to draw the carriage in which the cable reel is mounted for laying, and the tractor was used also for drawing the backfilling equipment. The method now in use and which is particularly economical where a comparatively short extension is to be made, takes advantage of equipment which is commonly available in rural districts.

The trench is made by alternate trips of a common farm plough to break up the soil and a road scraper by means of which the earth is removed from the trench. The road scraper is a machine made use of generally throughout Ontario in grading the highways. This machine is drawn by horses and the same equipment is used in replacing the earth over the cable. The cable reel carriage is also horse-drawn. Frequently the reel can be carried along close to the trench and the cable laid therein with a minimum amount of handling.

Cable joints are enclosed in lead sleeves, compound filled and sealed with wiped joints to the cable sheath.

At each location where service is required for a consumer a wood pole is erected and the cable carried up the pole, terminating in a pothead with disconnecting apparatus; in order to continue the circuit further along the highway the cable is carried down the pole again from a second pothead. This arrangement eliminates the necessity of a joint at the foot of the pole and the disconnecting potheads form a convenient means of opening the circuit for a test or other purpose. The potheads are installed with wiped joints. The cable on the side of the pole is covered with a protective moulding. On the pole the service transformer is mounted and the secondary circuit is carried overhead to the consumer's premises. An experimental installation is now being made in which the transformer will be placed in a small concrete housing and the secondary wires run underground to the consumer's premises. The concrete housing will be placed on the ground or rather, for stability, with its base slightly below ground level. This departure from the present scheme has some very attractive features and may prove cheaper in cost than the present method.

As between the overhead and underground construction generally, it is not expected that the latter will entirely supplant the former. Local conditions in each

Plate No. 4b,—Underground Rural Transmission Lines.
Trench excavated ready for installation of cable.

Plate No. 4c,—Underground Rural Transmission Lines.
One method of re-filling trench after installing underground cable.

individual district will have a great influence in deciding which type of construction should be installed. Under conditions favourable to the installation of the underground method the capital cost will be less than that of the overhead method. This applies to single-phase circuits only, where the lead sheath is used as the grounded conductor of the circuit, in parallel, of course, with the earth itself. The electrical conductivity of the lead sheath is equal to that of a No. 10 B. & S. gauge copper wire.

Excepting under conditions extremely unfavourable to overhead construction the capital cost of 3 cables laid for a 3-phase circuit will exceed the cost of a similar circuit erected on poles. The cost of maintenance and the rate of depreciation should prove decidedly in favour of the underground system.

In general, the cable now in operation has proved satisfactory. Occasional faults have developed and in nearly every case these are found to be due to lack of care in installation. In fairness to the system, it should be stated that the original work was commenced late in the year and continued in haste under winter conditions. Later installations have been made under more favourable conditions without similar trouble developing. Novel methods have been devised for finding faults in the cable and the location and repair is now accomplished quickly and satisfactorily.

There is considerable popular demand for the underground construction. It is less in evidence than the overhead type and therefore more desirable. It avoids the necessity for cutting shade trees and is immune to sleet storms.

Costs of Rural Distribution Lines

The following table shows the cost of one mile of a typical rural wood-pole line with 3-phase circuit, installed complete, including supervision and overhead charges.

Poles and crossarms	$ 384.77
Hardware and guys	30.55
Conductors and insulators	366.55
Labour and tools	464.21
Engineering	62.30
Total cost per mile	$1,308.38

The following table shows the cost of one mile of a typical rural wood-pole line with single-phase circuit, installed complete, including supervision and overhead charges.

*Poles	$ 318.55
Hardware and guys	58.60
Conductors and insulators	208.41
Labour and tools	426.65
Engineering	50.61
Total cost per mile	$1,062.82

The following table shows the cost of one mile of a typical rural underground cable for single-phase circuit, installed complete, including supervision and overhead charges.

Material	$554.88
Labour and tools	208.38
Engineering	36.00
Total cost per mile	$799.26

NOTE: — At each point where service is required, it is necessary to erect a wood pole on which the cable is terminated. The additional cost at each point of service is $47.21.

Having now reviewed the principal features which characterize the work of the commission in constructing its rural distribution lines, reference will be made to some of the principal uses to which the electrical energy is applied.

*The above cost is for that type of construction known as "pole-top pin construction"; no crossarms are used.

A Basis for Estimating Rates

It was not long before the officers of the Hydro-Electric Power Commission found that the representations made in the petitions from rural residents did not always constitute a safe basis upon which to estimate. It was decided, therefore, to establish a minimum business basis of a minimum connected load per mile upon which to determine the estimated rates to those requesting information upon proposed electrical rural service. The basic cost of the electrical energy is the cost at the distribution centre from which it is proposed to extend the rural line.

In many districts it has been found that the early efforts made by those interested result in the securing of an insufficient number of contracts to meet the assumed basis upon which the rates submitted were made; that is, three farm contracts per mile or the equivalent thereof. In such cases it becomes necessary for a representative of the commission to meet the working rural committees and again deal with the various factors involved, and it usually happens as a result of these further educative efforts and the renewed efforts of those interested, that the necessary amount of business is pledged.

The rates quoted in a rural power district are determined upon the same basis as the commission determines the rates for city or town service; namely, *at cost.* The government bonus for the primary lines is taken into due consideration.

The rates may be said to consist of two parts: First, the service charge, which is designed to cover the annual fixed charges and the operating cost of the distribution system in the district; and second, the power charge which is based on the cost of power at the distribution centre from which the rural lines originate; and is in the form of a charge per kilowatt-hour for the first 14 hours use per month of the consumers' class demand rating, and a follow-up kilowatt-hour charge of two cents, a little over one penny. There is a prompt payment discount of 10 per cent on the total bill.

With respect to the feature of diversity in rural power districts or the resale of power, it may be stated that this diversity varies greatly. It has been found where manufacturing plants are located in rural districts, combining with the general rural load, that, under certain conditions, there is effected a complete resale of the power for at least two purposes, and thus a relatively small amount of power purchased is made to serve a fairly large connected load. This diversity factor varies on the "Hydro" rural systems from 3 to 10.

Rural Electrical Service Classification

In order that the commission would be best able to deal with the various rural situations in a discriminating and fair manner, it became necessary to distinguish between different classes of services. A schedule of classification is furnished to prospective electrical rural users and in contracting with their township they are required to choose, with certain limitations, from the classes enumerated as follows:—

CLASS I : *Hamlet Service* — Includes service in hamlets, where four or more customers are served from one transformer. This class excludes farmers and power users. Service is given under three sub-classes as follows:

I-A : Service to residences where the installation does not exceed six lighting outlets or twelve sockets. Use of appliances over 600 watts is not permitted under this class.

Plate No. 5a,—Rural Distribution of Power.

Cable from underground primary circuit taken up pole to transformer and 220/110 volt service wires carried overhead to consumer's premises.

I-B : Service to residences with more than six lighting outlets or twelve sockets, and stores. Use of appliances over 750 watts permanently installed is not permitted under this class.

I-C: Service to residences with electric range or permanently installed appliances greater than 750 watts. Special or unusual loads will be treated specially.

CLASS VIII : *Syndicates* — Any group of customers with individual contracts in any of the foregoing classes may form a syndicate, provided the summation of their respective class demands will warrant permitting this to be done.

The experiences of the commission in rendering rural electrical service extending over a period of years are embodied in the rates and the classification of services above given, and these have proved satisfactory with respect to all applications for service thus far received.

The following table gives the estimated costs in a rural electrical power district of a 25-cycle system with power at

5 cents per kilowatt-hour for the first 14 hours' use per month of the consumers' class demand rating.

2 cents per kilowatt-hour for all remaining uses. With a prompt payment discount of 10 per cent. (Prompt payment meaning that the consumer must pay his bill within 10 days of the time his account is rendered.)

The Results

An appreciation of the magnitude of the commission's rural electrical undertaking may be gathered from a consideration of what was involved in making surveys requested in the petitions received in the year 1920. In this year, there were 68 petitions from townships covering an aggregate area of 2,895,082 acres. In connection with these petitions, personal visits were made

Table No. 1. — Class demand rating, average monthly kilowatt-hours, estimated consumption charge, estimated service charge and total estimated annual net cost for each class of rural consumer

Class	Description	Demand rating		Average monthly consumption	Estimated annual consumption charge	Estimated annual service charge	Total estimated annual cost*			
		kw.	h.p.	kw-hr.	$ c.	$ c.	$ c.	£	s.	d.
I	Hamlet service (a)	½	⅔	10	4.43	17.59	22.02	5	0	1
	(b)	¾	1	15	6.48	20.50	26.98	6	2	8
	(c)	2	2⅔	150	41.47	36.44	77.91	17	14	2
II	House lighting	1	1⅓	15	7.78	30.5	37.83	8	12	0
III	Light farm service	3	4	40	21.60	60.82	82.42	18	14	8
IV	Medium single-phase farm service	5	6⅔	70	37.80	66.94	104.74	23	16	1
V	Medium 3-phase farm service	5	6⅔	70	37.80	84.50	122.30	27	15	11
VI	Heavy farm service	9	12	150	73.22	130.97	204.19	46	8	2
VII	Special farm service	15	20	300	132.84	188.90	321.74	73	2	5

*Converted at £ = $4.40, being current rate of exchange at date of compilation.

CLASS II.-A : *House Lighting* — Includes such contracts as residences which cannot be grouped as in Class I. This class excludes farmers and power users.

CLASS II-B : *House Lighting* — Includes lighting of buildings and power for miscellaneous small equipment and power for single-phase motor not exceeding 2 horse power or electric range (motor and range not to be used simultaneously) on a small farm of 10 acres or less in fruit growing districts and 50 acres or less in mixed farming or dairy districts.

CLASS III: *Light Farm Service* — Includes lighting of farm buildings, power for miscellaneous small equipment, power for single-phase motors, not to exceed 3-horse power demand, or electric range. Range and motors are not to be used simultaneously.

CLASS IV: *Medium Single-Phase Farm Service* — Includes lighting of farm buildings and power for miscellaneous small equipment, power for single-phase motors, up to 5-horse power demand, or electric range. Range and motor are not to be used simultaneously.

CLASS V : *Medium 3-Phase Farm Service* — Includes lighting of farm buildings and power for miscellaneous small equipment, power for 3-phase motors, up to 5-horse power demand, or electric range. Range and motor are not to be used simultaneously.

CLASS VI : *Heavy Farm Service* — Includes lighting of farm buildings and power for miscellaneous small equipment, power for motors up to 5-horse power demand, and electric range, or 10-horse power demand without electric range.

CLASS VII : *Special Farm Service* — Includes lighting of farm buildings, power for miscellaneous small equipment, power for 3-phase motors from 10 to 20-horse power demand, and electric range.

Plate No. 5b,—Rural Distribution of Power.

Service pole with transformers and 3-phases, 220-volts, service wires to consumer's premises. Note wood housing for meter on pole.

to nearly 22,000 farms and about 1,730 industrial power prospects and it was found that it would be possible instead of serving 68 townships to serve 341 townships in the districts then being served with electrical energy by the commission. These covered an aggregate of about 17,366,000 acres out of a total acreage of approximately 22,600,000 acres in the areas considered.

Customers served from rural power lines would, of course, like to obtain their electrical service at the same rates as their friends 'in town'. Obviously, it is impossible to serve only about three electrical consumers per mile at the same rate at which service could be dispensed to hundreds of consumers per mile. Again, in rural districts there is not the diversity in kinds of loads that is found in urban centres, with the result that rates based on service at cost must carry a service charge much higher than the service charge for an urban municipality. With the introduction of electrical rural service the attention of rural residents has been directed to a broader outlook on the whole problem of electrical distribution and the rural citizens are appreciating more fully the basic conditions which govern in electrical distribution under various circumstances. The net result is that the rural consumers have become contented with the results of electrical service to their districts, preferring to appraise such service on its own basis and in terms of the satisfactory returns which are received for their relatively small yearly expenditure for electricity as compared with the cost of doing similar work by the former methods.

As previously pointed out, there has been a substantial reduction in the cost of service in rural districts where it has been possible to add the power load required for manufacturing industries in the district. Individual electric plants driven by internal combustion engines have, for years, had a place in many rural districts. In such instances, the advantages of electric light to rural residences have served to stimulate the desire for other advantages conferred by a fuller use of electrical energy, and usually when a service is proposed to be installed in a rural district by the Hydro-Electric Power Commission the owners of individual electric plants driven by internal combustion engines are the first to sign the contracts for new service. The commission's field men reporting from rural districts have drawn attention to numerous instances where those contemplating an investment in an individual electric plant are delaying such purchase in the hope that service by the commission may be extended to their township. Viewed, therefore, from certain standpoints, the individual plant, instead of being wholly a competitor, has often proved to be a good forerunner for the introduction of rural electric service by the commission.

The first rural distribution lines were built by the commission in 1912 as rural extensions from towns. The building of such extensions was continued until, in 1917, the cost of material and labour for such work, owing to conditions brought about by the great War became prohibitive and consequently little progress was made between 1917 and the beginning of 1921. During this period, however, the commission conducted operations in 81 townships, primary lines being built to the extent of 305.54 miles to serve 7,117 hamlet and suburban contracts and 1,652 farm contracts, a total of 8,769 contracts.

The amendment to the Power Commission Act providing for the bonusing of rural lines, passed in May, 1921, immediately resulted in a pronounced renewal of electrical activities in rural districts. The following brief summary of work carried out by the commission in rural districts between June 1st, 1921 and October 31st, 1923,— the fiscal year of the commission ends on the 31st of October, — is of interest.

Primary line constructed		753.05 miles
To serve hamlet contracts	3,071 miles	
To serve farm contracts	2,170 miles	
Total		5,241 miles
Total rural contracts to date		$ 14,010
Contracts in hand not yet served		2,098
Capital expended prior to June 1st, 1921		$ 517,911.77
Total expended and approved to October 31st, 1923		$12,125,024.12
Bonuses approved on lines built prior to June 1st, 1921		$ 154,651.90
On lines built between June 1st, 1921 and October 31st 1923		467,612.53
Total		$ 622,264.43

During the fiscal year just closed, the commission built 216.69 miles of overhead, and 21.33 miles of underground extensions to serve 1,484 hamlet users and 745 farms, a total of 2,229 customers.

Power Required for Township Users and Systems

It will be interesting to comment upon the amount of power required by rural districts. The aggregate amount of such power is comparatively small. The commission now supplies a total of 3,500 horse power which serves 14,010 consumers of all classes, including many small hamlet consumers.

The commission, from time to time, has collected and analyzed various information respecting the uses of electricity for different kinds of farm work and it is believed that the following tables Nos. II, III, IV, V, VI and VII convey a fair idea of the requirements of electrical energy for different purposes.

Table No. II shows the amount of electrical energy used for lighting and for appliances. The appliances used on each farm are itemized in table No. V.

Table No. II. — Power used for lighting and appliances
Kilowatt-Hours

Month	Farm No. 1	Farm No. 2	Farm No. 3	Farm No. 4	Farm No. 5	Farm No. 6
Jan	52	59	39	35	25	61
Feb	46	45	36	31	39	52
Mar	41	39	30	27	18	52
April	37	38	20	22	23	49
May	28	25	13	16	21	38
June	21	16	15	11	15	33
July	23	15	13	9	3	28
Aug	23	17	7	9	4	29
Sept	29	25	15	17	12	37
Oct	32	24	17	16	22	38
Nov	46	41	25	42	24	46
Dec	57	67	36	44	25	57
Total	435	411	266	279	231	520

Table No. III gives the uses of power furnished by the motor which, on each of the five farms specified, happens to be a 5-horse power motor. The uses itemized in this tabulation clearly indicate that 5 horse power is undoubtedly too much to provide for the work being done, provided the machinery on the farm would permit using a smaller motor.

Table No. III. — Power used by 5-horse power motor
Kilowatt-Hours

Month	Farm No. 1	Farm No. 2	Farm No. 3	Farm No. 4	Farm No. 5
Jan	..	..	40	30	10
Feb	20	..	40	30	20
Mar	50	10	40	30	20
April	50	6	30	50	30
May	30	20	30	40	20
June	30	20	40	40	20
July	20	30	10	20	..
Aug	20	20	10	30	10
Sept	10	30	30	30	20
Oct	10	20	30	30	30
Nov	30	10	20	40	20
Dec	30	40	40	30	20
Total	300	206	360	400	220

Table No. IV indicates the uses resulting from the employment of a large equipment for silo-filling and threshing driven by a 20-horse power motor. This outfit is shown in one of the illustrations accompanying this article.

Table No. IV. — Power used by 20-horse power syndicate outfit
Kilowatt-Hours

Month	Farm No. 1	Farm No. 2	Farm No. 3	Farm No. 4	Farm No. 5	Farm No. 6
Jan	294	19	66	210	..	101
Feb	41	188	145	..	79	..
Mar	..	..	..	..	..	189
April	..	..	..	..	21	48
May	..	61	..	..	..	49
June	..	..	..	..	..	17
July	11	..	..	..	..	56
Aug	..	..	..	..	..	21
Sept	138	68	68	66	69	84
Oct	..	47	154	138	..	8
Nov	245	105	..	..	109	127
Dec	..	..	162	182	..	40
Total	729	488	595	596	278	740

Table No. V gives the appliances made use of on the farms listed in tables Nos. II, III and IV.

Table No. V. — Equipment on farms in tables Nos II, III and IV

Farm No.	Motor	Other Appliances
1	5-horse power, 3-phase	Washing machine, iron and toaster
2	5-horse power, 3-phase	Washing machine, iron and toaster
3	5-horse power, 3-phase	Washing machine, iron and toaster
4	5-horse power, 3-phase	Iron and toaster
5	5-horse power, 3-phase	Iron and toaster
6	Two 1-horse power, single-circuit on lighting	

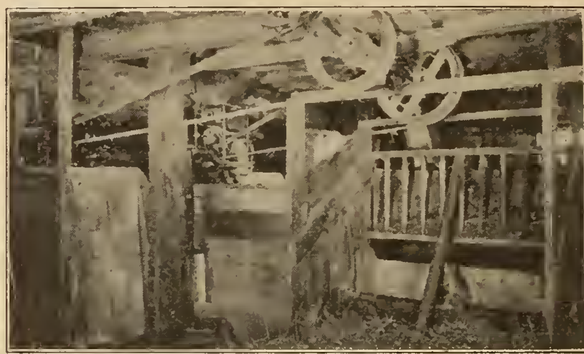
Table No. VI shows the uses to which electricity has been applied in order to do all of the work on a large dairy farm; in this case a farm of 300 acres.

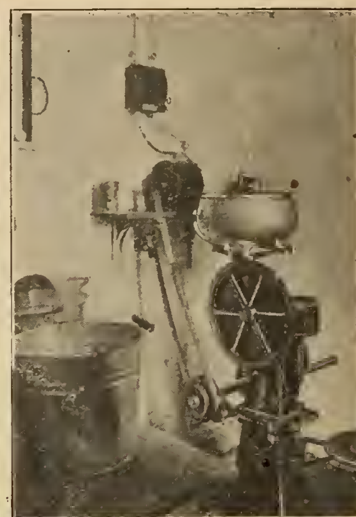
Table No. VI. — Uses on a large dairy farm including threshing and silo-filling

Operation	Times used per year	Used each time	Total hours used per year	Horse power of Motor	Demand in kw.	Energy consumption for the year kw-hr.
Milking	730	1 hr.	730	3	1¾	1,241
Grinding	52	3 hr.	156	5	3¾	525
Sawing wood	3	4 hr.	12	5	3¾	45
Pumping	183	5 hr.	915	2	4/5	732
Threshing	...	....	...	25	20-25	322
Silo-filling	...	....	...	25	2-30	402
Vacuum cleaner	12	1 hr.	12	1/6	1/8	2 (1½)
Electric iron	52	4 hr.	208	...	½	104
Washing	52	½ hr.	26	1/6	1/8	2
Lighting	...	....	...	...	....	300

Total kw-hr. per year 3,675

Table No. VII presents the maximum and minimum demands for power for driving the different machines commonly found on Ontario farms. The variation in the amount of power required for electrical appliances is so great that it would take a large amount of space to submit the data in detail. Moreover, such detailed results would not be of special value if for no other reason than that the attention which the average farmer gives his machines is not conducive to obtaining the most efficient results. The commission has devoted considerable attention to the subject of power required for electrical appliances and has used its endeavour to have the various classes of machines as well as the driving equipment reduced to the most efficient types and sizes.





Plates Nos. 6a, 6b, 6c & 6d,—Electrical Power on the Farm

6a,—A 5-horse power motor belted to a line-shaft in the barn. Note starting switch to the left of the motor and chopper in background. The other machinery in this barn is not shown in this picture.

6b,—A one-quarter-horse power motor belted to pump. In the average installation the pump has a capacity of 300 to 500 gallons per hour.

6c,—A one-half-horse power motor driving a cream separator.

6d,—A dairy stable scene showing cows in stations without any divisions and a pressure-vacuum milking machine installation with three units set in place ready for milking.

Table No. VII. — Power for Electrical Appliances

Machine or Appliance	Recommended size of motor in horse power	Power demand watts
Washing machine.........	1/6 to 1/4	125 to 167
Electric iron.............	....	625
Toaster..................	....	625
Vacuum cleaner..........	1/8 to 1/4	125
Water pump.............	1/4 to 2	167 to 1,500
Cream separator.........	1/6 to 1/4	167 to 250
Churn — farm size.......	1/8 to 1/2	167 to 375
Milking machine.........	1/4 to 2	188 to 1,500
Ensilage cutting box......	5 to 30	3,750 to 22,000
Thresher................	5 to 20	3,750 to 15,000
Root pulper.............	1 to 3	750 to 2,250
Chopper.................	2 to 20	1,500 to 15,000
Buzz saw................	2 to 10	1,500 to 7,500
Drag saw................	2 to 5	1,500 to 3,750

Power Consumption for Various Operations

Silo-filling..........About ½ ton per kilowatt-hour cut ¾ inch long and elevated 40 feet into silo.
Threshing wheat... 4 bushels per kilowatt-hour.
Threshing oats......6¾ bushels per kilowatt hour.
Chopping grain.....Amount of power taken for this work varies greatly. On farm types of machines it has been found that it takes about 1 kilowatt-hour per 100 pounds.
Rolling oats.........About 1 kilowatt-hour per 100 pounds.
Cutting fodder......2 kilowatt-hours per short ton.

The extensions being made in the main transmission and distribution lines of the municipally-owned hydro-electric undertaking, are constantly opening up new rural territory and present indications are such as to promise for the future an unprecedented extension of rural electrical services. The benefits of such service *at cost* are now being more fully recognized by rural dwellers as a blessing which is revolutionizing domestic and farm labour to an extent never before attained through any other agency. In the broadest sense it is the power of the people being developed by the people for the service of the people.

Appendix

The legislation of the province of Ontario, passed in order to enable the Hydro-Electric Power Commission of Ontario to act in the matter of supplying electrical service to rural consumers, is presented below as an appendix to "Electrical Service for Rural Districts as provided by the Hydro-Electric Power Commission of Ontario".

The sections below quoted are from the legislation appertaining to the work of the Hydro-Electric Power Commission.

The Power Commission Act — Part II

Supply to Individual Users

25. In this Part, *Interpretation.*

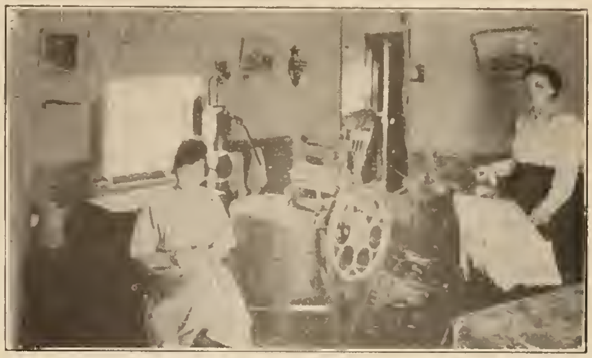
"Corporation" shall mean the corporation of a city, town, township or village municipality. R.S.O. 1914, c. 39, s. 25. *"Corporation."*

26.—(1) Any one or more of the ratepayers in a municipality the corporation of which has not entered into a contract with the Commission under Part I may apply to the corporation requesting it to obtain from the Commission a supply of electrical power or energy for the use of such ratepayer or ratepayers for lighting, heating and power purposes, or for any of such purposes. *Application for supply of power to municipality for use of particular ratepayer.*

(2) The application shall be in writing signed by the applicants and shall state the lots or parts of lots owned or occupied by each of them and the purposes for which the electrical power or energy is required. R.S.O. 1914, c. 39, s. 26. *Form of application*

27.—(1) The Council of the corporation shall thereupon request the Commission to supply the electrical power or energy for the purposes mentioned in the application. *Request for supply.*

(2) Upon such request the Commission shall furnish to the corporation an estimate of the maximum cost per horse-power at which the electrical power or energy will be supplied at the point of development or of its delivery to the Commission, and an estimate of the cost of constructing and providing a transmission line by means of *Estimates, etc., to be furnished by Commission*



Plates Nos. 7a, 7b, 7c & 7d, — Electrical Service in the Farm Home

7a,—Electrical washing machine and iron in the kitchen of an Ontario farm home.

7b,—Kitchen in an Ontario farm house, showing electric stove on which all of the cooking throughout the year is being done. During the past year, hundreds of electric stoves have been installed in Ontario farm homes.

7c,—Kitchen and dining-room in another farm in Ontario, showing washing-machine, electric iron, table grill and electric lighting.

7d,—Kitchen in farm house in Ontario built about 1850 showing on the right, the old fire-place, a part of the original log house.

which the amount of electrical power or energy required is to be supplied and of maintaining the same, and may furnish to the corporation plans and specifications of the work, plant, machinery and appliances necessary for the distribution of such power or energy by the corporation to the applicants, and an estimate of the cost thereof and such other information as the Commission may deem advisable.

By-law authorizing contract with Commission

(3) Within one month after the delivery of the statement and estimates mentioned in the next preceding subsection the council shall, at a special meeting called for that purpose, of which notice shall have been given to each of the applicants, consider the statement and estimates furnished by the Commission, and, with the consent of the applicants or such of them as shall signify their desire to enter into a contract for the supply of electrical power or energy by the Commission, the corporation, without submitting the same to a vote of the electors and without any of the other formalities required in the case of a by-law passed under Part I, may pass a by-law for entering into a contract with the Commission for the supply of the electrical power or energy required by the applicants, and may enter into a contract with the Commission for that purpose.

Debenture issue.

(4) The by-law may provide for the issue of debentures of the corporation, payable within twenty years from the issue thereof, to meet the cost of construction and installation of the works, plant, machinery and appliances necessary for the distribution of the electrical power or energy, and for the levying of a special rate for payment of principal and interest in the manner provided by THE MUNICIPAL ACT. R.S.O. 1914, c. 39, s. 27.

1922, c. 72. Annual payments by corporation

28. All the provisions of Part I, as to the annual payments to be made by corporations which have entered into contracts with the Commission, shall apply to a contract entered into under this Part. R.S.O. 1914, c. 39, s. 28.

Admission of further subscribers

29. The contract may provide for the admission from time to time of further subscribers, or for the making of a contract between the corporation and the Commission under Part I, and the readjustment thereupon of the accounts payable annually to the Commission and of the amounts payable annually by the subscribers in such manner as may be agreed upon or determined by arbitration or otherwise. R.S.O. 1914, c. 39, s. 29.

Amount payable by applicants.

30. The amount payable by the applicants in each year, for the electrical power or energy supplied to them, shall be sufficient to recoup the municipality the amount required to pay the principal and interest of any debentures issued and to meet the annual payments required to be made to the Commission as provided by Part I, and in default of payment any amount due to the corporation under this section may be entered on the collector's roll and collected in the same manner as other taxes. R.S.O. 1914, c. 39, s. 30.

Part II A

Supply of Power for Street Lighting in Townships

Petition of residents in a locality for supply of power for street lighting.

30a.—(1) A majority of the resident freeholders according to the last revised assessment roll, residing within the area described in the petition and situated in the township, may petition the council of the township to take the necessary proceedings to procure from the Commission a supply of electrical power or energy for the purpose of lighting the streets or roads in the locality described in the petition.

Certificate as to sufficiency of signatures.

(2) The petition shall be accompanied by the certificate of the clerk of the township stating that the petition is signed by a majority of the resident freeholders in the locality described in the petition as shown by the last revised assessment roll. 4 Geo. V, c. 16, s. 5, part.

Application by council to the Commission.

30b.—(1) The council of the corporation shall thereupon request the Commission to supply electrical power or energy for the purposes mentioned in the petition.

Estimates etc., of cost to be furnished

(2) Upon such request the Commission shall furnish to the corporation an estimate of the maximum cost per horse power at which the electrical power or energy will be supplied at the point of development or delivery by the Commission, and an estimate of the cost of constructing and providing the transmission lines by means of which the amount of electrical power or energy is to be supplied and of maintaining the same, and may furnish to the corporation plans and specifications of the works, plant, machinery and appliances necessary for the distribution of such power or energy for the purpose of lighting the streets or roads in the locality defined in the petition and an estimate of the cost thereof and such other information as the Commission may deem advisable. 4 Geo. V, c. 16, s. 5, part.

Consideration of the estimates plans, etc., by the council.

30c.—(1) Within one month after the delivery of the statements and estimates mentioned in the next preceding section the council shall at a special meeting called for that purpose, of which notice shall have been given to each of the petitioners, consider the statements and estimates furnished by the Commission.

Withdrawal of petitioners.

(2) If at such meeting the petitioners or any of them desire to withdraw their names from the petition they may do so and should the remaining names be insufficient to constitute a majority of the resident freeholders in the locality described in the petition, no further proceedings shall be taken thereon.

Power of council to pass a by-law authorizing contract.

(3) If at the close of the meeting there are sufficient names remaining of the petitioners to constitute a majority of the resident freeholders in the locality described in the petition, the corporation may, without submitting the same to a vote of the

electors, and without any of the other formalities in the case of a by-law passed under Part I pass a by-law for entering into a contract with the Commission for the supply of electrical power or energy for the purposes required by the petitioners and may enter into a contract with the Commission for that purpose.

Debenture issue. (4) The by-law may provide for the issue of debentures of the corporation payable within twenty years from the issue thereof to meet the cost of construction and installation of the works, plant, machinery and appliances necessary for the distribution of the electrical power or energy, and for the levying of a special rate upon the taxable property within the locality described in the petition for payment of principal and interest in the manner provided by THE MUNICIPAL ACT. *1922, c. 72.*

Special rate of property affected. (5) All moneys required to meet the costs incurred by the corporation under this Part shall be raised, levied and collected by an annual special rate upon the taxable property lying within the locality described in the petition. 4 Geo. V, c. 16, s. 5, part.

Annual payments to the Commission. 30d.—All the provisions of Part I as to the annual payments to be made by corporations which have entered into contracts with the Commission shall apply to the contracts entered into under this Part. 4 Geo. V, c. 16, s. 5, part.

Part II B

Construction and Operation of Distribution Works in Rural Power Districts

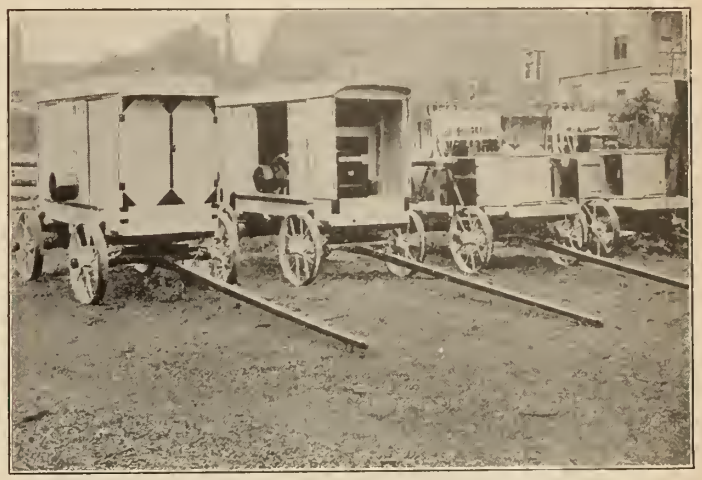
Contracts for construction and operation of distribution works in townships. 30e.—Subject to the approval of the Lieutenant-Governor in Council the Commission may enter into a contract with the municipal corporation of a township, or with the municipal corporations of two or more townships, for the supply or distribution of electrical power or energy in the township or townships, and the Commission may with the approval of the municipal corporation and in pursuance of such contract lay out and define areas hereinafter called "rural power districts" in the township or townships for the distribution of electrical power or energy, and may construct and operate all works necessary for the transmission of electrical power or energy to a rural power district and for the transforming and distributing of such electrical power or energy to the premises of persons within the rural power district, and the Commission may from time to time with the approval of the municipal corporation enlarge, alter or vary the boundaries of any rural power district. 10-11 Geo. V, c. 18, s. 5, part; 12-13 Geo. V, c. 31, s. 4.

By-law. 30f.—The council of the township or the council of each of such townships party to such contract, may pass a by-law for entering into such contract and may execute the same, and it shall not be necessary to submit any such by-law to the vote of the electors or to comply with any of the other forms required in the case of a by-law passed under Part I of this Act. 10-11 Geo. V, c. 18, s. 5, part.

Apportionment of cost on annual adjustment. 30g.—(1) The Commission shall annually fix, adjust and apportion the cost of all the works mentioned in section 30e to be borne by each of the municipal corporations entering into such contract*.

Amount of contributions by townships. (2) The total amount for which each of the corporations shall be liable shall include a sum sufficient to provide annually the corporation's proportionate cost of the capital cost of the work so as to form in thirty years a sinking fund for the payment of the amount expended by the Commission on capital account for the acquisition or construction of the works necessary for transmitting, transforming, distributing and delivering electrical power or energy in a rural power district and a further sum sufficient to pay the Commission interest

NOTE: Section 30e was made retroactive as from the 4th day of June, 1920. 12-13 Geo. V, c. 31, s. 4.



Plates Nos. 8a, and 8b,—Electric Power in Rural Industries

8a,—Two 20-horse power Syndicate Outfits. The motors are mounted in a wagon with the starter. The transformer, secondary cable, primary cable, primary switch and metering equipment are mounted on a second wagon. Syndicates are groups of men who band themselves together for the purpose of owning and operating outfits of this kind for doing the heavier work of threshing and silo-filling. The equipment is moved from farm to farm as required.

8b,—Power plant in a cheese factory. The 7½-horse power steam engine on the left is now superseded by the 5-horse power electric motor on the right.

*See Rural Hydro-Electric Distribution Act.

upon the proportionate part of such expenditure to be borne by the corporation, and a further sum to pay the corporation's proportionate part of the line loss and the costs of operating, maintaining, renewing and insuring of such works and of the other charges set out in section 23. 10-11 Geo. V, c. 18, s. 5, part.

30h. The rates to be charged to customers receiving electrical power or energy from the Commission in a rural power district shall be fixed by the Commission from time to time and shall be sufficient to provide the sum necessary to pay all the charges to be borne by the corporation under section 30g. 10-11 Geo. V, c. 18, s. 5, part. *Rates to be fixed by Commission.*

30i. All the provisions of Part I as to the annual payments to be made by the corporations which have entered into contracts with the Commission shall apply to a contract entered into under this Part. 10-11 Geo. V, c. 18, s. 5, part. *Application of Part I as to annual payments.*

30j. Where any person receiving a supply of electrical power or energy in a rural power district is in default of payment of any account due in respect of such supply, the Commission may notify the corporation of the municipality in which the premises of the person so in default are situate stating the amount due and such amount shall thereupon be entered upon the collectors' roll of the municipality and collected in the same manner as other taxes. 10-11 Geo. V, c. 17, s. 5, part. *Collection of rates in arrears*

The Rural Hydro-Electric Distribution Act, 1921

11 GEORGE V, CHAPTER 21

As amended by 12-13, Geo. V, c. 32

An Act to make more Equal Provision for the Cost of Hydro-Electric Power in Ontario

HIS MAJESTY, by an with the advice and consent of the Legislative Assembly of the Province of Ontario, enacts as follows:—

1. This Act may be cited as THE RURAL HYDRO-ELECTRIC DISTRIBUTION ACT, 1921. 11 Geo. V, c. 21, s. 1. *Short title.*

2. There shall be established a fund to be known as The Hydro-Electric Power Extension Fund, hereinafter called the Fund, and the Treasurer of Ontario shall open in the books of the Province an account to be known as The Hydro-Electric Power Extension Fund Account. 11 Geo. V, c. 21, s. 2. *Fund account.*

3. There shall be placed to the credit of the said fund in such account annually at such time as the Lieutenant-Governor in Council may direct:— *Amounts to be placed annually to credit of fund.*

(a) A sum equivalent to the total amount falling due to the Province from the rentals of water powers since the 1st day of January, 1918, but not including rentals falling due under agreements entered into by the Commissioners of the Queen Victoria Niagara Falls Park for the development of power within the park; *Equivalent of rentals of water powers.*

(b) A sum equivalent to the revenue derived from the rentals payable or collectable under the several agreements between the Commissioners of the Queen Victoria Niagara Falls Park and certain companies developing power in the Queen Victoria Niagara Falls Park after deducting any sums required to meet the charges and payments referred to in sections 21 and 23 of THE QUEEN VICTORIA NIAGARA FALLS PARK ACT; *Equivalent of revenue from rentals re Niagara Falls Park.*

(c) Such additional sums as may from time to time be voted by the Legislature of the Province of Ontario for the purposes hereinafter mentioned. 11 Geo. V, c. 21; s. 3. *Additional sums voted.*

4. Where power is supplied to a rural power district under the provisions of THE POWER COMMISSION ACT and amendments thereto*, there may be paid† to the municipality or commission distributing the power in such rural power district upon the recommendation of The Hydro-Electric Power Commission of Ontario and the order of the Lieutenant-Governor in Council, a sum not exceeding fifty per cent of the capital cost of constructing and erecting in the rural power zone primary transmission lines and cables required for the delivery of power in such rural power district. 11 Geo. V, c. 21, s. 4. *Where power supplied to rural power districts.*

4a. Where the corporation of a town or of an urban municipality supplies or distributes electrical power or energy within any such rural power district there may be paid† to such corporation upon the recommendation of the Hydro-Electric Power Commission of Ontario, and the order of the Lieutenant-Governor in Council a sum not exceeding fifty per cent of the capital cost of constructing and erecting in the rural power district primary transmission lines and cables required for the delivery of power or energy in such rural power district. *Payment of grant where municipality is distributor of power.*

5. The grant made under this Act shall be payable out of the Consolidated Revenue Fund, and the sums required to be credited to the Fund shall be chargeable to the Consolidated Revenue Fund, and every grant of money made under this Act shall be debited to the Fund in the said account and the said account shall be so kept that at all times it shall show the amounts properly credited to the Fund as provided by section 3 and all amounts chargeable thereto. 11 Geo. V, c. 21, s. 5. *Grant, how payable.*

6. The Lieutenant-Governor in Council may make regulations for the better carrying out of the provisions of this Act. 11 Geo. V, c. 21, s. 6. *Regulations.*

7. This Act shall come into force on the 1st day of June, 1921. 11 Geo. V, c. 21, s. 7. *Commencement of Act.*

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*S. 30 (e).

†Payments and allowances authorized by sections 4 and 4a may be made in respect of works constructed before or since the 1st day of June, 1921. 12-13 Geo. V, c. 32, s. 3.

The Utilization of Power in the Pulp and Paper Industry

R. W. Leeper,
Power Engineer, H. S. Taylor, Consulting Engineer, Montreal, Que.

In the production of pulp and paper an adequate supply of power is almost equal in importance to that of raw materials. The importance of any item entering into a manufacturing or conversion operation can usually be measured by the quantity required per dollar of product. In this respect, the use of power in the paper industry ranks among the highest and is possibly not exceeded in any industry, except those of aluminum or steel.

For brevity, the term "pulp and paper mills" will be used to include pulp mills, pulp and paper mills, and paper or conversion mills.

In Canada, the bulk of the paper produced is newsprint, which consists of approximately 80 per cent mechanical pulp or groundwood, which gives to the sheet its ability to absorb quickly the ink when run through a modern high speed printing press, and 20 per cent chemical or sulphite pulp, which is necessary for the requisite strength. (See plate No. 1.)

Mechanical pulp requires for its production about 75 h.p., per daily ton of 2,000 pounds, chemical pulp about 22 h.p. The actual conversion or paper making process adds from 15 to 25 h.p., so that for a mill for the manufacture of newsprint, complete within itself, from 90 to 100 h.p., per daily ton are average figures for power consumption. (See plate No. 1.)

The cost of power for the pulp and paper industry in Canada varies quite widely according to locality and conditions. A large proportion of the power used is purchased from water power companies, this having the advantage of relieving the manufacturer of large capital expenditure for generating plant, and such purchased power varies under existing contracts from $15. to $25. per horsepower-year. On the other hand, many large manufacturers locate on water power sites and generate their own power and since this eliminates both profit and transmission the cost may be considerably below even $15. In the average 100 ton complete newsprint unit, these power costs of $15. to $25. per horsepower-year represent about $5.00 to $8.35 per ton of product.

Turning to power plants using coal or oil fuel, it has been found by averaging the results secured in several representative plants that the cost per horsepower-year is about $75., the greater cost in comparison with hydro-power being due to fuel and increased labour charges. There are, of course, a few plants using wood refuse under the boilers in which the steam so generated can be used for power purposes. Such mills are, however, limited as to number and capacity.

It is indicated by the foregoing that the relationship of the cost of power to the selling price of paper renders essential an ample supply of cheap power and the industry, therefore, has been in the past, and undoubtedly will be in the future, dependent upon hydraulic energy either directly applied through water wheels to the equipment to be driven or through the medium of electricity.

The Dominion is particularly fortunate in having in close proximity to areas covered with wood suitable for pulp or paper making, large water powers, the greater portion being as yet partially or entirely undeveloped. (See plate No. 2 and plate No. 3.) According to the most reliable estimates available the developed power used in the paper industry is but about 2 per cent of the commercial power remaining to be developed, and in the future this undeveloped power will certainly play a most important part, not only in the development of this essential industry, but of Canada as well. (See table No.1.)

A Large Canadian Pulp and Paper Mill with Hydro-electric Installation.

Table No. 1, — Water Power by Provinces

Province	Available h.p. at ordinary Minimum flow (Estimated)	Used h.p. (By paper mills)
Quebec	6,915,244	368,352
Ontario	4,950,300	271,174
British Columbia	1,931,142	55,140
New Brunswick	50,406	14,378
Nova Scotia	120,751	17,331
Prairie Provinces	4,259,253	....
Totals	18,127,096	726,375

of which the power used is divided as follows:

Hydro-electric purchased	228,755 h.p.
Hydro-electric produced by mill	210,053 "
Direct mechanical drive	287,567 "

The growth of the paper industry in Canada may be considered phenomenal. Since 1908, the first year for which records are available, to and including 1922, the yearly production of pulp, (both groundwood and chemical), has increased approximately six times, to a grand total for 1922 of 2,150,251 short tons. During the same period the groundwood production has increased about 4½ times. The power consumption has of a necessity increased in about the same proportion, which represents an approximate increase of 100 per cent every seven years. (See tables Nos. 2 and 3.)

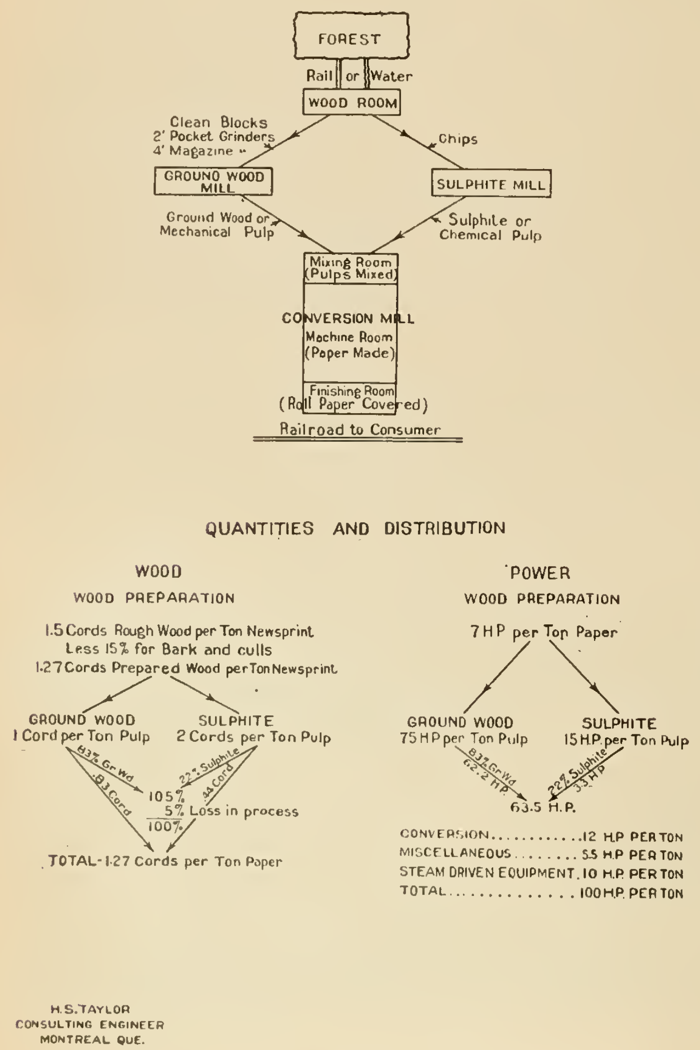

Plate No. 1,—Progress Diagram, Newsprint Mill.

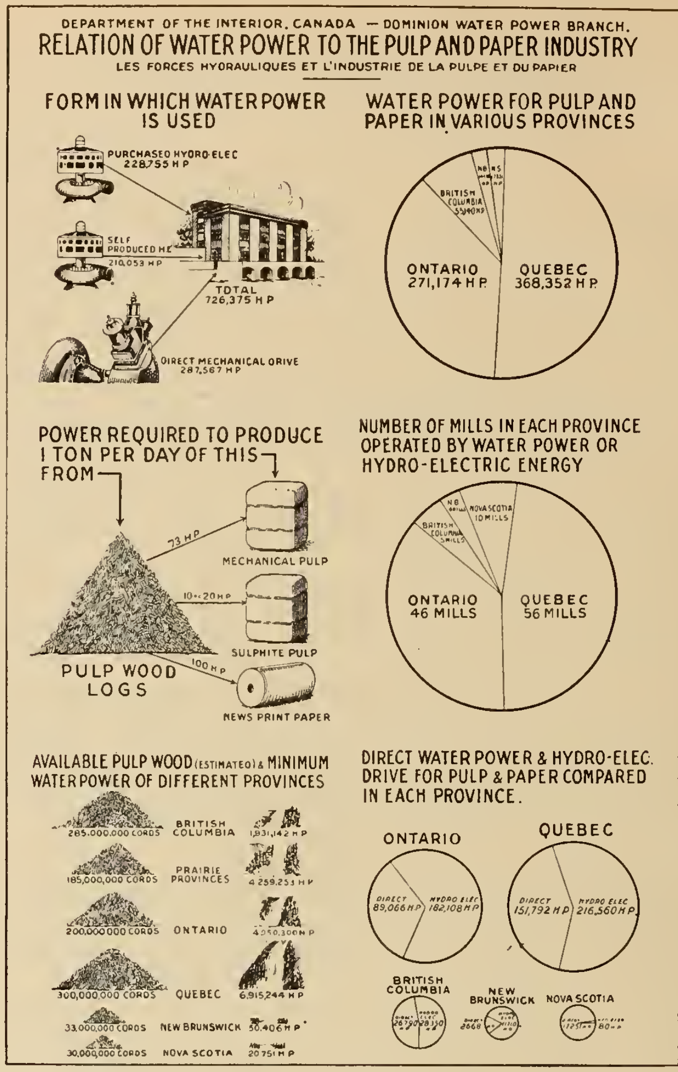

Plate No. 2,—Relation of Water Power to the Pulp and Paper Industry.

Table No. 2. — Daily Production, Short Tons (Water Power)

Province	No. Mills	H.P. Rec'd	Mechanical Pulp	Chemical Pulp	News-print	Paper Exclusive Newsprint
Quebec	56	368,352	3,000	1,500	1,400	740
Ontario	46	271,174	2,200	1,800	1,900	735
British Columbia	5	55,140	390	430	445	30
New Brunswick	4	14,378	30	300	—	—
Nova Scotia	10	17,331	200	—	50	—
Totals		726,375	5,820	4,030	3,795	1,505

Table No. 3. — Yearly Pulp Production, Short Tons

Pulp	1920	1921	1922	1923
Mechanical	1,090,114	931,560	1,241,185	Not available as of Feb. 10th.
Sulphite	675,773	481,984	678,878	
Sulphate	188,487	131,337	217,862	
Soda	5,768	4,201	793	
News	875,696	805,134	1,081,364	1,263,000
Book and writing	73,196	53,530	64,808	Not available as of Feb. 10th.
Kraft	77,292	55,898	81,793	

At present about 40 per cent of the hydraulic energy is supplied through the medium of direct connected water wheels, together with some form of mechanical drive consisting of a system of line shafting, gears and belts. This is not only inefficient but objectionable for various reasons. The mill must be located at the power site even though entirely unsuited from a manufacturing standpoint; the mill buildings must be arranged with reference to power supply; the capacity of the unit is limited to the power available.

As electrical equipment was developed suitable for the service demanded, motors superseded the direct connected water wheel drive in nearly all of the newer developments, until to-day electrical energy, either generated by the mill or purchased, supplies about 60 per cent of the total power consumed. (See table No. 1.)

The advantages of electric drive in a paper mill are many; the mill may be located at the most advantageous point from a manufacturing and shipping standpoint; the equipment is driven at a more uniform speed, which means a better product and increased production; the size of the unit is not limited to the power available from one source. The mill can be designed to comply strictly with manufacturing conditions. To-day electricity possesses so many advantages, that except under the most favourable conditions, it is universally admitted that the power should be developed electrically and applied through the medium of motor drive in the mill.

Electricity in the form of power first became a factor in the pulp and paper industry on this continent about 1900 — and during subsequent years the growth has been remarkable. From the first major installation of less than one thousand kilowatts capacity, the demand of the individual mill has increased until at present there are several installations of approximately ten thousand kilowatts capacity, and a few still larger, the average capacity being far in excess of the first important development. This advancement can be attributed principally to the two following reasons:—

First: Power could be electrically distributed and applied throughout the mill with greatly increased economy over former methods.

Second: The development of electrical equipment suitable for the service.

In the manufacture of pulp and paper as in other commodities, there is an insistent demand for increased production per unit, which has led to three new developments of exceptional interest, that in a very few years have become essential to the industry, and which are large consumers of electricity in the form of power; the magazine pulp grinder, the sectionalized individual paper machine drive, and the electric boiler.

The first wood pulp grinder was patented in 1847, and about 1852 the first practical grinder was built. About 1910 the first magazine grinder was built, and in 1913 it was introduced on this continent. The production of the first grinder was about ½ ton per 24 hours, that of the most modern type of magazine grinder 22 tons, the average production per stone of the hydraulically operated pocket grinder being from 7 to 8 tons. The development of the magazine grinder, therefore, marked a distinct step forward in production. It may be added, however, that the horse power per ton is practically the

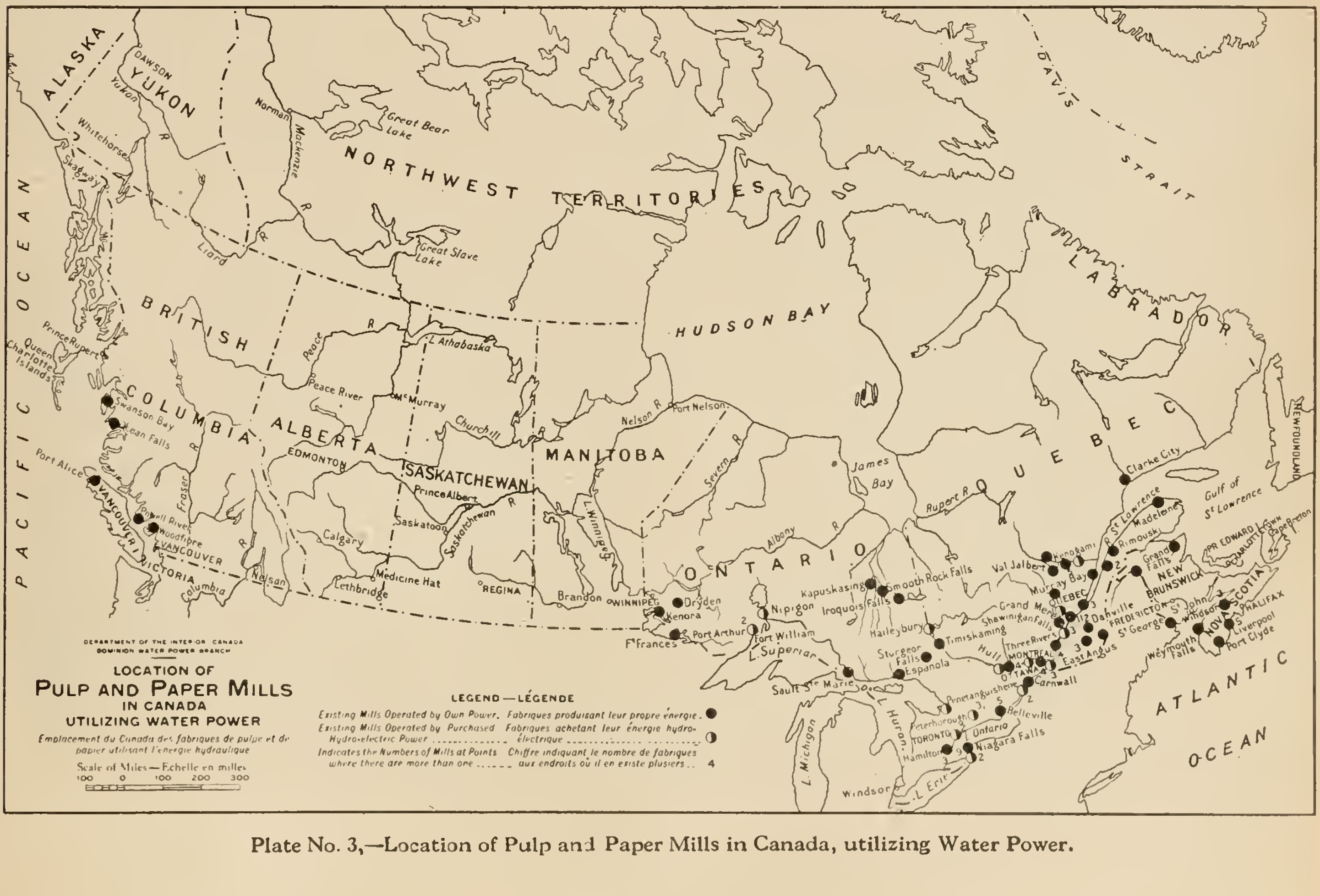

Plate No. 3,—Location of Pulp and Paper Mills in Canada, utilizing Water Power.

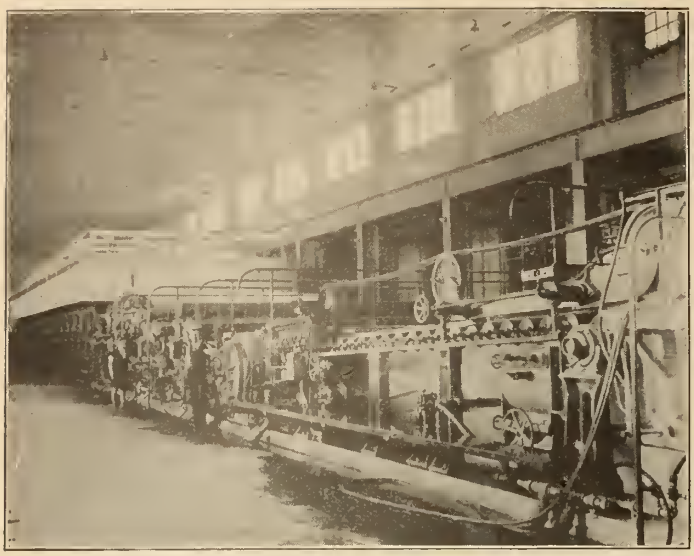

Plate No. 4,—Magazine Grinders

same for either the pocket or magazine type of grinder for the same grade of pulp, the power consumption per stone for the former being about 500 h.p., as compared to 1,400 h.p. for the latter.

In the earlier mills grinders were almost universally driven by direct connection to water wheels, and while this arrangement is unquestionably efficient, its disadvantages more than offset the saving from either an efficiency or initial cost standpoint. In the more modern mills, motors have generally been used, due in so small part to the development of synchronous motors of high rating, suitable for the service to be performed. (Plate No. 4, — Magazine Grinders.)

Before the advent of the sectionalized motor drive for paper machines, the demand was for higher and still higher machine speeds, increased production and lower operating costs. With this demand the problem of maintenance and successful operation of the variable speed drive became more and more serious until the limits of the types in use were reached. For years electrical manufacturers had been experimenting with various schemes by which it was proposed to drive each section of a paper machine with an individual motor. The problem was exceedingly difficult on account of the close regulation required between sections, often over a wide range in speed. It can now be said that the problem is solved as there are to-day in successful operation three different types of sectional individual drives. With this development there is in sight no practical limit to the speed at which a machine can be operated in so far as the drive is concerned. (Plate No. 5, — Sectionalized Individual Paper Machine Drive.)

In the pulp and paper mill steam is required in fairly large quantities, for cooking, drying and heating. The manufacture of chemical pulp requires about 8,000 pounds of steam per ton, the drying process at least 3 pounds per pound of paper produced, heating a varying amount depending upon climatic conditions, but averaging for many mills from one to two pounds per pound of paper made during heating season. A boiler plant is therefore an essential part of each installation. There is generally a certain amount of refuse, possessing a limited heating value, but in addition, to produce the required amount of steam, many tons of coal or barrels of oil must be burned.

To meet this demand for steam, where considerable quantities of surplus and off-peak hydro-electric energy are available, an electric boiler has been developed within the last few years and units totalling over 150,000 h.p., have been placed in operation in Canada, in addition to a considerable number in the United States.

The normal development of hydro-electric plants is such that almost all the total cost of development such as dams, excavations, power house sub-structure, have to be constructed initially, the only varying quantities being the number of wheels and generating units together with their switchboards, etc., which can be installed from time to time as the demand for power warrants their completion.

Where there is a power market such as these steam boilers, which have a low capital cost and can be used together with fuel-fed boilers, it frequently is possible to complete more of the power house than is warranted by existing demand, under an arrangement by which as the industrial power load grows, the power supply to these electric boilers can be reduced. There is again surplus power available on Sundays which can be very readily used on these boilers, and also some seasonal fluctuations in some of the rivers which can be turned into steam.

As one pound of coal is roughly equal to 3 k.w.hrs. from the heating point of view, it is evident that with coal at $10.00 a short ton, electricity must be available at ⅓ of a cent per k.w.hr.

The electrical boiler, however, can be installed at less cost than either an oil or coal fired plant, the attendance and repair items are less, and it can be used where power otherwise wasted is available. With the development of water powers in Canada especially for paper mills, or where it will be mainly used by them, the amount used for steam generation will unquestionably increase. These boilers are described and illustrated in the section of the symposium on utilization of power devoted to electro chemical and metallurgical uses of power.

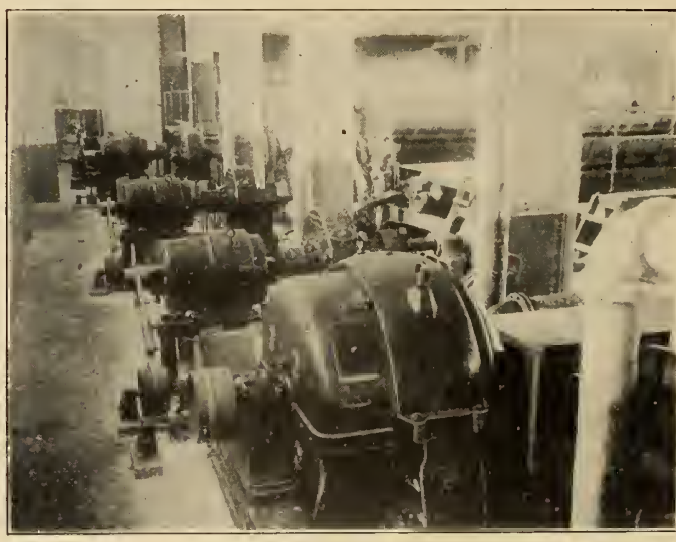

Plate No. 5, — Sectionalized individual Paper Machine Drive.

The Use of Power in the Mineral Industries of Canada

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Before discussing the use of power in the mineral industries of Canada it is desirable to review briefly the size, nature and distribution of those industries.

The "mineral industries" must be taken to include all branches of mineral production, first because statistics on this subject, while including some processes of a manufacturing nature, are kept separate from those included in the general "Census of Manufactures", and second because it is impossible in many cases to differentiate between "mining" and "metallurgy". For instance, the concentrating, amalgamating and cyaniding of gold ores, the reduction of copper and nickel ores and the amalgamation of placer gold are so intimately connected with the production of the ore in a state for shipment that no distinct division for statistical purposes can be made.

Principal Divisions of the Industry

There are 60 principal items included in the three main divisions of the mineral production of Canada, i.e., metallic 17, non-metallic 27, structural materials and clay products 16. Seventeen of the 60 items had in 1923 a production value of $1,000,000 each or over and these in order of value are:—

1. Coal
2. Gold
3. Nickel
4. Portland cement
5. Copper
6. Silver
7. Clay products
8. Lead
9. Asbestos
10. Natural gas
11. Stone
12. Zinc
13. Lime
14. Cobalt
15. Sand and gravel
16. Gypsum
17. Salt

Size of the Industry

It is not possible to summarize briefly the amount or quantity of output on account of the different measures employed for different products, such as tons, gallons, barrels, bushels, cubic feet, etc. The value of output has been subject to fluctuations due to conditions succeeding the war but may be fairly represented by the average of the 5 years 1919 to 1923. The size of the industry and its distribution by provinces is summarized in the following tables:—

Table No. 1, — Annual Mineral Production of Canada

Year	Value of production	Value per capita
1910	$106,824,000	$14.93
1911	103,221,000	14.32
1912	135,048,000	18.33
1913	145,635,000	19.35
1914	128,863,000	16.75
1915	137,109,000	17.44
1916	177,202,000	22.05
1917	189,647,000	23.18
1918	211,302,000	25.37
1919	176,686,000	20.84
1920	227,860,000	26.40
1921	171,923,000	19.56
1922	184,297,000	20.57
1923	214,020,000	23.40
Increase per cent	100%	57%
Average value for last 5 years	$194,957,000	$22.15

Plate No. 1,—Hydro-Electric Development of Granby Consolidated Mining, Smelting and Power Company at Anyox, British Columbia, 13,400 horse power.

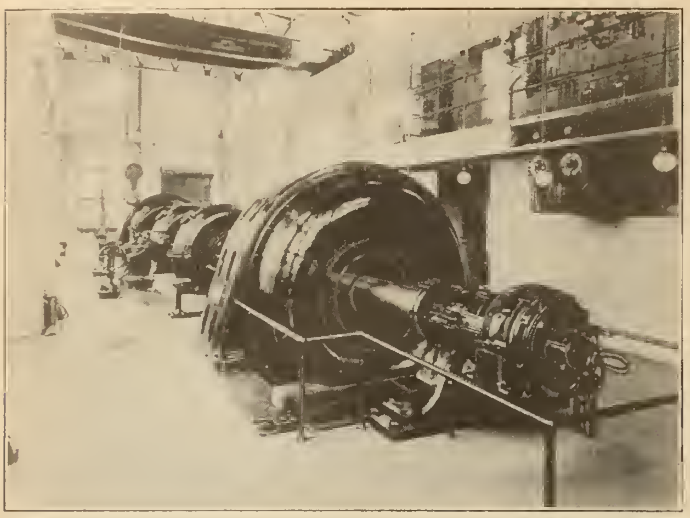

Plate No. 2,—Hydro-Electric Installation of Canadian Collieries (Dunsmuir) Limited on the Puntledge River, British Columbia, 12,000 horse power.

It will be observed that the value of production, since the first reaction in 1921 after the war, has recovered to nearly the peak of the war-period value. Concerning this the Dominion Bureau of Statistics states that:—

"Commodity prices, which reached a peak in 1920, have since receded and this fact must be borne in mind when production is computed in terms of values. A weighted index showing the volume of production would undoubtedly mark 1923 as the banner year in Canada's mineral industry. New output records were established for coal, lead, zinc, asbestos and the value of cobalt."

The value of production by provinces for 1923 stands thus:—

Table No. 2, — Annual Mineral Production by Provinces

Province	Value of production 1923	Per cent of total	Largest items 1921
British Columbia	$ 44,143,000	20.6	Coal, copper, lead.
Yukon	2,642,000	1.2	Gold, silver, lead.
Alberta	31,647,000	14.8	Coal, natural gas, clay products.
Saskatchewan	1,350,000	0.6	Coal, clay products.
Manitoba	1,754,000	0.8	Gypsum, clay products, lime.
Ontario	79,917,000	37.4	Gold, nickel, silver.
Quebec	19,827,000	9.3	Asbestos, cement, clay products.
New Brunswick	2,206,000	1.0	Coal, gypsum, lime.
Nova Scotia	30,534,000	14.3	Coal, gypsum, stone.
	$214,020,000	100.0	

Table No. 3, — Mineral Production by Classes, 1923

Metallic	$ 84,188,000	39.3%
Coal	73,504,000	34.4%
Non-metallic other than coal	19,335,000	9.0%
Structural materials and clay products	36,993,000	17.3%
	$214,020,000	100.0%

Capital Invested

The total capital invested in the mineral industries at the present time is estimated to be not less than $800,000,000, divided as to the source of capital approximately thus:—

		Per cent
Canada	$446,000,000	55.8
United Kingdom	100,000,000	12.5
United States	220,000,000	27.5
Other countries	34,000,000	4.2
	$800,000,000	100.0

Power Used in the Mineral Industry

The following table shows the horse power used in the principal divisions of the industry and the power of each kind in each division, as at January 1st, 1924:—

Table No. 4, — Total Power Used

	Fuel power	Water Power		Total power	Per cent
		Generated	Purchased		
Metallic mining	32,700	26,000	111,700	170,400	33.2
Coal mining	160,900	15,300	15,000	191,200	37.2
Non-metallic	29,500	1,100	62,200	92,800	18.1
Structural materials and clay products	12,800	2,000	44,300	59,100	11.5
Totals	235,900	44,400	233,200	513,500	100.0

The relation of primary power installed at the mines, quarries, etc., and purchased power, may be shown thus:—

Installed Power and Purchased Power

			Per cent
Primary power installed:			
Fuel power	235,900 h.p.		
Water power	44,400 h.p.		
		280,300 h.p.	54.6
Purchased power (all water power)		233,200 h.p.	45.4
		513,500 h.p.	100.0

Proportions of Water and Fuel Power

	H.P.	Per cent
Water power	277,600	54
Fuel power	235,900	46
	513,500	100

Proportion of Fuel Power

	Per cent
Steam	96.3
Gas	2.0
Oil	1.7
	100.0

The total power used in the industry is over 500,000 h.p. and 54 per cent of this is water power.

Examples of Power Supply

Table No. 5 gives examples of power supply to some of the mines requiring over 1,000 h.p. The intention is to illustrate the blocks of power used but the table by no means includes all the companies that could be listed.

The Principal Mineral Industries

Canada contains 16 per cent of the world's known coal reserves, is the third largest gold producer and has the greatest asbestos, nickel and cobalt deposits in the world. All the provinces except Prince Edward Island have large mineral resources and it is an outstanding factor that in all the mineral-bearing areas, except in parts of the coal fields, there is ample water power available for their development.

Below are given brief details of some of the principal mining industries. A tabulation is given in each case from which can be seen the minerals mined in each province and the production. To this has been added particulars of exports and imports to indicate how production compares with home requirements and particulars, where possible, of the capital invested and power used.

Asbestos

The production is entirely in Quebec but during the year a test shipment was made from a newly developed deposit in Deloro township, Ontario. The total produc-

Table No. 5, — Examples of Power Supply to Mines Requiring over 1,000 h.p.

(Those not otherwise specified are water power)

Mineral	Supplied by	Supplied to	H.P. supply or capacity
	British Columbia		
Copper	Granby Mining, Smelting & Power Co	Granby Mining, Smelting & Power Co	13,200
Gold	Surf Inlet Power Co	Surf Inlet Mining Co	1,200
Copper	Britannia Mining & Smelting Co	Britannia Mining & Smelting Co	19,100
Copper	B.C. Electric Railway Co	Britannia Mining & Smelting Co	6,000
Coal	Canadian Collieries Ltd	Canadian Collieries Ltd	12,000
Copper, etc.	West Kootenay Power & Light Co	Consolidated Mining & Smelting Co. and others	40,660
Coal	Crow's Nest Pass Coal Company, (*steam power*)	Crow's Nest Pass Coal Company	4,875
	Yukon		
Gold	The New Northwest Corporation Ltd	Various companies	9,700
Gold	Yukon Gold Co	Yukon Gold Co	3,180
	Alberta		
Coal	West Canadian Collieries Ltd., (*steam power*)	West Canadian Collieries Ltd	1,200
Coal	International Coal & Coke Co., (*steam power*)	International Coal & Coke Co	2,250
Coal	Hillcrest Collieries Ltd., (*steam power*)	Hillcrest Collieries Ltd	1,080
	Ontario		
Iron and gold	Algoma Power Co	Various companies	1,600
Iron	Algoma Steel Corporation	Algoma Steel Corporation	2,600
Nickel, copper	Lorne Power Co	Mond Nickel Co	9,600
Nickel	International Nickel Co	International Nickel Co	21,300
Talc	H.E.P. Com. of Ontario	Various companies	3,500
Gold	Associated Gold Fields Ltd	Associated Gold Fields Ltd	1,600
(Gold, silver	Northern Ontario Light & Power Co	Various companies	16,335
(Cobalt, etc.	Northern Ontario Light & Power Co	Various companies	5,500
Gold, silver, etc.	Northern Canada Power Co	Various companies	19,800
Nickel	British America Nickel Corporation (*steam power*)	British America Nickel Corporation	6,000
	Quebec		
Asbestos	Shawinigan Water & Power Co	Various companies	10,000
Asbestos	St. Francis Water Power Co	Various companies	3,360
Copper	Southern Canada Power Co	Various companies	1,185
Nickel & copper	Ottawa and Hull Power & Manufacturing Co	British America Nickel Corporation (Deschênes)	5,000
	Nova Scotia		
Gold	Bradford Mines Ltd	Bradford Mines Ltd	1,600
Coal	Acadia Coal Co. Ltd., (*steam power*)	Acadia Coal Co	9,000
Coal	Nova Scotia Steel & Coal Co., (*steam power*)	Nova Scotia Steel & Coal Co	5,280

tion in 1923 was 233,000 tons, a value of $7,500,000 at the mill. Exports were worth nearly $9,000,000 and imports $700,000.

The asbestos mines occur in the Eastern Townships of Quebec, south of the St. Lawrence and employ approximately 15,000 h.p.

Coal

The production of coal in 1923 was:—

Province	Production		Value
	Quantity—Tons	Per cent	
Alberta	6,848,000	40.4	$28,279,000
Nova Scotia	6,596,000	38.8	29,153,000
British Columbia	2,823,000	16.6	14,088,000
Saskatchewan	440,000	2.6	919,000
New Brunswick	277,000	1.6	1,065,000
	16,984,000	100.0	$73,504,000

The production was slightly in excess of the previous record in 1920. The exports were 1,654,000 tons, — the imports 22,687,000 tons or 57 per cent of the total consumption. Yukon produces a few hundred tons per annum. The capital employed in 1921 was $174,000,000. The power employed in the industry is over 190,000 h.p.

The Use of Water Power for Coal Mining

It would at first sight appear that coal mines are not a very favorable field for the use of water power since they have available for power production the inferior and waste coal that would otherwise go on the dump. The coal required for power may however run to as much as 10 per cent of the total output and the

Plate No. 3,—Hydro-Electric Power Station and Concentrating Mill of Britannia Mining and Smelting Company, Limited, Britannia Beach, British Columbia, 15,000 horse power.

Plate No. 4,—Hydro-Electric Development of International Nickel Company of Canada, Limited, at High Falls on the Spanish River, Ontario, 13,800 horse power.

advantages claimed for purchased power include reduction of fixed charges on the investment; reduction on costs of labour, superintendence, repairs and maintenance; increased flexibility of the energy supply, fixed power costs under long term contracts and additional coal made available for sale.

The following are examples of the application of water power to coal mining in Canada:—

Canadian (Dunsmuir) Limited collieries in Vancouver Island, have been entirely operated by hydro-electric power during the past eight years and no coal is now used except for shunting locomotives. Two 6,000-h.p. water turbines are installed and there are 35 miles of transmission lines to operate the various collieries of the company. The power plant accounts are kept separately and the mines are charged one cent per k.w.hr. Previous to electrification 10 per cent of the output of coal was used to produce power; this portion was valued at $2.00 per ton and required 42 firemen. The cost for coal and labour alone was $10,000. per month, the present cost with water power, including maintenance, is under $2,000. per month.

The East Kootenay Power Company of British Columbia supplies hydro-electric power to all the coal mines operating in its district, the Hillcrest Collieries, the Crow's Nest Pass Coal Company, the International Coal and Coke Company, the Corbin Coal and Coke Company, McGillivray Creek Coal and Coke Company and the Western Canadian Collieries.

Copper

Copper has been produced in Quebec, Ontario, Manitoba, British Columbia and Yukon. Quebec produced 2,692,000 pounds in 1919 but this fell to 352,000 in 1921 and none since; Manitoba produced 3,348,000 pounds in 1919, somewhat less in 1920 and none since; Yukon produced 278,000 pounds in 1920 and none since.

In 1923 the production was:—

	Pounds	Value
British Columbia	56,360,000	$ 8,128,000
Ontario	31,582,000	4,554,000
	87,942,000	$12,682,000

this being about double the total output for Canada for the preceding year.

In addition to Canadian production, over $8,000,000 worth was imported. Recent tariff changes provide for a bounty of 1½ cents per pound on copper bars and rods produced in Canada.

As copper and nickel are in some cases produced from the same ore the industries are intimately interwoven. In 1921, the latest year for which complete statistics are available, the total capital employed was $45,000,000.

Amongst the large power users in British Columbia are the Britannia Mining and Smelting Company, using about 25,000 h.p., the Granby Mining, Smelting and Power Company, 13,000 h.p., and in Ontario the Mond Nickel Company, producing nickel-copper ore, some 10,000 h.p.

Gold

The production of gold in 1923 was:—

Province	Production		Value
	Quantity—Oz.	Per cent	
Ontario	971,340	79.38	$20,079,320
British Columbia	191,180	15.63	3,952,040
Yukon	60,020	4.90	1,240,800
Quebec	630	0.05	13,100
Manitoba	30	0.01	620
Nova Scotia	400	0.03	8,190
	1,223,600	100.0	$25,294,070

The exports were worth nearly $4,000,000 and the imports $47,000. The production was slightly less than in 1922 but this was due to a shortage of power in northern Ontario, now remedied. It is stated that promising discoveries have been made in Quebec adjacent to the gold districts of Ontario and that it is quite probable that Quebec will soon become an important producer.

Some notes on power consumption for gold and silver mining are given under the head of "silver".

Lead

The production in 1923 was:—

Province	Production		Value
	Quantity—Lbs.	Per cent	
Quebec	520,000	0.5	$ 37,000
Ontario	4,559,000	4.1	327,000
British Columbia	99,473,000	89.8	7,141,000
Yukon	6,178,000	5.6	444,000
	110,730,000	100.0	$7,949,000

There were 55,000,000 pounds exported and about 3,500,000 pounds imported. The production was 19 per cent above that of the previous year.

Nickel

The production in 1923 was 62,454,000 pounds valued at $18,322,000, three times as much as in the preceding year. The exports were 51,869,000 pounds valued at $8,726,000; none was imported.

About 85 per cent of the world's nickel supply is mined in the Sudbury district, Ontario, by the following companies:—

The International Nickel Company of Canada Limited. The company has been established twenty years and has two hydro-electric plants totalling 21,300 h.p. to operate its mines and smelter at Copper Cliff, about 27 per cent being used for mining and 63 per cent for smelting. The refinery is at Port Colborne and uses a smelting process requiring about 1,500 h.p., but considerable quantities of matte are exported to Virginia to be made into Monel metal. All the refined nickel produced by this company is now made in Canada, its plant in New Jersey being dismantled.

The Mond Nickel Company, Coniston. Established twenty years. This company controls the Lorne Power Company which has two hydro-electric plants with 9,600 h.p., and supplies the Mond Company with power in bulk for mining and smelting. The company has five mining and reduction plants and the matte is all shipped to Wales.

The British America Nickel Corporation. This company has been established four years and its mines and smelter require 6,000 h.p. The company operates its own steam plant with coal but it expects to replace most, if not all of this, with water power in the near future. The refinery, at Deschênes, Que., is operated by an electrolytic process and power is obtained in bulk from the Ottawa and Hull Power and Manufacturing Company; 7,000 h.p., is contracted for and 5,000 h.p., is being used.

Silver

The production of silver in 1923 was:—

Province	Production		Value
	Quantity—Oz.	Per cent	
Quebec (in ores exported)..	29,563	—	$ 19,178
Ontario..................	10,285,247	58	6,672,348
Manitoba and Nova Scotia.	19	—	12
British Columbia..........	5,964,095	34	3,869,087
Yukon (in placer gold and in ores exported)...........	1,475,782	8	957,383
	17,754,706	100	11,518,008

There were 17,000,000 ounces exported and approximately 1,540 ounces imported. The production was about the same as for the preceding year.

Amongst the large power users for silver and gold mining are the Surf Inlet Power Company, B.C., 1,200 h.p.; the Bradford Mines Limited, N.S., 1,600 h.p.; the Great Northern Power Company, 4,000 h.p.; the Associated Gold Fields Limited, Ont., 2,000 h.p.; the Yukon Gold Company, 3,180 h.p.; the Northern Ontario Light and Power Company supply over 16,000 h.p., to various companies, the Northern Canada Power Company over 19,800 h.p., and the Canadian Klondyke Company nearly 10,000 h.p.

Zinc

The production in 1923 was:—

Province	Production		Value
	Quantity—Lbs.	Per cent	
British Columbia..........	60,050,000	99	$ 3,989,000
Quebec....................	318,000	1	....
	60,368,000	100	$ 3,989,000

There was $2,500,000 worth exported and $500,000 imported. The production exceeded that of the previous year by 7 per cent in quantity and 24 per cent in value. Nearly the whole production was from British Columbia and concerning this the Dominion Bureau of Statistics states that:—

"During the year the new concentrator of the Consolidated Mining and Smelting Company at Kimberley, B.C., was completed and put in operation. The solution of the metallurgical problems involved in the treatment of the complex ores of the Sullivan mine by the staff of this company has been a truly wonderful achievement and it may be said that, due entirely to their efforts, an enormous tonnage of a mineral aggregate with doubtful value has become a great Canadian natural resource."

Plate No. 5,—Hydro-Electric Development of Mond Nickel Company at Nairn Falls on the Spanish River, Ontario, 4,800 horse power.

The Importance of Water Power in the Mining Industry of Canada

Canada may be divided into five main mineral areas, *I* the Maritime Provinces; *II* Quebec; *III* Ontario; *IV* the Prairie Provinces, and *V* British Columbia and the Yukon; and in each of these the influence of the abundant supplies of hydraulic energy advantageously situated, is making itself felt. This is particularly the case in the provinces of Ontario and Quebec, which, being situated in the acute fuel area of Canada, would be almost entirely dependent upon imported coal were it not for hydraulic power. In many cases large-scale operation, which alone marked the difference between profit and loss, would be impossible without the hydraulic energy furnished at relatively low cost to the various mining fields. Many mines on account of their geographical location would find the cost of rail haul on coal or untreated ore prohibitive, but with hydraulic power profitable operation has been possible. Even that phase of super-economy, the generation of electricity from fuel at the pit head, has been abandoned by one coal mining company in favour of hydro-electric energy which has to be transmitted over 20 miles from the generating station; while a considerable number of others have made contracts with central stations for supplies of hydro-electric power.

From estimates made by the Dominion Water Power Branch, Department of the Interior, Ottawa, it is computed that at January 1st, 1924, the hydraulic installation for mining purposes in Canada had reached a total of 277,600 h.p., of which 44,400 h.p. is installed by the mines themselves, and 233,200 h.p. is purchased from central electric stations. A conservative estimate of the capital investment necessary to develop this power is $74,000,000.

Maritime Provinces

Based upon value of product, approximately 90 per cent of the mining carried on in the Maritime Provinces is for the recovery of coal and water power has not yet been utilized for this purpose. In Nova Scotia, however, there are three hydro-electric developments operated by gold mining companies, their installation being 1,600 h.p., 425 h.p. and 30 h.p. respectively.

Quebec

The mineral output of the province of Quebec at the present time is mainly non-metallic, the leading asbestos mines of the world being found in the south-eastern portion of the province. The Shawinigan Water and Power Company supply most of the power used in this field, transmitting it across the St. Lawrence near Three Rivers. Power is also furnished to this field by the St. Francis Water Power Company and the Southern Canada Power Company supply a comparatively small amount of power for copper mining.

Within the last two years prospecting for gold has been actively carried on in Rouyn and adjoining town-ships in Timiskaming county, northwestern Quebec. Important discoveries have been made and large areas staked. Power for the development of this field can be obtained from the numerous rapids and falls of the Quinze and upper Ottawa rivers.

Ontario

Ontario ranks first among the provinces in diversity and value of mineral production and, being situated in the acute fuel area, great advantage to the industry has been derived from the abundant supplies of hydraulic and hydro-electric energy which are available to every field.

The major hydraulic developments for mining are, of course, located in the gold, silver and nickel areas of northern Ontario, where over 107,000 h.p. are installed for this purpose; while several large additional installations are under construction or in contemplation, much of which will be in place by the end of 1924, probably terminating the power shortage which has hampered production in the past. Chief of these new plants will be the 24,000-h.p. station of the Hollinger Consolidated Gold Mines, Ltd., on the Abitibi river, while power will also be available over the recently constructed transmission line of the Northern Canada Power Company from their new 20,000-h.p. station under construction on Quinze river in western Quebec.

Representative companies generating and distributing hydraulic power for mining in northern Ontario are the International Nickel Company with 21,300 h.p. installed in two stations on the Spanish river; the Northern Ontario Light and Power Company with 20,420 h.p. in four hydro-electric stations; and 5,500 h.p. in a hydro-compressed air station in the Cobalt district; the Northern Canada Power Company with two stations totalling 19,800 h.p. near Timmins, while a subsidiary of the latter company has recently installed 4,000 h.p.; the Great Northern Power Company with 4,000 h.p.; the Mond Nickel Company, (Lorne Power Company), with 9,600 h.p. with a prospective addition of 2,750 h.p. in 1924; and the Wanapetei Power Company with 9,900 h.p. There are also a considerable number of smaller organizations distributing power in this area.

In the southern portion of the province mineral production is limited to non-metallics and here the demand for power is met by the extensive transmission systems of the Hydro-Electric Power Commission of Ontario.

The Prairie Provinces

The Prairie Provinces are Manitoba, Saskatchewan and Alberta. Manitoba possesses a comparatively small field of lignite coal. Saskatchewan possesses some 66,000 million tons of lignite and ranks third among the provinces of the Dominion in coal resources; Alberta has anthracite, bituminous and lignite coals, constituting 88 per cent of the total coal resources of the country. No metallic deposits of value had been found in Manitoba and Saskatchewan until comparatively recently when gold was discovered in the northern portions. Even more important than the gold finds have been the copper-zinc sulphide deposits at Flin-Flon and Schist lakes. Hydro-electric power for both these fields may be developed on adjacent power rivers. This area is so far without transportation facilities, and as no local supplies of fuel are found could not be developed profitably without hydraulic energy.

The known coal resources of Alberta are greater than those of any other province and in the past have, as in Nova Scotia, been depended upon to provide power for the industry. Upon the completion of the East Kootenay Power Company's 15,000-h.p. station at Elko, B.C., many of the larger Alberta mines contracted for supplies of hydro-electric power. Among the mines which changed from steam power to hydraulic may be mentioned the West Canadian Collieries at Bellevue and Blairmore; International Coal and Coke Company at Coleman; and Hillcrest Collieries at Hillcrest.

British Columbia and the Yukon

Water power has been extensively developed for mining purposes in both British Columbia and the Yukon Territory, over 81,000 h.p. being installed for that purpose in British Columbia and 13,000 h.p. in the Yukon.

The large-scale operations for the production of zinc-copper and lead carried on in the Kootenay district by the Consolidated Mining and Smelting Company of Canada Ltd., operating such well-known mines as the Centre Star, Le Roi, War Eagle and Josie in West Kootenay, and the Sullivan mines at Kimberley in East Kootenay, are supplied with hydro-electric energy from two plants on the Kootenay river, with a total installation of 38,000 h.p. and one on the Cascade of 3,900 h.p. operated by a subsidiary of the mining company, the West Kootenay Power and Light Company Ltd. Power from these stations is transmitted over 450 miles of line to the various mines and so great is the demand that construction work to provide an additional 30,000 h.p. is at present under way. Power for the Sullivan mines is also being secured from the East Kootenay Power Company.

One of the most important coal mining areas in Canada is that of the Crow's Nest Pass and Elk River district in East Kootenay and here recently completed hydro-electric developments are rapidly replacing coal as a source of power for mining. The East Kootenay Power Company, operating a 7,500-h.p. station on Bull river and a 15,000-h.p. station near Elko, have completed contracts with many of the leading mines of the district, including the Crow's Nest Pass Coal Company, Corbin Coal and Coke Company and the McGillivray Creek Coal and Coke Company. On the Pacific coast the extensive copper and gold areas are supplied with power from a number of important developments. The Britannia Beach Mining and Smelting Company have two developments totalling 19,000 h.p.; the Granby Consolidated Mining Smelting and Power Company, one of 13,200 h.p.; the Hedley Gold Mining Company, one of 1,600 h.p.; the Surf Inlet Company, one of 1,200 h.p.; and there are a large number of smaller installations. Extensive coal mining operations conducted on Vancouver island by the Canadian Collieries Ltd. are supplied with power from a 12,000-h.p. hydro-electric plant operated by the company on Puntledge river.

In the Yukon five water power sites have been developed to supply power for mining, only two of which need be mentioned, viz. that of the New North West Corporation Ltd., with 10,000 h.p. and the Yukon Gold Company with 3,180 h.p.

In conclusion it may be said that there is every indication of the rapidly increasing use of hydraulic power for mining. With the growth of activity which is taking place additional supplies of power must be provided and it is indeed fortunate that latent water power exists in proximity to every mining field with the exception of certain coal-mining areas in the Central Plains.

Summary

A few of the principal facts covered in the preceding pages may be here brought together:

The Value of Production

In 1923 the value of production was $214,000,000 — the average value over the past 5 years $195,000,000. The leading provinces in order of precedence are Ontario, British Columbia, Alberta and Nova Scotia. *(Pages 477 and 478)*.

Progress

The previous record year in value of production was 1920. Prices have fallen since then, but the Bureau of Statistics states that a weighted index probably would show 1923 to be the banner year in value of production, and that new output records were established for coal, lead, zinc and the value of cobalt. (*Page 477*).

Production by Classes

In value of production metallic mining leads, then coal, followed by non-metallic and then structural materials and clay products. (*Page 478*).

Capital Invested

The capital invested now stands at about $800,000,000, of which about 56 per cent is held in Canada, 13 per cent in the United Kingdom, 27 per cent in the United States and 4 per cent in other countries. (*Page 478*).

Power Used

The total horse power used is 514,000 of which 54 per cent is water power and 46 per cent fuel. The proportions of primary power installed and power purchased are about the same. (*Pages 478*).

Principal Mineral Industries

Information showing mineral production by provinces and, as far as possible, the capital invested and power used, is given on *pages 478 to 481*

The Importance of Water Power

In the mineral industry is dealt with on *pages 481 to 483*, which indicate not only that water power replaces fuel wherever it is developed, but also that this low-priced power is essential to the successful exploitation of many of the minerals.

Conclusions

It is claimed that Canada is destined to be the world's greatest mineral producer. The mineral resources already definitely established are so vast that it needs but little investigation to find convincing evidence of this claim. North of the more or less prospected area are still vaster areas which are known to be mineral bearing but which have been prospected but little, and in many cases not at all.

Plate No. 6,—Hydro-Electric Development of the Northern Ontario Light and Power Company, Limited, on the Matabitchouan River, Ontario, supplying power to the Cobalt Silver Mines, 11,000 horse power.

It is of interest to consider why even greater progress has not been made in the past. The mineral wealth of Canada lies mainly in the northern portions of the Dominion, lapping over into the, at present, thinly populated districts and extending far to the north of present settlement. Canada, until recently, was looked upon mainly as an agricultural country; the agricultural land is largely a comparatively narrow strip along the southern border and through this have been built three transcontinental railways, mainly with the object of opening up this agricultural country, but so far but few lines of importance have been built north and south and extended into the mineral fields, those that have been built have brought immediate results in mineral development.

A good example is the Temiskaming and Northern Ontario Railway, running north from North Bay to Cochrane some 250 miles and under process of extension to James bay some 200 miles farther north. This has opened up one of the northern mineral areas and so rapid has been the development that it is now admitted to be one of the richest mineral areas in the world. Other examples are the Algoma Central running north from Sault Ste. Marie and the Hudson Bay Railway through The Pas opening up that and the Flin-Flon districts. It is possible that other lines may be built in the future to the similar areas lying in the north of Quebec, Ontario and the western provinces and that similar results may be expected.

Many of these areas have little or no coal but practically all are known to possess ample and well distributed water powers that will provide in abundance the low-priced power necessary for development of the minerals.

Possessing therefore mineral resources so vast and varied and known water power resources available in practically every area, Canada looks to her mineral development with confidence,

Use of Electric Power in the Cement Industry of Canada

W. G. H. Cam, A.M.E.I.C., A.M.I.E.E.
Electrical Engineer, Canada Cement Company, Limited.

The productive capacity of cement mills in Canada totals about 44,000 barrels or 7,700 tons daily. Hydro-electric power lies behind practically all the cement produced, and it is usual to consider that one horse power per barrel of capacity represents economical usage. Load factors run from 85 to 90 per cent with reasonably good operating.

Kilowatt-hours, per barrel of finished cement, run from 13 to 18 according to the character of the raw materials and the machinery used. The Canadian barrel is 350 pounds, and a mill of 10,000 barrels daily capacity will employ about 300 motors ranging in size from 250 horse power downwards with a total of about 15,000 horse power.

Induction motors are almost exclusively used and squirrel cage rotors up to 175 horse power. A few synchronous motors appear on the list, but they are generally for power-factor corrosion only. Three-phase current at 60 or 25 cycles, and 550 or 440 volts is the form of the distributed supply.

Roughly speaking one-third of the energy used is employed in grinding and pulverizing the raw materials, one-third in grinding clinker and the remainder for various subsidiary purposes. The circle diagram, plate No. 2, shows actual distribution of power consumption in a 3,500-barrel mill.

In the early days of the industry in Canada marl deposits were mainly exploited and a large number of wet process mills were built. At present, however, most of the mills use limestone rock with the addition of the requisite amount of clay or shale to make a true Portland cement mixture, and the dry process of manufacture is almost exclusively used.

Well drills, steam-shovels and electric haulage are typical of the quarry lay-out. Roll, gyratory and jaw crushers and hammer mills do the crushing; ball mills of

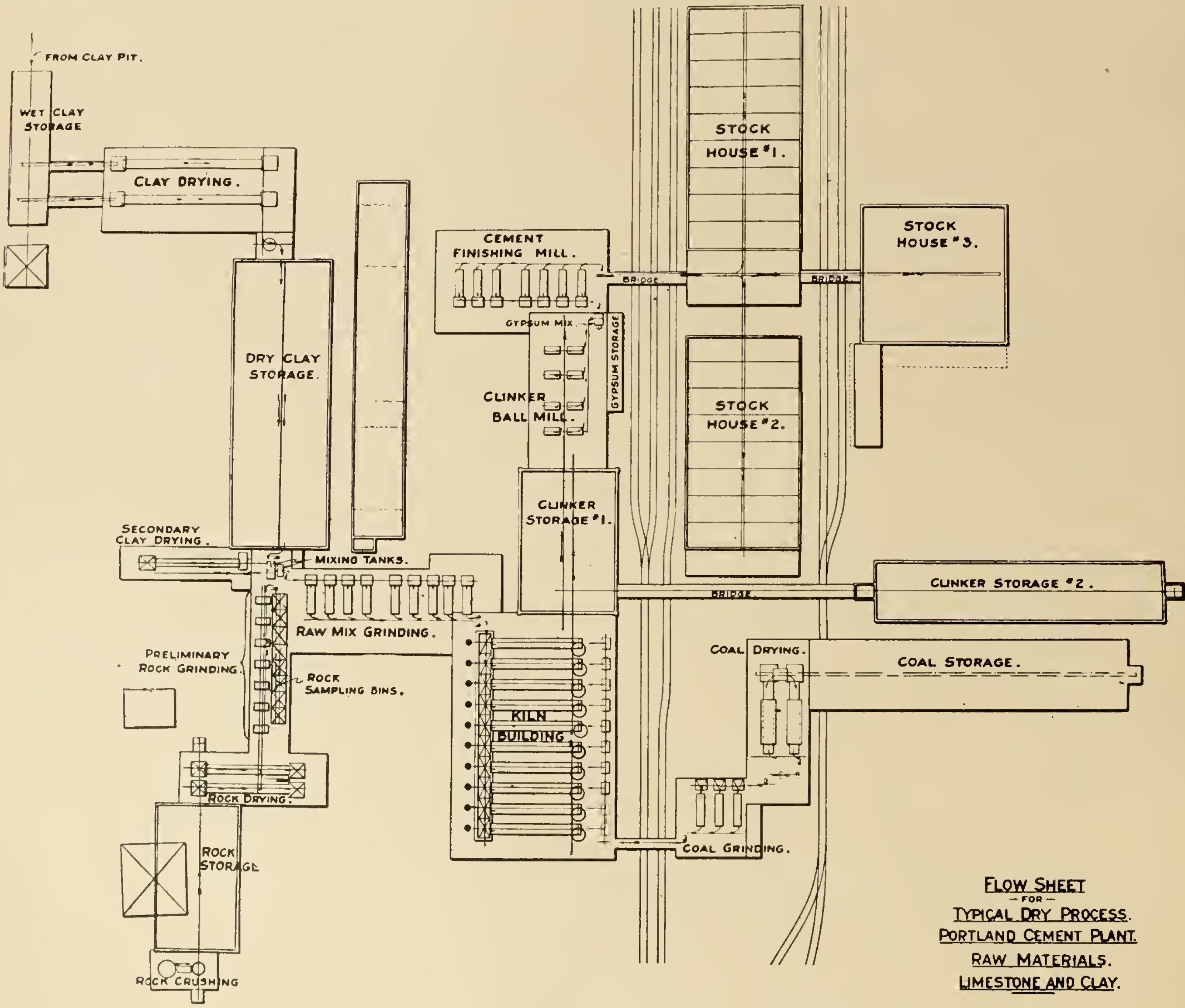

Plate No. 1,—Actual Distribution of Power Consumption in 3,500-barrel Cement Mill.

various kinds and tube mills complete the pulverizing process. Rotary kilns run all lengths from 60 feet to 150 feet, and 8 feet to 10 feet diameter. Conveying is handled by bucket, belt and screw conveyors. Dryers are mainly rotary. Coolers are stationary or rotary. Packing is handled by machine through a valve in the bottom of the sack.

The necessity of keeping up with current repairs, in what is essentially a destructive process, accounts for a considerable proportion of the labour employed, for apart from repairs and machine tending, inanimate power does practically all the hard work.

It should be borne in mind, however, that while an abundance of cheap hydro-electric power cheapens the mechanical process, cement manufacture here as elsewhere is a chemical industry calling for constant technical supervision and continuous sampling, testing and adjustment at every stage of the process, to insure the uniformity and high quality of the product marketed.

The typical flow sheet, plate No. 1, of a 3,000-barrel mill figured, should prove interesting for purpose of comparison with the practice of other countries, while a birds-eye view, plate No. 3, of a 10,000-barrel plant has been included so that those who have not had the opportunity of seeing for themselves may realize the progress that has been made in the last twenty years in what is now one of the basic industries of Canada.

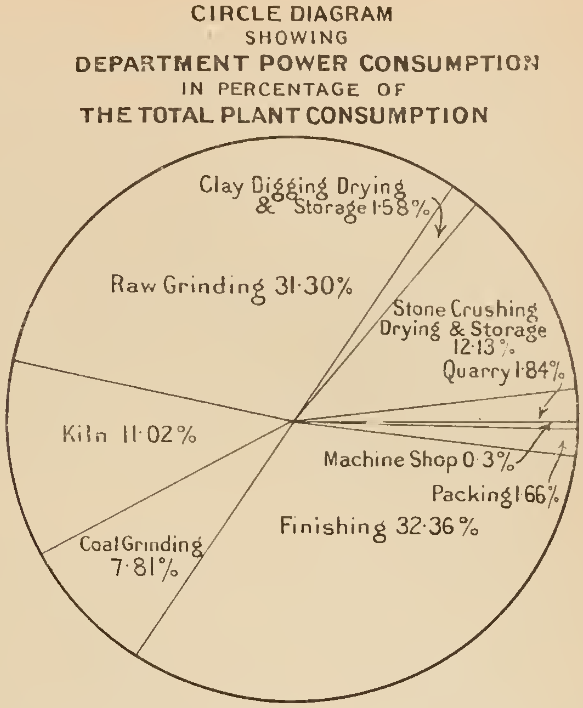

Plate No. 2,—Typical Flow Sheet of a 3,000-barrel Cement Mill.

As compared with the United States the cement market of Canada is seasonal, and this accounts for the large cement storage capacity which is provided in Canadian mills so that operation may be more or less on a twelve-month schedule, although the market may be very dull for the winter months.


Plate No. 3,—Large Canadian Cement Mill, 10,000-barrel Capacity.

The Use of Power for Port Facilities

M. T. S. Casey,
Secretary to the President, Montreal Harbour Commission.

Port facilities in Canada afford a number of very interesting features in connection with the utilization of power, particularly in the matter of the handling of grain, the greatest of Canadian export commodities. Of the numerous ports, both on the seaboard and on the inland waters, the port of Montreal has been selected for the subject matter of this paper, offering as it does an excellent example of the diversified use of power on a large scale for port facilities. This port, situated on the banks of the St. Lawrence river one thousand miles from the ocean, is second in importance of the sea ports of North America and ranks fifth in the harbours of the world.

Growth of Power Requirements

The most important development and growth of the port of Montreal has taken place within the past twenty years. In that period the wharf accommodation for vessels has increased from some 3,000 feet to 8½ miles. In 1904 there was no harbour railway. To-day the system extends the entire length of the port, serving every pier and shipping berth, and every industry adjoining the harbour, and comprising some sixty miles of track. Twenty years ago the grain handling equipment of the port consisted of a few floating grain elevators, with a capacity of 8,000 bushels per hour each. To-day there are four fireproof concrete grain elevators, with a combined storage capacity of 12,150,000 bushels, and with a total handling capacity per day of some 2,000,000 bushels in and the same quantity out to ocean vessels, which means that in all 4,000,000 bushels of grain can, in the course of a day, be handled by the vessel-unloading marine towers, and by the car dumpers, be weighed, conveyed over miles of rubber belting, and delivered to storage bins or drawn from storage and delivered into holds of waiting ocean ships. In 1904, wheat exports through the port of Montreal amounted to 7,425,000 bushels. In 1923 the wheat exports reached the quantity of 89,566,000 bushels, and of all grains a total of 120,107,000 bushels. In the same period the number of ocean vessels trading to the port increased from 796 ships of a net registered tonnage of 1,856,697 tons, to 1,117 vessels of 3,728,740 tons in 1923.

In line with the foregoing has been the increase in the revenue of the port, which in twenty years has grown from $330,659.22 to $3,721,159.99, the latter being the figure for 1923. Naturally, as the facilities and trade of the port have grown, so have the power requirements been extended, and the electrical installation and the organization necessary to take care of these increases have advanced step by step with the other facilities. Thus in 1904 the report of the Harbour Commissioners contained a reference to the electrical requirements, and makes interesting reading now. The only concern of the electrical department at that date was the lighting of the wharves, and the power consumed only amounted to a few thousand horsepower-hours. The cost of this service in that year was $7,135.53. The cost of the electric lighting system in 1923 was $34,604.88, which takes no account of the power used in the grain elevators, for railway operation and at the cold storage warehouse.

The report of the electrical engineer of the port of Montreal for the year 1923 gives the following as the power consumption for the season of navigation:—

Cold storage warehouse	2,966,589	h.p.-hours.
Elevator No. 1	2,463,493	"
Elevator No. 2	2,008,331	"
Railway electrification	1,561,035	"
Elevator "B" and conveyors	1,324,174	"
Grain conveyors at elevators Nos. 1 and 2	1,009,900	"
Harbour lighting	631,821	"
Sheds Nos. 2 to 15	295,059	"
Sawmill on Bickerdike pier	220,216	"
Miscellaneous	136,396	"
Freight hoists	113,637	"
Harbour yard	78,500	"
Sheds Nos. 16 to 19	54,564	"
Engine shops	50,274	"
Elevator No. 3 (construction)	33,718	"
Head office: power and lighting	32,931	"
Sheds Nos. 24 and 25	23,165	"
Elevator "B" extension, construction	13,985	"
Total	13,016,788	h.p.-hours.

As will be seen from the foregoing, the grain elevators and conveyor system, (which is an integral part of the grain handling equipment), consume by far the largest proportion of the power used annually, for this service alone a total of 6,805,898 h.p.-hours having been required during the season of 1923. The cold storage warehouse came next with a consumption of 2,966,589 h.p.-hours, and that portion of the railway system which was operated electrically during 1923 consumed 1,561,035 h.p.-hours. The various other smaller services, including lighting of the wharves, were responsible for the balance.

From this it will be appreciated that the grain elevators, and their auxiliaries such as conveyor galleries, car-dumping machines, etc., are easily the most important branches of the harbour organization from an electrical point of view, and are thus entitled to major consideration in an article such as this one, but the electrical aspect of food preservation, as exemplified in the service at the cold storage warehouse, and the new ground being broken by the electrification of the harbour railway, are well worthy of mention.

For the purposes of distribution, the whole area requiring power has been subdivided into zones or districts, and a substation located in the centre of each, equipped to provide the total requirements of that zone. Because of this arrangement, as the harbour continues almost

Plate No. 1,—Montreal Harbour Electrification, Catenary 2,400-V., D.C.

year by year to expand and increase its area of concentrated activity, so the electrical department is kept busy adding to the capacity of various sub-stations, or providing entirely new and additional sub-stations.

There are at present five sub-stations serving the electrical requirements of the port. The power is purchased by the Harbour Commissioners and is brought in over primary feed lines to the various sub-stations, where it is converted or transformed from 20,000-volt to 550-volt, 3-phase, alternating current for the elevators and cold storage warehouse, etc., and for lighting purposes to 110 volts. These high-tension lines extend from one end of the harbour to the other in duplicate, with additional tie-in lines between sub-stations, to avoid any serious interruptions to the service should a primary connection fail at one or other of the sub-stations. (See plate No. 1.)

Power Requirements of Grain Elevators

The amount of motor power required by one of the grain elevators when in full operation, receiving, weighing, conveying, and delivering grain, is very large indeed. A fully equipped working house requires approximately 1,000 h.p. in motor capacity for every 1,000,000 bushels storage accommodation in the plant. The conveyor galleries, which are the outlets for the grain stored in the plant, and the inter-communicating interior belts connecting the bins with the working house, require approximately 100 h.p. per 1,000 feet of horizontal belting. The following table shows the connected motor load at each of the three elevators at present in service:—

Elevator No. 1 and conveyor galleries	6,000 h.p.
Elevator No. 2 and conveyor galleries	3,500 h.p.
Elevator No. "B" and conveyor galleries	3,500 h.p.

In order to follow intelligently the application of power quantities to the actual working of a grain elevator, it will be necessary to accompany a consignment of grain through the elevator, and note the various phases of the work, and the motor capacity required for the various functions. The grain arrives at the elevator by lake boat, and is taken into the elevator by a marine leg, which delivers it to a lofter leg. The nominal capacity of a marine leg varies from 15,000 to 20,000 bushels "on the dip", or an average capacity of from 9,000 to 10,000 bushels per hour. To operate a marine leg, 100 h.p. is required. The lofter legs elevate the grain to the upper garners, and this in turn requires motor capacity of 100 h.p. The garners deliver to the scales, and the grain is weighed, this function requiring no electrical power, and the scales deposit the grain on belts which carry the grain from the working house to the distributing floor. The capacity of each scale is 60,000 bushels, and this quantity is weighed in approximately four minutes. From the distributing floor the grain is conveyed by belts to any of the storage bins in the house, and for this service the ratio of 100 h.p. per 1,000 feet of belting is maintained.

When the grain is taken out from storage for purposes of delivery to ocean vessels, it is taken from the bottom of the bin to the shipping house, and elevated to the scales by a shipping leg, which has a capacity of approximately 14,000 bushels per hour, and which is operated by a 100-h.p. motor. From here it is delivered to a shipping belt, and taken to the conveyor galleries, from where it is poured down a spout into the holds of waiting ocean vessels. The capacity of the shipping belts is approximately 16,000 bushels per hour, and as already mentioned, 100 h.p. is the approximate capacity required to operate 1,000 feet of belting.

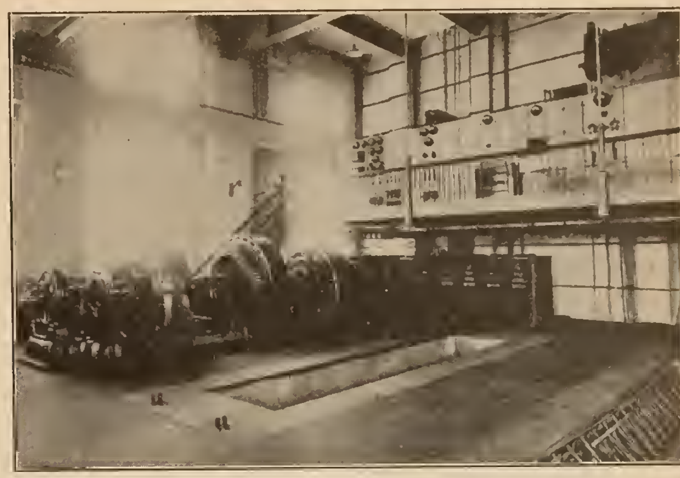

Plate No. 2,—View of Electric Railway Power House taken during installation, showing one Generator Set Mounted—Montreal Harbour.

Electrical Equipment of Cold Storage Warehouse

The cold storage warehouse is a new facility, which was constructed during 1920 and 1921, and was put into operation in the spring of 1922. The enormous demand on its available space which has been a marked feature of the plant since its erection, has demonstrated how valuable a utility it is to the shippers of perishable food stuffs, particularly meats, fish, and dairy products such as cheese, butter and eggs. In addition to a large export business, this plant has been widely availed of by local retailers for the storage of their supplies, and in this way has handled a highly varied list of commodities, ranging from hops, for the use of the manufacturers of ales and beers, to the storage of valuable furs in the hot summer months, and embracing fruits, both fresh and dried, vegetables, liquors, etc.

As in the case of the grain elevators, electrical power is the mainspring of the activities of this plant. The ammonia compressors, of which there are three in the power house adjoining the warehouse itself, send the cooling brine flowing through coils in all the refrigerating rooms, where temperatures of from 15 degrees below zero Fahrenheit to any desired temperature above, may be obtained. These ammonia compressors are driven by electric motors, one of 250 h.p. and the other two of 225 h.p. each. Not so important, perhaps, as these ammonia compressors, but still of great importance for the proper operation of the plant, are various other small facilities, all of which are driven by electric motors, varying from a little 10- or 12-h.p. motor driving an air cooling fan in the conditioning room, to 75-h.p. motors operating the four brine pumps. An air compressor is driven by a 75-h.p. motor, and a water pump by one of 20 h.p. The freight hoists, of which there are four, are each driven by a 25-h.p. motor, and there is a river pump, which is operated by a 40-h.p. motor.

Harbour Railway Electrification

The terminal railroad operated by the Harbour Commissioners of Montreal consists of surface lines situated between Victoria Bridge and the Imperial Oil Wharf, and having various spur tracks and sidings serving every berth and pier in the port, totalling in all some 60 miles of track. In the year 1918, after the Commissioners had visited several important electrified freight terminals, and had closely studied the conditions there, it was decided that since electrification in freight yards and terminals had been found very economical and satisfactory, electric locomotives being considerably more efficient than steam locomotives, particularly during the severe winter climate of Canada; that it would be desirable to have the harbour railway terminals electrified. Accordingly work was begun on this project in 1919, and plans and specifications were prepared calling for tenders for the material, the actual work of erection being undertaken by the electrical department of the commissioners. The work was divided into four main sections as follows:—

1. Power station machinery equipment.
2. Control, protective and signal equipment.
3. Overhead catenary line material.
4. Rail bonding material.

Power Station Apparatus

The station was designed for a capacity of three 1,000-k.w. motor generator sets, the units having a very heavy over-load capacity for a short period to meet railway conditions, and capable of carrying 250 per cent load for five minutes. Each set, (see plate No. 2), consists of a three-piece unit, a 1,500-h.p., 2,300-volt, 3-phase, 60-cycle, 720-r.p.m. synchronous motor directly connected to a 500-k.w., 1,200-volt, 720-r.p.m. compound wound d.c. generator on either end, each generator being permanently connected in series giving 1,000 k.w. at 2,400 volts. Exciters for the synchronous motor and generator fields are mounted on the same bedplate. Each of the motor-generator sets weighs 40 tons, mounted on its frame, and covers a floor-space of 28 feet long by 8 feet wide and approximately 7 feet high. Water-cooled, oil-insulated power transformers of 2,000 kv.a. have been installed, taking the power at the incoming lines at 11,000 volts and stepping it down to 2,300-volts a.c. for the synchronous motors. These transformers weigh approximately 30 tons each.

Control and Protective Apparatus

The switchboards, cell, remote control, oil switches, and protective equipment are mounted on galleries on the second floor and consist of twenty-one marble panels with the necessary meters and indicating mechanism for the complete control of the generator sets, quick acting breakers, storage batteries, power transformers and exciters.

Overhead Catenary Line Apparatus

The overhead line equipment consists of cross span and bracket construction supporting the main messenger which is a 7/16-inch extra galvanized Siemens-Marten steel cable anchored in half-mile sections. The anchor poles are very heavily guyed in all directions. The cross spans are supported by steel poles at spacings of 150 feet on tangent double track, and 120 feet or 105 feet as conditions require on curves or yards. (See plate No. 1.)

Cross-span messengers consist of 5/16-inch high strength galvanized steel cable, the tension on all messengers being maintained at approximately 2,300 pounds. Attached to and supported by the main messenger is the conductor, consisting of 4/0 grooved hard drawn copper, fastened by hangers of various lengths, keeping the trolley at a uniform height of 23 feet above the top of the rail. Steel poles are used, the poles being set in concrete carried well above the ground level.

Rail Bonding

The rail bonding, while not a very noticeable part of the installation is, however, a highly important section of the system. All the return current must get back to the power station by the rails, and close attention must be paid to the method of welding the copper bonds to the rail joints in order to get the best results. The type of bond used is a steel armoured terminal gas-welded copper-stranded bond, capacity 4/0, seven inches long, cold pressed and headed.

By the beginning of 1923, some 40 miles of track had been electrified, and in that season two 85-ton electric locomotives were rented from the Canadian National Railways, and were operated over that part of the system which had been provided with power connections. The service thus obtained, however, was at best only of a partial or temporary nature, as none of the rail connections to piers and sheds had been electrified, but the work of completing the installation was carried on vigourously during 1923 and in the early part of the present year, and it is hoped that by the end of the season of 1924, by which time delivery is expected of four new 100-ton electric freight locomotives, that complete operation of the system by electricity will be possible.

Power Requirements in the Lumbering Industry in British Columbia

A. M. Smith,
Chief Engineer, Vancouver Lumber Company, Vancouver, B.C.

The lumbering industry, especially that carried on on the Pacific coast, requires a large amount of power; in fact a survey of the power requirements in all industries shows that it stands highest on the list. This is partly accounted for by the fact that a large proportion of the raw material is converted into completely finished product before it leaves the sawmill premises, i.e., moulding, flooring, ceiling, etc.

Logging and Sawmill Operations

Before dealing with the power required for the different operations, it may be well to follow the log from the time the 'feller' has whanged his crosscut saw through the tree, delivered his last blow on the head of the wedge and the 150-foot monarch has swished to the ground.

Immediately the tree has been laid low, "Buckers" cut off the branches at the top, and the tree or log is hitched to a steam donkey engine by a heavy cable skidding line, as shown in plate No. 1, and transported to the loading berth. In this case the same engine is used to load the logs on to the cars; drums being provided on the same frame for this purpose.

Plate No. 2 shows the machine used for this purpose. This machine is provided with boilers having up to 1,065 square feet of heating surface and 190 pounds working pressure, twin engine up to 12-inch by 14-inch cylinders capable of developing 500 h.p. for a short period. The drums are made to hold sufficient cable to work over an area with a radius of 2,000 feet.

Plate No. 3 shows the type of machine used for roading, i.e., hauling the logs from the skidder to the railroad or to the water. The boilers and engines are built up to the same size as the skidder but the drums have space for 5,000 to 6,000 feet of 1¼-inch cable. This machine is made necessary where the railroad can not be built up to where the logs are being taken out or where it is less than a mile haul to the water.

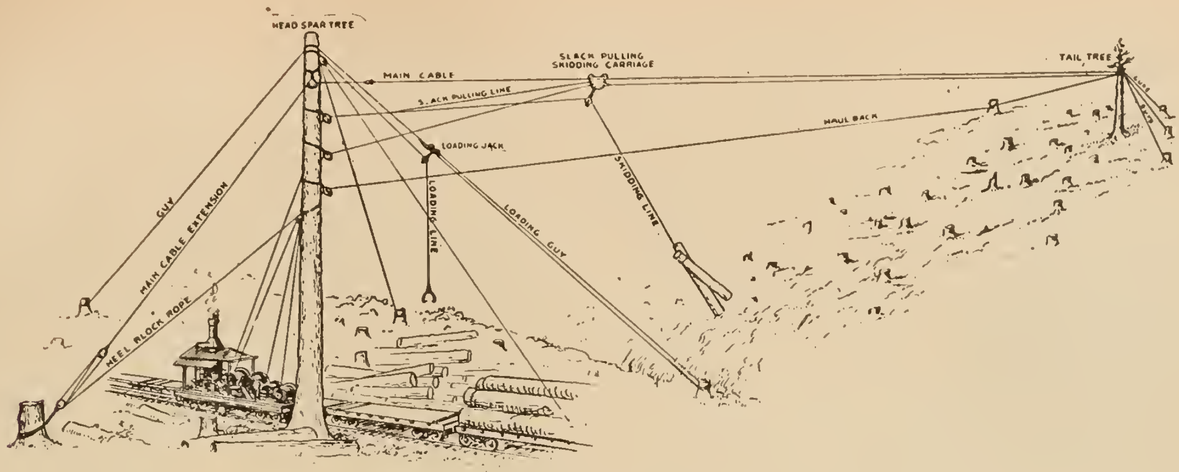

Plate No. 1.—Cable Skidding Line.

On the railroads in use, the tracks are standard and locomotives from 30 to 90 tons are in use, which are usually of the geared type owing to the heavy grades encountered. At present roads 30 miles long are being used to get out logs. The terminus of the railroad is usually a trestle built on piles, out to deep water; one rail being raised to give the cars of logs a tilt or pitch toward one side. When the cars have been run out on this the bunks or chocks are knocked out and the logs allowed to roll into the water. Here they are made up into booms according to grade and specie.

The logs are placed side by side and end to end to the desired width and length. Large holes are bored in the ends of the outside logs, which are picked for the purpose; and heavy chains are passed through from one log to the next, thus forming a barrier around the whole of the logs. Some logs are rolled up on top, crosswise of the logs and chained to the outside logs. This is to prevent logs from leaping over the boom sticks in case of rough weather, while the whole is being towed to the mill, which, in some cases, is 200 to 400 miles away.

When the logs reach the mill-pond, the chains are removed, and each log is guided to the foot of the jack ladder or log haul, (see plate No. 4), up which a massive endless chain is moving and to which are fastened bunks, (large steel castings with teeth or prongs sticking up), and as the end of the log is brought in contact with these bunks, the teeth bite into it and it is pulled up to the log deck. Here it is measured and its contents entered in the log sheet.

Underneath this deck is situated a series of steam cylinders; one of these now comes into operation and "kicks" the log on to an inclined plane, down which it rolls until brought to rest against the stops. These stops, controlled by the sawyer, and actuated by another steam cylinder, are shaped like the rockers of a rocking horse; so that, there being more than one log on the deck, when the stops are moved to allow a log to roll on the loader and thence to the carriage, they prevent the next log from moving until the stops are again returned to the normal position.

The log having rolled on to the loader, another steam cylinder operates a set of pusher arms, by which the sawyer pushes the log hard against the carriage knees and the 'doggers' pull the "dogs teeth" into the log to hold it in position.

The carriage, driven by a twin reversible steam engine, is now run along the track bringing the log in contact with the saw, and a slab is sawn off. The slab falls on to a set of live rolls which carry it along and drop it on a set of chains moving at right angles to the rolls, and which pass beneath the clasher saws, where the slab is cut into four feet lengths. It is then dropped into the main refuse conveyor. This conveyor passes through the lath mill and here the pieces suitable for making lath, broom handles, etc., are picked out and the remainder passes on to the burner or refuse destructor, unless "hog fuel" is required for some purposes; then the slab may be dropped into a hog which cuts it up so that it can be handled by sawdust conveyors and it is fed to the furnaces to produce steam.

Meanwhile the carriage is again run back to the starting point and the log again brought in contact with the saw and a board 1-inch or 2-inches or 3-inches thick is sawn off, drops on the rolls, which this time carry it to a point in front of the edger. Here a steam lift raises another set of chains by which the board is moved to a point directly in front of the edger. Another steam lift raises a live roll and the board is carried on to the edger rolls which feed it through the saws of the edger, taking off the bark at the two edges and sawing the board into the required widths. The board then drops on to the trimmer chains which carry it under a gang of saws set two feet apart. These saws can be raised or lowered at the will of the operator who sits in a cage above the chains where he has a clear view of the lumber passing beneath. In front of this trim-saw man is a set of keys called the

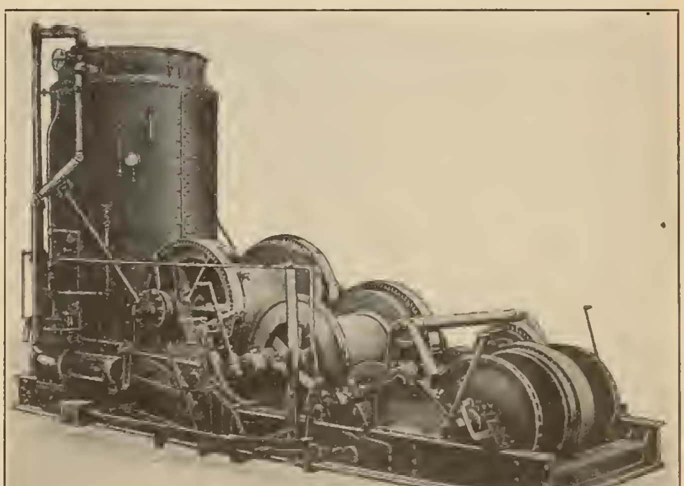

Plate No. 2,—Donkey Engine for Cable Skidding Line.

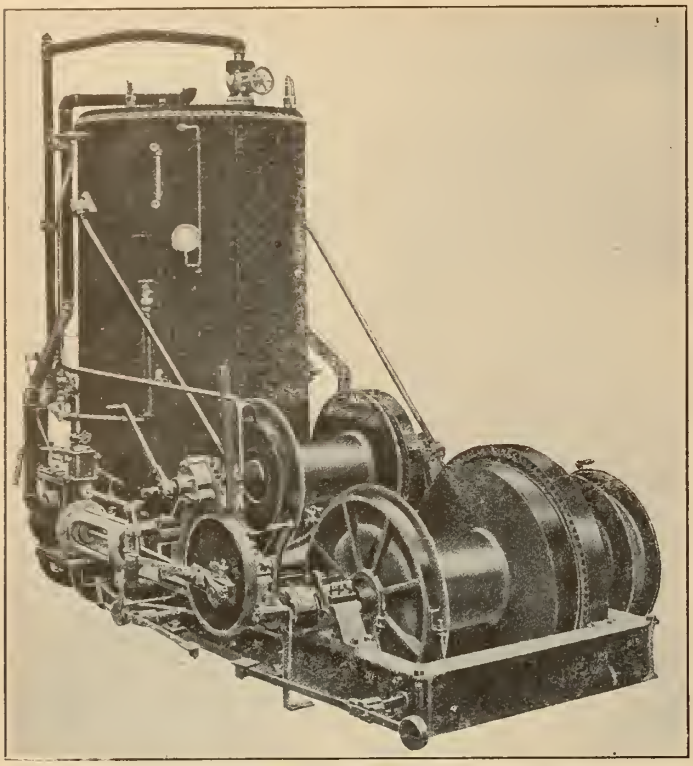

Plate No. 3,—Type of Engine for Roading.

piano. By pressing one or more of these keys compressed air is admitted to the cylinders which control each saw; thus the boards are cut to the length dictated by the quality of the board and the orders called for.

When the boards have passed through the trimmers, they are carried by a series of live rolls and transfer chains to the sorting table where the common is separated from the clear lumber; the clear lumber, i.e. that which has no defects, goes on over chains to the dry kiln stackers, where steel cars are waiting to receive it. On these, 5,000 feet B.M. to 6,000 feet B.M. is mechanically stacked and the cars with their load run into the dry kiln chamber.

After the lumber has been dried to the required moisture content, it is drawn out and unstacked by mechanical means, and conveyor chains again come into action and carry it to the storage sheds. In some cases the unstacker is placed directly behind the planing machine and the boards are unloaded directly on to the feed table.

This table, another automatic contrivance, feeds the lumber, one board at a time, to the machine where it is made into V-jointing, flooring, etc. Coming through the machine it falls on to a series of belt conveyors and transfers by which it is carried to the trim saws where it is cut to exact lengths according to what the board will make. When trimmed, it falls on to another belt conveyor and is carried to the bundlers where it is tied in bundles and is ready to be placed in the railroad car or motor truck, as the case may be. Thus, in an up-to-date mill, a large proportion of the lumber, from the time it is placed on the jack ladder in the shape of a log until it is ready to be shipped, is handled entirely by mechanical means.

Power required for each Operation

The size of logs being manufactured has a large bearing on the question of power required at each machine, but in any case a large surplus has to be provided over the average to take care of a run of extra large logs.

Plate No. 5 shows an extra large log on the jack ladder. This magnificent fir was cut by the Peck Logging Company at Frederick Arm, 125 miles from Vancouver by Union Steamship Company. Here it is shown on the ways at Hastings Mill. Out of this stick were sawed two pieces 54 inches square and 12 feet long. At the Empire Exhibition at London these squares will be exhibited. They will form part of an arch and will support timbers 61 feet long. One of the features of this log is that it is exactly 7 feet at either end. It is the second log of a mammoth tree which contained in all over 30,000 board feet. The average log cut in the mill in the picture will, of course, be considerably smaller than the one depicted, but the machinery must be made to handle just such as these. In cutting the log above, the head saw would probably be taking 400 h.p. although the practice is to allow about 300 h.p. for a band saw mill handling this size of log.

The capacity of a mill is usually stated in thousands of feet, board measure, per 10-hour day, and the power required by coast sawmills is around 6 to 8 h.p. per thousand feet, and for planing mills from 3 to 4 h.p. per thousand. For interior or mountain mills where smaller logs are being cut up, satisfactory operation is carried on with considerably less power than this; some mills using as low as 4 h.p., per thousand for the sawmill and 2 h.p. per thousand for the planing mill.

Size and Type of Motors in General Use in Motor Driven Mills.

	Motor			
	Type*	Size h.p.	r.p.m.	Method of drive
Log haul	WR / SC	25-50	900	belted or geared[1]
Log lift	WR	35-50	900	geared to drum
Carriage set works	SC	5-10	900	geared, belted or chain driven
Rock saw	SC	10-15	1,200	belted
Head saw	WR	100-300	600	belted
Live rolls and transfer chains	WR / SC	3-15	600-900	Back geared and chain driven
"Jump" or "Swing Up" saws	SC	7½-25	600-1,200	belted
Slasher	SC	35-75	900-1,200	direct connected
Edger	SC	35-250	1,200-1,800	direct connected
Trimmer	SC	25-75	900	direct connected[2]
Gang saw	WR	75-250	720	belted[3]
Sorting table	SC / WR	5-10	900-1,200	direct connected[4] or belted
Resaw	SC	75	900	direct connected
Stacker	SC / WR	5-7½	1,200	belted
Unstacker	SC	3	1,200	belted
Timber sizer	SC	50-75	900	direct connected
Hog	SC	15-100	1,200	direct connected or belted
Rolls, various kinds	SC / WR	3-10	900-1,200	chain driven or geared
Saw grinders, stretcher, re-toother and scarfing machines	SC	2-5	1,200	belted
Exhaust fans	WR	20-150	600-1,200	belted or direct connected
Conveyors	SC / WR	10-25	900-1,200	geared
			Lath Machines	
Lath bolter	SC	40-50	1,800	direct connected
Lath mill	SC	25-40	3,600	direct connected
Lath trimmer	SC	5-10	1,200	direct connected
			Shingle Mills	
Main saw	SC	20	1,800	direct connected
Trimmer saw	SC	3	1,800	direct connected
			Logging	
Donkey hoist	WR	150-200	600	geared

*SC = squirrel cage; WR = wound rotor.
[1]Solenoid brake generally supplied.
[2]Flexible coupling to shaft from which saw arbors are belted.
[3]High resistance.
[4]Ending motor and friction device generally used.

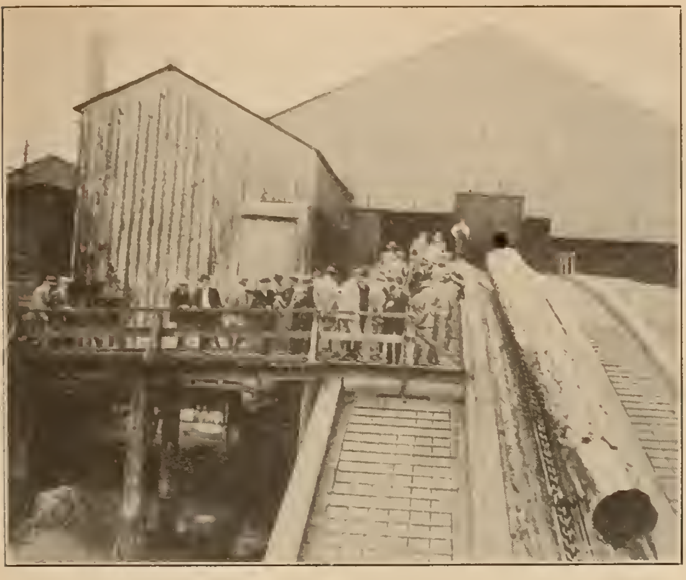

Plate No. 4,—Jack Ladder or Log Haul.

Steam Engine or Motor Drive

The advantage of motor drives for the planing mill and other outside requirements is beyond question; each machine being independent of the other. In the sawmill the advantages of the motor drive is not so obvious for various reasons. Each machine is a link in a complete series and stoppage of a small motor driving the live rolls behind the headsaw or edger or chains to the trimmer, etc., holds up the whole plant.

Owing to the necessity of over motorizing every machine because of the heavy duties infrequently applied the power factor is often so low that in some cases the wattless current is greater than the friction load on a shaft and belt driven mill and it is impossible to find drives where synchronous motors for correction purposes are practicable owing to the fluctuating load. Increase of production has been shown where shaft drive has been changed over to motor drive, but the writer is of opinion that the increase has been due to the provision of greater capacity in the prime mover.

Steam must be supplied to the twin engines or shot gun feed that moves the carriage up and down the track as so far no electric device has been developed that will take their place. Also steam has been found to be the best medium for operating the niggers and turners, loaders, etc. for handling the large logs on the carriage.

Since fuel is not a factor to be considered, first cost and maintenance must be the deciding factor whether the sawmill shall be motor or direct steam engine driven. With regard to breakdowns, any serious ground or short in one of the major motors is invariably a longer repair job than any conceivable break in the shafting or belting. It is obviously out of the question to provide spare motors for each major drive and since the speeds and characteristics of the different motors vary so widely one or two motors will not be sufficient to act as spares in case of breakdown.

If the mill is situated remote from a repair shop and an armature winder not maintained on the pay roll, then the delay due to a motor that must be partly or entirely rewound will be an extended affair depending on how quickly outside help can be secured or how quickly the motor can be sent to a repair shop, or a replacement motor rented. On the other hand there is hardly a break in the shaft and belt transmission that cannot be repaired in a few hours by the mill's own machine shop.

The machines in the sawmill with the exception of the edger, lend themselves to easy shaft and belt transmission so that except for the very largest mills, the engine drive is probably the best and most economical. A combination of sawmill engine drive with exhaust steam or mixed pressure turbine supplying power to the planing mill and other scattered machines has proven successful in many cases.

One horse power for every horse power developed by the main engines and auxiliaries in the mill can be obtained by this means and the efficiency of the combination be as good as a single large turbine; thus the capital charge in the boiler room is about equal and the first cost, at least, up to a mill of 200,000 b.m. per day, will be less.

Source of Power

Until such times as a use can be found for the sawdust, shavings, slabs, and edgings, which make good fuel, the lumberman will find it cheaper to install his own power plant than to buy from an outside source; for even if the outside service is as cheap as he himself can produce it, there is a negative value in this waste material, entailed in the getting rid of it. Those plants now producing their own power and destroying the surplus by burning in a destructor, would have to provide much larger facilities for conveying and burning if they were to discard their own plant and buy power.

From an economic standpoint, it is reprehensible that the waste is as large as it now is. This will be realized when it is known that from 40 per cent to 50 per cent of the solid log is lost in the manufacturing process. There is a loss of 20 per cent in the sawmill in saw-kerf alone, 10 per cent loss in slabs and edgings and 2 per cent in trims, making a total of 32 per cent. Then there is a further loss in the planing mill of over 28 per cent. Of course, it will be understood that only a portion of the total output of the sawmill goes to the planing mill, but at any rate we are safe in saying that 40 per cent of the solid log goes to waste in the sawmill and planing mill.

The heat value of the waste as a fuel runs from 6,000 to 9,800 B.t.u. per pound, when dry, but only that from the planing mill is dry, having passed through the dry

Plate No. 5,—Large Log on Jack Ladder.

kilns; the sawdust and hog fuel containing an average of 35 per cent to 40 per cent moisture.

A test conducted by Professor Killam of the University of British Columbia at the Murphy sawmill, Ladner, B.C. showed an evaporation of 5 pounds of water from and at 212 degrees Fahrenheit per pound of dry fuel, and in a test at the P. Burns and Company's plant at Vancouver, an equivalent evaporation of 2.48 pounds of water from and at per pound of fuel burned. This fuel was from the sawmill only, i.e. sawdust and hog fuel, and was composed of 40 per cent hemlock and the balance spruce and fir. This was fired by hand and difficulty was found in keeping the bars covered. Other tests conducted at the Vancouver Lumber Company's plant have shown an evaporation of 3.9 pounds per pound of fuel fired. In this case dry planing mill shavings formed 25 per cent of the fuel.

Therefore it can safely be assumed that the average evaporation is around 3 pounds of water per pound of fuel as fired. This is close to half the value of the average coals used in this part of the Dominion and some idea of the large economic loss can be had when it is known that the log cut is over 2 billion board feet per annum, and as already stated 40 per cent of this is waste or 800,000,000 feet b.m. The average weight of 1,000 feet b.m. is around 3,900 pounds, making a total waste of 1,560,000 tons, with a heat value equal to 780,000 tons of coal compared with the total coal production of British Columbia for 1923, which was 2,343,675 tons. This 2,000,000,000 board feet per annum, at 10 h.p. per 1,000 feet per day. for sawing and dressing, requires almost 70,000. h.p.

Various authorities estimate that the annual cut can be increased two or three times the present output and still be within the annual increase by new growth, that being estimated at six billion board feet per annum, this, of course, being dependent on how well the forests are protected from fire and other destructive agencies.

The Application of Compressed Air in Industry

Canadian Practice.

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Compressed air, it has been said, stands second only to electricity in the number and variety of its applications. There are few industries in which this power medium is not now used in some form or other. Mining, contracting and industry in general have developed very rapidly in Canada within the past two or three decades and the use of pneumatic appliances and processes has followed in close step.

Methods of Compressing Air

Compressed air is a power transmitting agency and must, therefore, derive its force from some source of power such as a steam, gas or oil engine, electric motor, water wheel or turbine, or falling water.

Mechanical Methods

With the exception of the last-named, all the above methods require the use of mechanical compressors. Due to the widespread development of hydro-electrical power and its availability throughout Canada, air compressors are driven chiefly by electric motors. Steam-driven units are not as common as in other countries. Oil-engine drive is used for isolated plants and is now receiving considerable attention in the mining field. Gasoline (petrol) engine drive is usually limited to small units such as portable outfits. Direct drive by water-wheels is used to a limited extent. A few rotary or turbo-compressors are still in use for steel plants or smelter service.

Compression by Direct Action of Falling Water

An interesting method of securing compressed air in commercial quantities is by the direct action of falling water. There are, in Canada a number of plants using this method. When air in small bubbles is intimately mixed with water, the water breaks into a foam, through which the bubbles try to rise and escape. But if the mixed air and water be drawn swiftly downward as in a vertical pipe the air is compressed. Then if, after reaching the depth and head of water-column necessary to produce the desired compression, the direction of flow be changed to the horizontal, and the velocity diminished, the bubbles of compressed air will be liberated and may be collected in a suitable chamber. The air pressure in this chamber corresponds to the effective head of water, that is, its depth below the level at the outflow or tailrace. Thus, in this method of compression no pistons, rotors, valves or other moving parts are used.

As the bubbles are small and thoroughly mixed with the water during its descent, the cooling surface is very large and isothermal compression results. The moisture carrying capacity of the air theoretically is, therefore, smaller than if it were compressed adiabatically. During compression the percentage of moisture in each globule of air increases until the point of saturation is reached; on further compression the moisture is deposited, so that when re-expanded the air is relatively dry. This method was first tested on a working scale by I. P. Frizell, of Boston, about 1878.

In 1890 the Taylor Hydraulic Air Compressing Company erected a plant at Magog, Que., for textile mill service. This plant has since been abandoned. In 1895-1898 a plant was installed for the Kootenay Air Supply Co., Ainsworth, B.C. The most important plant of this kind, however, is the Cobalt Power Company's plant installed at Ragged Chutes on the Montreal River in 1909. This plant compresses 40,000 cubic feet of free air per minute corresponding to about 5,500 h.p. The air is carried through nine miles of 20-inch pipe to Cobalt and then distributed to the various mines. The total length of the piping, (20, 5 and 3 inches in diameter), is about twenty-one miles. The total cost exclusive of piping was about $1,000,000. or $185. per horse power. The air is sold by the company at 0.25 cents per 100 cubic feet at 100 pounds gauge.

The cost of operating and maintaining hydraulic compressors is not large, no skilled attendance is required and depreciation is normal. They are generally unsuitable for small plants, however, as the first cost is rather large.

Field of Application of Compressed Air

Compressed air has properties which render it peculiarly suitable in many applications. For driving reciprocating machinery and devices of small capacity, it has all the advantages of steam, with the additional property of permitting the application of the power at

Plate No. 1,—Locomotive and Train of Cars, International Coal and Coke Company, Coleman, Alberta.

considerable distances from the central power source. Unlike electricity or high-pressure steam, it affords a means of storing readily available energy indefinitely at small cost; and unlike gas or oil engines and steam engines with coal-fired boilers, its use does not involve the liberation of noxious gases at or near the point of utilization of the power. It is also peculiarly adapted to the transportation and projection at high velocity of finely divided particles, and even of larger particles as in the case of concrete, to the atomization of liquids, and to the promotion of combustion.

Some of the specific applications in which its properties have proven to be of greatest value in various Canadian industries will be briefly described.

The Application of Compressed Air in Mines and Collieries

Compressed air is used underground for running rock drills and coal cutters; blowing smoke, hoisting, hauling and scraping; operating mucking and loading machines; operating direct-acting air lift or return-air pumps for unwatering, and station or sump pumping. It is also applied to pumping, hoisting and hauling on the surface; operating air brakes and controls on large hoists; unloading cars; opening bin gates and chutes; running drill steel sharpeners, bit punches; blowing smiths' fires and drill steel furnaces; running pneumatic tools and hoists in the repair shop, etc.

Rock Drilling Practice

One of the most important uses for compressed air in mining is for rock drilling. Since the earliest days of power rock drilling there has been no serious rival of the pneumatic drill. Electricity is particularly adapted for producing rotary motion as in the ordinary motor. Compressed air on the other hand is well suited to the operation of reciprocating mechanism as in the pneumatic drill.

Rock drills are of two general classes, the piston and hammer types. The former is the older and the less frequently used at the present time. In this type of drill the steel is rigidly connected to the piston and moves with it. In the hammer drill, invented by Leyner, the piston is free in the cylinder and literally hammers on the steel while the latter is rotated in the hole.

Hammer drills may also be divided into three general types, viz: the "Jackhamer" or self-rotated hand hammer drill, the drifter or mounted hammer drill, and the stoper or air feed hammer drill.

Hand Hammer Drills

Drills of the "Jackhamer" type range in weight from 21 to 75 pounds and are used for shaft sinking and other forms of down hole drilling, trimming, cutting hitches, block holing and many other forms of work. It requires only a few seconds to mount or demount a "Jackhamer", so that it probably represents the nearest approach to a really universal drill so far made.

Drifters or Mounted Drills

Drifters range in size from 130 to 225 pounds or more and are used for drifting, tunnelling, putting in toe holes, drilling deep down holes and to a limited extent for stoping.

Modern drifters will put down holes to a depth of from 10 to 40 feet, depending on the air pressure and the nature of the rock. The lighter drifters are sometimes provided with cross handles to permit their use as hand drills. Heavy drifters have largely superseded piston drills for use on tripods or quarry bars and are sometimes provided with special tower mountings for deep hole work. Mountings of this type are used in one of the large asbestos quarries in the province of Quebec. For underground use drifters are nearly always mounted on columns or shaft bars. Mountings of this class are quickly set up and allow maximum flexibility in the use of the drill.

Methods of Using Rock Drills

All modern hammer drills use hollow steel and employ the Leyner principle for feeding water or a mixture of air and water through the steel to remove the cuttings from the hole. These drills have been highly developed, drilling speeds of 10 to 22 inches a minute in hard rock, (drilling speed depends on nature of rock and the air pressure) now being possible.

In collieries and soft ore mines, small "Jackhamers" with twisted or auger steels have largely replaced the old style hand augers formerly employed.

For open cut mining and quarrying, "Jackhamers" and large tripod mounted hammer drills are generally

Plate No. 2,—Three little Tugger Hoists installed for hauling a 12,000-pound loaded Car of Rock up a Rock Tunnel driven in the Mine of a large Coal Company.

used at the present time. "Jackhamers" are employed for drilling the benches, block holing, etc.

For large operations on which gasoline or electric-drive churn drills were formerly used, the larger types of hammer drills are now extensively employed for tunnelling, putting in snake holes, etc. In some kinds of open cut work, well drills are used to put down deep vertical holes and hammer drills for running snake or toe holes at right angles to these vertical holes, thus permitting very large faces to be blasted out at one time.

For deep hole work, drilling in badly broken ground, etc., the piston drill is still widely used. One large Canadian deep hole piston drill, using hollow steel, will put down holes 60 feet or more in depth.

Coal Cutters

In addition to "Jackhamers" and other types of hammer drills, compressed air coal cutters are employed in Canadian collieries. These are mainly of the puncher and Radialaxe types. The former is the oldest type of power cutter and a big producer, but is generally limited to use in flat seams with a slight angle. It cannot be used with pitching seams.

The Radialaxe coal cutter is of the reciprocating type, mounted on a column with a simple and efficient swinging gear. It can be used in flat or pitching seams and will cut at any height in the seam. It may be operated in long wall, advancing or retreating systems, in advancing and retreating bord and pillar systems, and can be used for cutting out clay bands, and sulphur balls.

The output of these machines varies considerably, depending on local conditions, the existence of sulphur balls, etc. A time study in an eastern colliery showed that 21 minutes were required to make a 6-foot undercut, 12 feet wide. The initial set up required just five minutes.

In addition to the puncher and radial coal cutters previously described, compressed air driven chain, disc or bar machines are sometimes used. This class of equipment, however, is more often electrically driven. Most of these machines are built for a single class of work, so that it is sometimes also necessary to use radial cutters. The radial type comes nearer to being an universal machine than any other type so far developed and also has the advantage of exceptionally low maintenance cost. In one large colliery using over 300 of these machines, which have been in service for six months to three years, the maintenance cost was found to average less than $1.50 per machine per month.

Drill Steel Sharpening

The high drilling speed of the hammer drill demands steels of the highest quality with properly formed shanks and bits. This necessitates the use of air operated drill sharpening machines, which are now standard equipment in practically all mines, collieries or quarries where hammer drills are used. Compressed air is also used to operate shank and bit punches, steel heating and tempering furnaces, grinders and other equipment used in the blacksmith shop.

The problem of maintaining a good supply of sharp steels at hand for each drill becomes increasingly difficult as mine workings become more extensive. Sharpening shops, are, therefore, sometimes established underground, in order to eliminate carrying the steel to and from the surface for redressing. The difference between sharp and dull drill steels is so marked that an almost unbelievable improvement in drilling speed, increased footage per steel and less wear and tear on the drilling machine invariably follows the use of machine made bits.

The output of the modern drill steel sharpener is from 50 to 100 steels per hour. These machines are also used for many other odd forming and forging jobs around a mine such as heading bolts, car draw heads, coal cutter or chamber bits, and sharpening pick axes.

On all modern drilling operations employing hammer drills, hollow drill steel is used. In shanking or forming the bits, the holes have a tendency to close up so that some method of opening them after working is required. This need is met by the air operated shank and bit punch of which there are several sizes and varieties. Some of these can be attached directly to the sharpening machine or mounted on a pedestal as a separate unit.

Repair and Construction Work

Air hoists of both the direct acting and motor types are used in the repair shops of Canadian metal mines, collieries and quarries.

Pneumatic riveting and chipping hammers, drills, reamers, wood borers, grinders, etc., have many applications in mine repair shops. Concrete breakers, clay diggers, drift bolt drivers and other contractors' tools also prove useful for many classes of mine construction and repair work.

Wood borers and drift drivers are particularly useful in the framing of heavy timber structures and cut down the labour required to a large extent. Compressed air jets for cleaning also form a necessary part of mine repair shop equipment.

Pneumatic Hoist Control

Compressed air readily lends itself not only to the operation of mine hoists, but to the control of large electric hoists as well. Two large electric hoists recently built in Canada and installed in northern Ontario are good examples of this practice. In these hoists the following features are operated entirely by compressed air; brakes, friction clutches, liquid rheostat, motor acceleration control, circuit breaker reset, primary reversing oil switches, primary switch interlocks, reverse protection in case of overwind, emergency stop and brake regulators for emergency stop. So completely are these hoists protected that the operator might even fall in a faint when the hoist was running at full speed, and it would be brought to a stop gradually and properly before reaching the end of its travel. On some hoists the brakes alone are controlled by air. The extent to which air is applied for this class of service is determined largely by local conditions and the nature of the equipment used.

Compressed Air Haulage

Compressed air haulage systems have been carried to a high state of development in Canada. In Alberta and British Columbia a number of two-stage locomotive systems are in use, (see plate No. 1), while in other sections stationary reciprocating air haulage engines are used to operate balanced or main and tail rope systems.

In actual practice compressed air locomotives compare favourably with other types in convenience, efficiency and economy. Their outstanding virtue is the entire absence of fire hazard and of danger from electric shock as well as the avoidance of noxious exhaust gases. The air locomotive is self-contained, and after the laying of track there is no supplementary rail bonding to be done; a particular advantage when the trackage is at best only temporarily needed. Modern air locomotives use air expansively in two-stages and the manufacturers state that, except under unusual conditions, the cost of power to operate is no greater than that required for electric types.

In a paper read before the Canadian Mining Institute in 1916, the comparative cost of compressed air and horse haulage in a coal mine was given as follows:—

	Compressed Air	Horses
Labour	$0.046	$0.072
Supplies	0.017	0.022
Depreciation	0.015	0.015
Total cost per ton mile	$0.078	$0.109

These figures apply to a mine working under the following conditions: Seams pitching 25 degrees or more; pit cars containing two to three tons; rails weighing 30 to 40 pounds per yard; grades fluctuating but little from 0.46 to 1.00 per cent in favour of the loads; gangways roomy; tracks fairly well kept; curves few and slight.

The first air-haulage plant in western Canada was installed nineteen years ago at Coleman, Alberta, by the International Coal and Coke Company, Ltd. The compressor has duplex steam cylinders of 16-inch bore and 24-inch stroke and the air is compressed from atmospheric pressure to a final discharge pressure of from 1,000 to 1,200 pounds. The first and the second-stage cylinders are double acting and the third and the fourth stages are single acting. The air line consists of a quantity of extra-heavy piping, tested to a pressure of 1,800 pounds per square inch; and charging stations are placed at the mouth of the mine and at partings. These charging stations are provided with flexible couplings, so that the locomotives can be charged in a fraction of a minute.

It is now nineteen years since this plant was installed and the compressor and two of the three original locomotives are still in continuous service.

Since this original installation further plants have been installed at Bankhead, Lille, Calmene, Jasper Park and Coleman, Alberta, and at Michel, Hosmer and Corbin, B.C., and there are now in all twelve air haulage installations in use.

Air Operated Column Hoists

In the past five years small air-operated column hoists have been evolved and carried to a high state of development. (See plate No. 2.) These hoists are now obtainable in several sizes and types with single or double drums and for wire or manila rope. They range in size from 2½ to 11 h.p. and in rope pull from 1,000 to 2,400 pounds.

These hoists are now widely employed in coal and metal mines for hauling and switching cars; operating drag scrapers, and loaders; hoisting ore, steel, powder or much in winches and prospect shafts; skidding timbers, etc. Due to their small size and light weight they are easily moved about and quickly set up, and may be used where larger hoists or mucking and loading machines could not operate.

Pumping with Compressed Air

Direct Acting Pumps

Compressed air is often employed for mine unwatering and for station or sump pumping. In the open pit excavations of the Thetford-Asbestos District and in many Canadian mines and collieries air-operated simplex direct-acting pumps are used, mainly for the same reasons that causes compressed air to be employed for hoisting. In open pits or in underground workings, steam cannot be employed on account of the condensation losses during the winter season.

Plate No. 3,—Portable Compressor operating Paving Breaker.

The Application of Compressed Air in Construction and Quarrying

The use of compressed air in construction and quarrying operations in Canada has increased very largely in the last few years due to the construction of large hydro-electric power developments, the opening up of the country, the construction of highways and the general industrial expansion.

For example, the recent Chippawa development at Niagara Falls, carried through so successfully by the Hydro-Electric Power Commission of Ontario, used approximately twenty thousand cubic feet of free air per minute, and employed upwards of five thousand men. This project, necessitating the use of hundreds of compressed air driven rock drills, and pneumatic machines, illustrates the transition from a few pneumatically operated machines to present practice.

Compressed Air in Quarrying

Only a few years ago, the average quarry secured ample production by using a few steam operated tripod drills. Holes were drilled on short benches, and block holing was done by sand blasting or mud capping. Large quarries, operating as cited above, in the days of cheap labour and cheap powder, could produce and market their stone at reasonable prices, but with the general advance in the price of labour, and all other commodities, it was necessary to resort to other methods. Working faces were increased and modern compressed air equipment installed. In many quarries where a deep face is now worked, and where electric driven or gasoline driven churn drills, or well drills are employed for the long deep hole drilling, compressed air cuts costs by driving large hammer drills, for drilling toe holes or snake holes. Small self-rotating Jackhamers are used for block holing, etc. Air is also used for running drill sharpening machines, hoists, etc.

In other quarries where short benches of twenty or twenty-five feet are worked, the installation of air compressors, with modern drilling and sharpening equipment, has increased the output as much as 300 per cent.

The quarrying of brick shale has also profited by the use of compressed air, for, the small self-rotated air driven

"Jackhamer", operated by one man, will in one day give as much footage of hole, as was obtained in nearly one week from the old steam operated tripod drill, manned by two men.

The advent of the gasoline or electric driven portable compressor unit. has enabled the small quarry operator to derive all the advantages from the use of compressed air, which formerly was only enjoyed by the owner of a permanent installation. Small isolated quarry operations can now efficiently use compressed air drills, sharpening equipment, etc., with the added advantage of portability.

Compressed Air in Contracting Field

One of the most notable advances in the use of compressed air has been in the contracting field. Only a few years ago in isolated cases a steam driven compressor was employed by some adventurous contractor, whereas to-day practically every town and city has portable compressors in operation on its streets. The field ranges from large hydro-electric developments to small sewer contracts. For instance, on a very large job now being carried out two 2,000 cubic feet direct connected electric driven air compressors, each driven by synchronous motor, furnish air for rock drills, steel sharpening equipment, pumps, pneumatic tools, and other apparatus. It is not so long ago that steam drills, or drills operated by compressed air produced by steam generated by wood fired boilers would have been employed on a contract of this kind. Thus, while compressed air has long been recognized as most valuable on a large construction job, its scope has become so wide that future large construction work will probably necessitate the use of so much compressed air that the contractor will be compelled to demand the utmost efficiency from his air equipment.

Plate No. 4,—Ramming Sand for small Mold with a Bench Type Pneumatic Sand Rammer in a Canadian Foundry.

The portable gasoline driven air compressor unit has made it possible to utilize many labour saving devices, which previously could not be employed on a small contract, owing to the cost of setting up, tearing down, or moving a permanent compressor plant from place to place. At the present time, no matter how isolated the contract, these gasoline driven compressor units permit a supply of compressed air being available at any given point.

One of the most notable examples of the use of compressed air in speeding up work on small contracts is its application to sewer work. Methods of performing this type of work are now being revolutionized by the invention of the pneumatic clay digger. In many cities storm sewers are being constructed by tunnelling through clay underneath the city streets. Recent performances have demonstrated that the pneumatically operated clay diggers have increased production from 90 per cent to 150 per cent per man, over the old fashioned hand pick. The same thing is true of open cut excavations. This tool when fitted with an extension handle in the hands of an experienced operator will loosen enough ground to keep five or six hand shovellers busily engaged. Should hard rock be encountered the contractor has a supply of compressed air at hand to operate the ever-ready Jackhamer drill.

Another labour-saving device whose use has been made possible by the development of the portable compressor is the pneumatic paving breaker, which is proving indispensable to the cities, contractors and public utility corporations. Such work as repairs to concrete or asphalt pavement, manhole excavation, rehabilitation of street railway system, opening up gas services, etc. can be accomplished now-a-days in one half the time formerly taken, due to the application of compressed air. Plate No. 3 illustrates such a portable outfit.

Erection of steel for bridge repairs and the erection and maintenance of steel transmission-line towers come within the scope of the contractor having portable compressed air equipment. The cutting out of old rivets, replacing rivets, cleaning scale, painting or sand-blasting, no longer cause any worry. Compressed air drives riveting hammers, sandblasts, pneumatic wire brushes and paint sprays.

Another important use of compressed air in connection with construction and repair work is for operating cement guns and placing concrete. In using the cement-gun the concrete mixture called "gunite" is applied as a spray. One of the chief applications of the process is in preserving structures such as dams, bridges, buildings, etc. It is also used for lining reservoirs, tunnels and shafts.

In the pneumatic placing of concrete, batches of concrete are blown from a central point through pipes to the forms. Aggregates up to 4 inches in diameter are used. The process is of special value in tunnel work.

Day by day it is possible to see many unique applications of compressed air in contracting work, for instance, operating pneumatic tools under water on harbour improvement work, operating "Jackhamer" drills in the hands of divers, drilling boulders under water for power development, operating dredge gates, etc.

Foundries and Metal-working Plants

An important part of most machine manufacturing plants is the foundry. Compressed air is so valuable in the foundry, and has so many widely varied uses that it would not be very far from the truth to say that compressed air is just as necessary in the modern foundry as sand.

Air hoists have here quite a variety of applications. There are two types of air hoist, each with a definite field of use. The direct-lift hoist consists of cylinder, piston, — to which the hoisting rod is directly attached,—and valve; and is much the simplest and cheapest form of power hoist, both in first cost and operating expense. The motor type of air hoist has a three-cylinder air motor geared to the hoist proper, the motor being of the same type as is used in the pneumatic drill. The motor type of hoist is not limited in lift as the direct lift air hoist is, and does not require so much head-room. Both types find considerable use in foundry work, the direct-lift type for operating core oven doors, etc., the motor type in operating jib cranes, and on runways to handle moulds, etc.

On the foundry moulding floor there are a number of ways in which compressed air is put to work. The core sand is conveniently sifted in an air operated sand riddle; then there is the pneumatic sand-rammer, which is practically the ordinary hand-rammer operated by compressed air, that is to say, the pneumatic sand-rammer accomplishes the work formerly done by the hand-rammer, but very much more quickly and uniformly. Two types of pneumatic rammer are in use, for bench and floor. The pneumatic sand-rammer for foundry work has demonstrated that it is one of the greatest friends and labour savers of the progressive foundryman to-day. Plate No. 4 shows an application of this type.

In the cleaning department of the foundry the sand-blast has proved of great value. Cleaning is performed by a chipping action, and the thousands of sharp particles of clean sand quickly impart the necessary appearance to the product. Handles and levers that have been sand-blasted are much more pleasant to the touch, and the defects in castings or forgings show very plainly after being cleaned in this way.

Three members of the pneumatic tool family are found working in the cleaning department of the foundry: the pneumatic chipper, the grinder and the wire brush. All three of these are in use to remove fins, smooth down corners, and generally improve the appearance of castings. In steel mills pneumatic chippers are also used to chip out seams in order to discover how deep they may be, and determine whether the billet or forging must be scrapped. The pneumatic chipper is an air-operated hammer, in which the piston moves freely in the cylinder and hammers on the chisel head. The number of blows delivered per minute is in the neighbourhood of two thousand. Pneumatic grinders and wire brushes are operated by a three or four cylinder air motor similar to that used in the pneumatic drill.

In the Machine Shop

Pneumatic tools find two main applications in machine-shop practice — in the vise department, and in assembly. All vise work includes a considerable amount of chipping, and this can, as a rule, be done better by the pneumatic chipper than by hand. In the assembly department, particularly where machines are at all bulky, there is work for pneumatic chippers, grinders, wire brushes and drills. The work of the chippers, grinders

Plate No. 5,—Portable Compressor and Jackhammer Drills on Road Construction Work.

and wire brushes is similar to their work in the foundry, removing fins, smoothing down corners, etc. The pneumatic drill is useful because it is portable. The main drilling is done on the ordinary drill-presses, but as a rule there are some holes that can be more conveniently cut with a small portable pneumatic drill.

Air hoists are used in machine-shop work for serving machine-tools. The direct-lift hoist is best adapted for the medium size tools, and the motor type for the heavier boring mills, etc. The air hoist serving the machine-tool saves a great deal of time, and one man can run a machine without having to call on another for help every time he moves a heavy casting.

The war developed the air-operated chuck and mandrel for lathes, which has since proved valuable on many forms of quantity production work.

In one Canadian machine shop the direct-lift air hoist is used in a rather novel way as a "quick-return" on large lathes. It was found that a four-inch hoist placed horizontally at the back of the machine, and yoked to the carriage relieved the operator of a good deal of hard work with a very little expense.

Shipbuilding

The modern shipyard uses compressed air in very large quantities and the speeding up of shipbuilding that took place during the war was due largely to the increased use of compressed air. Many Canadian yards are equipped with the most modern types of pneumatic equipment.

The largest use of compressed air in shipbuilding is for riveting.

Air hoist, wire brushes, sand blasts, paint sprays. deck caulking machines, etc., are also used in the modern shipyard.

Pumping by Compressed Air

Air lift pumping is now widely used in Canada, the system at the well consisting of two pipes, an air pipe and a water pipe with a few fittings. Air is forced to the bottom of a well and mixes with water, forming a foam of bubbles, which is lighter than the water in the surrounding rock and is forced to the surface by the weight of the water surrounding it. To be successful the air must be thoroughly mixed with the water, and all air lift systems have special mixing chambers in which the air is delivered in very small bubbles. An advantage of air lift pumping is that the water is automatically aerated, which improves it considerably for drinking purposes.

Displacement pumping by compressed air is used to a large extent in chemical plants to transfer acids and corrosive liquids; it is also used for moving liquids containing grit or sand, as there are no moving parts to clog. One of the chief advantages of this system of pumping is that in intermittent service a large volume of liquid can be moved very quickly by using the storage capacity of a large air receiver.

An increasingly important application of compressed air is in the use of air jets for different purposes. Oil and powdered coal are becoming more and more important as fuel for steam boilers. These cannot be successfully used without a special form of burner, which blows the oil or coal into the furnace, at the same time thoroughly mixing it with air. A large number of burners have been patented for both types of fuels, all however, include some form of air jet, using either high or low pressure air. The air jet is also very useful in automobile factories for spraying paint and varnish; a number of large plants paint all their motor cars in this way. In smelters, chemical plants, tanneries, ice and refrigeration plants, textile mills, etc., the air jet is widely used for agitating solutions in tanks, cleaning, aerating, etc. For cleaning electric motors, particularly in dusty locations the air jet has no equal.

Railroads

The principal applications of compressed air in railroad work are for operating signal systems, tie-tampers, pneumatic tools in shops and in bridge and building repairs, paint spraying and sand blasting, etc.

Remarkable savings are made by the pneumatic tie-tamper, two men with one of these tools often doing as much as sixteen men working by hand. Two, four, eight and twelve tool gasoline and electric motor driven compressor cars are used to run the tampers. Many railroads also use portable compressors and tools for bridge and building repairs, etc. Pneumatic tools and hoists are very extensively used in railroad shops.

Miscellaneous Applications

Compressed air, in addition to being used for many of the operations previously described, is also used for special purposes in textile mills, grain elevators, flour mills, chemical plants, breweries, public buildings, saw mills, tanneries, oil refineries, and road work (see plate No. 5).

Acknowledgment

The writer especially desires to thank Mr. G. R. Southee of Toronto, Messrs. Robt. Peele, Frank Richards and the Canadian Ingersoll Rand Co., for their kindness in supplying data which has been included in this review.

Electro-Chemical and Electro-Metallurgical uses of Power

L. E. Westman,

General Manager, Canadian Chemistry and Metallurgy.

The use of electric power in chemical and metallurgical operations is one of the outstanding developments of Canadian industry. No other single factor has had so much weight in deciding the location of many large manufacturing plants. In some cases chemical loads have been developed to convert surplus or off-peak hydro-electric energy into marketable products; in other cases the industry has sought the power. The principal plants, which depend wholly upon electric power for the operation of their processes, are located in the vicinity of low-cost hydro-electric developments at Niagara Falls, Ontario; Ottawa, Ontario; Hull, Quebec; and at Shawinigan Falls, Quebec.

The possible applications of electric energy and what has been accomplished in Canada to date are graphically shown in the accompanying chart. (Table No. I.)* Some of the products of these industries are notable for their novelty and for the high grade of the technical skill that developed successful processes on a commercial basis; others are notable chiefly for the capacities of the units and for quantitative production.

Electric energy is used chiefly for the production of heat or to promote chemical actions or reactions. The heat effects may be applied to the fusion of metals or to the fusion of electrolytes; they may also be utilized in a number of industrial operations where temperatures above the normal air temperature are needed. The chemical effects are obtained either in fused electrolytes or by the use of aqueous solutions of salts.

*Prepared for publication in a Report on the Development of Chemical and Metallurgical Industries in Canada, by Alfred W. G. Wilson, Ph.D., M.E.I.C., Mines Branch, Ottawa, (No. 597, 1924).

Metallurgical Products

Fusion Processes

Prior to 1914 electric furnace development in Canada was relatively small; since that date many large furnaces have been put into operation for the melting of non-ferrous metals and alloys such as aluminum, brass, bronze, and Britannia metal. One plant is equipped with large furnaces for the fusion of copper-nickel matte and an induction furnace for melting nickel anodes. Ferro-silicon, steel, certain steel alloys, and grey iron are also made in electric furnaces in Canada.

The furnaces in use are practically all of the 3-phase arc type, operating at 25- or 60-cycles, alternating current, the capacity varying from 50 k.w. in a few small units to 5,500 k.w. in some of the large ferro-alloy furnaces.

There are 36 electric furnaces for steel installed in Canada, having a total rated capacity per heat of 175 tons, and an approximate monthly capacity for producing 20,000 tons of steel. These furnaces range in rated capacity from one ton per heat to seven tons. There are 10 electric furnaces, installed primarily for the production of low phosphorous pig iron. The total rated capacity of these units is 40 tons per heat, and the approximate monthly capacity for production is 3,000 tons. These furnaces range in rated capacity from one-half ton per heat to six tons. There are also nine large furnaces for the production of ferro-silicon with a total capacity of 40,000 k.w., one for ferro-chrome, and a number of small units installed in foundries for the fusion of non-ferrous metals and alloys.

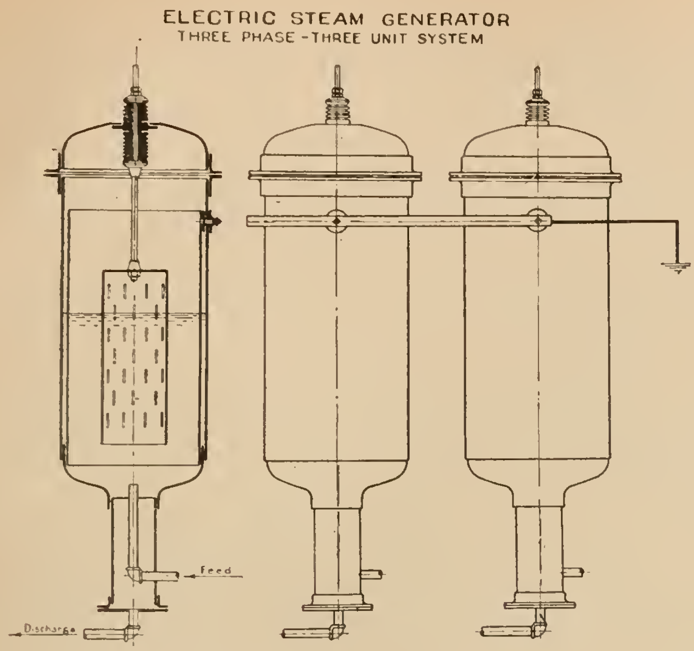


Plate No. 1,—Electric Steam Generator

Electrolytic Process

The following metals are produced by electrolytic processes, the electrolytes being made direct from ores of the metals: — Aluminium, zinc, copper, lead, nickel, magnesium, gold, silver. In addition, the production of electrolytic iron may be foreshadowed when market conditions warrant, because suitable ores are available at sites where the requisite hydro-electric energy is available.

Power Used in Processes

The quantities of power in use in these processes are not definitely known but the following figures are indicative of the extent of its applications in certain plants.

Aluminium

The Northern Aluminum Company at Shawinigan Falls, Que., is using 45,000 horse power for the production of metallic aluminium, the process being the electrolysis of the oxide in a bath of fused cryolite, a sodium aluminium fluoride. The oxide is prepared from the mineral bauxite. In addition, the Cedar Rapids development of the Montreal Light, Heat and Power Company, exports 80,000 horse power to the Aluminum Corporation of America for use at Messina, New York State, U.S.A.

Zinc, Copper and Lead

The following data have been supplied by the Consolidated Smelting and Refining Company, Trail, British Columbia, with respect to the power consumption in their different plants. The power used in the concentrating mill, where ores are prepared for treatment in the electrolytic units, has also been included in the statement.

Zinc Department

Production: 5,535,364 pounds per month.		
Power used for electrolysis 8,056,399 d.c.	= a.c.	9,260,215
Power used for roasters, cottrell, etc.	= a.c.	1,162,607
Zinc plant — Total a.c., k.w.-hours per month		10,422,822

Copper Department

Production: 3,000,000 pounds per month.		
Power used for electrolysis 1,077,000 d.c.	= a.c.	1,230,000
Smelting and converting	= a.c.	700,000
Rod mill	= a.c.	736,000
Total a.c., k.w. hours per month		2,666,000

Lead Department

Production: 7,786,540 pounds per month.		
Power for electrolysis, — k.w. hours per month 650,106 d.c.	= a.c.	747,260
Smelting	= a.c.	1,222,451
Items, transportation, etc	= a.c.	254,293
		2,224,004

Concentrating

1,100 tons per month.		
Power used k.w. hours, a.c. per month	=	667,000
Total power demand in k.w. hours per month, normal operation	=	15,982,000

The British America Nickel Corporation has installed an electrolytic copper refinery at Deschênes, Quebec, which has a rated capacity of about 4,000 tons per annum. A statement as to the power requirements is not available.

Nickel

About 85 per cent of the world's nickel is recovered from copper-nickel ores mines in the Sudbury district, Ontario. Most of the matte to which these ores are reduced is refined by a smelting process due to lack of hydro-electric energy. However, the electrolytic refinery at Deschênes, Quebec, is capable of producing about 7,500 tons of refined nickel annually. The hydro-electric power used in this process is about 6,000 horse power; this will be extended later to 10,000 horse power when additional power now under construction is available. A very considerable quantity of nickel is now exported unrefined in matte; this may later be refined in Canada.

Gold and Silver

Gold is refined electrolytically at the Royal Mint, and at one small private plant. Silver is refined at one private plant.

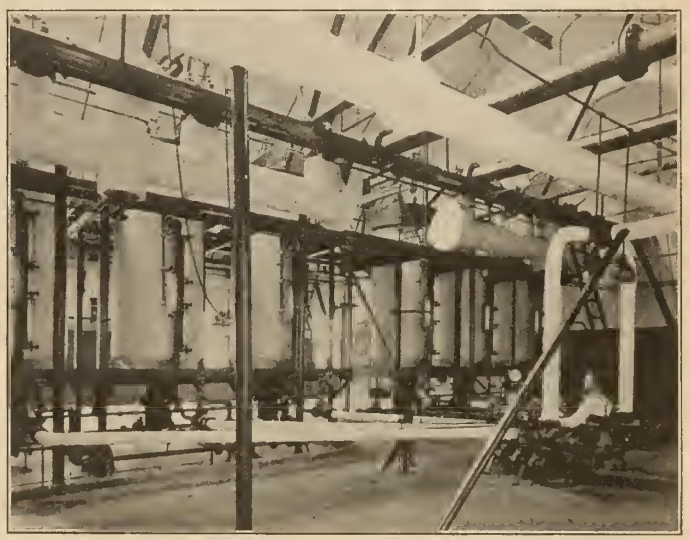


Plate No. 2,—Two Electric Boilers of the Laurentide Company, Grand Mere, Quebec, each 25,000 k.w., 6,600-volt, 3-phase, 60-cycle, 125 pounds steam pressure. Total capacity 150,000 pounds of steam per hour.

Electroplating

Canada is well supplied with gold, silver, copper, nickel, and cobalt, and the electroplating industry is well and widely established, both for custom work and in manufacturing metal appliances.

Chemical Products

Calcium Carbide

This compound is made at four plants. The Canada Carbide Company at Shawinigan Falls uses 30,000 horse power for this purpose; the total power consumption at other points has not been recorded. A considerable portion of the carbide produced at Shawinigan Falls is now converted into acetylene, acetic acid, and acetone through a remarkable series of syntheses. There are also several by-products made at this plant, including acetylene black and a number of organic chemicals. These secondary operations require an additional 14,700 horse power.

Cyanamide

The American Cyanamid Company at Niagara Falls, Ontario, produces and exports very large quantities of calcium cyanamide, all made by direct fixation of nitrogen in suitable electric furnaces. The capacity of the cyanamide works is 60,000 tons per annum. Some sodium cyanamide is also made at this plant. The power consumption in cyanide production is estimated at about 15,000 kilowatt hours per ton of nitrogen fixed. This cyanamide is utilized chiefly in the United States for the production of certain organic chemicals, including urea and concentrated fertilizers.

Phosphorus

Phosphorus is made in Canada at Buckingham, Quebec, chiefly from imported phosphates. The plant is located at this point solely because suitable power is available. The excess power is used for heating purposes.

Abrasives

Carborundum is made at four plants and aluminium oxide abrasives are produced at six plants.

Graphite

Graphite in several forms and graphite electrodes are made in one plant, and anthracite electrodes are produced at four localities.

Nitric Acid

One experimental plant for the production of nitric acid was in operation for a short time in British Columbia. Another plant, to use a new process for the fixation of nitrogen by the use of a rotating arc, is proposed at Merritton, Ontario, in the Niagara district.

Oxygen and Hydrogen

Oxygen and hydrogen are produced by electrolysis of water in Montreal, Toronto, and Winnipeg, about 3,000 horse power being used. Distribution cost is the main factor in regulating the market for these products.

Other Products of Electrolysis

Caustic soda, liquid chlorine, and bleaching powder are produced by Canadian Salt Company at Windsor, Ontario. Hypochlorite bleach is also produced at two wood pulp mills.

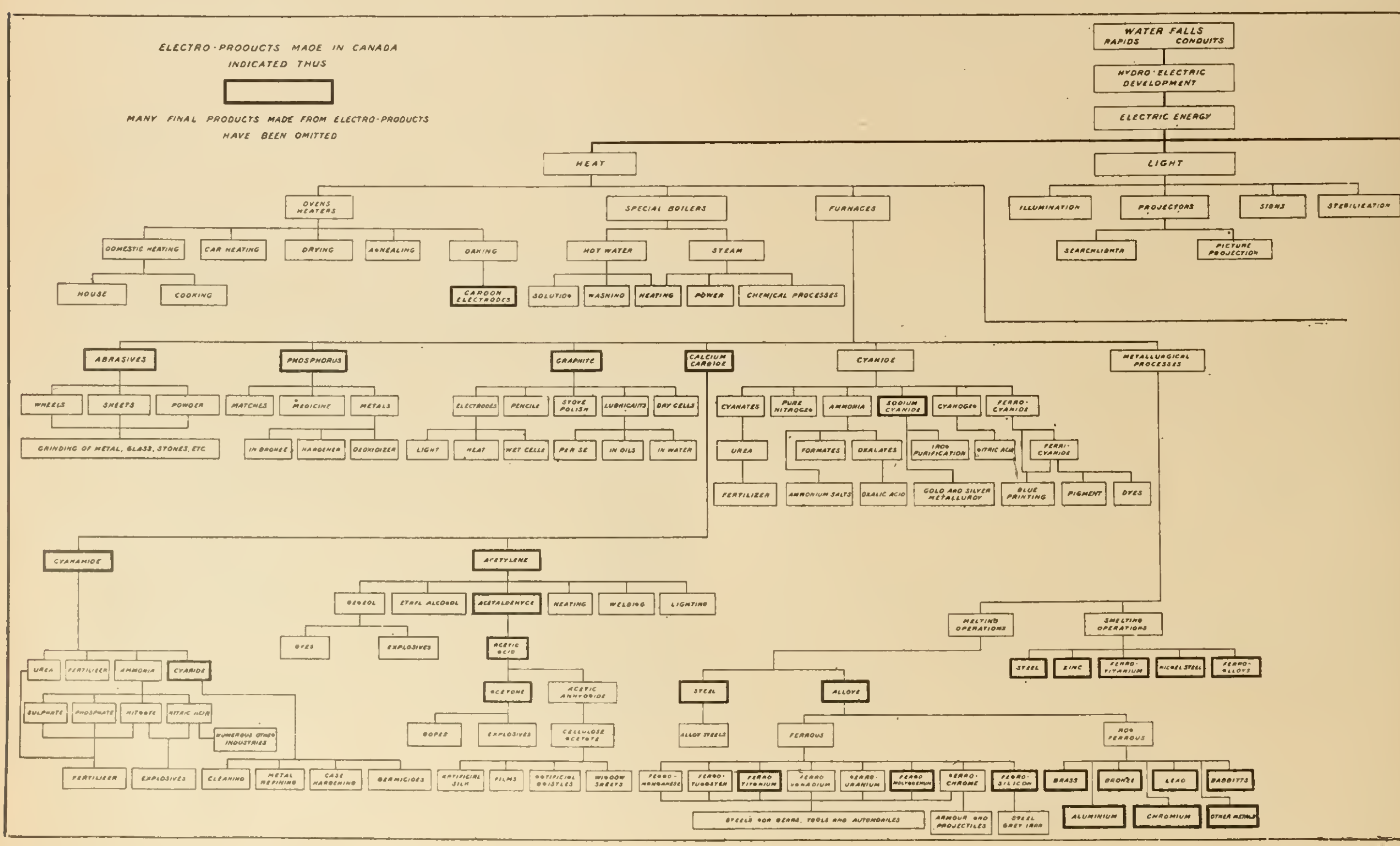


Plate No. 3,—Chart of Electro-Products

Heat Applications

Electric energy is used in a number of industrial processes to develop heat, either in special types of furnaces or for direct local application. A number of plants have installed electric units for core-baking, enameling, and the heat treatment of steels and other alloys. Electric welding appliances, and cutting equipment, are also employed in machine shops where suitable power is available. Surplus power and off-peak power are used for the generation of steam, both for industrial use and for heating at two plants. Heated water has been provided at another plant during the winter months for plant warming.

The most important development in the use of electric power for the production of steam is the installation of the Shawinigan Water and Power Company. The electric boilers used in this installation were designed by F. T. Kaelin, M.E.I.C., chief engineer of the company and the steam is generated for use in pulp and paper mills. There are at present in use 117,000 horse power of these boilers, in units up to 5,000 k.w. each.

These steam generators operate only on surplus power. They are of two types:—(1) Those in which the electric current passes through a combination of metallic resistors and (2) those in which water itself forms the resistance. The metallic type is suitable only for voltages up to 500. The large installations have been of the second type which is in operation on voltages up to 6,600 volts, 3-phase. In this type, the current passes through steam-tight insulating bushings, to a system of stationary electrodes, partly submerged in water.

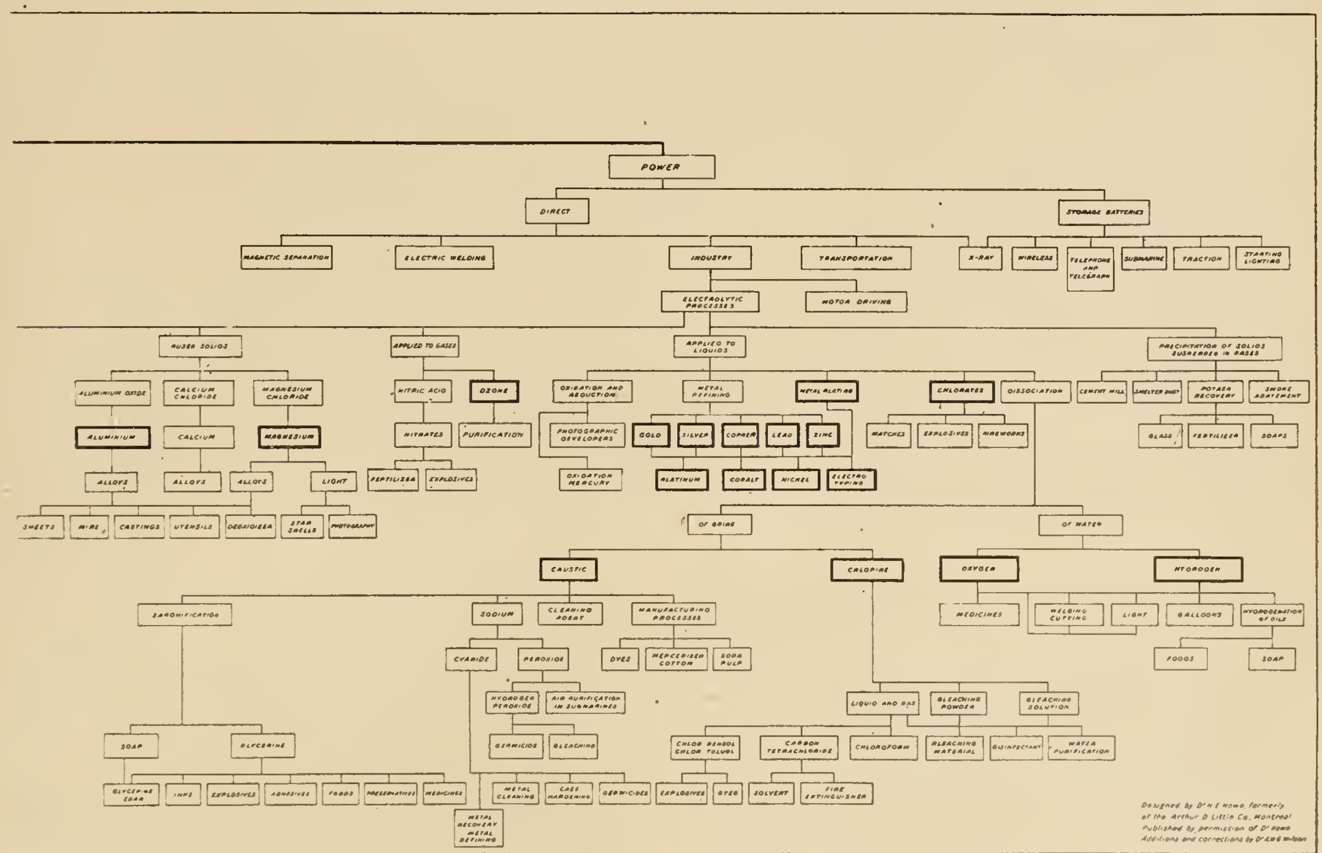
Plates Nos. 1 and 2 show a cross-section through a typical large unit and also a battery of these boilers totalling 50,000 k.w. installed in the Laurentide Company Paper Mill. The voltage in use on the installation noted in plate No. 2 is 6,600 and the installation produces 150,000 pounds of steam per hour.

The introduction of generators of this type in locations where power is available at intervals, and where coal is scarce will form a most economic outlet for large blocks of off-peak power.

Conclusion

It would appear that for the future certain types of chemical industries will find in the use of off-peak power conditions suitable for their development. As equipment for the utilization of peak loads increases, the necessity will increase for the careful development and expansion of industries that will balance in an economic way for the continuous use of all power available. There are also a number of large water powers in Canada, as yet undeveloped, which are located in unsettled districts. In the future these will probably be utilized for the development of chemical industries which require large blocks of continuous power.

Thanks are due officers of the Shawinigan Water and Power Company, Montreal, the Canadian Salt Company, Limited, Windsor, Ontario, and the Consolidated Mining and Smelting Company of Canada, Trail, B.C., for furnishing information concerning the installations of their respective companies. An advance copy of the manuscript of a report on the Development of Chemical and Metallurgical Industries in Canada, by Dr. Alfred W. G. Wilson, M.E.I.C., which will be issued by the Mines Branch, Department of Mines, Ottawa, during the present year, was also made available by the author.



showing those produced in Canada.

Power in Transport

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Superintendent of Rolling Stock, Montreal Tramways Company.

Section I. Development of Electric Transportation

Early History of Electric Traction in Canada

A study of the history of electric traction will show that Canada was not slow to appreciate the practical possibilities of the early experimental work of European and American engineers before 1880.

It was only about the year of Canadian Confederation, 1867, that it was discovered that an electric generator could drive a similar machine connected to it. Previous experiments were discouraging owing to the expense and limited output of chemical batteries, up to this time, the only means of producing electric current to operate the crude electro-magnetic motors that had been developed.

Although the practicability of electricity as a motive power was demonstrated in Europe by Siemens and Halske in Berlin and Paris in the year 1879 and 1881, it is interesting to note that as early as 1884, a short line was built and operated in Toronto, Canada, as a commercial proposition. This installation ranks as one of the first, if not the first, purely commercial adaptations of the new principle.

In 1886, Van Depoele, the engineer responsible for the Toronto venture, built and operated a line, 1.2 miles long, at Windsor, Ont. The equipment consisted of two cars, each equipped with one 20-h.p. motor. Current was collected, as in Toronto, from an overhead wire with an under-running trolley wheel and return through rails. In 1887, the same engineer built and operated a line seven miles long at St. Catharines, Ont.

In 1891, through the energy and courage of two enterprising pioneers in the electrical field, Messrs. Ahearn and Soper, the Ottawa Electric Railway began operating electric cars on regular schedule in the city of Ottawa. Toronto followed suit in the same year, and the horse-car lines of Montreal were electrified in 1892.

Influences Affecting Development

The severe temperatures and heavy snowfall of the eastern Canadian winter are such that when the operation of street cars was first considered as a commercially sound proposition, very grave doubts were expressed as to the successful operation of vehicles on wheels during the winter months on the streets of Ottawa, Montreal and Quebec. It had been the custom to substitute bob-sleighs or runners under the horse-drawn vehicles in winter.

Very serious trouble was encountered and time schedules were not to be depended upon during the first few winters of electrical operation, but motors and control apparatus rapidly improved and effective means were soon developed to keep the lines clear. It may be stated that, at the present time, none but the heaviest and most protracted storms have any serious effect upon the continuity and quality of the service in the larger eastern cities. Toronto and the western cities have a much lighter snowfall and do not have any serious difficulties in keeping operations normal throughout the winter months.

The general trend of traction development in Canada has followed very closely that of the United States. Being in close contact with this progressive neighbour both geographically and commercially, Canadian operating companies first turned to the American manufacturers for cars and equipment. Satisfactory car bodies could then be built in Canada but features of type and construction were reflected from United States standards. Trucks and motor equipments were at first imported from the same source, but Canadian manufacturers soon showed their ability to supply a satisfactory home-made product. Owing, however, to the close engineering relationship existing between the larger Canadian companies and their United States parent organizations, there has not been any tendency toward a distinctive Canadian type of rolling stock or motor equipment.

Climatic conditions in eastern Canada make it imperative to have every axle motor-driven. For the same reason, there is a tendency toward heavy cars and equipment because of better tractive possibilities on snow-covered rails and a reasonable margin of inherent heat capacity to meet the heavy current demand of operation during bad weather.

Canadian operating men fully appreciate the theoretical advantage of light cars and a high average load factor on small motors, but a survey of all modern cars in Canada will show that other considerations have predominated. It would seem to be a generally accepted principle that continuity of service, freedom from breakdowns and a reasonably long life of equipment windings are more desirable in the end than a possibility of economic savings that seem attractive on paper. Very definite proof of the wisdom of this tendency will be found by comparing the balance sheets of Canadian companies,

Plate No. 1, — Single Truck Closed Car — 1900.

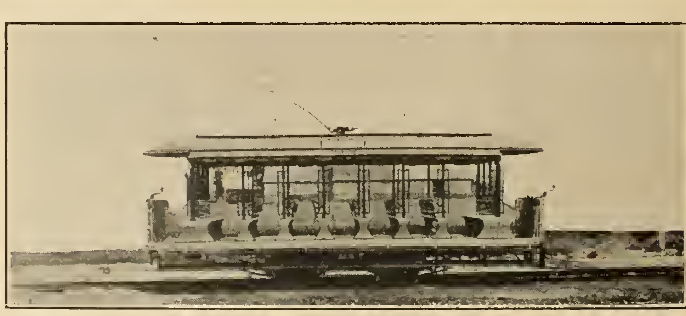


Plate No. 2, — Single Truck Open Car — 1901.

over a period of years, with those of some of the United States properties which have apparently been more progressive and where climatic conditions are much more favourable toward low operating costs.

Urban Tramways

Notes on Development

The population of Canada is at present about 9,100,000. There are seven cities of over 100,000, but outside of these centres, the density of the population is relatively very low as compared with European or eastern United States averages. The opportunities for successful operation of street cars are, therefore, limited.

The larger cities of eastern Canada were quick to take advantage of electric transportation as soon as that method became practicable, about the year 1890. Rapid development of generating machinery and motor equipment followed during the next ten years.

By the year 1900, two types of electric cars had been evolved that were practically the universal standard of American practice. These were the four-wheeled, single truck *closed* car, having longitudinal seats, and the single truck *open* car fitted with wooden slatted cross benches for summer use.

The protection offered by the closed and heated cars was a necessity in winter, but the efficiency and popularity of the open car were so marked that it was the usual practice to have two sets of car bodies for each equipment of trucks and motors. These cars measured about 30 feet overall in length, the closed cars having a seating capacity of about 28 passengers while the open bodies offered from 40 to 45 seats.

The motor equipment usually consisted of two, 25-h.p. series wound motors and the weight varied from 14,000 to 18,000 pounds.

Traffic conditions in the congested parts of the larger cities pointed toward the development of larger cars so as to decrease the number of car units for a given passenger movement. Furthermore, many of the main lines were extended out into more sparsely populated districts. The limited speed of the single truck car did not meet the demands of a satisfactory suburban service. The problem of ever increasing wages improved standards of comfort, safety and reliability; all these considerations had their influence on the development of the double truck car which was in almost universal use by the year 1910.

In the meantime, the use of the highly efficient and economical open car was first discouraged and finally prohibited by various provincial public utility boards. This was principally because of danger to the conductor who had to attend to the collection of fares while standing or moving from seat to seat on an open and unprotected running board along the side of car. The number of accidents resulting from this practice hardly justified the prohibition but the type is now almost obsolete.

The most popular city car in 1910 was known as the double truck, pay-as-you-enter type. The usual dimensions were:

Length overall	42 to 50 feet
Width	8 feet 4 inches to 8 feet 6 inches
Platform length	6 feet to 7 feet 6 inches
Body length	30 feet to 35 feet
Weight	36,000 to 54,000 pounds
Seating capacity	40 to 50 passengers.

This type of car was developed and first used in the city of Montreal in 1904. Its use quickly spread over the whole continent. Its principal feature was that it allowed, without undue delay at loading points, for the collection of fares at the rear end of car. The conductor was then able to supervise the movement of passengers on and off the rear steps and the reduction of accidents was very marked. The movement at front end was under the direct control of the motorman.

Before the year 1910, a very large portion of the street cars in Canada were of wood or wood reinforced with steel plates and angles. Since that time, the tendency has been toward composite bodies having all steel frames and side girders with wood floors, posts and roof, or, in some cases, a car that is practically of all-steel construction with the exception of the floor, headlining and interior finish.

In the larger cities, the large unit is still considered the most desirable type but on the smaller properties, there has been a tendency toward smaller and lighter units preferably designed for one-man operation.

Owing again to climate, it has not been usual to adopt the light standard Birney car so popular in the United States, because of its inability to drive its way through heavy snow. Double floors and heat insulating linings are also considered to be a necessity. The modern Birney car, as used in the United States, weighs from 15,000 to 16,000 pounds and is equipped with two 25-h.p. light weight, ventilated motors. The Canadian equivalent weighs from 16,500 pounds with 25-h.p. motors to 18,000 pounds with 35-h.p. motors.

Trend of Car Design

The controlling factor of modern car design is the saving of time. The constantly increasing volume of automobile traffic in motion and the complementary increase in the number of vehicles "parked" at the curb are making it very difficult to maintain car schedules at satisfactory speeds. Modern life in Canada, as in the United States, demands quick transportation.

The common use of the automobile has changed our ideas of speed. The public demand is for speed of transportation comparable with that of the automobile. The rapid growth of this means of transport is perhaps the greatest hindrance to the free movement of street cars in streets that were once considered broad but are now so obviously narrow.

Plate No. 3, — Early Double Truck Car — 1901.

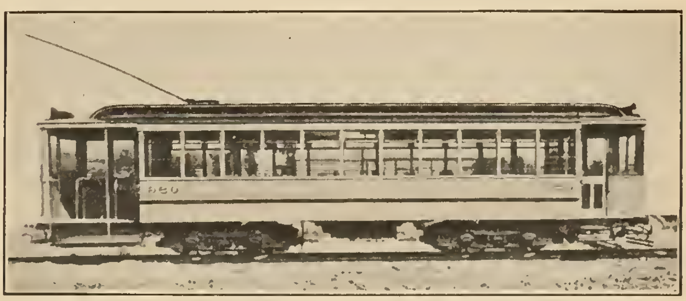


Plate No. 4, — First Pay-as-you-enter Car, Montreal — 1904.

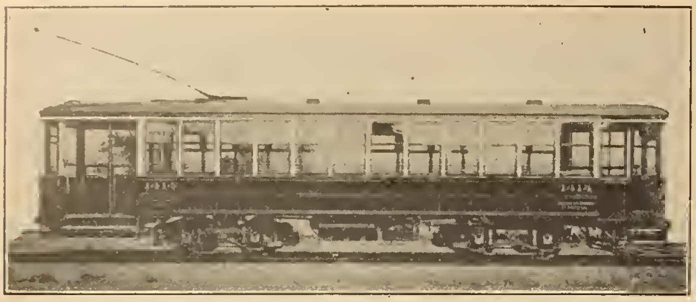


Plate No. 5, — Typical Pay-as-you-enter Car — 1912.

Canadian efforts toward a solution show a strong desire to expedite the loading and unloading of passengers. Maximum practical rates of acceleration and braking, as well as safe maximum speeds, have been reached.

The large rear platform of the pay-as-you-enter car provides sufficient space to accommodate a very large proportion of the groups of boarding passengers that are picked up in a days run. There are, however, congested transfer and initial loading points in every city where certain delays are occasioned by a slowing up of the movement into the car while the conductor is collecting fares, selling tickets, making change and collecting as well as issuing transfers.

The advantage of having the conductor in a fixed position in control of, and in plain view of the doors and steps is so clearly recognized that the next logical step in the evolution of the car is to increase the vestibule space between the street and the fare box.

This feature has been realized in the pay-as-you-pass or "Peter Witt" type of car. This car is usually constructed as a large unit. Its principal feature is that it provides a large space at the front end of car for the accommodation, without delay at fare box, of a rush of boarding passengers at heavy loading points.

Passengers enter a wide door at front end, in a double stream, without interference from descending passengers. The conductor's location is at about the centre of car. In this position he is in plain sight of, and can control the safe operation of doors and steps of the two centre exits while attending to fare collection. While a car is loading at, and after it leaves a crowded corner, the conductor collects fares from and issues transfers to those passengers who wish to enter the rear or "paid" space in the car. These are free to leave car at any time by one of the centre exit doors. Those remaining in the forward area are only required to pay their fare as they pass the conductor, either to reach the "paid" area in rear end of car or to leave directly from a second centre exit door immediately beyond the fare box. Suitable railings are provided to direct all movement in the desired directions.

The car offers great flexibility of operation because in case of a very large crowd entering an empty car at a turning point or at theatres, race tracks, athletic grounds, etc., all doors may be thrown open for entrance and all fares may then be collected as passengers leave the car in small groups.

Certain objections exist, viz.,

First. Opportunity is given for wide abuse of restricted transfer privileges because conductor cannot judge, when collecting a transfer coupon, if passenger was entitled to the use of same at time and place of entry into car.

Second. A part of the advantage gained, at heavy loading points, is offset by the necessary delay in collecting fares at exit, when car stops at heavy transferring points inside the congested area.

Third. What would seem to be an obvious weakness, viz., that passengers without means of paying fare may ride to their destination, has not proved to be a serious factor.

Illustrations of this type of car, as adopted by the new system of the Toronto Transportation Commission, are shown.

A large proportion of the new Toronto motor cars are provided with motor equipment of sufficient capacity to haul fifty-foot trailers during periods of heavy traffic. They may even perform continuous two-car train service on level lines throughout the day. The latest model of trailer has a third centre door. This offers means for loading at the centre as well as at the regular front entrance without interfering with the outward movement of passengers by way of the two regular centre exit doors.

The large number of new cars ordered by the Toronto Transportation Commission are all of the front entrance type. They have, therefore, decided, in order to minimize confusion and delay at loading points, to reconstruct a number of the older pay-as-you-enter cars so that they will also be suitable for front entrance operation.

Multiple Unit Trains in City Service

Experiments with ordinary trailers were made in Montreal in 1913 and 1914. Twenty-five motor cars, weighing 42,000 pounds, and equipped with four 55-h.p. motors, were coupled with twenty-five trailer cars without motors. The trailers weighed 30,000 pounds.

It was found that satisfactory operation, especially during the winter months, was restricted to lines on which the controlling grades were less than six per cent. Since only one of the main routes had grades within these limits and because all detours off this route, in case of blockade, resulted in operation over grades varying from nine per cent to twelve per cent, it was decided to experiment with two-car trains, both cars being equipped with motors and multiple unit control.

The leading car is of the standard pay-as-you-enter type. It is equipped with four 55-h.p. motors, entrance and exit doors at rear and exit door at front. Trailers are equipped with two 55-h.p. motors, with entrance and exit doors at front end only. Both cars are equipped with master controller, main controller, independent systems of air brake with compressor, separate trolley poles and automatic coupling of draw bars and air lines. A semi-automatic electric control cable connection completes the equipment.

Fifty, two-car trains were put into operation in 1917. Their performance has been very satisfactory and twenty-

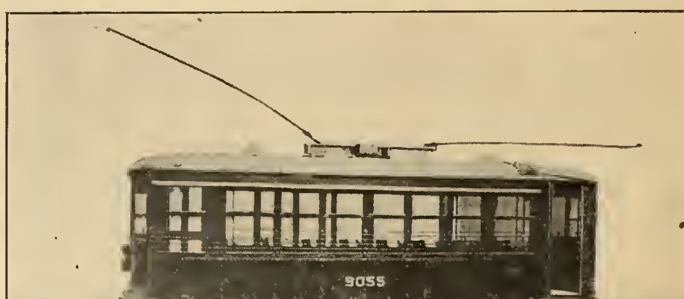


Plate No. 6, — Standard Birney One-man Car.

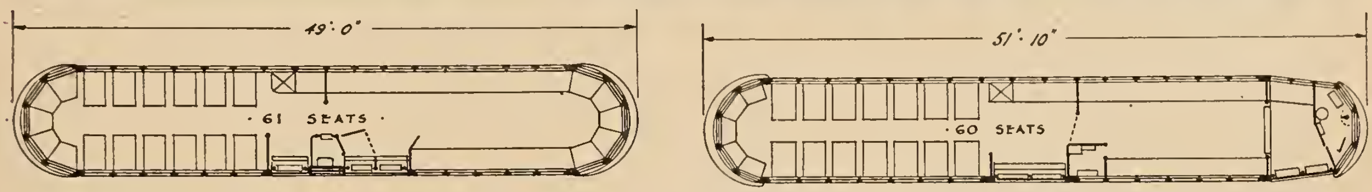


Plate No. 7, — Elevation and Floor Plan of Witt Motor Car with Three-Door Trailer, Toronto — 1922.

five extra trains are now under construction, these to be exact duplicates of the first lot.

The outstanding advantages are:—

First. Reduction in number of separate units on congested tracks.

Second. Reduction in platform operating expense; three men for two cars.

Third. Entrance at rear of motor car in combination with large entrance at front of trailer to provide quick loading facilities at one point thus obviating the confusion and delay that invariably results when entrances of a two-car train are widely separated.

Fourth. Automatic acceleration at a considerably higher rate than practicable with hand control.

Fifth. Flexibility of operation without delay and expense at coupling-up points. Trailer car can be operated to coupling point by conductor of second car and coupled to car ahead within 45 seconds. After performing rush-hour service, trailer can be disconnected at a suitable point without any delay and operated to its berth in car barn by conductor.

Sixth. In case of breakdown of control apparatus on forward car, the train can be operated to nearest car barn from the rear car.

These trains can be stopped and started on grades up to about 12 per cent without difficulty in almost any kind of weather. This is due to the fact that trailer is somewhat lighter than motor car. It has a clean rail for tractive effort and the wheels of the motor-equipped truck carry almost two-thirds of the total weight of trailer.

The maximum power demand of these trains is indicated by the fact that circuit breakers must be set at 480 amps. on the four-motor car and 300 amps. on the two-motor unit, or a total of 780 amps. Normal current during acceleration on level tract at 2 m.p.h.p.sec. is 660 amps. per train with usual full load of one hundred passengers per car or two hundred passengers per train. This is the same current as that required for operating up a 10 per cent grade with motors in parallel.

Power Requirements of Electric Railways in Canada

It has not been found possible to compile complete statistics but the power requirements of the larger cities are shown below for calendar year 1923.

Suburban and Interurban Railways

Opportunities for the rapid development of purely suburban and interurban electric railways in Canada are also limited. The reason is that the more desirable conditions for both agricultural and commercial success are restricted to a relatively narrow belt running east to west and immediately north of the international boundary. As a result of these conditions, the smaller towns have developed along the lines of the three transcontinental steam railways and are, therefore, directly connected with the larger cities and with each other.

Some of the many branch lines of the steam railways have been electrified and present conditions are such that many others can only be operated profitably by the substitution of small units, self propelled by storage battery or oil engines.

Province of Quebec

The electrically operated suburban lines of primary importance are the Montreal and Southern Counties Railway Company and the Montmorency Division of the

	Toronto	Montreal	Winnipeg	Hamilton	Quebec
Car-miles operated	27,250,000	23,261,700	9,574,000	2,963,000	2,424,200
Revenue passengers only	189,143,000	195,707,800	58,253,350	20,963,000	15,721,450
Maximum power demand	31,000 k.w.	40,820 k.w.	12,500 k.w.	2,600 k.w.	3,000 k.w.
K.w. hrs. consumed	90,750,000	110,915,000	37,646,450	None	8,116,400
Proportion, steam power	None	8 per cent	1 per cent	15 per cent	None
Proportion, hydro power	100 per cent	92 per cent	99 per cent	85 per cent	100 per cent
K.w. hrs. per car mile	3.32	4.77	3.93	None	3.48
Method of car heating	Coal	Electric	Coal	Coal	Electric

NOTES: — (a) Power consumption includes all services such as car heating, lighting, motive power for shops and construction tools and snow equipment in winter.
(b) Maximum demand during winter in Montreal is about 33 per cent higher than in summer.
(c) Average k.w. hrs. per car mile in Montreal during summer — 4.0
Maximum k.w. hrs. per car mile in Montreal during winter — 5.4
Relatively heavy demand due to hilly nature of city, short blocks with excessive number of stops and large proportion of narrow streets where rheostatic losses are abnormal.
(d) All city fares are on a flat rate regardless of distance travelled and number of transfers made to reach destination.

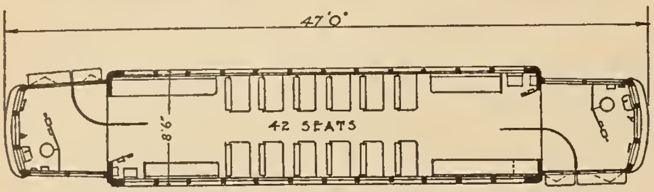


Plate No. 8, — Elevation and Floor Plan of Pay-as-you-enter Car converted to Front Entrance for "One Man" or "Two Man" operation, Toronto.

Quebec Railway and Power Company's system. The former operates about 52 miles of track to various towns between Montreal and the United States border. Twenty-five miles of this total was at one time operated as a steam railway by the Central Vermont Railway Company. There is now a joint steam and electric service over this section. The gross earnings for the year 1922 were $510,662.00. The Montmorency division of the Quebec Railway reports a mileage of 28.60 miles and gross earnings for 1922 of $327,000.00.

Province of Ontario

The principal suburban lines in Ontario are listed below.

Name of Railway	Miles Track	Gross Earnings 1922
Chatham, Wallaceburg and Lake Erie	36.73 d.c. 500 v.	$146,649.00
Grand River	24.36 d.c. 500 v.	377,914.00
Hamilton, Greensby and Beamsville	22.60 d.c. 500 v.	202,371.00
Hamilton Radial	22.86 d.c. 500 v.	188,841.00
Hull Electric Company	16.54 d.c. 500 v.	315,284.00
Lake Erie and Northern	51.00 d.c. 1,500 v.	340,895.00
London and Port Stanley	24.50 d.c. 1,500 v.	564,481.00
Niagara, St. Catharine and Toronto	61.77 d.c. 500 v.	958,089.00
Sandwich, Windsor and Amherstburg	34.75 d.c. 500 v.	574,124.00
Toronto Suburban	65.51 d.c. 1,500 v.	345,244.00
Toronto and York Radial	66.22 d.c. 500 v.	130,661.00
Windsor, Essex and Lake Shore	37.35 a.c. 6,600 s.p.	312,092.00

Under Construction:—Toronto and Eastern Division C.N.R. 70.0 d.c. 1500 v.

Province of Manitoba

The Winnipeg, Selkirk and Lake Winnipeg Railway has 38.48 miles of track, using d.c. 500-v. power, and had gross earnings in 1922, of $213,741.00.

Province of British Columbia

The British Columbia Electric Railway, besides operating the street railways in Vancouver, New Westminster and Victoria, also operate a very complete and well equipped system of interurban and radial electric lines throughout the Pacific coast area of the province. The line running from New Westminster to Chilliwack, a distance of 64 miles, is the longest electric interurban stretch in Canada. The total interurban mileage is 190 miles, of which 25 miles are on Vancouver Island.

In addition to the carriage of passengers, this company derives a large revenue from the operation of about 425 freight cars and 18 Electric Locomotives.

Province of Nova Scotia

The Cape Breton Electric Company operates 30.59 miles of track in the coal mining and steel manufacturing district of Nova Scotia, and in 1922 had gross earnings of $296,811.00.

High Voltage Traction

A list of the Canadian high voltage systems is given below. These railways do a general passenger and freight business and are operated in much the same manner as the steam trunk lines.

	Lake Erie and Northern	London and Port Stanley	Toronto Suburban Railway	Toronto and Eastern Division C.N.R.	Montrea Tunnel Terminal C.N.R.
Length of route, miles.	54	24	49	70	10
Single track mileage	56	30	56	..	30
Type of O'Head Construction	*Cat. trol.	Cat. trol.	Cat. trol.	Cat. trol.	Cat. trol.
D.C. voltage on trolley	1,500	1,500	1,500	1,500	2,400
Transmission voltage	26,400	13,200	25,000	..	11,000
Frequency	25	25	25	..	60
Phases	3	3	3	..	3
Number of motor cars	8	8	6	20	8
Weight of motor cars	40 tons	51 tons	45 tons	..	80 tons
Free running speed	45 m.p.h.	50 m.p.h.	52 m.p.h.	..	50 m.p.h.
Number of trailers	3	10	0	..	Train haulage
Number of locomotive	2	3	0	..	6
Weight of locomotives	60 tons	63 tons	..	..	83 tons
Original operation	New	Steam	New	New	New

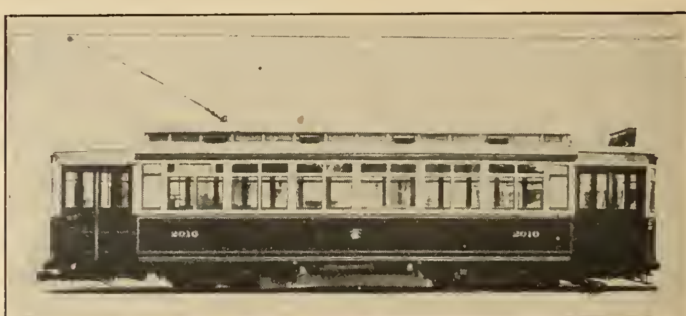
NOTE:—The lines of Montreal Harbour Commission are being electrified on a voltage of 2,400 d.c., 58 miles and four 100-ton locomotives.

Single-Phase A. C. Traction

Only one railway in Canada uses this system, viz., the Windsor Essex and Lake Shore Rapid Railway, which operates 37 miles, using 6,600 volts, single-phase, a.c.

Statistics — Canadian Electric Railways

The last official returns available are those for the calendar year of 1922. Very little construction has been accomplished since that time and the figures for 1923 will be substantially the same.



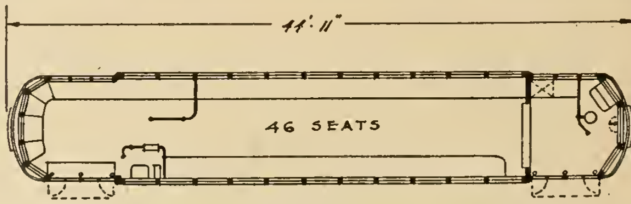


Plate No. 9, — Elevation and floor plan of Pay-as-you-enter Car converted to Pay-as-you-leave,—Toronto.

*Catenary trolley.

Plate No. 10, — Multiple Unit — 2-Car Train — Montreal 1916 and 1924.

First Main Track Mileage by Provinces

Nova Scotia	55.42	miles
New Brunswick	25.86	"
Quebec	300.27	"
Ontario	811.40	"
Manitoba	127.01	"
Saskatchewan	47.22	"
Alberta	108.24	"
British Columbia	249.18	"
Total first track	1,724.60	"
Add total second track	513.22	"
Total track in operation exclusive of sidings, etc	2,237.82	miles

Operating Statistics

Total operating track miles	2,237.82
Gross earnings from operation	$49,660,485.00
Miscellaneous income	4,195,536.00
Total income	$53,856,021.00
Operating expenses	$35,986,871.00
Taxes, funded debt, etc	$10,567,202.00
Net income	$7,308,947.00
Fare passengers carried	738,908,949.00
Freight carried — tons	2,445,425.00

Of the mileage operated, 65 per cent is privately owned, the remaining 35 per cent is publicly owned.

Distribution of Publicly Owned Lines

Ontario	456.43	miles
Manitoba	7.65	"
Saskatchewan	38.22	"
Alberta	106.49	"
British Columbia	3.38	"
	612.17	miles

Rolling Stock Owned

Closed passenger cars	3,868
Open passenger cars	258
Combination passenger cars	103
Freight cars	741
Comb. passenger and baggage cars	38
Work cars	20
Snow plows	65
Snow sweepers	146
Miscellaneous cars	278
Electric locomotives	56
Trackless trolley cars	8
Busses	27

Section II. Railroad Electrification in Canada.*

Canada is a country where relatively long distances occur between large centres of population; the cost of electrification therefore between cities is prohibitive at the present time. Schemes have been prepared for the electrification of various sections of the railroads across Canada and there are no physical difficulties to prevent the total electrification.

From a purely operating point of view electrification is very desirable as the power is available and obtainable for practically the whole distance from existing power stations. The bulk of this available power is hydro-electric excepting in the eastern section and the prairie section where ample coal or natural gas exists.

The severity of Canada's winters favours electric operation compared with steam, inasmuch as the capacity of the electrical equipment is increased in cold weather whereas the reverse is the case for steam locomotives.

Outside of suburban electrification referred to elsewhere in this paper, which electrified systems, although built to steam road specifications and carrying on most of the business normally incident to a steam railroad, do not form any part of the main trunk line, there are a few electrifications which have the characteristics of main line railroad operation and operate as part of trunk line systems. These are as follows:—

*Prepared by J. A. Shaw, B.Sc., M.E.I.C., Electrical Engineer, Canadian Pacific Railway, Montreal.

Sarnia Tunnel: This tunnel which extends under the St. Clair river and connects the Canadian National main line tracks in Ontario with those in the state of Michigan on the direct Montreal-Chicago route, was electrified in 1908. The total length of electrification is 10 miles, the system being an overhead trolley, 3,300 volts, single-phase, alternating current. The locomotives are 125 tons, rated at 1,500 h.p. and able to haul 1,000-ton trains up 2 per cent grades at 10 miles per hour.

Montreal Tunnel: The Canadian National Railway operates their system from their Montreal terminal for a distance of some six miles, including the tunnel under Mount Royal, entirely electrically; direct-

Plate No. 11, — Typical Suburban Car — Montreal & Southern Counties Ry.

current, 2,400-volt system is used, 100-ton locomotives taking their service by means of pantagraph collectors from a solid overhead catenary system.

Montreal Harbour: The harbour front, Montreal, has been electrified and 50 miles of track will be put into operation this summer. This electrification will form part of the Canadian National electrification in Montreal and the same 2,400 volt direct system has been installed. Further reference to this electrification will be found in the paper on the "Use of Power for Port Facilities".

As the population of Canada increases and the smaller towns increase, without doubt some main line electrification will take place. Neither Ontario nor Quebec, where the bulk of the railroad mileage exists, has any coal; each of them has very considerable unused reserve in water power. Inevitably, electrification will extend and steam operation diminish.

Section III - Current Practice in use of Electric Power for Tramway Operation

Distribution

Prime Movers

Hydraulic power is the source of nearly all the energy used for traction in Canada. A great proportion of the total is generated by large units at a considerable distance from the 600-volt d.c. substations. General practice as to choice of generator voltage varies widely as elsewhere, a maximum being at about 13,000 volts. In general, the most suitable transmission voltage is much higher than the highest practicable generator voltage and it is therefore common practice to wind generators for 2,300 volts, 25-cycle, 3-phases. This is then stepped up to pressures between 20,000 and 110,000 volts according to distance of transmission.

The Montreal Tramways Company operates a very efficient steam turbine station where power is generated at 13,200 volts in the generator windings. This is tied in with their local distribution trunk lines operated at the same voltage.

Substations

The general practice of electric railways is either to purchase power or to use only a part of the output of a generating station for railway purposes. The only power plants of particular interest in a discussion of transportation are, therefore, the sub-stations where alternating current power is received from one or more sources and there converted to direct current for distribution to the cars.

There can be no fixed rule as to choice of capacity and location of these stations but, since d.c. power at trolley voltages, can only be transmitted economically over a very short distance, it is usual to locate the main distributing point as near the centre of gravity of car movement as is economically possible. More stations are added as necessity or economy requires.

Wide variations will be found in Canada as to type and size of converting units and also as to the means adopted to proportion the load at each station according to its capacity. Rather than attempt to differentiate between the many schemes adopted, it will perhaps be better to give a short description of a typical system of local distribution with which the author is familiar, namely, that of Montreal.

A very complete and interesting description of the development of automatic substations in Canada has been prepared for this report by Mr. F. F. Ambuhl of the Toronto Hydro-Electric System. This will be included in full.

Distribution System - Montreal

Primary alternating current power is purchased under various forms of contract from two power companies who operate six large independent hydro-electric plants. In addition to having these long distance transmission sources of power at their demand, the railway company owns and operates two steam-driven stations. The smaller of these is located at the site of the original steam plant near the centre of the city, which was the only source of supply before hydraulic power was available at a reasonable cost. The present capacity of this station is 3,200 k.w., 600-v., d.c. divided between three small units.

A relatively new steam station has been built at the east end of the city. This consists of:—

Two	1,000 k.w. reciprocating engines,	2,000 k.w.	600 v., d.c.
One	2,000 k.w. " "	2,000 k.w.	600 v., d.c.
Two	12,500 k.w. turbo-generator......	25,000 k.w.	13,200 v., a.c. 3-phase
	Total......................	29,000 k.w.	

The installation of one of the large units is not yet complete.

The steam units up to the present time only produce about 10 per cent of the total kilowatt hours of energy

Plate No. 12, — Modern Substation — Montreal.

Plate No. 13, — Interior View of Modern Substation — Montreal.

consumed, but they serve several very important purposes, as follows:—

First. As a dependable insurance against breakdown or failure of transmission lines.

Second. As a means of maintaining a very high load factor on "horse power per year" and "maximum demand" power contracts. Since the daily "rush-hour" peak load on the tramway system overlaps the commercial load peak, these features are of very great importance. The company is in a position to make favorable 24-hour per day contracts to cover normal demand and can generate a large output to meet peak load demands at a smaller nett cost per kilowatt hour than if it were obliged to contract for an excess of 24-hour power and also pay the usual high penalties for temporary overloads during the maximum demand period.

Third. To meet abnormal demand during snow storms.

The main substation is on Côté street located at almost the exact centre of gravity of load. Outside the central district is a circle of nine substations, each one of which normally supplies the demand of a definite section of the trolley system. All of the stations are ring-connected to the central substation by means of a 13,200-volt, a.c. underground transmission line. A double bus bar system is so arranged at the central distributing station that failure of any of the direct transmission lines, feeding the various substations, can be immediately cor-

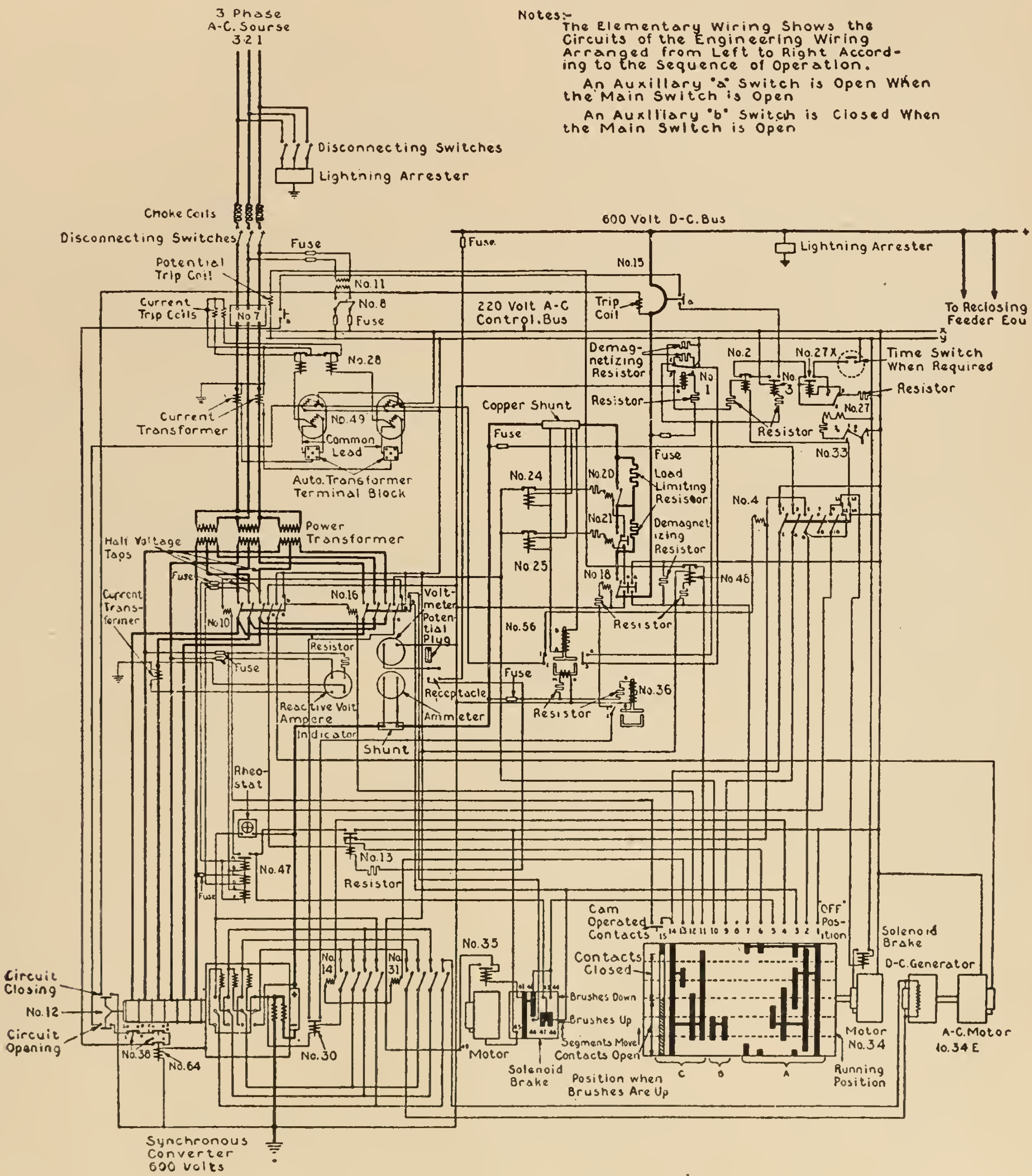


Plate No. 14, — Scheme "A" Wiring Diagram rected. This is done by switching the idle machines on to the intermediate underground feeder system which is energized through the central station from the steam plant. This arrangement also serves to keep the diversity factor of the whole system very near unity because surplus power from any of the substations can, at times, be diverted to an overloaded station.

Purchased power is received under present contracts in various forms, viz.,

600-volt, d.c. (one station only)
2,300-volt, a.c. 2-phase 60-cycle
2,300-volt, a.c. 3-phase 60-cycle
12,500-volt a.c. 3-phase 60-cycle

The a.c. current is converted to d.c. by induction motor-generators, synchronous motor-generators and rotary converters. The synchronous motors serve the useful purpose of regulating the power factor on transmission lines.

Return Circuit

It is customary to take full advantage of rail conductivity and the value of good bonding is fully appreciated. Rail welding is now quite common. Regulations as to definite voltage drop in rails are not so stringent as in Europe but losses are limited as much as is reasonably possible. Through bonding around all intersections is now the regular practice in most cities.

Rail conductivity is supplemented, when advisable, by stranded copper cables bonded to rails at suitable intervals and connected at manholes to underground cables in conduits or to overhead cables carried on the trolley poles at side of street. The track cables are usually laid in wooden box conduits and liberally surrounded with pitch to prevent electrolysis. The practice of running jumper cables to equalize areas of high rail voltage with other areas of low voltage is followed to a limited extent.

Automatic Railway Substations *

The railway converter substation, is an indispensable link in the chain of operations carried on in operating the majority of electric railway systems. This is particularly so where the generating station is too far distant from the load for economic transmission at trolley voltage. Power generation, too, is now carried on by means of much larger units than are suitable for traction work, and the almost universal use of alternating current except for railway, also renders some means of conversion necessary.

An interesting example is the case of Toronto, Ontario, where all of the power used is generated in the hydro-electric plants at Niagara Falls and where the generated voltage of 12,000 is stepped up to 110,000 volts for transmission to Toronto, a distance of approximately 100 miles. In Toronto, this voltage is again stepped down to 13,200 volts for distribution over the city to the different substations. Some of these supply both alternating and direct current power and lighting, whereas others supply direct current to the railway alone.

There are ten substations supplying power to the railway with a total capacity of 31,000 k.w. Of this number, six supply the railway only and two of these are automatic stations. The first of the automatic stations was placed in operation June 20th, 1921, and it is believed to be the first fully automatic station to be operated in Canada. The second was placed in operation December 14th, 1922 and a third automatic station is now under construction and will be placed in operation during the fall of this year. Only synchronous converters are used for railway work, as they are preferable to motor-generator sets for this service, for the reason that the converter has proven its reliability from the operating point of view, while its efficiency including transformers, is from five to eight per cent better than that of a similar motor-generator without transformers. Another feature in favour of the synchronous converter is, when self-started from the alternating current side, it is self-synchronizing, materially reducing the time in restoring service after power failure.

Methods of Control

Three types of control equipment are in use for railway substation work:— (a) Manual control, (b) Remote control, (c) Automatic control.

The three classifications above are given in the order of their development. In the manual controlled station, as the name implies, all switching operations are executed by an attendant. The principal objection to the manually controlled station, is the expense for operating labour, particularly as there is little for the operator to do except start up and shut down.

The high cost of operating the small converter station, led to the development of the remote control station which was introduced about twelve years ago. This type of station was developed out of the manually controlled station and paved the way for the fully automatic station. Along with it, the remote controlled station is showing remarkable progress and is likely to become one of the most popular types.

While it embodies many of the control features now in use in the fully automatic station, starting and stopping together with a number of other operations are performed over control wires by means of control switches in a distant substation.

A number of companies are using this method with certain variations today, and while it is feasible to operate any station by means of control wires for each operation, the manufacturers have developed remote control to a point where any number of switching operations may be performed over comparatively few control wires, usually three, by means of the proper type of supervisory control relays or synchronized switches at sending and receiving points.

The next step was the transformation of the manually controlled to an automatically controlled equipment, and for the same reason as that for the telephone, namely, increasing the efficiency of the station by reducing the operating cost. Just how far-reaching this will be, depends on the saving effected by the installation of this equipment, under different operating conditions. Except for inspection and the usual amount of repairs this type of station requires no manual assistance whatever for its operation.

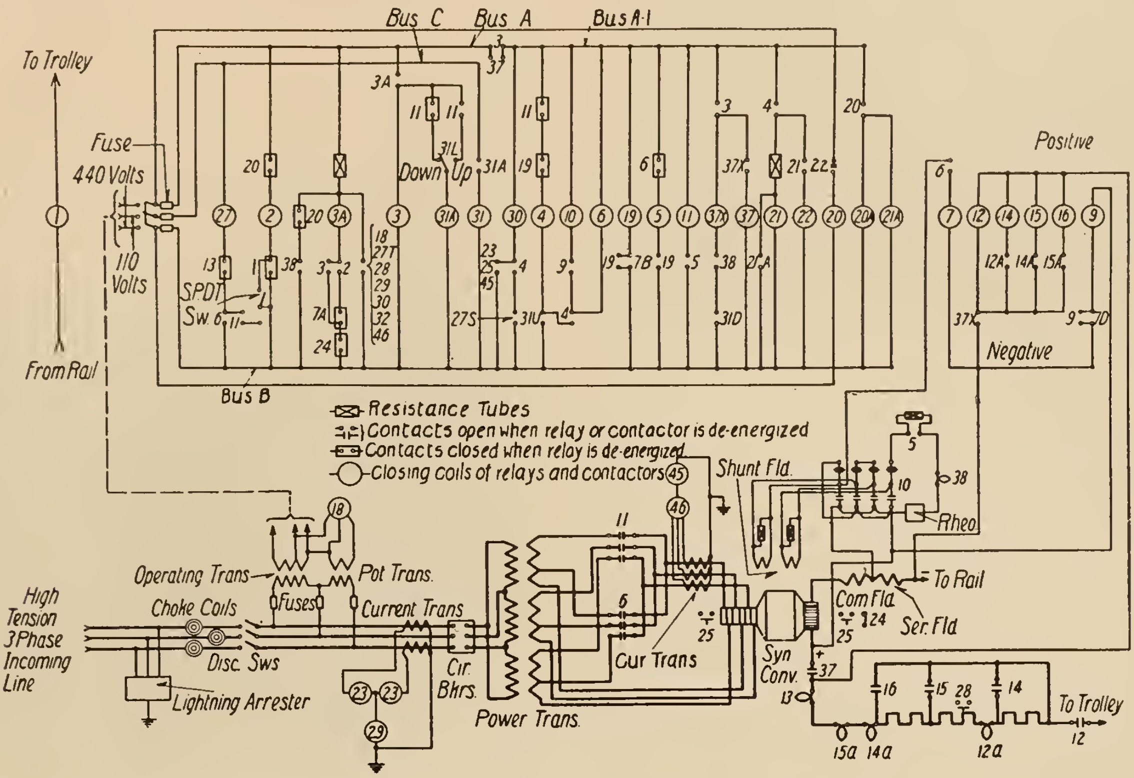
It is the function of the automatic substation, to perform all the essential duties of the operator which involve starting up the machine at the proper time, connecting it to the line, running under load and shutting down entirely, without manual assistance.

Two general schemes of automatic control are available, one in which a master drum controller initiates the various operations in proper sequence and the other, in which these steps take place through the guidance and control of various relays and interlocks which function according to a predetermined plan, in a step by step fashion, the ultimate results being the same in both cases, namely, that of starting up and shutting down the station

* Prepared by F. F. Ambuhl, Toronto Hydro-Electric System.

as required. These will be referred to as scheme *A* and scheme *B* in this paper.

In both of these schemes it is the general practice to arrange for starting up on load demand which is determined by a suitable contact-making voltmeter and shutting down when the load is reduced to an uneconomical point. In other words, when the trolley voltage is reduced to a minimum amount by the increasing load, a



SCHEME "B" - WIRING DIAGRAM

1 Undervoltage D-C. Relay
2 Low Voltage Delay A-C. Relay
3-a Master Relay—(1 pole)
3 Auxiliary Relay—(2 pole)
4 Starting Contactor Relay—(3 pole)
5 A-C. Shunt Relay—(2 pole)
6 A-C. Starting Contactor—(3 pole)
7 D-C. Polarized Motor Relay
9 Field Contactor Relay—(2 pole)
10 Field Reversing Contactor (4 P.D.T.)
11 A-C. Running Contactor—(3 pole)
12 D-C. Line Contactor—(1 pole)
12-a, 14-a, 15-a D-C. Overload Relays
13 D-C. Overload Relay
14, 15, 16 D-C. Resistance Shunting Contactors
17 S. P. D. T. Knife Switch
18 Reverse Phase and Low Voltage A-C. Relay
19 A-C. Shunt Relay—(2 pole)
20 Oil Circuit Breaker—(Solenoid Operated)
20-a No Voltage Release
21 Circuit Breaker Control Relay
21-a Low Voltage A-C. Relay
22 Circuit Breaker Contactor
23 A-C. Overload Relay
24 Overspeed Device
25 Bearing Thermostat
27 Underload Delay Relay
27-S Contact closed in 2 minutes
27-T Contact closed in from 3 to 30 minutes
28 Grid Thermostat
29 Thermal Overload Relay
30 Lockout Relay
31 Brush Lifting Device Motor
31-a Brush Lifting Device Relay
31-d Interlock closed with brushes down
31-u Interlock closed with brushes up
32 D-C. Reverse Current Relay
37 Line Contactor
37-x D-C. Line Contactor Relay
38 Field Current Relay
45 Phase Balance Relay—(low tension protection)
46 Phase Balance Relay—(high tension protection)

	Device Number → Operation Number ↓	1	2	3	3a	4	5	6	7	9	10	11	12	13	14	15	16	19	20	21	21a	22	27T	31a	31d	31u	37x	37	38	Remarks
START	1	O							A					O											O					Station idle Trolley Voltage reduced
START	2	O	O						A					O											O					Relay 2 closes after a few seconds
START	3	O	O		O				A					O											O					Master Relay 3a energized
START	4	O	O	O	O				A					O										O	O					Auxiliary Relay 3 energizes Aux Control Bus A1
START	5	O	O	O	O	O			A					O												O				Brushes lifted off commutator
START	6	O	O	O	O	O		O	A					O						O						O				Starting Contactor closed
START	7	O	O	O	O	O		O	A					O					O	O		O				O				Oil Circuit Breaker 20 closed converter starts
START	8	O		O	O	O		O	A					O					O		O					O				Bkr Latch 21a energized Bkr coil 20 de energized
START	9	O		O	O	O		O	D					O					O		O					O			O	Polarity of Converter incorrect · Contact 7D closed
START	10	O		O	O	O		O	D	O				O					O		O					O			O	Field Contactor Relay 9 closed
START	11	O		O	O	O		O	D	O	O			O					O		O					O				Field Contactor 10 reverses field
START	12	O		O	O	O		O	A					O					O		O					O			O	Polarity of Converter correct
START	13	O		O	O	O		O	B					O				O	O		O					O			O	Interlock Relay 13 energized by contact 7B
START	14	O		O	O				A					O				O	O		O					O			O	Converter disconnected from starting taps
START	15	O		O	O		O		A					O				O	O		O					O			O	Running Contactor Relay 5 closed
START	16	O		O	O		O		A			O		O				O	O		O					O			O	Converter connected to running taps
START	17	O		O	O		O		A			O		O				O	O		O			O		O			O	Brushes lowered onto commutator
START	18	O		O	O		O		A			O		O				O	O		O				O		O		O	Line Contactor Relay 37X closes
START	19	O		O	O		O		A			O		O				O	O		O				O		O	O	O	Line Contactor 37 closes
START	20	O		O	O		O		A			O	O	O				O	O		O				O		O	O	O	Converter connected to Trolley thru res
START	21			O	O		O		A			O	O	O	O			O	O		O				O		O	O	O	- - part res
START	22			O	O		O		A			O	O	O	O	O		O	O		O				O		O	O	O	-
START	23			O	O		O		A			O	O		O	O	O	O	O		O				O		O	O	O	· directly to Trolley
STOP	1			O	O		O		A			O	O	O	O	O	O	O	O		O				O		O	O	O	Load light - Time Delay Relay 27 operating
STOP	2			O	O		O		A			O	O	O	O	O	O	O	O		O		O		O		O	O	O	Contact T of Relay 27 closes
STOP	3								A					O											O					Station Idle Voltage Normal

Plate No. 15, — Scheme "B" Wiring Diagram and Sequence Chart.

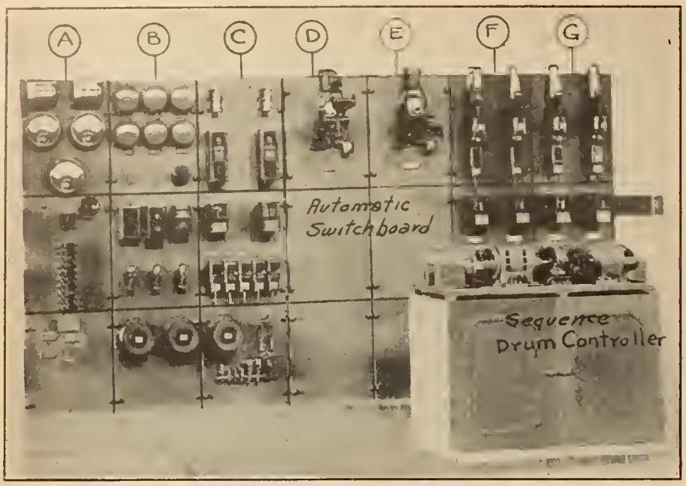


Plate No. 16, — Automatic Control Switchboard Scheme "A"

Panel A — Metering and Transfer Panel on which are mounted A.C. Voltmeter, A.C. Ammeter, D.C. Voltmeter, D.C. Ammeter, Power Factor Meter, Transfer switches and Field Control.

Panel B — Relay Panel on which are mounted D.C. Feeder Ammeters, Time Limit Starting and Stopping relays, Time Limit Starting Protective Relay, Master Starting Relay, A.C. undervoltage relay, Open Circuit Field Relay, Control Contractors, Machine Temperature Relays.

Panel C — Relay Panel on which are mounted Control Contractors, D.C. Overload Relays, D.C. Reverse Power Relay, Polarity Relay, A.C. Flashing and Overload Protective Relays, Time Limit Temperature Relay and Master Control Contractor.

Panels D and E — Machine Panels on which are mounted machine Circuit Breakers.

Panels F and G — D.C. Feeder Panels on which are mounted Automatic Reclosing Circuit Breakers, Time Limit Relays, Reclosing Relays and Time Limit Temperature Relay at bottom of panels.

contact-making voltmeter energizes a relay which starts the sequence of operations for starting up the station.

In place of the circuit breakers opening up and clearing the station, current limiting resistors are inserted between the machine and the machine bus, the amount cut in depending on the severity of the over-load. Should an over-load persist for some time and the resistors tend to over-heat, a thermostat placed in proximity to the resistors operates to shut down the machine. After the resistors have cooled sufficiently, the thermostat circuit is returned to normal and the station will start again on load demand. It was originally the practice to insert resistors in the feeder circuits, as well as in the machine circuits, though many of the later installations use the current limiting resistors only in the machine circuit and short-circuit detector panels for protecting the feeders. Protection is afforded against every possible trouble, electrical or mechanical, thus, the automatic station has a greater amount of assurance against damage from either of these causes, than the manually controlled station.

Automatic stations are arranged for either full automatic operation or for remote controlled starting and stopping. In the latter case, the station can be started up through the use of the oil circuit breaker in the supply station controlling the high tension line or by a pair of telephone wires from any point on the system.

Operation

A brief description of the operating sequence of the two schemes, is outlined as follows: In scheme *A*, a motor operated drum controller is started through the action of a low voltage relay as mentioned above. This causes the high tension breaker to be closed, energizing the transformers and is followed by the closing of the a.c. starting switch, impressing sufficient starting voltage across the rings to bring the machine up to synchronism. When full speed is reached, the converter fields are excited from a small direct current generator, which is driven by the motor on the drum controller. This gives a positive method of obtaining correct polarity. The converter is then connected for self-excitation and the running switch closed, impressing full voltage on the machine and giving normal field excitation. As soon as the machine reaches normal voltage, the direct current line switches are closed, connecting the machine to the line through the current limiting resistors in the machine circuit and if the current taken by the machine is not excessive, the current limiting resistors are immediately cut out. The controller then remains at rest and the converter operates normally on load until the current supplied by the station falls below some predetermined value, when a low current relay operates, starting the controller toward the off position, thus shutting down the station.

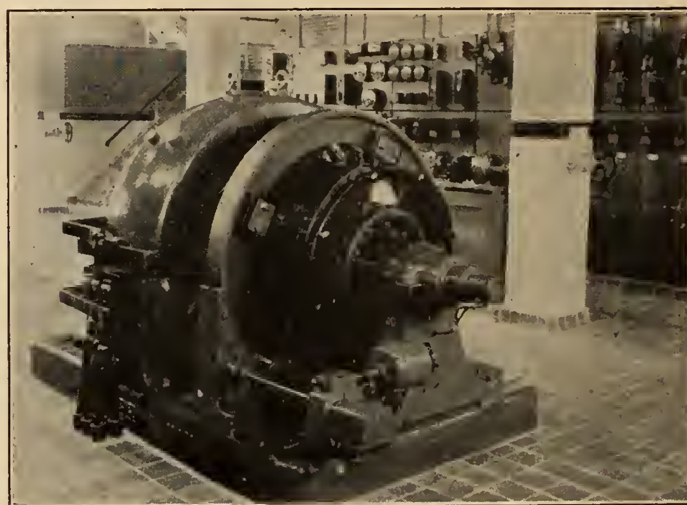


Plate No. 17, — 1,000-k.w. Automatically Controlled Converter and Control Board Described in Scheme "A".

The operation of scheme *B* is briefly described as follows: The rotary transformers are energized through the operation of a low voltage relay and subsequent relays, similarly to the other scheme, after which, the starting contactors are closed and the machine then builds up in speed in the usual manner. During the time interval of starting, the polarity is checked and if found incorrect, is reversed automatically by slipping a pole. This is accomplished by means of a polarized motor relay, driven by a d.c. motor having a permanent magnet field and with the armature connected across the convertor commutator. While the converter is accelerating, the voltage across the commutator is alternating and the relay motor armature merely tends to oscillate. As synchronism is approached, the voltage merges into a direct current potential. The relay armature then revolves in one direction or another, dependent upon the polarity of the machine and turns a drum contactor. If correct polarity is obtained, by the order in which the contacts are closed, the starting contactor drops out, the running contactor is closed and the brushes are lowered. If, on the contrary, the converter builds up with incorrect polarity, the relay armature revolves in the opposite direction and closes a different set of contacts. In this case, the normal field switch is opened and the reverse field switch is closed. As a result, the d.c. voltage dies down and when it reaches zero potential, the reverse field switch is immediately opened and the normal field switch again closed. Polarity usually builds up in the right direction after this operation. But should it fail to do so, the same operation is repeated.

When correct polarity has been obtained, the starting contactor is opened, the running contactor is closed, the brushes are lowered, and the d.c. switches are closed. This connects the machine to the load, through the current limiting resistors which are then shunted out in steps by contactors which close through the functioning of accelerating relays. The machine remains in operation until cut out of service by light load conditions similarly to that of the previously described scheme. The time required for starting, from standstill until the machine is on the line, is from 35 to 60 seconds, depending largely on the acceleration of the armature.

Protective Features

It is most important that provision be made for adequate protection of the apparatus against damage from the numerous causes experienced in operating and especially so in the automatic station. The automatic equipment as supplied affords protection against the following:—

1 Single-phase starting
2 A.C. undervoltage
3 Wrong position of the brushes
4 Incomplete start
5 Under speed
6 Field failure
7 Wrong polarity
8 Reverse power
9 Over heated machine windings
10 Hot bearings
11 D.C. flashover
12 A.C. flashover
13 D.C. overload
14 A.C. overload
15 Overspeed

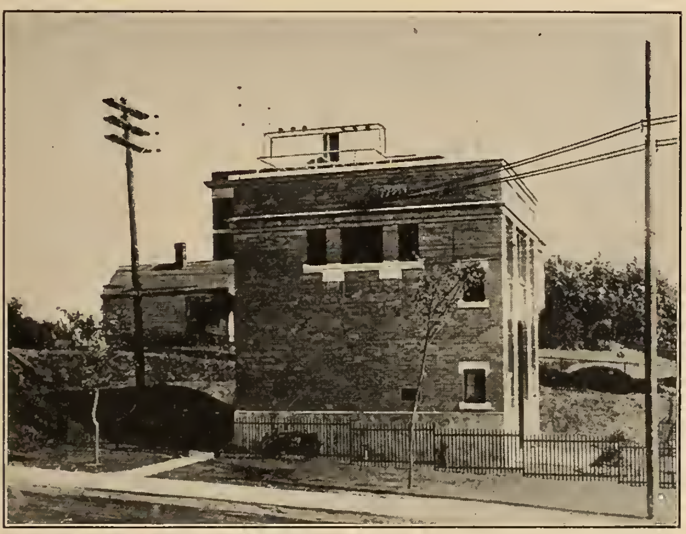


Plate No. 18, — Exterior view of 1,000-k.w. Automatic Converter Substation Toronto — Described in Scheme "B".

The protective features will be discussed in the above order:—

Single-Phase Starting. The possibility of starting the converter on single-phase is protected against by two single-phase relays, the coils of which are connected across the starting taps on the secondary of the power transformer. The contacts of these relays are connected in series with the coil of the starting contactor and in case of a single-phase condition these relays will not close their contacts thereby preventing the starting contactor from closing.

A. C. Undervoltage. The possibility of operating the converter during a period of low a.c. voltage is protected against by an a.c. undervoltage relay. If the voltage is below a predetermined amount, the undervoltage relay prevents the control bus from being made alive, also if low voltage occurs while the machine is operating the converter is caused to shut down.

Wrong Position of Brushes. The proper position of the brushes is assured by the brush operating mechanism. A drum switch attached to this mechanism is electrically interlocked with certain segments on the master drum controller which governs the sequence of switching. If the brushes are not down when the running switch is closed, the drum controller will stop and if after a short period the brushes have not gone down, a relay operates to shut the machine down and wait for an inspector.

Incomplete Start. If the machine starts, but fails to get fully on the line, within a specified time, a time limit relay operates to shut down the machine.

Underspeed. This protection is obtained by a centrifugally operated circuit closing switch, the contacts of which remain open until the converter reaches approximately 95 per cent synchronous speed.

Field Failure. The coil of a relay is connected in series with the shunt field of the converter and its contacts are connected in series with the operating coil of the direct current line contactor. In case of field failure while the machine is operating, the contacts of this relay open, thus opening the coil of the d.c. line contactor. This procedure operates another relay which shuts the machine down to await an inspector.

Wrong Polarity. A d.c. generator, direct connected to the motor used for driving the master drum controller, flashes the field of the machine in order that the converter may come into step with the correct polarity on every start. As an additional precaution, a polarized relay is provided, the coil of which is connected across the positive and negative sides of the machine and must be energized in the proper direction before the d.c. line contactor can close.

Reverse Power. Reverse power protection is obtained in the usual way by a reverse power relay which may be set to operate on a certain predetermined amount of current in the reverse direction.

Overheated Machine Windings. If the machine is running overloaded and the windings become overheated, a circuit opening thermal relay having the same heating characteristics as that of the machine, will open and will

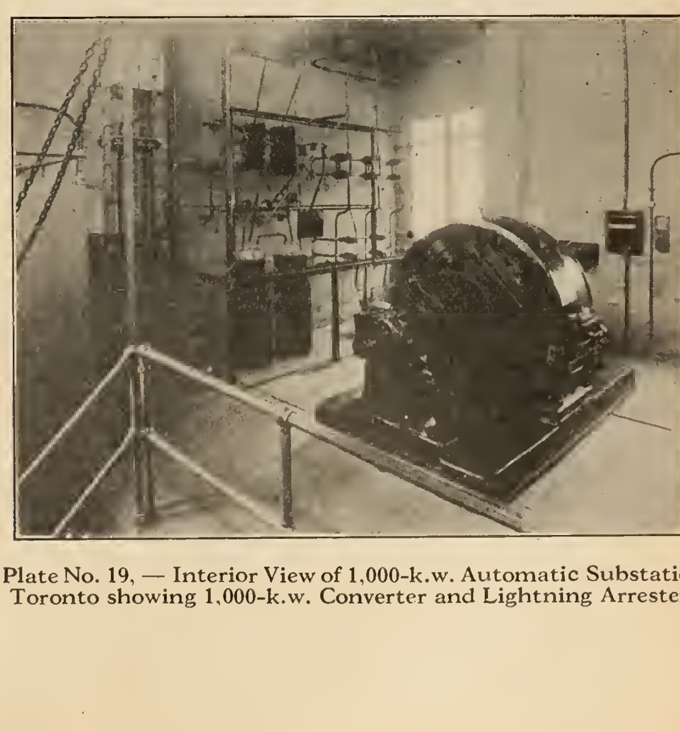


Plate No. 19, — Interior View of 1,000-k.w. Automatic Substation Toronto showing 1,000-k.w. Converter and Lightning Arresters

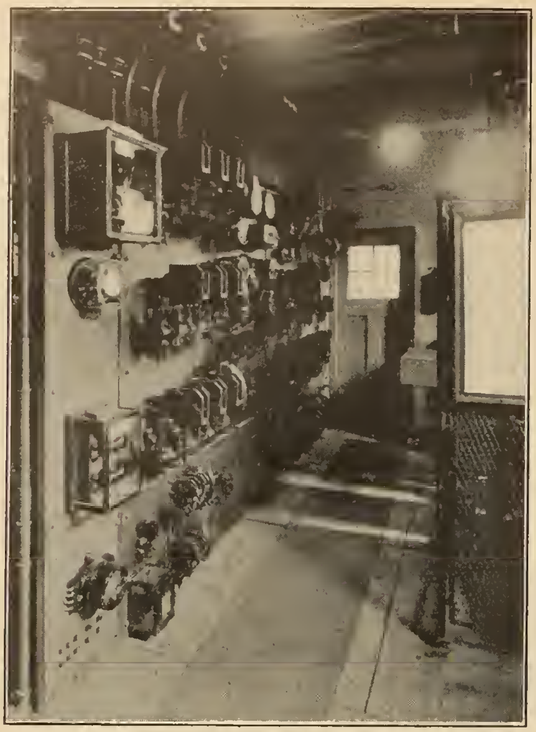


Plate No. 20, — 1,000-k.w. Automatic Control Board in Toronto Described in Scheme "B".

shut the machine down until the machine cools off, after which, it will start up again.

Hot bearings. Protection against hot bearings is obtained by the use of thermal relays consisting of a flexible spun copper bellows connected by a fine copper tube to a metal cylinder. These are inserted in a hole at the bottom of each bearing near the surface of the babbitt where they will be quickly affected by overheating. The bulb and bellows are filled with a non-freezing liquid which has a boiling point of approximately 90° C. In case of hot bearings, the liquid boils and expands the bellows which closes the relay's contacts, tripping the machine out until this relay is again reset by hand.

D. C. Flashover. Repeated d.c. flashover is prevented by a special relay designed for that purpose. It is also a hand reset relay, having a coil of No. 2/0 wire with three-foot leads. It is mounted on the machine frame and connected between the machine frame and ground. When a d.c. flashover occurs, the coil of this relay carries part of the current from the machine frame to ground which causes the relay to operate and shut down the machine.

A.C. Flashing. Flashing protection is obtained by the use of three flashing relays connected to current transformers on the low tension side of the power transformers. The relays are circuit opening and in case of a flashover or short circuit, one of the relays will open its contacts thereby dropping out the control contactor and shutting down the machine.

D.C. Overload. For d.c. overload protection two or more relays are connected by suitable shunts to the d.c. bus and are set to trip in succession as the load increases. When the load on the machine becomes sufficient to trip the first relay it opens a contactor and inserts a section of resistance in the line. If the load increases, another relay will operate to insert another section of resistance in the line. These resistances are designed so that when all are in circuit, the current in the line on short circuit will be limited to a safe value. As the load is removed, the relays cause the resistance to be cut out again in the reverse order and normal conditions of operation are again restored.

The above scheme is intended primarily for heavy overload conditions and a quick acting circuit breaker is used to protect the machine against severe d.c. short circuits that may cause the current to rise to a dangerous value before the resistance described above can be out in. This type of breaker is the fastest device ever developed for opening high capacity d.c. circuits. It starts to reduce the current in .008 of a second and is completely open in .08 of a second. The reduction of current is started in less time than it takes a commutator bar to pass from one brush holder to the other.

The standard breaker takes from .08 to .15 of a second to complete its operation and is too slow to prevent flash-overs.

A.C. Overload. Protection for a.c. overload is affected by the use of two inverse time limit relays connected to current transformers installed on the primary side of the power transformers. When these relays operate, due to overload, the d.c. contactors and high tension switch are opened causing the machine to shut down until started by an inspector.

Overspeed. Protection against overspeed is taken care of by a speed limit device which consists of a centrifugal switch mounted on the end of the converter shaft, similarly to that of the underspeed device mentioned above and trips the d.c. contactor when the speed exceeds 15 per cent of synchronous speed. In this case also it is necessary for the inspector to reset the speed limit device before the machine will start again.

The protective features, outlined above, have reference to the drum type control scheme *A*, though the protective features are similar in both methods of automatic control.

Comparative Cost of Manual and Automatic Stations

From the foregoing, it will be seen that the automatic station requires considerably more apparatus than the manually controlled station. The following shows a comparison between automatic and manually controlled stations without respect to any economies effected in distribution. In other words, these costs are for two stations side by side, one with fully automatic control and the other with manual control.

The data given in these tables is based on prevailing prices in Canada at the time this paper was written. The items making up these tables will be described in the order given.

Buildings. (*Table No. 1, Items 1-A and 1-G.,*) It will be noticed that building costs are only slightly smaller for

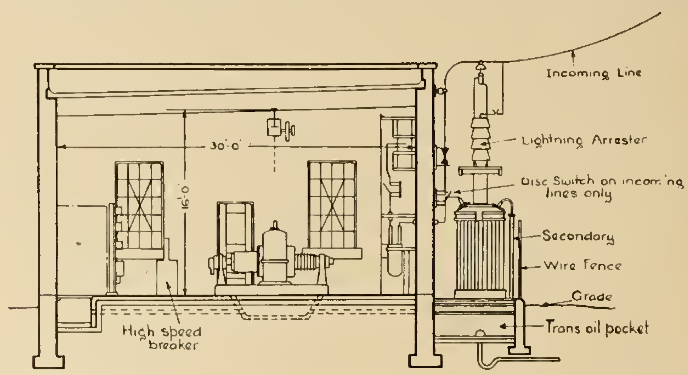


Plate No. 21, — Typical Cross-section of Automatic Station.

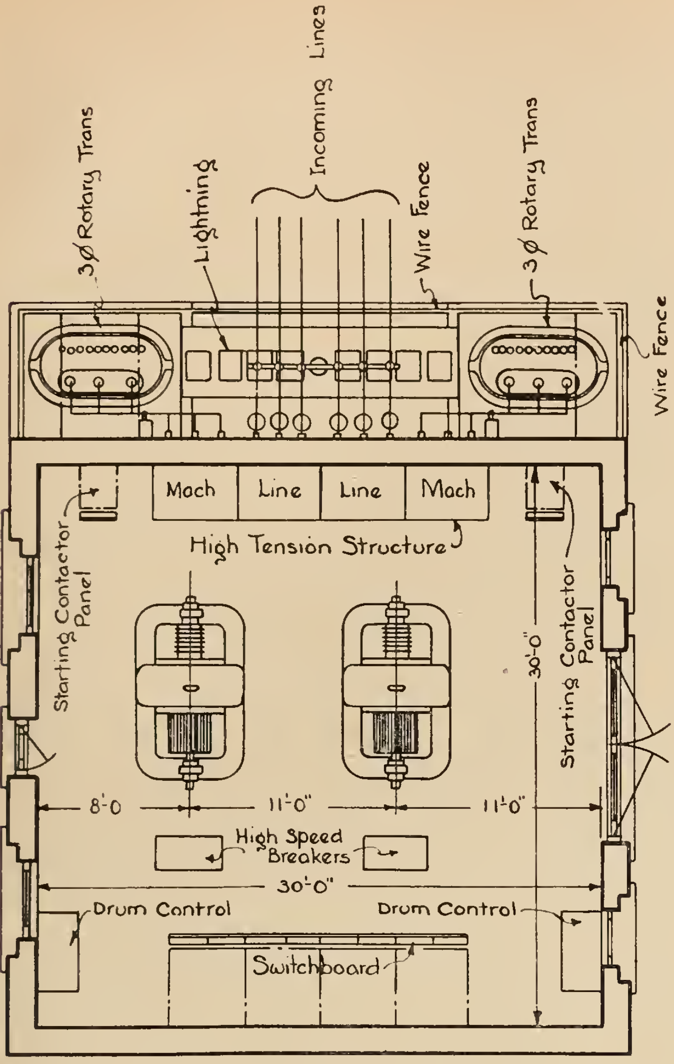


Plate No. 22, — Main Floor Plan of Double Unit Automatically Operated Station.

The type of building considered is one of fireproof construction throughout and of moderate cost, having stock brick walls inside and out, concrete foundations, steel and concrete floors and roof, metal covered doors, steel sash with wire inserted glass and tile coping to walls. Such stonework as is used is confined to door and window trim.

The building on which costs are given under the 1,000-k.w. head is a two unit building and the equipment costs under the same heading are for one machine installed.

Lavatory facilities and service accommodation should be provided in the attended station, while for the automatic type, such facilities are optional. In the smaller sizes, they have been omitted, while in the larger, it is advisable to make some provision in view of the larger amount of construction and maintenance work necessary. It should be emphasized that land costs have not been included.

Lighting and Heating. (*Items 1-B and 1-H, table No. 1.*) These take into account the necessary lighting and heating which is somewhat less in the automatic station than in the manual controlled station.

Switching Equipment. (*Items 1-C and 1-J.*) These items include all switching and connecting material, together with control conduit and wiring. The control conduit and control wiring run into considerably more money for the automatic as against the manually controlled, about six to seven times more, depending on the layout and method of construction used.

Two incoming high tension lines have been considered as forming part of the high tension equipment and their arresters have been assumed as the out-door type, either electrolytic or one of the newer forms of arrester containing no liquid and depending on the breaking down of an oxide film.

The hand operated board, included in the switching costs, has been priced on a basis of one control panel for each feeder, one a.c. panel and one breaker panel for each the automatic as compared to the manually controlled station. Automatic equipment requires the same floor space as does the manual equipment, since while in attended stations more room is required for safety and ease of operation, the accessory equipment such as resistance grids, etc., in the automatic type, counter balance any saving that might otherwise be made. Wherever an automatic station has been crowded into a small area, it will usually be found congested and difficulty will be encountered in the making of repairs and in maintenance. Savings, however, result from less ornamentation and service accommodation.

From the accompanying illustrations, it will be seen that each machine practically takes up the same floor area for the two sizes of stations shown, giving nearly a direct proportion between the capacity of station and its size.

A chain block and trolley have been provided for machinery handling in all stations since this type of equipment results not only in a cheaper building but also in a material saving in cost over that necessitated by a crane of adequate size. The building cost includes the building proper, lavatories in the manual stations, chain block and supporting steel and that portion of the cable pits and ducts usually installed by the contractor, in connection with the concrete work.

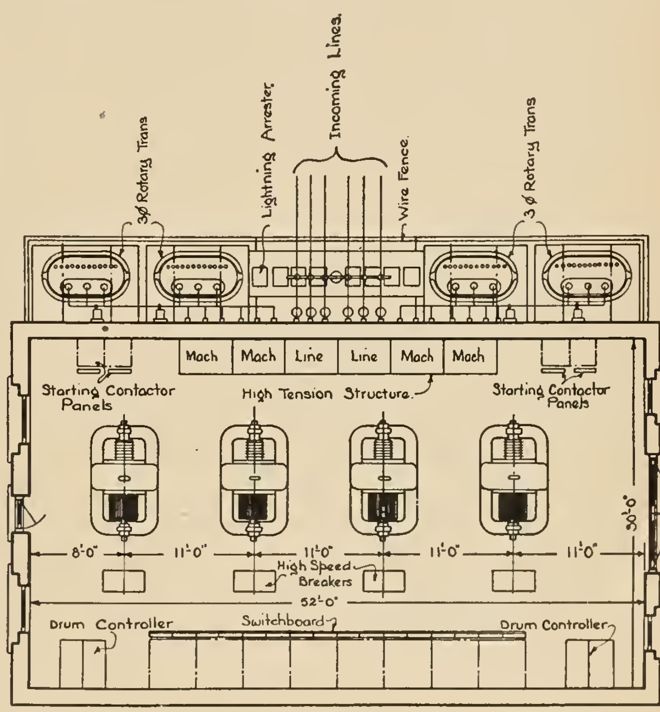


Plate No. 23, — Main Floor plan of 4-unit automatically Operated Station.

Plate No. 24, — Single Truck Snow Sweeper.

machine and three feeder breaker panels for each machine.

The automatic board includes the complete board with relays, starting gear and circuit breakers.

Three feeders per machine, each of 1,250 amperes. capacity have also been assumed.

Transformers. (*Item 1-O and 1-K.*) The transformers have been placed outside, an arrangement originating in the warmer climates and now found quite satisfactory under the more rigorous conditions of the Canadian winter. A catch basin drained to sewer has been provided under each transformer for oil removal in case of fire. The outdoor installation, while resulting in lower building cost also removes a not inconsiderable fire hazard and results usually in decreased insurance rates. The transformers are of the 1,000 kv.a. 3-phase, 13,200-volt primary, 25-cycle, oil-immersed, self-cooled type. They are rated at 150 per cent full load for two hours, following upon a full load run until constant temperature is reached.

Converters. (*Items 1-E and 1-L.*) The converter in all cases has been taken as being one of the standard types of high speed machines, rated at 1,000 k.w. continuous output, 750 r.p.m., 6-phase, diametral, 25-cycle with interpoles and compounding winding. The extra attachments for the automatic converter is included in the cost of switching, item 1-J. Items 1-F and 1-M cover such requirements as painting of apparatus, guards, supplies and equipment not otherwise provided for.

Operating and Maintenance Costs

Table No. 2 covers operating and maintenance costs per kilowatt per year. Operating cost, items 2-A and 2-B, has been based on full time, 24 hours per day, 365 days a year. In the smaller stations, one operator per shift is sufficient but from 3,000-k.w. capacity up, two operators, one first and one second, have been provided.

Inspection and maintenance charges, items 2-C and 2-D, vary with every operating company and with the different types of apparatus used. Those given here are only to be taken as typical of a Canadian city of considerable size. Maintenance material such as brushes, oil, etc., is included.

It will be noticed that this item of inspection and maintenance is considerably higher for the automatic than for the attended station. This has been found to be the case from actual experience.

Comparative Annual Costs

Table No. 3, summarizes in comparative form, the information already given on manual and automatic stations. It will be seen that these costs favour the automatic station throughout, although, for the larger stations, the relative cost of buildings and other factors may throw the balance one way or the other.

The automatic station, in all cases, represents a greater investment and the relative saving will be materially affected by the carrying charges on this investment. A rate of 10 per cent has been taken to cover interest on and repayment of capital charges. Interest is figured at the rate of 5½ per cent and the capital to be wiped out in twenty years. With higher investment charges, the relative annual charges on the automatic station increases.

The most important factor affecting the comparison is that of operator's wages. Referring to table No. 2, it will be noticed that only one operator has been considered for the one and two unit stations, whereas with the three unit or above, two operators have been considered. Where two operators in a one or two-unit station are required by law, or where this is customary, the automatic station will show a still greater saving over the manual controlled station.

From the foregoing, it will be seen that if conditions are such that the building of a substation is warranted, the automatic station especially for the smaller sizes, is more economical than the manually controlled station.

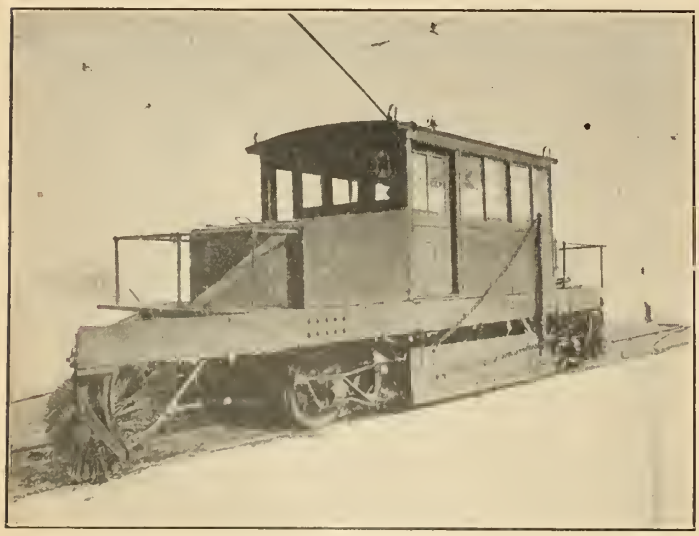


Plate No. 25, — Double Truck Snow Sweeper — Montreal.

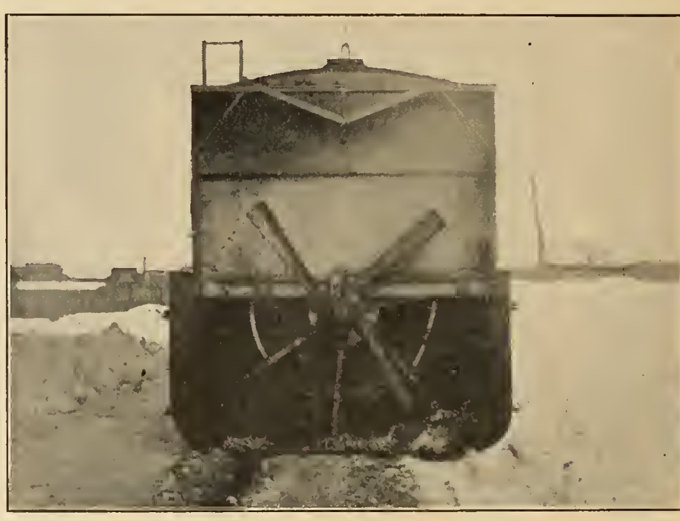


Plate No. 26, — Double Truck Rotary Snow Plow.

Table No. 1.—Cost per K.W. of Substations
Manually Controlled Stations

Item	Description	Installed Capacity				
		1,000 k.w.	2,000 k.w.	3,000 k.w.	4,000 k.w.	6,000 k.w.
1A	Building	$15.54	$ 7.77	$ 6.48	$ 5.58	$ 4.56
1B	Lighting and heating	0.30	0.26	0.23	0.19	0.12
1C	Switching equipment	15.40	13.80	12.71	12.00	11.60
1D	Transformers	8.50	8.50	8.50	8.50	8.50
1E	Converter	11.80	11.80	11.80	11.80	11.80
IF	Miscellaneous	3.00	2.00	1.80	1.60	1.21
		$54.55	44.13	41.52	39.67	37.79
	Full Automatic Stations					
1G	Building	15.30	7.65	6.40	5.52	4.52
1H	Lighting and heating	0.20	0.17	0.14	0.11	0.08
1J	Switching equipment	25.90	22.60	21.51	20.65	19.45
1K	Transformers	8.50	8.50	8.50	8.50	8.50
1L	Converter	11.80	11.80	11.80	11.80	11.80
1M	Miscellaneous	3.00	2.00	1.80	1.60	1.21
		$64.70	52.72	50.15	48.18	45.56

Table No. 2.—Operating and Maintenance Cost per Kilowatt per Year
Manually Controlled Station

Item	Description	Installed Capacity in Station				
		1,000 k.w.	2,000 k.w.	3,000 k.w.	4,000 k.w.	6,000 k.w.
2A	Operator at 75c per hour	$6.57	3.28	2.19	1.64	1.09
2B	" " 63c "	..	..	1.84	1.38	0.94
2C	Inspection & maintenance	0.40	0.35	0.33	0.32	0.30
	Total	$6.97	3.63	4.36	3.35	2.33
	Automatic Station					
2D	Inspection & maintenance	1.00	0.95	0.90	0.85	0.75

Table No. 3—Total Annual Operating Cost per K.W. of Installed Capacity
Automatic Stations

Description	1,000 k.w.	2,000 k.w.	3,000 k.w.	4,000 k.w.	6,000 k.w.
Station investment Plant and equipment	$64.70	52.72	50.15	48.18	45.56
Carrying charges on capital investment at 10% based on 5½% interest charge	6,470	5,272	5,015	4,818	4,556
Operating and maintenance	1,000	950	900	850	750
	$7,470	6,222	5,915	5,668	5,306
Manual Controlled Substation					
Station investment Plant and equipment	$54.55	44.13	41.52	39.67	37.79
Carrying charges on capital investment at 10%	5,455	4,413	4,152	3,967	3,779
Operating and maintenance	6,970	3,630	4,360	3,350	2.330
	12,425	8,043	8,512	7,317	6,109

Motor Design and Rating

The design of railway motors in America is fundamentally the same as in European practice. Series wound motors with compensating poles are standard and almost universal practice. Forced ventilation by means of curved vanes integral with the armature end plate is a feature of all motors built for electric traction. Commutators are large and the limits of safe commutation when using a good grade of carbon brush is usually more than 100 per cent greater than the one-hour rating of the motor. Brush holders are rugged and simple and the use of plain clock spring pressure fingers, without pig-tails, is standard practice. Field coils are nearly all ribbon wound and are usually made up in separate layers, graded in size, so as to utilize all available space for windings.

Plate No. 27, — Single Truck Levelling Plow — Montreal.

Special attention is paid to high water, and oil-proofing of insulation on coils because experience has shown that almost any material having high and permanent waterproofing qualities will provide ample dialectric resistance to prevent breakdown under the action of a 600-volt pressure.

The split frame motor has been practically eliminated in favour of the solid frame with end housings. Armature bearings are usually of bronze and are lined with a very thin layer of babbitt metal or "tinning" to provide a soft initial seating for the shaft. Axle bearings are usually of bronze without babbitt lining.

Standard gear practice calls for a very high grade of heat-treated rolled steel of .50 to .60 carbon. Some companies favour a case-hardened gearing for which very long life is claimed but since the life of heat-treated gears, properly lubricated, should be more than fifteen years of continuous service, it is difficult to ascertain the ultimate comparative economy. Both types are highly satisfactory. Helical gearing is also coming into general use, especially on the high speed or light weight type of motor. American practice will likely be standardized on a 7½° angle with a long and short addendum tooth form.

Fears were experienced, at first, that end wear of journal bearings would result from the constant side pressure resulting from the angular meshing of gears. The weight of evidence, so far, would indicate that there is no danger of trouble from this source; also that smoother running and longer life are certain.

Methods of rating motors have changed during the last ten years. It is now the custom to measure the capacity of a motor by its ability to perform continuously under average conditions of service within definite heating limits. Motors are still known commercially by their "One Hour Rating."

It is still necessary to exercise good judgment in making a choice because the inherent heat capacity or ability to stand temporary overloads of the new type of ventilated motor is not as great as in motors of the older type. This feature must be fully considered when equipment may be called upon to haul trailers for a limited period or when overload capacity may be required to meet the operating conditions of heavy winter weather.

Miscellaneous

The usual rates of acceleration as found in actual practice with hand control vary from 1¼ to 2 miles per hour per second. The latter rate requires good judgment on the part of motorman but equipment is usually selected on the higher basis. This rate is equivalent to a tractive effort of 200 pounds per ton under ordinary conditions of city operation. Rate of braking is usually estimated at 2 miles per hour per second on level track.

Owing to the fact that the ultimate capacity for making high schedule speed is usually of paramount importance, there is a strong tendency toward decreasing gear ratios below their most efficient theoretical dimensions. The maximum or free running speeds of cars are therefore considerably higher than is usual in Europe.

When the relatively low cost of power and the higher cost of labour are taken into account, the net result is not as bad as might be expected.

Schedule speeds in city service vary from 8 miles per hour in the congested downtown districts to 13 miles per hour in the more open areas. A usual average for the whole system is about 9 miles per hour.

Section IV. Miscellaneous Use of Power

Compressed Air on Cars

Practically all Canadian street cars are now equipped with air brakes and a large number are fitted with air operated doors and sanding devices. A relatively small number have air operated "line switches" placed underneath the car, the function of which is to open the main motor circuit when power is to be cut off either by means of the controller or upon the operation of safety devices. This feature has the advantage of removing all arcing from the contacts of the controller and overcomes the annoyance to passengers of a circuit breaker operating within the car.

An independent motor-driven air compressor is mounted on each car. The standard unit for city service and for most suburban cars has a capacity of about 15 cubic feet of free air from atmospheric pressure to about 75 pounds per square inch per minute. The motor has a capacity of about 3 h.p. and is series wound for 600 volts. It is started and stopped under load by an automatic pressure governor without rheostatic resistance.

Prevailing practice in regard to maximum brakeshoe pressure varies from 85 per cent to 110 per cent of weight supported by wheel contact when car is empty.

Snow Equipment

The average annual snowfall in the more densely populated parts of Canada varies from about thirty inches in the western and prairie provinces and in southern Ontario to about 140 inches in that part of the province of Quebec in which are situated the cities of Montreal, Three Rivers and Quebec. The task of keeping the tram lines open and in almost normal condition during the winter requires the use of a considerable amount of power for the operation of snow fighting equipment as well as on account of increased rail friction.

The winter conditions west of Ottawa are such that the use of the standard American sweeper is usually sufficient to keep all lines open. Suburban lines in certain districts and on open right-of-way sometimes find it more economical and satisfactory to use nose plows equipped with spreaders in addition to sweepers.

On eastern lines, it has been found advisable to use heavier sweepers with more substantial spreader wings and these units are supplemented with heavy shear plows or levellers having mechanically operated levelling wings from fifteen to eighteen feet long which may be extended outward to a distance of ten to twelve feet from rail.

These wings are usually about thirty inches high and are equipped at their lower edge with removable hardened steel cutting blades. The levellers are both four-wheeled and eight-wheeled types. The former weigh about 30,000 pounds and the latter about 50,000 pounds. Their chief advantage is that they maintain a level hard surface contiguous to the track allowance suitable for vehicular traffic. They prevent the excessive formation of hard packed snow and ice due to the passage of heavy traffic and they push back the ridges or banks of snow that are piled up at a lesser distance from the tracks by the snow sweepers with shorter wings.

The American sweeper is a four-wheeled vehicle consisting of a substantial cab mounted on four cast iron or steel pedestals in which are suitable slides for the spring supported axle boxes. At each end is mounted a rotary broom filled with ¼ inch rattan. These are from five to eight feet long and from thirty-two to thirty-six inches in diameter. They revolve at a speed of from 125 r.p.m. to 400 r.p.m., depending upon the loading of the series wound motor used for driving purposes.

The average sweeper weighs about 24,000 pounds and is equipped with two 50-h.p. motors for propulsion and one 50-h.p. motor for driving the brooms through a chain and sprocket wheel. Some of the later sweepers have been equipped with gear driven brooms. The brooms can be raised and lowered from within the cab and are set at an angle of about 60° to the rails. The four-wheeled sweepers are usually equipped with a short front wing which pulls snow in from the space between trucks and delivers it to the front broom. They also have a short side wing which pushes back accumulations of soft snow to a distance of six or eight feet from rail on the right or curb side of double track.

The more modern sweepers in Ottawa and Montreal are heavy steel structures mounted on double trucks. They are equipped with four 55-h.p. motors for propulsion and two 55-h.p. motors on the brooms. Their weight is about 45,000 pounds and they carry side wings about twelve feet long and thirty inches high. The

Plate No. 28, — Crane Car.

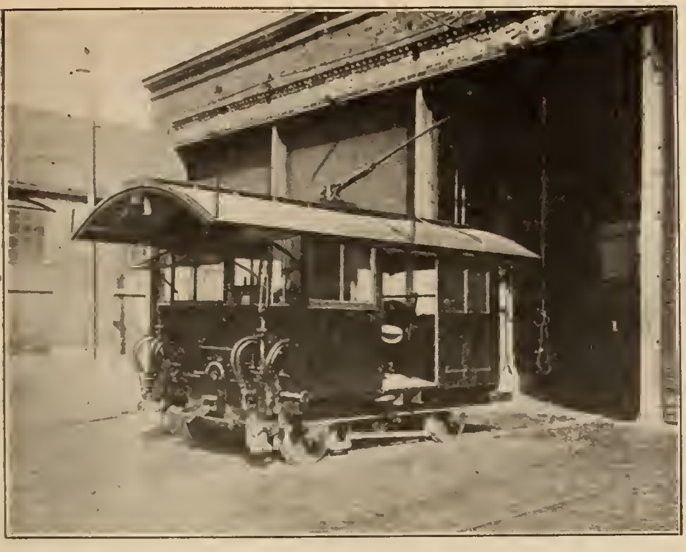


Plate No. 29, — Bond Welding Car.

smaller sweepers operating in fairly heavy snow require a continuous power input of about 125 amperes at 600 volts or 75 k.w. Overloads up to 350 amperes or 210 k.w. are not uncommon. The larger units are often worked up to a maximum load of 700 amperes or 420 k.w. in heavy snow banks and on steep gradients.

All sweepers must be capable of doing effective work at the rate at which normal car traffic moves in city streets, viz., from eight to ten miles per hour.

A small number of rotary plows are in use in eastern Canada. The use of this equipment is only necessary during very heavy and protracted storms or when weather conditions favour continued drifting of snow for some days after a storm. Their use is limited to suburban connections on private right-of-way or along country roads and their most important function is to cut through deep accumulations of snow that would otherwise completely block the traffic. They are usually driven at a slow speed of 6 to 10 miles per hour by four 55-h.p. motors, geared to as low a speed as possible. The rotary knives and ejector blades are about 7 feet in diameter and are driven by two 55-h.p. motors at speeds from about 150 to 200 revolutions per minute. The snow is delivered through a chute at the upper corner of rotor housing with sufficient speed to deposit the snow in powdered form up to a distance of about 40 feet from track.

Shop Machinery and Tools

The usual method of driving shop tools in the smaller shops is by means of a 550-volt, d.c., series wound motor belted to line shafting. In the larger shops, it is usual to adopt a.c., motors with individual machine drive to a large extent although it is common and economical practice to group certain units that are in practically constant operation and to drive these groups by belts connecting to line shafts.

Air Compressors and those machines that are only used intermittently such as wood-working machines, planers, etc., are usually supplied with individual motors. In such shops, the current used is usually 200 or 550, 3-phase, a.c.

Arc Welding is widely used. The a.c. system is very satisfactory for superficial building up operations on armature shafts, axles, etc., but d.c., current is more generally used.

Rivet Heating is very satisfactorily and cheaply done in special machines using a.c., current and suitable transformers.

Baking Ovens for insulating operations are almost always electrically heated.

Electric Soldering Irons and electrically heated retorts for heating of ordinary soldering coppers are in general use.

Portable Tools. Electrically driven drills, reamers, wood-borers and portable grinders are in very common use.

Electric Hoists. Many of the newer car houses and shops are equipped with special car hoists which consist of two parallel I-beams about twenty-five feet long mounted on four substantial screws. Pockets are sometimes provided in floors to house these I-beams when in the "down" position. These I-beams are railed by means of four ball bearing nuts having a worm driven gear at their outer periphery. These are revolved by longitudinal worn shafts driven by a motor and bevel geared cross shaft in pit. They are very highly satisfactory for all car house operations and have practically eliminated the repairing of motors from the uncomfortable and badly lighted pits.

Overhead Cranes. Most shops have adopted the generous use of air hoists on jib cranes but some shops have installed electric hoists on jibs and mono-rails for handling and moving heavy material.

Track Tools

Locomotive Cranes. Modern methods include the use of substantial locomotive cranes for handling special work, braking concrete, loading broken concrete slabs into cars, handling rails in yards, etc. A picture of one of these is shown.

Rail Welding. The usual method adopted by Canadian tramways is to weld special fish plates to head and base of rail, using portable or semi-portable double wound single machines or motor generator sets wound to transform 550-volt, d.c., to about 30-volt, d.c. The machines in general use have a maximum capacity of about 400 amperes, for two welding electrodes. Both the carbon arc and metallic arc are in general use. Carbon welds are made at from 150 to 170 amperes, and metallic welds, at about 200 amperes, using 5/32-inch rods.

Bond Welding. Where bolted fish plates or continuous joints are in use, a very satisfactory machine for obtaining a Thomson weld consists of a small self propelled car on which is mounted a d.c., motor of 30 to 50 h.p. having

Plate No. 30, — Winter conditions on a quiet street — Montreal.

slip rings tapped at back of armature winding for obtaining an a.c., current supply for a step down transformer. The larger machine will weld copper terminals on cables up to 750,000 c.m. This method of bonding is highly efficient and very satisfactory.

Tie Tamping. Compressed air tools are being rapidly introduced for this work. Electric driven air compressors mounted on motor trucks or trailers are used to supply power.

Grinding Rail Joints. It is now general practice to grind off every rail joint, no matter how made, in order that there may be no initial imperfection in the smooth continuity of the rail tread. Electrically driven grinding machines of various designs perform this work cheaply and well. The grinding wheels are given an automatic reciprocating horizontal motion, the vertical adjustments being made by hand.

Section V.—Typical Large Railway Locomotives.

Description of Canadian Pacific Railway Company's Standard Heavy Passenger Locomotive

The passenger trains on the main line of the Canadian Pacific have been handled for the past few years by locomotives of the Pacific type, with driving wheels of 75 inches and 70 inches diameter, to design as illustrated in plate No. 31. This type of locomotive develops a tractive effort of 42,600 pounds, or has capacity to haul the heaviest passenger trains at a maintained speed of sixty miles per hour through the severest winter weather; the average weight of a standard all steel passenger train, consisting of fifteen cars, approximating 800 tons. The main dimensions of the locomotive are given in the accompanying dimension sheet.

Adequate boiler capacity being of prime importance, in order that reserve capacity be always available to permit of successful operation where it is most important that passenger trains be maintained on schedule, and in addition to furnish the heavy demand of steam for heating purposes when the thermometer is below zero and coal frozen and mixed with snow, has led to the boiler, grate area, firebox volume, being made with very ample proportions.

The locomotives are hand fired with fire doors controlled by air operated foot control valves. The locomotive is complete with vestibule type of cab to give locomotive crew the greatest protection through severe weather. The lighting of headlight and cab is carried out by means of a steam turbine driven direct current generator, furnishing power at 34 volts, the headlight projecting a beam of 600,000 candle power. Other specialties include complete superheating equipment, raising steam temperatures 250 degrees over and above normal temperature. The bell is operated by air ringer. Air pump to furnish the heavy demands of compressed air for locomotive and the various auxiliary demands of train apart from the braking, such as for water raising, is furnished by an 8½ inch cross-compound compressor. The reverse gear is of the screw type, permitting of the minimum effort on the part of the enginedriver.

These locomotives are used almost entirely in the hauling of the "Trans Canada", the train operating from Montreal to Vancouver, a distance of 2,900 miles in 92 hours, i.e., the longest and quickest continuous run of any train in the world. Owing to the careful attention given in the design to the proportions and appearance of this locomotive, its power is not as apparent as would be the case where this effect was not achieved.

The following technical description will be of interest.

Table of Dimensions, Weights and Proportions

Railroad	Canadian Pacific
Builder	Montreal Locomotive Works
Type of locomotive	4-6-2
Service	Passenger.
Cylinder, diameter and stroke	25 in. by 30 in.
Valve gear, type	Walschaert.
Valves, piston type, size	14 in.
Maximum travel	7 in.
Outside lap	1 ⅛ in.
Exhaust clearance	¼ in.
Lead in full gear	¼ in.
Cut-off in full gear, per cent	85

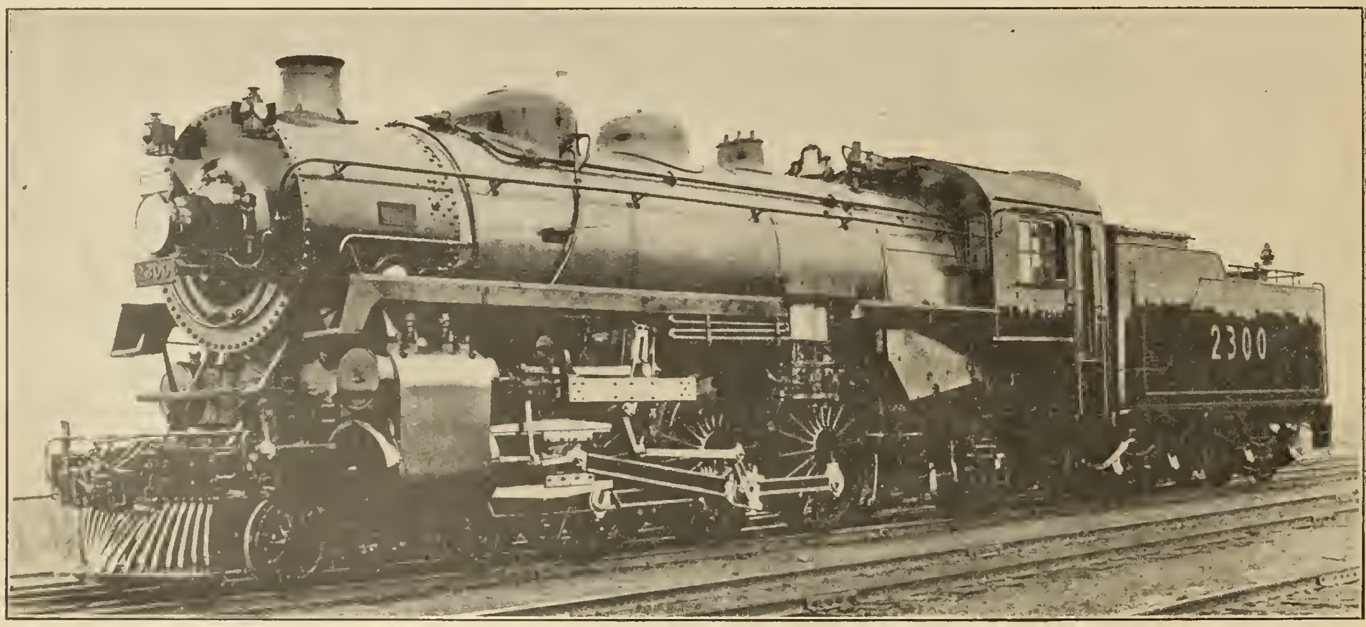


Plate No. 31. — Canadian Pacific Railway Passenger Locomotive.

Plate No. 32, — Largest Locomotive Operating in Canada.

Weights in working order:

On drivers	181,500 lbs.
On front truck	60,000 lbs.
On trailing truck	59,000 lbs.
Total engine	300,500 lbs.
Tender	188,500 lb.

Wheel bases:

Driving	13 ft. 2 in.
Rigid	13 ft. 2 in.
Total engine	34 ft. 9 in.
Total engine and tender	67 ft. 1 in.

Wheels, diameter outside tires:

Driving	75 in.
Front truck	31 in.
Trailing truck	45 in.

Journals, diameter and length:

Driving, main	11½ in. by 21 in.
Driving, others	10½ in. by 14 in.
Front truck	7 in. by 13 in.
Trailing truck	9 in. by 14 in.

Boiler:

Type	St. top-extended wagon bottom
Steam pressure	200 lbs.
Fuel, kind	Bituminous.
Diameter, first ring, inside	78¼ in.
Firebox, length and width	111⅛ in. by 84⅜ in.
Height, mud ring to crown sheet, back	5 ft. 6¼ in.
Height mud ring to crown sheet, front	7 ft. 2½ in.
Arch tubes, number and diameter	5—3 in.
Combustion chamber length	26 in.
Tubes, number and diameter	205—2¼ in.
Flues, number and diameter	38—5½ in.
Length over tube sheets	18 ft. 6 in.
Gas area through tubes	4.6 sq. ft.
Net gas area through flues	3.26 sq. ft.
Total gas area through tubes and flues	7.86 sq. ft.
Air inlet through grates	20.54 sq. ft.
Air inlet to ash pan	9.4 sq. ft.
Grate type	Butt finger, no dump.
Grate area	65 sq. ft.

Heating surfaces:

Firebox and comb. chamber	258 sq. ft.
Arch tubes	40 sq. ft.
Tubes	2,224 sq. ft.
Flues	1,008 sq. ft.
Total evaporative	3,530 sq. ft.
Superheating	830 sq. ft.
Comb. evaporative and superheating	4,360 sq. ft.

Tender:

Style	Rect. water bottom.
Water capacity	8,000 Imp. gal. 9,600 U. S. gal.
Fuel capacity	12 tons.

General data estimated:

Rated tractive force, 85 per cent	42,600 lbs.
Cylinder horse power (Cole)	2,252 h.p.
Boiler horse power (Cole) (est.)	2,293 h.p.
Speed at 1,000 ft. piston speed	44.6 m.p.h.
Steam required per hour	46,840 lbs.
Boiler evaporative capacity, per hour	47,640 lbs.
Coal required per hour, total	7,320 lbs.
Coal rate per sq. ft. grate per hour	112.5 lbs.

Weight proportions:

Weight on drivers divided by total weight engine, per cent	60.5
Weight on drivers divided by tractive force	4.26
Total weight engine divided by cylinder h.p.	133.75
Total weight engine divided by boiler h.p.	131.2
Total weight engine divided by comb. heat. surface	69

Boiler proportions:

Boiler h.p. divided by cylinder h.p. per cent	101.8
Comb. heat. surface divided by cylinder h.p.	1.94
Tractive force divided by comb. heat. surface	9.78
Tractive force × dia. drivers ÷ comb. heat. surface	734
Cylinder h.p. divided by grate area	34.61
Firebox heat. surface divided by grate area	4.58
Cylinder h.p. divided by gas area (tubes and flues)	286
Grate air inlet divided by grate area, per cent	31.6
Ash pan air inlet divided by grate area, per cent	14.45
Firebox heat. surface, per cent of evap. heat, surface	8.4
Superheat surface, per cent of evap. heat. surface	23.5
Tube length divided by inside diameter	110.5

Description of Canadian National Railway Newest Passenger Locomotive

Another notable locomotive is shown in plate No. 32. This is the largest locomotive operating in Canada and it was built at the Canadian Locomotive Company in Kingston, Ontario, and put into service in June 1923 on the Montreal-Toronto run, a distance of 333 miles, which is made without changing the engine. It will pull a passenger train of 15 cars at an average speed of 73 miles per hour.

Among the other leading features of engine No. 6,000, is that it is equipped with everything known to modern railroad practice in regard to safety devices, labour-saving equipment and economy of operation. It has the automatic stoker, which the Canadian National Railways were the first railroad in Canada to adopt, feed water heater, super-heater, power reverse gear and power grate shakers. The fire-box is electrically welded, thereby eliminating riveted seams. The combustion chamber also has the points made by electrical welding. The driving axles and main crank pins are hollow, giving extra strength for the same weight of material:

Apart from its many unique features, engine No. 6,000 will be noted for its new design. The vestibule cab is somewhat shorter than those of other engines, and it has the main steam turrets and connecting pipes located on top of the boiler in front of the cab. There are 16 of these engines now in service and 21 more are on order.

The main technical features are as follows:—

Railroad	Canadian National
Builder	Canadian Locomotive Co.
Type of locomotive	4-8-2.
Class of service	Heavy passenger.
Gauge	4 feet 8½ inches
Cylinder	26 inches x 30 inches
Driving wheels — diameter	73 inches
Boiler — inside diameter — first course	80 ⅞ inches
Boiler — outside " — largest "	90 inches
Working pressure	210 lbs.
Firebox	114 ⅛ inches x 84 ¼ in.
Tubes, No. of 2¼ inches	188
" " 5½ inches	40
Tubes, length	22 feet, 3 inches
Combustion chamber — length	48 inches
Wheel base —driving	19 feet 6 inches
" " — engine	41 feet 9 inches
" " — engine and tender	79 feet 1¾ inches
Weight in working order — engine truck	57,300 lbs.
" " — driving	226,770 lbs.
" " — trailing	54,930 lbs.
" " — tender	239,000 lbs.
" " — total engine and tender	577,000 lbs.
Heating surfaces — tubes and flues	3,731
" " — fireboxes & arch tubes	348
" " — total	4,079
Grate area, sq. ft.	66.7
Maximum tractive power	49,600 lbs.
Factor of adhesion	4.5
Capacity of tender — water	10,000 Imp. gals.
Capacity of tender — coal	17 tons.
Limiting height	15 feet 3 inches
" width	10 feet 8¾ inches
Fuel	Bituminous coal.

Illumination

W. H. Woods,
Chairman, Toronto Chapter, Illuminating Engineering Society.

Illumination in Canada is very largely effected by electricity which is available to about 50 per cent of the population. In districts where electric energy is not available the illuminant is almost always petroleum, an imported product or natural gas which exists in several areas notably at Medicine Hat.

Acetylene derived from calcium carbide manufactured by electric power, is used in a few individual plants and also in river buoys and highway danger signals. (See plates Nos. 1 and 2.) Pintsch gas, a gas derived from oil, is also used to a limited degree for illuminating some of the older railroad cars. Electricity, where available, is installed in over 80 per cent of the homes in Canada, the total number of wired houses being over 1,000,000.

Cost of Lighting to the Consumer

The cost to the consumer for electric light has been consistently reduced as is shown in plate No. 3, based on data compiled by the Department of Labour at Ottawa. It is estimated that the number of kilowatt hours per annum used for the average residence consumer is from 200 to 250. The average cost to the consumer varies with the density of population and the investment necessary to provide the consumer with service, but a fair round figure would be from $10.00 to $15.00 per annum in large cities and from $15.00 to $25.00 per annum in small communities. This amount includes the use of small appliances, irons, toasters, etc., but not cooking or water heating.

Illuminating may be divided under six principal headings:

1. Residences
2. Schools and public buildings
3. Factories
4. Stores
5. Signs
6. Streets.

Residence Lighting

The tendency is always a higher intensity of house lighting and to make more harmonious colour and shade effects. Owing to the intrinsic brilliancy of the nitrogen filled lamps such lamps must always be shaded to prevent direct rays striking the eye.

The lighting of a modern house is well shown in the paper entitled "Domestic Use"; various intensities are in use, from the kitchen which will include a daylight unit of 100 to 150 watts, to the bedroom which will include lights at each side of the mirror, a ceiling fixture, a bedside lamp and other portable lamps as required.

Lighting in Schools and Public Buildings

The standard of illumination is improving all the time, the tendency being to increase the general lighting and do away with individual lamps for specific purposes. From 6- to 8-foot candles at the useful plane is considered a reasonable intensity; it is obtained in various ways, namely, by direct totally enclosed units, semi-indirect, indirect and concealed units. Larger and larger units are required, 300 watt units being quite extensively used.

Factory Lighting

Manufacturers have learned that a high intensity of lighting prevents accidents and permits daylight production to be maintained. Although there is no factory law requiring a minimum standard of lighting such as exists in several states in the United States, it will only be a matter of time until such legislation is enacted in Canada.

Lighting schemes vary with requirements but general lighting has supplanted individual lighting to a great degree and intensities as high as 8-foot candles are used on operations needing close watching. An average condition is represented by 100-watt lamps, suitably reflected, spaced on 10- to 12-foot centres. Blue glass lamps are in general use for colour matching in many textile industries as also in the tobacco industry.

Store Illumination

The merchant, whether he keeps a corner grocery store in a rural town or is proprietor of a mammoth departmental store in a metropolitan city, now knows that light is his best form of advertisement. It enables him to display his goods to the best advantage; it attracts passers-by to look; and everyone who stops to look at a window display or an interior is a prospective customer. The merchants have increased the illumination of their stores from one-half or one foot candle to ten and fifteen foot candles; a fair average being about six foot candles in metropolitan centres where competition is keen, as the customer nowadays does not wish to shop in a dingy, badly lighted store.

Store window lighting has been remarkably improved in the last five years. No longer can the merchant afford to continue low illumination in the store window. The average intensity has increased from ten to fifty and one hundred foot candles in all cases the use of diffusing mediums are recognized. Where high intensities are desired the standard practice is to install the lighting units in suitable reflectors behind a Valency or transparency. Special installations using an intensity of two thousand foot candles exist for the purpose of counteracting mirage on the show window during the daylight. This has become a permanent installation in the large mercantile show windows for emergency use. Stores use general lighting, direct, semi-indirect and total indirect, the average being 100-watt, 200-watt and 300-watt concentrated filament lamps, auxiliary lighting being in the nature of show case lighting where miniature reflectors are in use with 15-watt lamps.

Sign Lighting

During the past few years the electric sign has expanded and every community has one or more signs. In the larger towns and cities the electric sign is very prominent. The growing interest of these signs is evidenced by the building architect including the design of the sign in the building plan in an effort to improve the daytime appearance of the sign. These signs are made up in a large number of styles using 10- to 100-watt lamps. There are almost as many flashing or flickering or running borders and flashing signs as there are still ones. The sign which flashes two or more messages is very popular; signs which obtain curious effects by flashing different colours are quite common; and very effective signs in which the wording drifts by over a bank of lamps are numerous. Building outline lighting has become practically obsolete in this country and there is a tendency of new and beautiful colour effects rather than in greater brilliancy of the light sources in signs. Electric signs will become more extensively used as they become more artistically and architecturally fitting; at present the majority of large signs in daytime are ugly and too frequently offensive to the eye.

Plate No. 1, — St. Lawrence River Buoy.

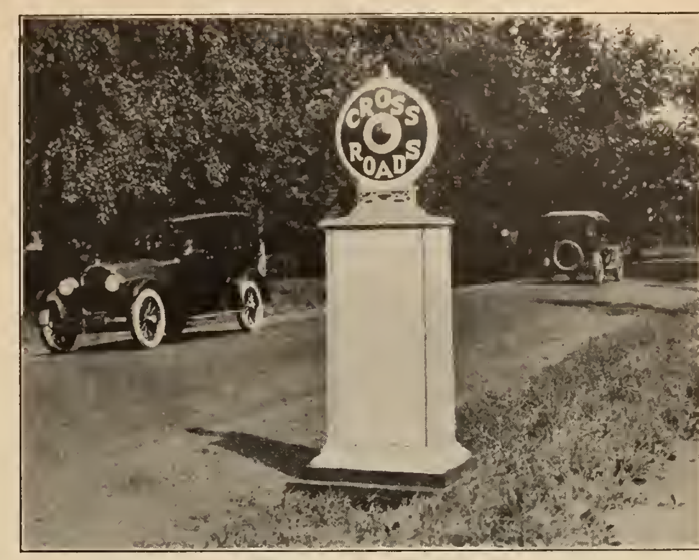


Plate No. 2, — Highway Lighthouse.

Street, Highway, and Canal Lighting

The increased size of incandescent lamps available for street lighting has hastened the retirement of the gas and arc lamps from the streets of the communities. The cluster standard is fast being retired in favour of a single light unit for the latter is a much more attractive architectural design of post, and largely used for "main street" lighting. A distinct change is also noticeable in the character of the glassware, which has expanded from a globular form to the urn-shape, while the tops are covered either with reflector canopies or the glass is so designed as to re-direct light thrown upwards and formerly wasted. Series street lighting circuits predominate; a few com-

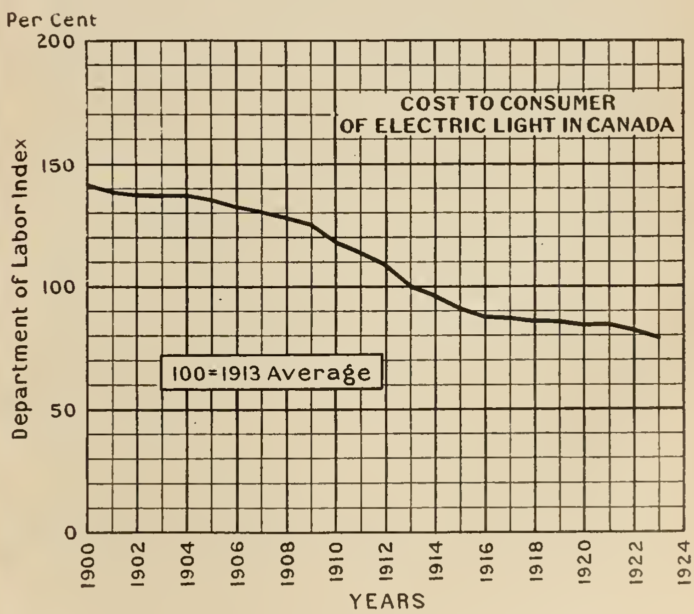


Plate No. 3, — Cost to Consumer of Electric Light in Canada.

munities use the parallel distribution of current. Main streets have an average intensity of one-half foot candles while side streets in best lighting communities have an average of one-tenth foot candles and less. In the metropolitan centres 600-c.p. 20-ampere series units, or

Table No. 1, — Street Lighting Practice in Canada

Town	Type of Unit: Plate No.	Type of Unit: Business Section	Residential Section	Size of Units	No. of Units
Vancouver		5 light units	incandescent	400 & 600 c.p.	. .
New Westminster		5 light units	incandescent	600 c.p.	. .
Victoria		5 light units	luminous arc	600 & 1,500 c.p.	1,850
Calgary		luminous arc	luminous arc	1,500-2,000 c.p.	. .
Edmonton		incandescent	luminous arc	1,000 c.p.	. .
Winnipeg	4 5	luminous arc	luminous arc and incandescent	100-250 c.p. & 1,000 c.p.	3,000
Walkerville		incandescent	incandescent	1,000 c.p. & 250 c.p.	. .
Toronto	6 7	incandescent	incandescent	100 watts 300 watts, 600 c.p.	 49,719
Montreal		luminous arc and incandescent	luminous arc and incandescent	1,500 c.p. 2,500 c.p. 60 & 80 c.p.	4,018 818 3,173
Westmount	8	incandescent	incandescent	1,000 c.p. & 600 c.p.	. .
Halifax		incandescent luminous arc	incandescent luminous arc	1,000 c.p. & 1,500 c.p.	. .
St. John, N.B.	9	incandescent	incandescent	1,000 c.p. & 100 c.p.	. .

Plate No. 4, — Winnipeg, Manitoba — day view.

Plate No. 5, — Winnipeg, Manitoba, — night view.

500-watt "type C" lamps, spaced 100 feet on each side of the street parallel or staggered, is now common, while for side streets 100-c.p. series or multiple incandescent lamps spaced 100 to 300 feet is the practice. Approximately 95 per cent of the total mileage of the streets of the communities is illuminated.

Table No. 1 shows in some detail the types of lighting in use in the larger cities of Canada.

Arc lighting is gradually being superseded by large nitrogen filled units which are now procurable in 1,000-c.p. sizes; these lamps are operated at 20 amperes from series circuits frequently by means of current transformers stopping up the line current from 6.6 amperes to 20 amperes.

Typical Example of Street Lighting

A typical example of street lighting can be gathered from the following description of the system in Winnipeg:

The city of Winnipeg is perhaps one of the best lighted cities in Canada as far as street lighting is concerned. On the main streets in the downtown section, which are exceptionally wide from building front to

Plate No. 6, — Toronto, Ontario, Sunnyside Boulevard — night view.

Plate No. 7, — Toronto, Ontario, Sunnyside Boulevard — day view.

Plate No. 9, — St. John, N.B. — night view.

building front, there are installed on each trolley pole two 6.6-ampere d.c. luminous arc lamps. On the main thoroughfares through portion of the residential districts the magnetic arc lamp is also used; there being in all 17,000 of these units. In addition there are 1,300 20-ampere 1,000-c.p. series incandescent units, and in the outlying districts 100- and 250-c.p. incandescent lamps are used.

The city of Winnipeg is gradually improving the efficiency of the system by utilizing improved type electrodes for the arc lamps and more efficient glassware. On the incandescent units they are embodying the dome refractor and the outer rippled globe. This brings the incandescent lamp nearer to the standard of the illumination of the luminous arc lamp taking the dead appearance from the lamps by the ripples in the globe, which adds a sparkle to the unit at night and in addition gives the incandescent lamp a whiter appearance which is necessary when used in the vicinity of the arc lamp, which is a very white lamp as compared with the incandescent lamp. In addition to this, with the use of the dome refractor they obtain maximum illumination at about 10 degrees below the horizontal, increasing the intensity on the road surface about 40 to 50 per cent. On all the incandescent units used in Winnipeg they embody the auto transformer enabling the use of the 20-ampere lamp.

General Tendency in Street Lighting

The general tendency in Canada is to increase the intensity, and at the same time install lighting units that will not detract from the general appearance of the street in daytime, but rather improve the appearance of the street in the daytime as well as at night. The tendency is to obtain units which are efficient and which give the maximum illumination for the wattage consumed and not to forget the æsthetic values. Also to obtain the maximum illumination on the road surface, and at the same time to allow a sufficient percentage of light in the upward plane, thus beautifying the general appearance of the street at night. (See plate No. 10.)

Plate No. 8, — Westmount, Quebec — day view.

Plate No. 10, — Peterborough, Ontario — night view.

Plate No. 11, — Calgary, Alberta — night view.

The enormous increase in fast moving vehicle traffic, is making high intensity of street lighting an absolute necessity from the point of view of safety.

A lighting installation in Walkerville which has just been completed is of particular interest. On one of the main highways leading into the city, 75 single highway lighting units, which comprise a nest of reflectors, have been installed. These units are mounted 30 feet high, with a spacing of 325 feet apart, and give even illumination along the highway, making a confined ribbon of light along the highway.

In each unit is utilized a 250-c.p., 6.6-ampere series lamp consuming about 155 watts. The system is fed from pole type constant current transformers, which are automatic and controlled by a season-changing time switch which is electrically wound and which has adjustments on it to open and close the switch at dusk and dawn. This installation marks a new era for highway lighting in Canada and has proven a great success.

Included in this article are to be found the following views:—

Winnipeg, day and night...........	Plates Nos. 4 and 5.
Sunnyside Boulevard, Toronto, day and night.....................	Plates Nos. 6 and 7.
Westmount, day and night.........	Plate No. 8.
St. John, New Brunswick, night.....	Plate No. 9.
Peterborough, night................	Plate No. 10.
Calgary..........................	Plate No. 11.

which show both the type of fixture in use and the appearance of well lighted streets at night.

Recent Developments in Electric Lamps

J. T. Scott,
Sunbeam Lamp Works, Canadian General Electric Company.

The incandescent lamp has kept step with progress in the growth of the electrical industry of Canada. It has been fairly estimated that the present consumption of large lamps for general lighting purposes is about 1.8 per capita. Therefore the demand for incandescent lamps may be placed at about fifteen millions per annum.

There are in Canada approximately one million domestic lighting customers. These customers will average ten lamp sockets per house, with lamps rating at about 50 watts each. The connected load for domestic lighting purposes may be taken at 500,000 k.w.

The million lighting customers represent over four millions of Canada's inhabitants, so we have nearly fifty per cent of the entire population as dwellers in electrically lighted abodes.

Analysis of Demand

The annual demand for incandescent lamps may be divided roughly between the vacuum and the gas-filled types, disregarding the now very small demand for carbon lamps. The consumption of vacuum lamps represents 73 per cent of the demand, and the gas-filled 27 per cent.

There is a very steady trend towards increased demand for the gas-filled lamps as against the vacuum type on account of the higher values in illumination being used both for domestic and industrial lighting. In practically all places where the application of light is carefully studied there is a demand for illumination of higher intensity.

The 25-, 40-, 50- and 60-watt vacuum lamps amount to seventy per cent of the total vacuum lamp demand. The 40-watt size being the most popular, with the 60-watt following closely. In gas-filled types, the 75-, 100- and 200-watt sizes amount to fifty per cent of the total gas-filled demand.

Standard Voltages

Considerable progress has been made in the standardization of voltages. Seventy-five per cent of the lamps used fall within a voltage range of 110 to 120; 115 volts predominating. The remaining twenty-five per cent of the demand is for odd voltages in special areas, private plants, etc.

The advantage of three standard voltages not only enables the dealer to carry a smaller stock and to give prompt service, but allows manufacturing to be standardized for output, higher efficiency, and lower costs. The investment and overhead costs for stock are lower and future improvements are more readily effective and reach the public much sooner than would be the case if many odd voltages had to be carried in stock.

Lamp Rating

The ratings of lamps are now expressed in terms of "lumens per watt", thus permitting any increase in lamp efficiency to be shown by an increase in the number of lumens per watt. A purchaser of lamps is therefore able to easily recognize by the higher figures the lamp having the greatest light output for an equal wattage. The rating of lamps in candle-power without reference to the watts consumed, or the rating in watts without reference to the light output, is not a method which enables the average consumer to purchase the most efficient lamp. Rating in "lumens per watt" is therefore becoming better understood as an indication of lamp value with respect to light output.

Standard Lamp Specifications

The Canadian Engineering Standards Association formed a sub-committee in 1919 to consider a set of specifications for incandescent lamps. The committee included representatives of the various manufacturers interested as well as a number of large purchasers.

The standards were published in October 1923, and as showing the scope of the work we might quote from the preface:

> "The following specification is designed to: (a) Detail the standards and definitions pertaining to tungsten incandescent lamps, the physical and electrical characteristics that constitute good lamps, and the tolerances permissible in their inspection and testing; (b) Provide a scientific and authorative method of determining tungsten lamp quality with respect to mechanical characteristics, lumen maintenance, and life performance; (c) Provide tables of the dimensions and electrical characteristics of the regular classes of tungsten lamps; (d) And thus to afford a technical basis for contracts governing the sale and purchase of tungsten incandescent lamps that will adequately protect both the purchaser and the manufacturer."

The use of these specifications by lamp manufacturers, and their acceptance by the buying public, has done much to eliminate some of the unsatisfactory products made to no standard at all by foreign lamp makers.

This matter of lamps made to a standard specification also has a bearing upon the use of lamps in reflectors of standardized manufacture; the light-center of lamps made in the Dominion being uniform with the correct position in standard reflectors. The lamp makers and reflector manufacturers here working together for uniformity of production and progress by providing lamp and reflector which shall give the maximum value in lighting for industrial purposes.

Lamp Developments

Tipless Lamps

The most important advance in recent lamp development has undoubtedly been the production of the tipless lamp. This is now the standard of manufacture, and lamps of all types for all services are tipless; thus the old style of tipped lamp is entirely superseded. This change necessitated considerable capital outlay to provide for the extensive alterations required in machinery and for new apparatus. The achievement has provided a lamp that is improved in appearance, more rugged in use, and a safer product in transit.

Spray Colour

A colouring material has been produced by the lamp manufacturers which is practically permanent under all conditions. The material is easily applied by a spray process to the lamp bulbs, giving a fine even colouring. The colour will not chip, flake or wash off, and it is unaffected by heat. These features make it possible to provide various colour schemes for indoor or outdoor service by the use of coloured lamps which will retain their initial clearness and beauty of effect. This is an important feature in modern illumination, not only for outside decorative work but in show windows, theatre interiors and stage lighting. In domestic use also, instead of the entire supply of light proceeding from one central fixture or lamp, some coloured lamps individually placed in appropriate fixtures lend charm to the modern living room.

Bowl-enamelling and frosting is also accomplished by means of the spray process. Since the greater use of the gas-filled lamp involves the use of a filament many times more brilliant than that in the older vacuum lamp, a more diffusing finish is necessary in order to cut down the ill effects of glare. By the white spray-coating, the glare is thus modified without any appreciable reduction of transmitted light.

Sign Lamps

Lamps for sign lighting purposes are now made with the coiled, or concentrated, filament, in ring form which ensures greater mechanical strength and increases the end-on, or tip candle-power. This improvement applies to all the sign lamps. It provides a more continuous line of light as reflected by the letter troughs than was secured by the earlier types of lamp.

Street Series Lamps

Owing to the improvement in reflector equipment for street lighting units, higher candlepower lamps have been developed and these are now available for use on 20-ampere constant-current circuits in sizes of 1,000, 1,500 and 2,000 candle power. Prevention of accidents and safe travel on thoroughfares is of such importance that the further advance in the use of these modern units is assured.

Research

Minor developments and improvement of methods are constantly taking place in lamp manufacturing, and while some may seem rather intangible, yet in the aggregate over a period of years they amount to considerable steps in the progress of lamp engineering.

Various Services

Tungsten filament lamps, vacuum and gas-filled, are now specially manufactured for many forms of service, and the Canadian lamp maker is always ready to meet any new demand. Among the wide-spread range of special lamps for particular conditions may be mentioned a few: The railroad signal lamps, operated through track circuit relays from small transformers for semaphore and block signal work; lamps specially developed for light-house service, having a filament which provides correct lighting for the form of lens used; motion picture lamps of all types, from the 30-ampere lamp with heat-resisting glass bulb for regular picture-house work, to the small fourteen volt lamp operated through a transformer for use with the miniature movie picture outfit in the home; and decorative lamps for fancy purposes, including Christmas-tree lamps, spray-coloured and wired eight in series, for use on the house voltage.

Only a very slight indication has been given of the wide demand for lamps for all purposes which go to make up the connected lighting load.

The noticeable increase in the aggregate wattage and lumens serves to show the trend to higher values in general illumination. Increase in efficiency and lamp improvement have played their part in this, besides having had at the same time considerable influence in reducing the cost per unit of light. The reduced cost per unit is a factor in increasing the amount of light used. The increase of light is a stimulant of business in general, it aids the speeding-up of industrial processes, and is a considerable feature in welfare and safety. We have come a long way in half a century, and there is no better measure of civilized progress than the state of development of artificial light and lighting.

The International Joint Commission and the International Water Powers of Canada

The Scope of the Commission's Activities, Its Powers, and Investigations Already Undertaken.

Lawrence J. Burpee, F.R.S.C.,
Secretary for Canada of the International Joint Commission.

Of all the natural resources, remarkable as much for their variety as their extent, with which nature has endowed the Dominion of Canada, none is of more permanent value than its water powers. Coal beds however vast must some day become exhausted. So must oil wells and iron and other mineral deposits. Forests are gradually cut down, and even the products of the soil diminish with its fertility. Water power alone is inexhaustible. As long as rivers run it will remain possible to harness them and use them for the benefit of mankind.

Water Powers along the International Boundary

The water powers of Canada form one of its greatest assets, and not the least important are those that lie along the international boundary, within economic reach of nearly all the principal centres of population of the country. These international water powers, owned jointly by Canada and the United States, represent approximately 8,000,000 horse power, more than the total water power of any country in Europe.

To appreciate the extent of territory served by these international water powers, it must be remembered that eighteen hundred miles of the boundary between Canada and the United States run through waterways. The boundary starts in Passamaquoddy bay, on the Bay of Fundy, and runs up the St. Croix river to its upper waters. Then it strikes overland until it reaches the St. John river near Grand Falls. It then follows the St. John and the St. Francis rivers to a small body of water known as Boundary lake. From there it again runs overland to the upper St. Lawrence, at the head of lake St. Francis, about sixty miles above Montreal. From this point the boundary follows that extraordinary system of waterways known as the Great Lakes, up the St. Lawrence to lake Ontario, from that lake up the Niagara to lake Erie, then up the Detroit river, lake St. Clair and the St. Clair river to lake Huron, from lake Huron up the St. Marys river to lake Superior, and from the latter lake up Pigeon river to the height of land and through an intricate series of small lakes and streams to Rainy lake, Rainy river and the Lake of the Woods. The water boundary ends in what is known as the North West Angle of the Lake of the Woods. From these it goes due south until it reaches the 49th parallel, and follows that line west to the Pacific.

Waterfalls are found on all these rivers, but the largest and most valuable, from the point of view of power, are those on the St. Marys river at the outlet of lake Superior, on the Niagara river, and on the upper St. Lawrence. The total drop from lake Superior to the sea is something over 600 feet, of which 20 feet are at the outlet of lake Superior, 325 feet on the Niagara, and 220 feet between lake Ontario and Montreal. The real value of these international water powers must be measured, as has already been suggested, not so much by their actual extent as by their nearness to large and rapidly-increasing centres of population and industrial development on both sides of the boundary. The proximity of basic raw materials and unrivalled transportation facilities both by land and water has already transformed the Great Lakes region into one of the most important industrial areas of North America, and it is inevitable that when all the available water powers have been brought into service it will become one of the greatest industrial regions of the world. From that point of view the value of these international water powers is almost incalculable.

Creation of the International Joint Commission

Recognizing their present and prospective value, and the importance of conserving them for the benefit of the people of both countries, Canada and the United States entered into a treaty with this as one of its principal objects. This treaty, signed at Washington in 1909, was designed to "prevent disputes regarding the use of boundary waters and to settle all questions which are now pending between the United States and the Dominion of Canada involving the rights, obligations, or interests of either in relation to the other or to the inhabitants of the other, along their common frontier, and to make provision for the adjustment and settlement of all such questions as may hereafter arise".

This treaty created what is known as the International Joint Commission, a body consisting of three members appointed by His Majesty the King, on the recommendation of the Canadian Government, and three appointed by the President of the United States, and endowed it with extraordinarily wide powers.

The mere fact that the commission consists of an equal number of Canadians and Americans, without an umpire or any provision for a casting vote, is significant of the spirit in which the treaty was conceived and the commission created. That spirit has indeed been the keynote of the commission's activities since its establishment, its members endeavouring to approach the varied and important questions brought before them, not as two more or less antagonistic groups jockeying for advantages, but on the contrary as a judicial tribunal pledged to give its best possible judgment, with the utmost impartiality, to the settlement of problems that arise sometimes on one side of the boundary and sometimes on the other.

The commission has now been functioning for over thirteen years, and in that time it has dealt among other things with a number of questions involving the development of water powers on international streams.

The St. Marys River Case

One of the most important of these was the St. Marys River case, which involved the complete control of the outflow of lake Superior, that immense inland sea that ranks among the natural wonders of North America, and which in a comparatively short period of years has been transformed from a waste of waters bearing nothing more than an occasional birchbark canoe paddled by Indians or fur-traders, and surrounded by an almost uninhabited wilderness, into one of the world's great thoroughfares of commerce, up and down which gigantic steamers carry hundreds of millions of tons of freight, and upon whose shores have sprung up populous and enterprising communities and immense industries.

The St. Marys River case came before the commission under the terms of article III of the Treaty of 1909, which vests in the commission the authority to finally determine any question involving the use or obstruction or diversion of boundary waters on either side of the line, affecting the natural level or flow of boundary waters on the other side of the line. In reality there were two applications before the commission, one from the Michigan Northern Power Company, on the United States side, and the other from the Algoma Steel Corporation, a Canadian company.

Each of the companies mentioned applied for authority to build works from its own side to the international boundary, the combined works making one structure across the river. At the hearings, legal and engineering representatives of various municipalities on both sides of lake Superior, and of railway and other corporations, expressed anxiety lest the proposed works should have the effect of raising the level of lake Superior and causing serious damage to wharves, buildings and sewage systems in Duluth, Fort William, and other towns around the lake. After hearing the testimony of a number of expert engineers, including representatives of the United States and Canadian governments, the commission approved of the proposed works upon certain conditions as to construction and operation, which, instead of being detrimental to the interests of navigation and of the several communities around lake Superior, would, by maintaining the level of the lake between certain points, be very much to the public advantage. It must be emphasized that only through such an international organization can the full commercial value of these water powers be obtained.

As part of their Order of Approval, the commission made it a condition that the works, both during construction and thereafter, were to be under the direct control of an international board of engineers, one member of which was to be appointed by the Canadian and the other by the United States government. In case of disagreement the board was to refer the question to the commission for decision.

In this way it was found possible to settle, in a very short time, and to the satisfaction of all the very important interests concerned, American and Canadian, public, navigation, and power, a question which might have dragged along for years under the old diplomatic procedure and been the cause of international irritation and material loss on both sides of the boundary.

It may be noted that the representatives of the various towns on lake Superior, American and Canadian, had been concerned over the possible effect of the proposed works at the outlet of the lake, if they were put under private control, but expressed complete satisfaction with the international control provided for in the commission's orders.

Special Provision for Niagara River

Special provision is made in the treaty for the water power situation on the Niagara river, the terms of article V being as follows:—

> The High Contracting Parties agree that it is expedient to limit the diversion of waters from the Niagara river so that the level of lake Erie and the flow of the stream shall not be appreciably affected. It is the desire of both Parties to accomplish this object with the least possible injury to investments which have already been made in the construction of power plants on the United States side of the river under grants of authority from the state of New York, and on the Canadian side of the river under licenses authorized by the Dominion of Canada and the province of Ontario.
>
> So long as this treaty shall remain in force, no diversion of the waters of the Niagara river above the falls from the natural course and stream thereof shall be permitted except for the purposes and to the extent hereinafter provided.
>
> The United States may authorize and permit the diversion within the state of New York of the waters of said river above the falls of Niagara, for power purposes, not exceeding in the aggregate a daily diversion at the rate of twenty thousand cubic feet of water per second.
>
> The United Kingdom, by the Dominion of Canada, or the province of Ontario, may authorize and permit the diversion within the province of Ontario of the water of said river above the falls of Niagara, for power purposes, not exceeding in the aggregate a daily diversion at the rate of thirty-six thousand cubic feet of water."

Since the date of the treaty momentous changes have taken place in the situation at Niagara Falls. At the present time practically the whole amount of water authorized by the treaty is in use, and by means of new processes of water power development, an enormously greater efficiency is obtained from the quantity of water diverted than was the case ten years ago. The Hydro-Electric Power Commission of Ontario has completed its great Chippewa-Queenston diversion, by means of which practically double the head is obtained which can be secured at the falls, and ultimately all the existing plants on the Canadian side at the falls will probably be scrapped, and Canada's share of the water developed entirely at Queenston.

On the American side of the river, partly because of different physical conditions, another programme is being worked out. There the various plants at the falls are being merged into one great development at the same place, and the drop in the river between the falls and the Whirlpool will probably be utilized by cutting a tunnel through the rock and carrying the water down to a power house below the Whirlpool. Some engineers are now of the opinion that a considerably larger amount than that fixed by the treaty may be diverted from the falls without seriously impairing their scenic beauty; in fact it is said that by means of a submerged weir above the point of the Horseshoe, which is rapidly being transformed into a Hairpin, the erosion will be checked, the appearance of the falls greatly improved, and at the same time a considerably larger amount made available for power development.

Investigations under Article IX of the Treaty

The power situation on the upper St. Lawrence and in connection with the Lake of the Woods, has been dealt with by the Commission under the terms of another article of the treaty, article IX, which reads as follows:—

> "The High Contracting Parties further agree that any other questions or matters of difference arising between them involving the rights, obligations, or interests of either in relation to the other or to the inhabitants of the other, along the common frontier between the United States and the Dominion of Canada, shall be referred from time to time to the International Joint Commission for examination and report, whenever either the Government of the United States or the Government of the Dominion of Canada shall request that such questions or matters of difference be so referred.
>
> The International Joint Commission is authorized in each case so referred to examine into and report upon the facts and circumstances of the particular questions and matters referred, together with such conclusions and recommendation as may be appropriate subject, however, to any restrictions or exceptions which may be imposed with respect thereto by the terms of the reference.
>
> Such reports of the commission shall not be regarded as decisions of the questions or matter so submitted either on the facts or the law, and shall in no way have the character of an arbitral award.
>
> The Commission shall make a joint report to both governments in all cases in which all or a majority of the commissioners agree, and in case of disagreement the minority may make a joint report

to both governments, or separate reports to their respective governments.

In case the commission is evenly divided upon any question or matter referred to it for report, separate reports shall be made by the commissioners on each side to their own government."

Under this article of the treaty the commission becomes an investigating body. It will be seen that an investigation under article IX may be requested by either government; that an obligation to make such a request is involved in the language of the article, the word "shall" being construed as mandatory; and that in making such an investigation the findings of the commission are not binding on the two countries, either as a decision or an arbitral award.

"It would," in the language of an editorial in the *American Journal of International Law,* "be difficult to overestimate the advantage and convenience to both countries of having a permanent body, organized as this is with both countries equally represented, upon which either may call for a thorough investigation of any questions of difference involving the interests of their citizens or subjects along the thousands of miles of their common frontier."

It may be noted here that in actual practice all questions so far referred to the commission for investigation under article IX have been referred jointly by the two governments, although it is obvious from the language of the article that either government could act independently if it saw fit to do so. It is also worth noting that, in the investigations so far reported on, the six commissioners have been in every case in substantial accord in their conclusions and recommendations. Their recommendations under article IX, like their decisions under article III, have been unanimous.

Of the four questions so far referred to the commission under the terms of article IX, the first related to the construction of a dyke in the Detroit river for the benefit of navigation; the second to the fixing of levels in the Lake of the Woods which would be best suited to the requirements of the various interests on both sides of the boundary; the third had to do with the pollution of boundary waters and appropriate remedies therefor; and the last requested recommendations as to the most practicable means of improving the St. Lawrence river between lake Ontario and Montreal for navigation and water power.

St. Lawrence River Navigation and Power Investigation

In the St. Lawrence investigation, the commission was requested to examine into and report upon the most practicable and efficient means of securing the maximum development from the upper St. Lawrence in terms of navigation and water power. This investigation involved many economic and engineering questions of unusual magnitude. In connection with the economic problem the commission held public hearings in a great many Canadian and American centres, from New York, Boston and Montreal in the east, to Calgary, Helena and Boise in the west. The engineering side of the question was dealt with by a board of engineers drawn from the technical staffs of both countries. The commission's final report, dealing exhaustively with every phase of this very big problem, filled about a dozen volumes. Only the main report and the report of the engineering board have so far been printed.

Briefly stated, the recommendations of the commission provide for a waterway from lake Ontario to Montreal with a minimum depth of 25 feet, which at some future time might be extended to 30 feet. In addition to deepening the river channel at certain places, canals and locks are provided for at Cornwall to surmount the Long Sault rapids, between lake St. Francis and lake St. Louis to surmount the Coteau, Cedars and Cascades rapids, and at Montreal to surmount the Lachine rapids. A lock is also provided farther up-stream at Ogden island. Each of the seven locks is to be 860 feet long and 80 feet wide.

For the development of water power, and also as part of the navigation scheme, the commission recommended the construction of two dams across the St. Lawrence, one at Ogden island and the other at the Long Sault rapids. These two dams would make possible a development of power estimated at about 1,500,000, one-half of which would be available for use in Canada and the other half in the United States. Both dams would be in the international section of the river. The commission did not recommend for the present the development of water power in the purely Canadian section of the St. Lawrence, below St. Regis.

The cost of the proposed works for navigation and power in the international section of the river was estimated at $159,000,000 and of the navigation works in the Canadian section of the river at $93,000,000. or a total of $252,000,000. The engineering board estimated that if at some future time it should be thought desirable to develop power in the national section of the river, about 2,260,000 horse power would be available at a cost of about $220,000,000.

Investigation of Levels in the Lake of the Woods

The other investigation involving water power interests related to the fixing of levels in the Lake of the Woods which would be best suited to the requirements of all the various interests on both sides of the boundary. It may not be generally known that the watershed of the Lake of the Woods exceeds twenty-six thousands square miles, equal to the combined areas of the states of Massachusetts, New Hampshire, Rhode Island, Connecticut and Delaware, or some five thousand square miles greater than the area of the province of Nova Scotia. The capital invested in the various industries in this region is considerably over $100,000,000; the resources are enormous, of great variety, and only beginning to be developed; and communities as far apart as Duluth and Winnipeg were more or less directly interested in the fixing of a level on the Lake of the Woods and its tributaries, which would give the maximum benefit to the people on both sides of the boundary.

The extensive field work involved in the investigation was under the direction of two consulting engineers, one an American, and the other a Canadian. After several years' careful work, in which they were of course constantly in touch with the commission and acted under its direction, they submitted their report to the commission in 1916. The commission's final report to the two governments was submitted in 1917. In this report the commission recommended that it be authorized to exercise supervision and control over the operation of all dams and regulating works in these waters extending across the international boundary, as well as the dams and regulating works at Kettle falls and at the outlets of the Lake of the Woods, which are in Canadian territory; and that it be empowered to appoint two engineers, one from each country to act as its representatives under such rules and regulations as it might prescribe. The documents in the Lake of the Woods investigation, which include several volumes of hearings and arguments, the results of the engineers' surveys and other data, and the commission's final report, have all been printed.

The commission's recommendations were designed to secure a level in the Lake of the Woods that would be of most service to the interests of navigation and also to those of water power, the latter being of paramount importance at the present time. In addition to the existing developments at the outlets of the Lake of the Woods, and at the outlet of Rainy lake, there are nine distinct power sites on the Winnipeg river, which discharges the water of the Lake of the Woods into lake Winnipeg. By means of suitable storage, it is possible and economically feasible to develop over 420,000 horse power at these sites. Several of them have already been developed, and the power is being utilized for industrial and other purposes in the city of Winnipeg and the surrounding district. As the level best adapted to water power would result in flooding certain agricultural lands on the shores of the Lake of the Woods, the commission recommended that provision should be made for compensating the owners of these lands.

Applications for Power Developments on Upper St. Lawrence

Under the authority vested in it by the terms of article III of the treaty, the commission has also settled several other cases involving important water power interests along the international frontier between Canada and the United States.

One of these was an application by an American corporation, the St. Lawrence River Power Company, one of the subsidiaries of the Aluminum Company of America, for permission to put a submerged dam in one of the channels of the St. Lawrence, on the American side of the river, at the Long Sault rapids. The application came before the commission in July, 1918, at a time when the issue of the European war was still wrapped in uncertainty. It was urgently represented to the commission, not only by the applicant company but also by the United States War Industries Board, the Bureau of Aircraft Production, and the United States Secretary of War, that the proposed dam was urgently needed to increase the available power at the company's works at Massena, and thereby insure an adequate supply of aluminum for war purposes from the company's plant.

In view of these representations, the commission issued an order permitting the company to build the dam and maintain it for a period of five years, or until the termination of the war if it should extend beyond that period.

Another application involving the development of water power on the upper St. Lawrence was that of the New York and Ontario Power Company, whose proposed works were at Waddington, N.Y. This case came before the commission in 1918, and as before it came up for hearing the commission had been advised of the St. Lawrence investigation, involving a complete scheme of water power development for the international portion of the river, it was not thought advisable to authorize the contemplated works at Waddington until it was known whether or not these would interfere with the larger scheme.

These are the more important water power cases which have come before the commission, either for investigation or final settlement. But power problems represent but one of several classes of questions that, under the terms of the Treaty of 1909, may be brought before the commission. It has already disposed of a very difficult and delicate case involving irrigation interests in Alberta and Montana; it made provision for a water supply for the city of Winnipeg from Shoal lake, which is connected with the Lake of the Woods; and, among other problems, it has approved of certain works for the improvements of navigation in the Detroit and St. Clair rivers. These last are of unusual importance, as they are necessary to the safety and convenience of the enormous and ever-growing commerce of the Great Lakes. It appears from official reports that about 70,000,000 tons of freight, of a total value of about $1,000,000,000 are carried annually during the season of navigation up and down the Detroit and St. Clair rivers and the Great Lakes of which they are the connecting links.

The Pollution of the Great Lakes and other Boundary Waters

A third question which was referred to the commission by the governments of Canada and the United States for investigation and report, was that of the pollution of the Great Lakes and other boundary waters. The investigation, which involved an examination of the waters of the Great Lakes and their connecting rivers, Rainy lake, Rainy river, the Lake of the Woods, and the boundary portion of the St. John river in the east, wherever pollution might extend from one side to the other, disclosed the gratifying fact that the great bulk of the Great Lakes water remains in its pristine purity, in spite of the fact that some seven million people had contracted the very bad habit of dumping all their sewage into these waters, and that the entire shipping of the Great Lakes, carrying in one season not less than 15,000,000 passengers, had followed the same evil practice. Serious pollution was found at many points along boundary waters, and particularly in the Detroit and Niagara rivers, where the cities of Detroit and Buffalo, with a number of smaller communities on both sides of the boundary, had been doing their best to make the waters of these rivers unfit for human consumption.

Severe epidemics of typhoid fever in the lake cities had for years past warned these communities that, while they were spending hundreds of millions on their streets and buildings, and in other ways adding to the comfort and convenience of their inhabitants, the most vital consideration of all, that of public health, was being grossly neglected. If the commission should achieve nothing more than to awaken the cities of the Great Lakes to the vital importance of protecting their water supplies, it would have more than justified its existence.

The commission in its report made certain recommendations designed to remedy the existing situation, and laid down in particular the principle that "effective sanitary administration requires the adoption of the general policy that no untreated sewage from cities or towns shall be discharged into boundary waters".

Questions involving Rights, Obligations or Interests of Either Country

In addition to its jurisdiction as a judicial, or quasi-judicial, body under articles III and IV, and as an investigatory body under article IX, of the Treaty of 1909, the commission is also vested with other and still more significant powers. Under article X it is constituted a tribunal for the final settlement of any question involving the rights, obligations or interests of either country in relation to the other. The importance of this provision of the treaty can hardly be exaggerated. The obligation on the part of the governments to refer questions to the commission under article X is, it is true, moral rather than legal. Article IX reads "shall be referred", while article X reads "may be referred". Nevertheless it will be noted that while under article IX questions are referred to the commission only "for examination and report", under article X they are referred "for decision". The commission therefore becomes under article X in a very real sense a court of final jurisdiction for the two countries.

Another interesting point is that the article contains no limitation as to the character of the questions that may be brought before the commission for adjudication, other than that they must involve "the rights, obligations, or interests of the United States or the Dominion of Canada, either in relation to each other or to their respective inhabitants". That obviously is a very flexible limitation, and embraces a tremendously large field within which article X may be applied. It puts into operation throughout this immensely greater region, and under more promising conditions, much the same principles embodied in the convention creating the Central American Court of Justice in 1908, by which Costa Rica, Guatemala, Honduras, Nicaragua and San Salvador bound themselves to submit to the court all controversies of whatever origin.

It is true that up to the present time no question or matter of difference has been referred under article X to the commission, but that need not be interpreted as a disinclination on the part of either government to entrust such questions to the commission for final settlement. Rather it means that the relations of these two countries have been so cordial, have been, one may say, so extraordinarily fortunate, that since the treaty was signed no occasion has arisen to take advantage of the terms of article X.

The Commission, a Successful Agency for Peaceful Settlement of International Disputes

Those who negotiated the Treaty of 1909 deliberately, and as the result of long and careful consideration, built a covenant designed to bind together these two nations of the New World more closely than any two countries that were not politically one. Someone has said that they builded better than they knew. One is inclined to dispute that statement. This treaty is the fruit of wise and constructive and far-seeing statesmanship. If James Bryce and Elihu Root, who negotiated the Treaty of 1909, had never achieved anything more than that, they would have earned the gratitude of the English-speaking world. And it must not be forgotten that both the creation of the treaty and the settlement of its broad terms owed much to the vision of that great Canadian statesman, the late Sir Wilfrid Laurier. The treaty put into tangible and practicable shape the aspirations of Canadians and Americans for the closest possible union consistent with political independence. Canada's relations to the great republic are to-day only slightly less intimate than her relations to the other members of the British Commonwealth.

In a letter to Sir Wilfrid Laurier, Sir George Gibbons, who had assisted in drafting the treaty, said: "Mr. Root's desire was to dispense with the Hague Tribunal so far as concerns matters between the United States and Canada, and set an example to the world by the creation of a judicial board as distinguished from a diplomatic and partizan agency". So far as Lord Bryce was concerned, up to the time of his death he took the keenest possible interest in the commission, and had complete faith in its possibilities of usefulness to Canada and the United States.

Chief Justice Taft and the late Mr. Roosevelt, among others on the United States side of the line, and the Duke of Connaught, the Duke of Devonshire, the late Earl Grey and the late Sir Wilfrid Laurier on the Canadian side, have on various occasions drawn attention to the importance and significance of the Treaty of 1909 and of the work entrusted to the International Joint Commission. Sir Robert Borden has on more than one occasion used the commission as a conspicuously successful type of agencies for the peaceful settlement of international disputes.

It is sometimes objected that the commission is less effective than it might be, because it has not been clothed with police powers, has no means of enforcing its own decisions. That is surely a mistaken criticism. Oppenheim, speaking of international courts, says, "We have neither desire nor need to equip these courts with executive power", and if that could be said of international courts in general, it is doubly true of this particular court, representing as it does the interests of two neighbouring democracies, bound together by so many ties of sympathy and understanding. The enforcing of the decisions of the commission rests with the governments of these two countries, and they can hardly be conceived as refusing to uphold the decisions of a tribunal they themselves have created.

But it is unquestionably true that the permanent success of the commission as a means of settling disputes and also of preventing them; and perhaps the latter is the more important service; must depend to a very large extent upon public understanding and support in the two countries. The people of the United States and Canada could not be expected to give their wholehearted support to such a radical departure, unless they thoroughly understood why the commission was created and how it has carried on its very important work. Intelligent publicity is as important in this case as in any other undertaking for the public good. While the commission cannot advertise its own activities, it welcomes every effort designed to put the facts before the people, and its consistent policy from the beginning has been to act not behind closed doors but in the open, to avoid everything suggestive of secret diplomacy, to make its procedure as simple and democratic as possible, and to invite to its hearings every man who has anything worth while to say on the question under consideration.

The relations between Canada and the United States are much closer, much more intimate, than between any two countries in Europe. They have to a very large extent the same political and social ideals, the same intellectual point of view, the same manners and customs, even the same prejudices. They have been good friends and neighbours for many generations, and it is to be hoped will remain good friends and neighbours forever. But even the best of friends and neighbours are liable to have their moments of misunderstanding, and if these are not to develop into something more serious, it is important that nothing should stand in the way of their coming together and making up their differences. If that is important in the case of individuals, it is infinitely more important in the case of nations. If the individuals were compelled to resort to some extremely roundabout means of effecting a reconciliation, it is possible that the slight misunderstanding might grow into a formidable grievance before it could be adjusted. And yet this is exactly the strain that for many generations the people of these two countries permitted to be put upon their good nature, on both sides of the boundary.

We have to thank the Treaty of 1909 for cutting the cords of the old bondage, and offering instead a means of getting together and adjusting differences with the minimum of friction and red tape. It does seem that the true measure of the commission's usefulness to the people of the United States and Canada lies not so much in its positive as in its negative qualities, not so much in the cases it has actually settled as in the much larger number of cases that never come before it for consideration, simply because the commission is there, as a sort of international safety-valve.

Lord Curzon at Lausanne referred to the commission as a significant illustration of what might be accomplished in connection with the Dardanelles, and during one of the discussions at the Peace Congress in Paris, Sir Robert Borden made particular reference to its jurisdiction as an illustration of what might be accomplished in connection with such European rivers of an international character as the Rhine and the Danube. One is tempted to speculate what the effect might have been in Europe if in 1914 Austria and Serbia had had a tribunal vested with such wide powers as those possessed by the commission, with jurisdiction centered in the Danube instead of the St. Lawrence. Austrian or Hungarian and Serb, instead of watching each other suspiciously from frontier fortresses, and attempting or pretending to compose their differences along the boundary by means of the cumbersome and roundabout and dangerously slow methods of diplomacy, might have met on common ground before a court in which both countries were equally represented. Old grievances, national sores, instead of being allowed to fester, could have been quickly and impartially examined and a remedy perhaps found for them. Questions bearing within them the seeds of war might have been left to the decision of a commission pledged to find a peaceful remedy.

Had Austria and Serbia possessed such a tribunal, we might have escaped the World War. But one must put a good deal of emphasis on the *might*, because after all, while international commissions endowed with wide powers are very effective weapons of peace, they are only weapons. In peace as in war, it is not the gun but the man behind the gun, that counts. Well-considered treaties are a tremendous asset to the nations concerned, if the people of these nations are determined to back them up.

Such a treaty and such a commission as this would have saved millions of lives and incalculable loss and suffering, if the European nations had been prepared to stand resolutely behind them, but not otherwise.

Canada and the United States possess, what perhaps no two nations have possessed before, an entirely practicable and flexible means of solving their differences that leaves, or should leave, no loophole for a resort to the arbitrament of war. It has functioned quietly and unostentatiously, and its success has measured up to the most sanguine expectations of those who created it. From the point of view of world conditions, it is a useful and suggestive example of what two or more nations may accomplish if they are really anxious to avoid dangerous misunderstandings, and are willing to adopt to that end a simple but very effective procedure.

THE

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The July Journal

Since the major portion of Canada's presentation at the World Power Conference is being made by engineers who are national authorities on the various subjects and who are well known members of *The Institute*, it is fitting that *The Engineering Institute of Canada* should make it possible for its members and thousands of others interested in power development to read and possess printed copies of the very excellent and highly creditable papers which form Canada's contribution to this important gathering. This issue, which has a circulation of eleven thousand, contains a wealth of valuable data and information, rendering it desirable as a permanent record, and as such it will serve for a considerable time to the many who require to be informed on the power situation.

In complimenting the authors on the very excellent papers, advantage is taken of the opportunity to acknowledge with sincere thanks their courtesy in assisting editorially with this publication and for their valuable co-operation towards making it a success.

While the editorial pages convey the story of Canada's progress in power development, the advertising pages likewise have an interesting and effective story to tell, as the firms and organizations whose apparatus and equipment are advertised played no small part in bringing Canada to the forefront as a power producing nation, and their announcements provide interesting reading as well as valuable reference.

Canada at the Power Conference

Engineers from thirty-one nations will meet in London from June thirtieth to July twelfth for the World Power Conference, being the first time in history that engineers from different countries have assembled to discuss a subject of common interest. Twenty-four nations have signified their intention of actively participating in the presentation of papers. About thirty Canadian engineers will be in attendance. That the representatives of Canada, who will present papers and take part in the discussions, will acquit themselves creditably is a foregone conclusion. A glance through the papers published in this issue, which comprise the entire subject matter of the Canadian papers, provides sufficient evidence of the high standard of excellence of the contribution being made by the Dominion on this historic occasion.

Although engineering is truly international, this is the first time that any such great gathering of experts and authorities has been organized to discuss an engineering subject, consequently it is believed that this unique event will have outstanding results in bringing engineers of the various nations in closer contact, establishing mutual goodwill and esteem, and possibly leading to the organization of an international group of engineers which will have a powerful influence in promoting arts of peace and in wielding a mighty influence against wars and national illwill. That the World Power Conference is being held at the British Empire Exhibition at Wembley will enable the engineers of other nations to better appreciate the engineering development of the British Empire and particularly the United Kingdom. Engineering works and equipment are being particularly featured and possibly one of the great results of the Exhibition will be a greater appreciation of the important place the engineer holds in the economic life of the civilized nations.

In his foreword, introducing Canada's part in the Conference and preliminary to the papers published in this issue on the Power Resources, Their Development and Utilization in Canada, Doctor Charles Camsell, M.E.I.C., chairman of the Canadian Management Committee, points out that the World Power Conference, initiated by the British Electrical and Allied Manufacturers' Association, and organized by a committee comprising the various technical and scientific institutions and industrial organizations in the British Isles, affords the Dominion of Canada a unique opportunity to present before the world her magnificent power resources, both water and fuel, and the efficient and economic manner in which they have so far been utilized. He mentions that Canada's participation is represented by five papers by recognized experts in the principal technical aspects of power production and use. These, although each is self contained, have been co-ordinated, forming a precise yet comprehensive and analytical summary of the power resources and their utilization. He expresses the opinion of the Canadian Committee in that while conferences of this character cannot, from their very nature, be frequently held, an international discussion of power production problems, say every three or five years, would, by promoting the arts of peace and industry, prove a prime factor for better international understandings. He suggests that the Canadian delegation, on the proper occasion, should suggest a second conference to be held within the sound of the mighty Niagara.

Each of the five papers presented by Canada is introduced by a summary of the paper, in this issue. The first of these, The Water Powers of Canada; Their Nature, Extent and Administration, by J. B. Challies, C.E., M.E.I.C., director and chief engineer, Dominion Water and Reclamation Service, Department of the Interior, Ottawa, is remarkable for the thoroughness with which the subject has been covered by the author, and for the fund of information it contains on this subject. This paper constitutes Part A of the series and is accompanied by a copy of the latest map illustrating the location and extent of the water powers of Canada. Part B is covered by B. F. Haanel, B.Sc., M.E.I.C., chief engineer, Division of Fuel and Fuel Testing, Department of Mines, Ottawa, in his paper, The Fuel Resources of Canada and Their Utilization for the Production of Power and other Purposes. In this paper he points out the problems arising from the use of fuels in Canada owing to their absence in the more populous and industrialized portions of the Dominion. He makes suggestions for overcoming the difficulties, points out present practice, and by the additional means of charts, tables, diagrams and figures, gives a comprehensive analysis of the fuel situation in the Dominion. The Generation of Hydro-Electric Power in Canada forms Part C of the series, being a remarkably clear and complete survey of Canadian hydro-electric practice since 1905, by H. G. Acres, D.Sc., M.E., M.E.I.C., until recently chief hydraulic engineer, Hydro-Electric Power Commission of Ontario. He refers to the individuality of Canadian practice through the study of ice problems, and indicates the trend of future hydro-electric development in the Dominion. Part D, The Transmission and Distribution of Electric Power in Canada, is presented under the joint authorship of Julian C. Smith, E.E., LL.D., M.E.I.C., vice-president, The Shawinigan Water and Power Company, and C. V. Christie, M.A., B.Sc., A.M.E.I.C., consulting engineer and associate professor of electrical engineering, McGill University. This paper details current practice in the design and operation of electrical transmission and distribution systems in Canada, points out that the distribution of water powers in the Dominion is so widespread that exceptionally long transmission lines have not so far been required, and that 110,000 volts is the highest line voltage at present in use, although this may possibly be increased to double that voltage in the near future. It mentions that practically every large industrial centre in Canada is now equipped with electric power. In addition to dealing with current practice, the authors of this paper are in an authoritative position to make suggestions embodying improvements in certain directions. The fifth section of this series, Part E, embodies a symposium on The Utilization of Power in Canada, prepared under the direction of P. T. Davies, president of the Canadian Electrical Association and includes: Electricity in the Canadian Home, by F. A. Gaby, D.Sc., M.E.I.C.; Electrical Service for Rural Districts, by F. A. Gaby, D.Sc., M.E.I.C.; The Utilization of Power in the Pulp and Paper Industry, by R. W. Leeper; The Use of Power in the Mineral Industries of Canada, by H. E. M. Kensit, M.E.I.C.; The Use of Electric Power in the Cement Industry of Canada, by W. G. H. Cam, A.M.E.I.C.; The Use of Power for Port Facilities, by M. T. Sheehy-Casey; Recent Developments in Electric Lamps, by J. T. Scott; The Application of Compressed Air in Industry, by F. A. McLean; Electro-Chemical and Electro-Metallurgical Uses of Power, by L. E. Westman; Power in Transport, by D. E. Blair, A.M.E.I.C.; Illumination, by W. H. Woods; and Power Requirements in the Lumbering Industry in British Columbia, by A. M. Smith.

In view of the unique means of adjusting international waterway questions between Canada and the United States through the agency of the International Joint Commission, it was decided that a paper on the question would be of interest to other countries participating in the World Power Conference, and accordingly The International Joint Commission and the International Water Powers of Canada, by L. J. Burpee, F.R.S.C., secretary of the Canadian Section, International Joint Commission, appears as Part F of the Canadian presentation, the whole series being creditable alike to the authors and the Dominion.

Hon. Charles Stewart, Minister of the Interior, Honorary Chairman, Canadian Management Committee, whose influence and faith in Canada's position have made possible Canadian participation at the Power Conference.

The entire transactions of the Conference will be published by the British Committee, an announcement concerning which will be found in the advertising pages.

The general secretary of the Canadian Management Committee, Mr. J. B. Challies, M.E.I.C., went to London early in June to complete arrangements for the Conference. Headquarters for the Canadian Committee were secured at the Imperial Hotel, Russell Square, where the majority of the Canadian delegates secured accommodation.

While the Conference is primarily technical, British hospitality is abundantly manifest in the arrangements made for the entertainment of visiting delegates. A cordial invitation has been extended to various receptions, luncheons, and banquets by the Institution of Civil Engineers, the Institution of Electrical Engineers and the Institution of Mechanical Engineers, which include as well trips to Cambridge and Birmingham, and the functions connected with the celebration of the Centenary of Lord Kelvin, the presentation of the Kelvin Medal, and special services in Westminster Abbey. The High Commissioner for Canada will entertain the delegates at a Canadian luncheon on Friday, July fourth, at which the Honourable Mr. Larkin will preside, and at the conclusion of the luncheon the Honorary Chairman of the Canadian Committee, the Hon. Charles Stewart, Minister of the Interior, or in his absence, Doctor Camsell, will speak briefly, to be followed by a short address for the occasion by Mr. A. Monro Grier, K.C. Mr. Arthur Surveyer, president of *The Institute*, will also speak briefly in French. In the evening of July third, the American Committee will give a dinner at the Hotel Cecil.

Officers of The Canadian Management Committee

Hon. E. H. Armstrong, Premier of the Province of Nova Scotia, Honorary Vice-Chairman, Canadian Management Committee, Chairman of the Nova Scotia Power Commission, intimately associated with power development in Nova Scotia.

Hon. Sir Adam Beck, LL.D., Chairman of the Hydro-Electric Power Commission of Ontario, Honorary Vice-Chairman, Canadian Management Committee, an outstanding figure in the hydro-electric power development in Ontario.

Canadians have been honoured in invitations to preside at two of the sessions of the Conference. On Thursday, July third, from 3.30 p.m., to 5.00 p.m., Mr. Arthur Surveyer, M.E.I.C., and Dr. F. A. Gaby, M.E.I.C., are named as joint chairmen of the meeting at which the question of Water Power Production is being considered. On Wednesday, July ninth, from 2.30 p.m., to 5.00 p.m., Mr. John Murphy, M.E.I.C., and Mr. O. O. Lefebvre, M.E.I.C., are joint chairmen at the session when the question of Power in Electro-Chemistry and Electro-Metallurgy is being considered.

Members of the Canadian Management Committee who definitely signified their intention of attending the Conference are: Hon. Charles Stewart, Minister of the

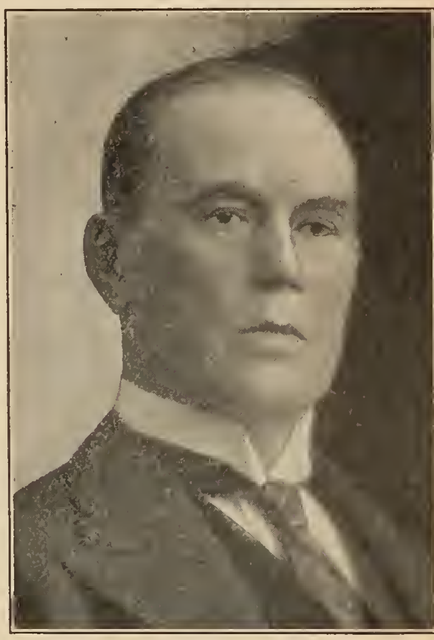
E. W. Beatty, K.C., President of the Canadian Pacific Railway, Honorary Vice-Chairman, Canadian Management Committee, who takes a deep interest in the question of development of Canada's natural resources.

W. W. Cory, C.M.G., Deputy Minister, Department of the Interior, Honorary Vice-Chairman, Canadian Management Committee, under whose department, through the Dominion Water Power Branch, the investigation of Canada's water power resources is carried on.

Officers of The Canadian Management Committee

A. Monro Grier, K.C., President of the Canadian Niagara Power Company, Honorary Vice-Chairman, Canadian Management Committee, Past-President, Canadian Electrical Association, a pioneer in Niagara power development.

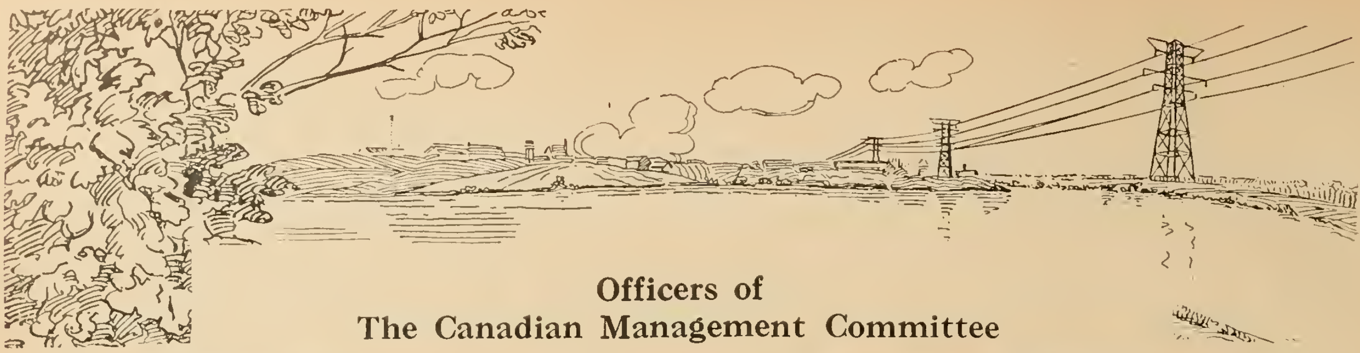
Sir Herbert Holt, M.E.I.C., President of the Montreal Light, Heat and Power Consolidated, Honorary Vice-Chairman, Canadian Management Committee, who has played an important part in building up by private enterprise an enormous power development in the province of Quebec.



Interior; Hon. Sir Adam Beck, Chairman, Ontario Hydro-Electric Power Commission; A. Monro Grier, K.C.; Hon. E. H. Armstrong; Arthur Surveyer, President of *The Institute;* H. G. Acres; Frederick B. Brown; Doctor Charles Camsell; J. B. Challies; E. A. Cleveland; F. A. Gaby; G. Gordon Gale; B. F. Haanel; Fraser S. Keith; O. O. Lefebvre; Brig.-Gen. C. H. Mitchell; W. H. Munro; John Murphy and K. H. Smith. Other members of *The Institute* who will be in attendance are H. S. Van Scoyoc; E. P. Fetherstonhaugh; D. M. Fraser; F. M. Dawson; H. C. Lott; K. R. MacKinnon; A. R. Greig; G. G. Ommanney; Doctor A. W. G. Wilson, S. Svenningson, A. D. Swan and Bernard H. Hughes in addition to members now in England or resident in the British Isles.

C. A. Magrath, M.E.I.C., Chairman, Canadian Section, International Joint Commission, Honorary Vice-Chairman, Canadian Management Committee, whose diplomacy has been an influential factor in adjusting international waterway problems.

Hon. H. Mercier, K.C., Minister of Lands and Forests—Quebec, Honorary Vice-Chairman, Canadian Management Committee. As chairman of the Quebec Streams Commission, Mr. Mercier administers the regulations relating to water powers.



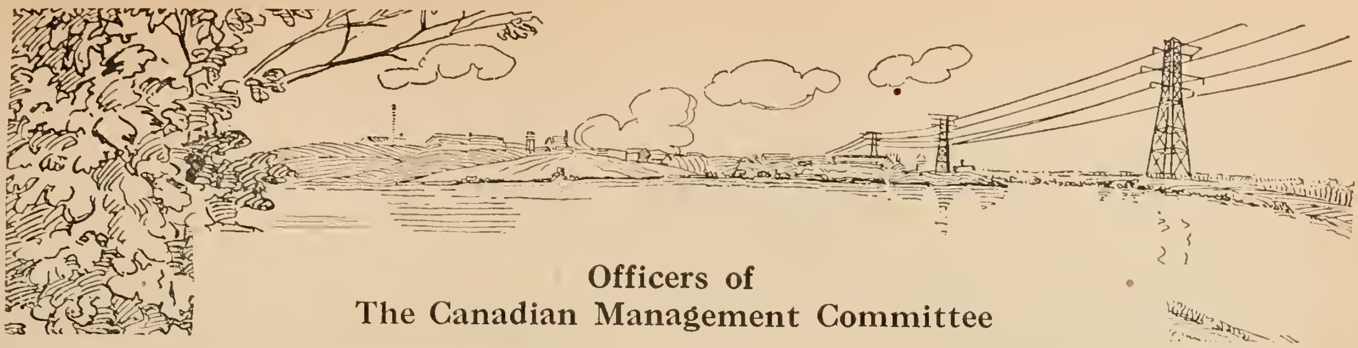
Officers of The Canadian Management Committee

Sir Henry Thornton, K.B.E., B.Sc., M. Inst.C.E., President, Canadian National Railways. Honorary Vice-Chairman, Canadian Management Committee.

H. M. Tory, M.A., D.Sc., F.R.S.C., LL.D., F.R.H.S., Chairman of the Research Council of Canada, Honorary Vice-Chairman, Canadian Management Committee.

Charles Camsell, B.A., LL.D., F.R.S.C., M.E.I.C., Deputy Minister, Department of Mines, Ottawa, Chairman, Dominion Fuel Board, Chairman, Canadian Management Committee.

J. B. Challies, C.E., M.E.I.C., Director, Dominion Water Power Branch and Dominion Reclamation Service, Department of the Interior, Ottawa. General Secretary, Canadian Management Committee.



Officers of
The Canadian Management Committee

H. G. Acres, D.Sc., M.E., M.E.I.C., M. Inst. C.E., M. Am. Soc. C.E., M. Am. Inst. E.E., Chief Hydraulic Engineer, Hydro-Electric Power Commission of Ontario. Vice-Chairman, Canadian Management Committee.

Arthur Amos, B.A.Sc., C.E., A.M.E.I.C., Director of the Hydraulic Service, the Quebec Streams Commission. Vice-Chairman, Canadian Management Committee.

John Murphy, M.E.I.C., F.A.I.E.E., Consulting Electrical Engineer, Department of Railways and Canals, and Dominion Railway Commission, Ottawa. Ont. Vice-Chairman, Canadian Management Committee.

Arthur Surveyer, B.A., B.A.Sc., C.E., M.E.I.C., Consulting Engineer, Montreal. President, The Engineering Institute of Canada. Member, Research Council of Canada. Vice-Chairman, Canadian Management Committee.

The Authors

Water Powers of Canada, their Nature, Extent and Utilization

For fifteen years J. B. Challies, C.E., M.E.I.C., whose paper on the nature, extent, and utilization of the water powers of Canada, constitutes part A of Canada's contribution to the World Power Conference, has been prominently and continuously connected with governmental activities in the investigation and the administration of Canadian water powers. As director and chief engineer of the Dominion Water Power Branch of the Federal Department of the Interior he has had occasion to organize and supervise basic water resource surveys and general power studies covering the principal rivers of the Dominion. In some cases, as for instance, on the Winnipeg river in the province of Manitoba, and on the Bow river in the province of Alberta, the reports of such investigations have not only assisted in a notable way the practical conservation and use of water power resources, but have proven unique contributions to the engineering literature of the Dominion.

Mr. Challies has organized and is now directing the Dominion Hydrometric Survey of Canada which comprehends the collection, the study and dissemination of surface run-off records for practically all important streams throughout the Dominion also the study of such records in relation to the power and other problems of these streams. He has filled important positions of a consulting capacity to the government of Canada in connection with international waterway problems. He is a member of the Dominion Power Board, the Dominion Fuel Board, and various other governmental organizations concerned with special phases of water power problems.

Mr. Challies holds the post-graduate degree of Civil Engineer from the University of Toronto; is a Member and vice-president of *The Engineering Institute of Canada;* a Member of the American Society of Civil Engineers; an Associate of the American Institute of Electrical Engineers; and a Charter Member of the Association of Professional Engineers of the Province of Ontario.

Fuel Resources of Canada, their Utilization for the Production of Power and other Purposes

The second part of the series of papers presented at the First World Power Conference is devoted to a review of the extent and utilization of the fuel resources of Canada. The author, B. F. Haanel, B.Sc., M.E.I.C., has devoted practically his whole life working on various fuel problems, chiefly those of Canada. He is chief engineer, Division of Fuels and Fuel Testing, Mines Branch, Department of Mines, and as such has been in contact and closely associated with the development of Canada's fuel resources. All research and development work conducted by the Mines Branch, including the testing of coal and peat on commercial and technical scales has been directly under his supervision. His book on the utilization of coal, peat and lignite for the production of power and industrial gas in by-product recovery and non-recovery type of producers, is recognized among the standard works on this subject. A paper, "The Fuels of Canada" presented by Mr. Haanel before *The Engineering Institute of Canada* in 1918 resulted in award of the Gzowski Medal the premier award of *The Institute.* During the past few years, when Canada's fuel problem became so acute, he has written many papers, addressed many societies and meetings, and his presentations have created wide interest throughout the Dominion.

Recently, Mr. Haanel has been intimately associated with the many investigations of both technical and commercial nature, conducted by the various boards and agencies of the government, such as the processing of various fuels with the object of conservation in mind, especially high and low temperature carbonization, gasification and many other similar investigations. Probably no one man in Canada is better qualified to explain the status of "Carbo" power development in Canada, as his ability to combine technical and practical knowledge is well known and his contributions towards the solution of Canada's fuel problems universally recognized.

B. F. HAANEL, B.Sc., M.E.I.C.

Mr. Haanel graduated from the Syracuse University in 1899. He is a member of Dominion Fuel Board; secretary and member of Joint Peat Committee (Federal Government and Province of Ontario); Member of the following societies — *The Engineering Institute of Canada,* American Institute of Chemical Engineers, American Institute of Mining and Metallurgy, Canadian Institute of Mining and Metallurgy, American Peat Society.

Transmission and Distribution of Electric Power in Canada

Julian C. Smith, E.E., LL.D., M.E.I.C., has been identified with the development and transmission of hydro-electric power throughout Canada and particularly in the province of Quebec for over twenty years, notably, as hydraulic engineer in charge of the development at Cedar Rapids, Quebec, as supervising engineer on the development of the Manitoba Power Company at Winnipeg, Manitoba, as well as chief engineer in the developments of the Shawinigan Water and Power Company and allied companies.

He is now vice-president and general manager of the Shawinigan Water and Power Company, president of the Quebec Power Company, president of the St. Maurice Power Company and is on the Board of Directors of many of the other power companies in the province of Quebec.

Mr. Smith was granted the degree LL.D. by Queen's University, Kingston, in 1922, in recognition of his great services to Canada in the practice of his profession of hydraulic and electrical engineering.

JULIAN C. SMITH, E.E., LL.D., M.E.I.C.

He is a member of the following engineering societies: *The Engineering Institute of Canada*, Institution of Electrical Engineers, American Institute of Electrical Engineers, American Institute of Civil Engineers, Canadian Electrical Association, National Electric Light Association.

* * *

Clarence V. Christie, M.A., B.Sc., A.M.E.I.C., consulting engineer, associate professor of electrical engineering at McGill University, has been attached to the staff of McGill University for seventeen years. His book "Electrical Engineering" has been widely used as a text book for electrical engineering students, both in the universities of Canada and the United States and he is now engaged in the preparation of a second book dealing with the problems of the transmission and distribution of electric power.

For several years he has been connected in consulting engineering work during the course of which he has had occasion to study some of the large transmission systems of Canada in detail, so that his knowledge of the subject of electric transmission is an intimate one.

He takes an active interest in the work of *The Engineering Institute of Canada* and is serving on the executive of the Montreal Branch. He is a member of one of the main committees of the Canadian Electrical Association and of one of the sub-committees of the Canadian Electrical Standards Association, and of the following societies: *The Engineering Institute of Canada*, American Institute of Electrical Engineers, Canadian Electrical Association, National Electric Light Association, Sigma XI.

CLARENCE V. CHRISTIE, M.A., B.Sc., A.M.E.I.C.

Generation of Hydro-Electric Power in Canada

The author of this paper, H. G. Acres, D.Sc., M.E., E.E., M.E.I.C., has spent practically the whole of his professional life in the various branches of hydraulic engineering, including surveys, design, construction and operation. As chief hydraulic engineer of the Hydro-Electric Power Commission of Ontario, he has under his engineering supervision twenty-five operating hydro-electric installations aggregating 1,020,000 e.h.p., of capacity in operation or under installation. Of this total he has directed the design and construction of eighteen plants, having a total installed capacity of 725,000 e.h.p.

Dr. Acres graduated from the University of Toronto in 1903, and had conferred upon him the degree of Doctor of Science at the convocation of the same university, on May 30th, 1924. He is a Member, and past vice-president, of *The Engineering Institute of Canada*, Member of the Institution of Civil Engineers of Great Britain, of the American Society of Civil Engineers, of the American Institute of Electrical Engineers, and of the Association of Professional Engineers of the Province of Ontario.

Dr. Acres has also acted as the Technical Associate of Counsel in connection with several matters of contention between Canada and the United States, as related to boundary waters.

Utilization of Power

The symposium on the Utilization of Power, being presented at the World Power Conference, has been prepared by a number of authors under the direction of P. T. Davies, A.M.I.E.E.

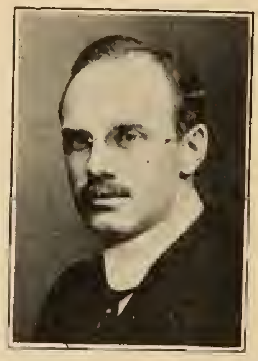
After a period of some seven years on engineering works in the Old Country, Mr. Davies came to Canada in 1907 and entered the services of the Montreal Light, Heat and Power Company, in the motor testing and meter departments. His promotion to assistant operating superintendent and later to operating superintendent of the Company, followed within two years. In 1912 he was appointed assistant to the general superintendent and chief engineer, and was placed in charge of the power sales department, and three years later when the

P. T. DAVIES

activities of the sales department were suspended, due to war activities, he was made manager. In 1917 the opportunity to again associate himself with a growing company led to an appointment as commercial manager with the Southern Canada Power Company, which position he still occupies.

Mr. Davies has always taken an active part in association work and was president of the Montreal Electrical Association in 1912. In the Canadian Electrical Association he was elected third vice-president in 1918, and president for two years 1922 and 1923. He is also a member of the National Electric Light Association, and an associate member of the Institution of Electrical Engineers.

Electric Service in Rural Districts and Electricity in the Canadian Home



F. A. Gaby
.Sc., M.E.I.C.

F. A. Gaby, D.Sc., M.E.I.C., the author of the two papers, Electric Service in Rural Districts and Electricity in the Canadian Home, does not require an introduction to the members of the engineering profession. As chief engineer of the Hydro-Electric Power Commission of Ontario since 1912, he has been constantly in touch with the problems presented through the service of electricity for domestic purposes and for use in rural districts. Mr. Gaby is an honour graduate of the University of Toronto receiving his degree of B.A.Sc., in 1903 and the degrees of M.E. and E.E. in 1904. His first work was with the Canadian General Electric Company as erecting engineer. He was later appointed chief assistant electrical engineer at the Point du Bois power plant on the Winnipeg River. From 1907 until his appointment as chief engineer Mr. Gaby was assistant chief engineer of the Hydro-Electric Power Commission.

The Utilization of Power in the Pulp and Paper Industry

R. W. Leeper

The first paper of the symposium on the utilization of power in Canada, deals with the pulp and paper industry and is by R. W. Leeper, power engineer with H. S. Taylor, consulting engineer of Montreal, Quebec. Mr. Leeper is a graduate in mechanical engineering from the Ohio State University and since graduating in 1907 has devoted his entire time to work in connection with pulp and paper mills. For twelve years after graduating he was with the General Electric Company on testing, construction, turbine engineering, and as paper mill specialist, and in 1919 was appointed to his present position.

The Use of Power in the Mineral Industries of Canada

H. E. M. Kensit,
M.E.I.C.

The extensive use of power in the mineral industries of Canada is described by H. E. M. Kensit, M.E.I.C., who is an honour graduate of the Electrical Standardizing and Training Institute, London. Mr. Kensit's early work was in the Old Country with the Westinghouse Company. After coming to Canada in 1908, he was engaged in the design and installation of the steam power station at Lethbridge, Alta., the construction of the electrical equipment of the Calgary Power Company's hydro-electric plant, and the investigation of existing and proposed power undertakings in Canada and the United States. Since 1912 he has been with the Dominion Water Power Branch, Department of the Interior, on the analysis of the financial and engineering aspects of power undertakings and the study of power markets in various localities. Mr. Kensit has made a continuous study of the water and fuel power resources of all parts of the Dominion and of the past and future demand for power and has furnished reviews of the relationship of water power and coal to the House of Commons and Senate Committees on Fuel Supply and to the Dominion Fuel Board. In 1918-19 he represented the department on the Government Water Power Committee in England and on the water power committee of the Conjoint Board of Scientific Societies.

The Use of Power for Port Facilities


M. T. Sheehy-Casey

The paper entitled, The Use of Power for Port Facilities, which forms part of the symposium on the utilization of power, deals with a particularly interesting feature of recent development in the utilization of electric power. This paper is by M. T. Sheehy-Casey, secretary to the president of the Harbour Commission of Montreal.

Use of Electric Power in the Cement Industry of Canada


William G. H. Cam, A.M.E.I.C.

William G. H. Cam, A.M.E.I.C., is power and safety engineer of the Canada Cement Company, Limited, having been with this company since 1919. Mr. Cam graduated in 1903 in electrical engineering at the City and Guilds of London Central Technical College. His first work was with the British Continental Electric Company, San Remo, Italy, as resident engineer. He came to Canada in 1909 joining the staff of the Montreal, Light, Heat and Power Company, and two years later entered private practice as electrical contractor. He was later with the Shawinigan Water and Power Company and the Southern Canada Power Company, leaving the latter to take over the duties of electrical engineer of the Canada Cement Company in 1919.

The Application of Compressed Air in Industry


Francis Allan McLean

Francis Allan McLean, author of the paper entitled The Application of Compressed Air in Industry, Canadian Practice, has made a special study of this subject for the past nine years. His specialized work in pneumatic machinery commenced in 1915 when he entered the employ of the McKiernan-Kerry Drill Company. Leaving the McKiernan-Kerry Drill Company, in the spring of 1917, he returned to Canada, and entered the employ of the Canadian Ingersoll-Rand Company, but left a few months later to join the Royal Flying Corps. At the close of the war he returned to the Canadian Ingersoll-Rand Company, and was appointed publicity manager the latter part of 1920. Mr. McLean has written many articles on such kindred subjects as construction work, mining, quarrying, oil engines, and the application of compressed air in various industries.

Power Requirements in the Lumbering Industry in British Columbia


A. M. Smith

The description of lumbering in British Columbia with particular reference to the power requirements of that industry as outlined in the paper by A. M. Smith, chief engineer Vancouver Lumber Company, Limited. Mr. Smith's early engineering experience was gained in the Old Country and in Belgium. He came to Canada in 1907 and was (to use his own expression) adopted by the Pulp and Lumbering Industry and has followed this work ever since. In setting forth the power requirements of the lumbering industry, Mr. Smith has outlined the operations required to produce the finished product from the time the tree is felled in the forest.

Electro-Chemical and Electro-Metallurgical Uses of Power


L. E. Westman

The review of the use of power in the electro-chemical and electro-metallurgical industries in Canada, has for its author, L. E. Westman, general manager of Canadian Chemistry and Metallurgy. Mr. Westman is a graduate of the University of Toronto, where he specialized in chemistry and metallurgy. He later entered the editorial field as editor of Canadian Chemistry and Metallurgy, later becoming publisher and business manager. He was chairman of the Toronto Branch of the Society of Chemical Industry in 1922, and is now general secretary of the Canadian Institute of Chemistry.

Power in Transport

D. E. Blair, A.M.E.I.C.

The use of power for transportation purposes is comprehensively treated by D. E. Blair, A.M.E.I.C., superintendent of rolling stock, Montreal Tramways Company. Mr. Blair graduated from McGill University in electrical engineering in 1897 and entered the Quebec District Railway's service the same year, as assistant chief electrician, and mechanical superintendent, remaining with that company and its successor, Quebec Railway, Light, Heat and Power Company until March 1903, when he was appointed assistant general superintendent, Montreal Street Railway, and afterwards superintendent of rolling stock, which position he has remained in since, with that company, and its successor, Montreal Tramways Company.

Recent Developments in Electric Lamps

J. T. Scott

J. T. Scott is a graduate in electrical engineering, of London University, from which he received the degree of B.Sc., in 1907. For twelve years he was engaged in construction and commercial engineering work for several corporations in England, Scandinavia and France, and for the past four years he has held the position of works engineer of the Edison Lamp Works Division of the Canadian General Electric Company, Toronto. Mr. Scott is secretary-treasurer of the Toronto Chapter of the Illuminating Engineering Society and chairman of the Lamp Committee of the Canadian Electrical Association, Montreal.

The International Joint Commission and the International Water Powers of Canada

The last of the series of papers, part F, is devoted to an outline of the activities and powers of the International Joint Commission, of which the author Lawrence J. Burpee, F.R.S.C., is secretary of the Canadian Section.

Mr. Burpee entered the services of the Canadian Government in 1890. He was private secretary to the late Hon. Arthur Dickey, during the Bowell-Tupper administration, and private secretary to Sir Oliver Mowat and the Hon. B. Mills, during the Laurier administration. For seven years from 1905 he devoted his time to library work, as librarian of the Carnegie Public library, Ottawa. In 1912 he was appointed to his present position on the International Joint Commission.

Mr. Burpee has made many contributions to Canadian literature, among which are: Canadian Life in Town and Country (joint author with Dr. H. J. Morgan); Charles Heavysege; A Bibliography of Canadian Fiction; Search for the Western Sea; Flowers from a Canadian Garden; Fragments from Sam Slick; By Canadian Streams; A Little Book of Canadian Essays; Songs of French Canada; A Century of Canadian Sonnets; Canadian Eloquence; An Index and Dictionary of Canadian History; Scouts of Empire; Canadian Humour; Pathfinders of the Great Plains; Among the Canadian Alps; Soldier's Dictionary; Sanford Fleming, Empire Builder. In addition he has contributed a large number of papers and articles, chiefly on Canadian subjects.

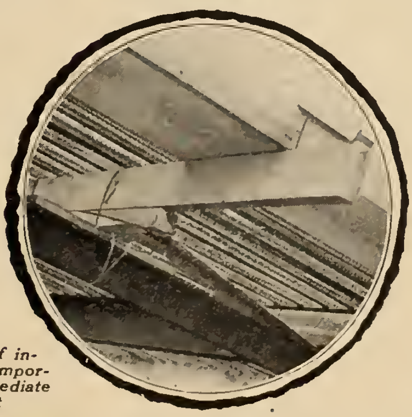
Mr. Burpee is a Fellow of the Royal Geographical Society; Fellow and Councillor of the Royal Society of Canada, and also a member of a number of historical societies, and president of the Canadian Authors Association.

Hy-Rib Concrete Roof under construction.

Method of attaching Hy-Rib to structural steel by means of Truscon Plate Clip.

Fastening Hy-Rib to Plate Clip.

Method of installing temporary intermediate supports.



Method of installing temporary intermediate support at gable end.

Office in Federal Building, Toronto, showing Dominion Battleship Linoleum floor.

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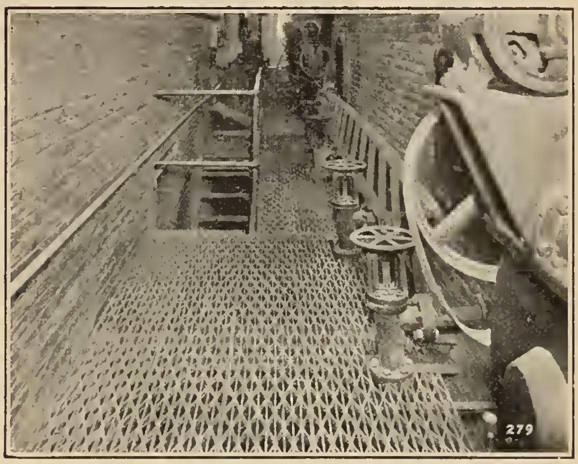

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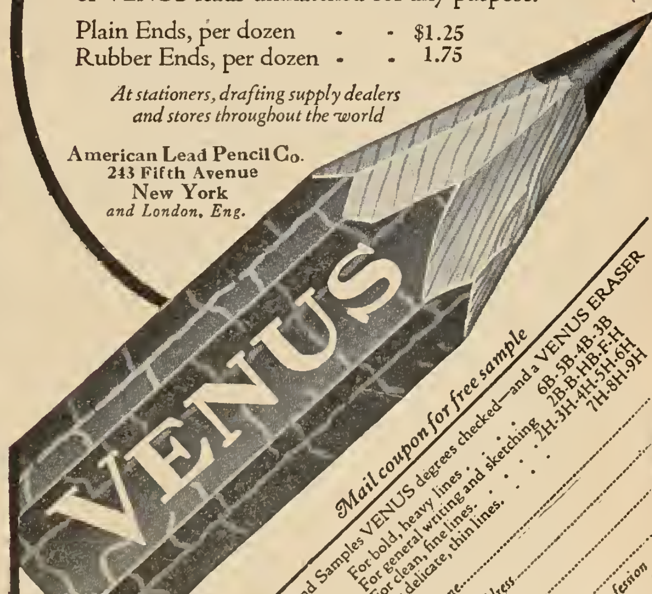

Purchaser's Classified Directory

A Selected List of Equipment, Apparatus and Supplies

For Alphabetical List of Advertisers see page 130

A

Acids:
Nichols Chemical Co., Ltd
Air Brakes:
Canadian General Electric Co., Ltd.
Air Coolers:
Laurie and Lamb.
Air Filters:
Midwest Canada Limited.
Alumina Sulphate;
Nichols Chemical Co., Ltd.
Ammonia Controlled Water Regulators:
Under-Feed Stoker Co., of Canada, Ltd.
Ammonia Valves and Fittings:
Crane Ltd
Anchorage Equipment:
Midwest Canada, Ltd.
Angles:
Canadian Vickers Ltd.
Dominion Bridge Co., Ltd
Hamilton Bridge Works Co., Ltd.
Arches, Flat:
Combustion Engineering Corp., Ltd.
Asphalt:
Imperial Oil Ltd.
Ash Handling Equipment:
Combustion Engineering Corp. Ltd.
Link-Belt Ltd.
Automatic Air Valves:
Jenkins Bros., Ltd.
Automatic Underfeed Stokers:
Combustion Engineering Corp., Ltd.
Taylor Stoker Co., Ltd.

B

Balls, Chromang Grinding:
William Kennedy & Sons, Ltd.
Balls, Steel:
Openshaw & Bennet Ltd.
Barge Cranes:
Industrial Works.
Bars, Reinforcing:
Algoma Steel Corp., Ltd.
British Empire Steel Corp., Ltd.
Burlington Steel Co., Ltd.
Midwest Canada Limited.
Bars, Steel & Iron:
Burlington Steel Co., Ltd.
Steel Co., of Canada Ltd.
Beams:
Canadian Vickers Ltd.
Dominion Bridge Co., Ltd.
Hamilton Bridge Works Co., Ltd.
Bearings, Ball:
Openshaw & Bennett, Ltd.
N. Slater Co., Ltd.
Belting:
General Supply Co., of Canada, Ltd.
Jones and Glassco, Regd
Bending Machines:
John Bertram & Sons Co., Ltd.,
Blowers, Centrifugal:
De Laval Steam Turbine Co.
Blue Print Machinery:
Montreal Blue Print Co.
Boilers:
Canadian Vickers Ltd.
E. Leonard & Sons, Ltd.
Mussens Limited
Boilers, Electric
Dominion Engineering Works, Ltd.
Boilers, Heating:
Combustion Engineering Corp., Ltd.
E. Leonard & Sons, Ltd.
Taylor Stoker Co., Ltd.
Boilers, Marine:
Canadian Vickers Ltd.
Boilers, Portable:
E. Leonard & Sons, Ltd.
Boilers, Return Tubular:
Babcock-Wilcox & Goldie-McCulloch Ltd.
Bolts:
British Empire Steel Corp., Ltd.
N. Slater Co., Ltd
Steel Co., of Canada, Ltd.
Bonds, Rail:
Dominion Insulator & Mfg. Co., Ltd.
Boring and Turning Mills:
John Bertram & Sons Co., Ltd.,
Boxes, Cast Iron:
G. & W. Electric Specialty Co.
Boxes, Valve:
Jenkins Bros., Ltd.
Brass, Sheets, Rods, Tubes:
Openshaw & Bennet Ltd.
Bridges, Steel:
Canadian Bridge Co., Ltd.
Canadian Vickers Ltd.
Canadian Des Moines Steel Co., Ltd.
Dominion Bridge Co., Ltd.
Hamilton Bridge Works Co., Ltd.
Broadcasting Equipment:
Northern Electric Co., Ltd.
Buckets, Clamshell, Grab:
Industrial Works.
Buckets, Clamshell, Orange-peel:
F. H. Hopkins & Co., Ltd.
Bucket Loaders:
Link-Belt Ltd.
Mussens Ltd.
Builders Supplies:
Jno. E. Russell Co., Ltd.
Building Papers:
Barrett Co., Ltd.
Buildings, Steel:
Canadian Vickers Ltd.
Canadian Bridge Co., Ltd.
Dominion Bridge Co., Ltd.
Hamilton Bridge Works Co., Ltd.
MacKinnon Steel Co., Ltd.

C

Cable End Bells:
G. & W. Electric Specialty Co.
Car Dumpers:
Canadian Mead-Morrison Co., Ltd.
Link-Belt Ltd.
Car Equipment Specialties:
Dominion Insulator & Mfg. Co Ltd.
Car Pullers:
Canadian Mead-Morrison Co., Ltd.
Link-Belt Ltd.
Car Steps, Safety
Irving Iron Works Co.
Car Wheels, Chilled Iron.
Canada Iron Foundries, Ltd.
Cars, Dump:
Canadian Equipment Co., Ltd.
F. H. Hopkins & Co., Ltd.
Hydro Salvage Syndicate.
Mussens Ltd.
Cargo Cranes:
Industrial Works.
Casements, Steel:
Trussed Concrete Steel Co., of Canada, Ltd.
Castings:
Babcock-Wilcox & Goldie-McCulloch Ltd.
William Kennedy & Sons, Ltd.
Castings, Brass:
N. Slater Co., Ltd.
Superheater Co., Ltd.
Castings, Car and Locomotive:
Canadian Steel Foundries, Ltd.
Castings; Ferro-Alloy.
Canadian Steel Foundries, Ltd.
Castings, Iron:
Canada Iron Foundries, Ltd.
Dominion Engineering Works, Ltd.
Gartshore-Thomson Pipe and Foundry Co., Ltd.
E. Leonard & Sons, Ltd.
Superheater Co., Ltd.
Castings, Steel:
Canadian Steel Foundries, Ltd.
Catenary Materials:
Dominion Insulator & Mfg., Co. Ltd.
N. Slater Co., Ltd.
Cement, Dealers:
Jno. E. Russell Co., Ltd.
Cement Gun:
General Supply Co., of Canada, Ltd.
Cement, Manufacturers:
Canada Cement Co., Ltd.
Chain Grate Stokers:
Babcock-Wilcox & Goldie-McCulloch Co., Ltd.
Chains:
Link-Belt, Ltd.
Chains, Silent:
Jones and Glassco, Regd.
Link-Belt Ltd
Channels:
Dominion Bridge Co., Ltd.
Hamilton Bridge Works Co., Ltd.
Chemist, Industrial:
Milton Hersey Co., Ltd.
Chimneys:
Combustion Engineering Corp. Ltd.
Circuit Breakers:
Dominion Engineering Agency Ltd
Clamshell Buckets:
Industrial Works.
Coal:
British Empire Steel Corp., Ltd
Coal Handling Equipment:
Canadian Mead-Morrison Co. Ltd.
Combustion Engineering Corp Ltd
Dominion Bridge Co., Ltd
Link-Belt, Ltd
Mussens Limited
Coke:
British Empire Steel Corp., Ltd.
Cooling Air Filters:
Midwest Canada, Ltd.
Compressor Filters:
Midwest Canada, Ltd.
Compressors:
Canadian Vickers Ltd.
General Supply Co., of Canada, Ltd.
Babcock-Wilcox & Goldie-McCulloch Co., Ltd.
Compressors, Air:
Canadian Westinghouse, Co., Ltd.
Hydro Salvage Syndicate.
Mussens Limited
Compressors, Ammonia:
Taylor Stoker Co., Ltd.
Compressors, Centrifugal.
De Laval Steam Turbine Co.
Concrete Armouring, Surface:
Irving Iron Works Co.
Concrete Inserts, Continuous:
Midwest Canada, Ltd.
Concrete Mixers:
General Supply Co., of Canada, Ltd.
F. H. Hopkins & Co., Ltd.
Hydro Salvage Syndicate.
Mussens Ltd.
Condensers, Synchronous & Static
Canadian General Electric Co., Ltd,
Construction Material:
Northern Electric Co., Ltd.
N. Slater Co., Ltd.
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E. O. Leahey & Co., Ltd.
Randolph MacDonald Co., Ltd.
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F. H. Hopkins & Co., Ltd.
Mussens Limited
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Canadian Westinghouse Co. Ltd.
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Combustion Engineering Corp., Ltd.
Link-Belt Ltd.
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Cranes:
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Canadian Vickers Ltd.
Cranes, Crawler:
Link-Belt Ltd.
Cranes, Electric:
Industrial Works.
Cranes, Locomotive:
Canadian Equipment Co., Ltd.
F. H. Hopkins & Co., Ltd.
Industrial Works.
Link-Belt, Ltd.
Mussens Ltd.
Cranes, Pillar:
Industrial Works.
Cranes, Transfer:
Industrial Works.
Cranes, Travelling:
Dominion Bridge Co., Ltd.
Cranes, Tunnel:
Industrial Works.
Cranes, Wrecking:
Industrial Works.
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Barrett Co., Ltd.
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N. Slater Co., Ltd.
Cross Arm Braces, Steel:
Burlington Steel Co., Ltd.
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Jno. E. Russell Co., Ltd.
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Pratt & Whitney Company of Canada, Ltd.
Cutting off Machines:
John Bertram & Sons Co, Ltd

D

Damper Regulation:
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Canadian Mead-Morrison Co., Ltd.
Mussens Ltd
Die Screw Plates:
Pratt & Whitney Company of Canada, Ltd.
Dies:
Pratt & Whitney Co., of Canada Ltd.
N. Slater Co., Ltd.
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Mussens Limited
N. Slater Co., Ltd.
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Canadian Vickers Ltd.
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Drilling Machines, Metal:
John Bertram & Sons Co., Ltd.,
Dumb Waiters, Electric:
Turnbull Elevator Co., Ltd.

E

Economizers:
Babcock-Wilcox & Goldie-McCulloch Ltd
Combustion Engineering Corp., Ltd.
General Supply Co., of Canada, Ltd.
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Industrial Works.
Electric Motors:
Lincoln Electric Co., of Canada, Ltd.
Electric Welders:
Lincoln Electric Co., of Canada, Ltd.
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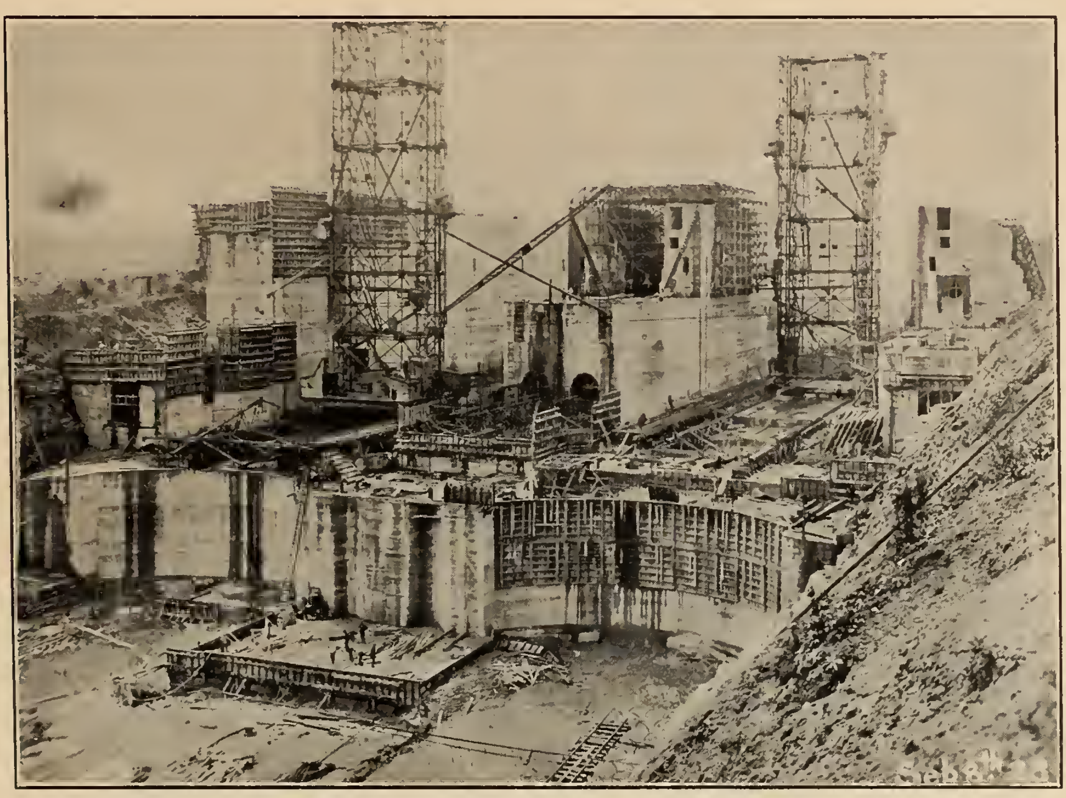
Northern Electric Co., Ltd.



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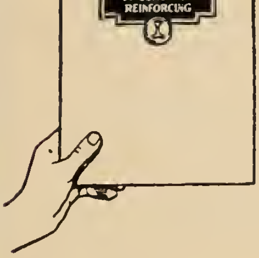

Purchaser's Classified Directory

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Dominion Insulator & Mfg. Co., Ltd.
Electrical Supplies:
Northern Electric Co., Ltd.
Elevator Safety Gates:
Turnbull Elevator Co. Ltd.
Elevators, Freight:
Turnbull Elevator Co., Ltd.
Elevators, Passenger:
Turnbull Elevator Co., Ltd.
Elevators, Push Botton:
Turnbull Elevator Co., Ltd.
Enamels, Acid & Fume Resisting:
Dominion Paint Works, Ltd.
Enamels, Industrial Lighting:
Dominion Paint Works, Ltd.
End Mills:
Pratt & Whitney Company of Canada, Ltd.
Engines, Gas and Oil:
Canadian Fairbanks-Morse Co., Ltd.
Canadian Vickers Ltd.
Engines, Gas & Oil, Filters:
Midwest Canada Limited.
Engines, Steam:
Combustion Engineering Corp., Ltd.
Babcock-Wilcox & Goldie-McCulloch Ltd.
Laurie and Lamb.
E. Leonard & Sons. Ltd.
Excavators:
Canadian Equipment Co., Ltd.
Mussens Limited
Excavators, Dragline:
Link-Belt Ltd.
Exhaust Steam Injectors, Locomotive:
Superheater Co., Ltd.

F

Fan Engine Regulators:
Under-Feed Stoker Co., of Canada, Ltd.
Feed-Water Heaters, Locomotive:
Superheater Co., Ltd.
Fence Posts, Steel:
Burlington Steel Co., Ltd.
Fillers, Wood and Metal:
Dominion Paint Works, Ltd
Filters, Air:
Midwest Canada, Ltd.
Fire Alarm Apparatus:
Northern Electric Co., Ltd.
Floor Stands:
Jenkins Bros., Ltd.
Flanges, Companion:
Jenkins Bros., Ltd.
Files, Valve:
Jenkins Bros., Ltd.
Flooring, Fireproof:
Irving Iron Works Co.
Flooring, Open Steel:
Irving Iron Works Co.
Flooring, Steel:
Irving Iron Works Co.
Flooring, Non-Slipping:
Irving Iron Works Co.
Flooring, Ventilating:
Irving Iron Works Co.
Forgings:
British Empire Steel Corp., Ltd.
Dominion Bridge Co., Ltd.
N. Slater Co., Ltd.
Friction Clutches:
Link-Belt Ltd.
Fuel, Oil:
Imperial Oil, Ltd.
Furnaces, Automatic:
Under-Feed Stoker Co., of Canada, Ltd.

G

Galvanizing, Hot Dip:
N. Slater Co., Ltd.
Gantry Cranes:
Industrial Works.
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Pratt & Whitney Co., of Canada, Ltd.
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Hamilton Gear & Machine Co.
Gears:
Canadian Vickers Ltd.
Hamilton Gear & Machine Co.
Link-Belt, Ltd.
Gears, Machine Cut:
Jones and Glassco,Regd
Gears, Double Helical:
De Laval Steam Turbine Co
Generators:
Canadian General Electric Co., Ltd.
Canadian Westinghouse Co. Ltd
Grab Buckets:
Canadian Mead-Morrison Co., Ltd.
Link-Belt Ltd.
Mussens Limited
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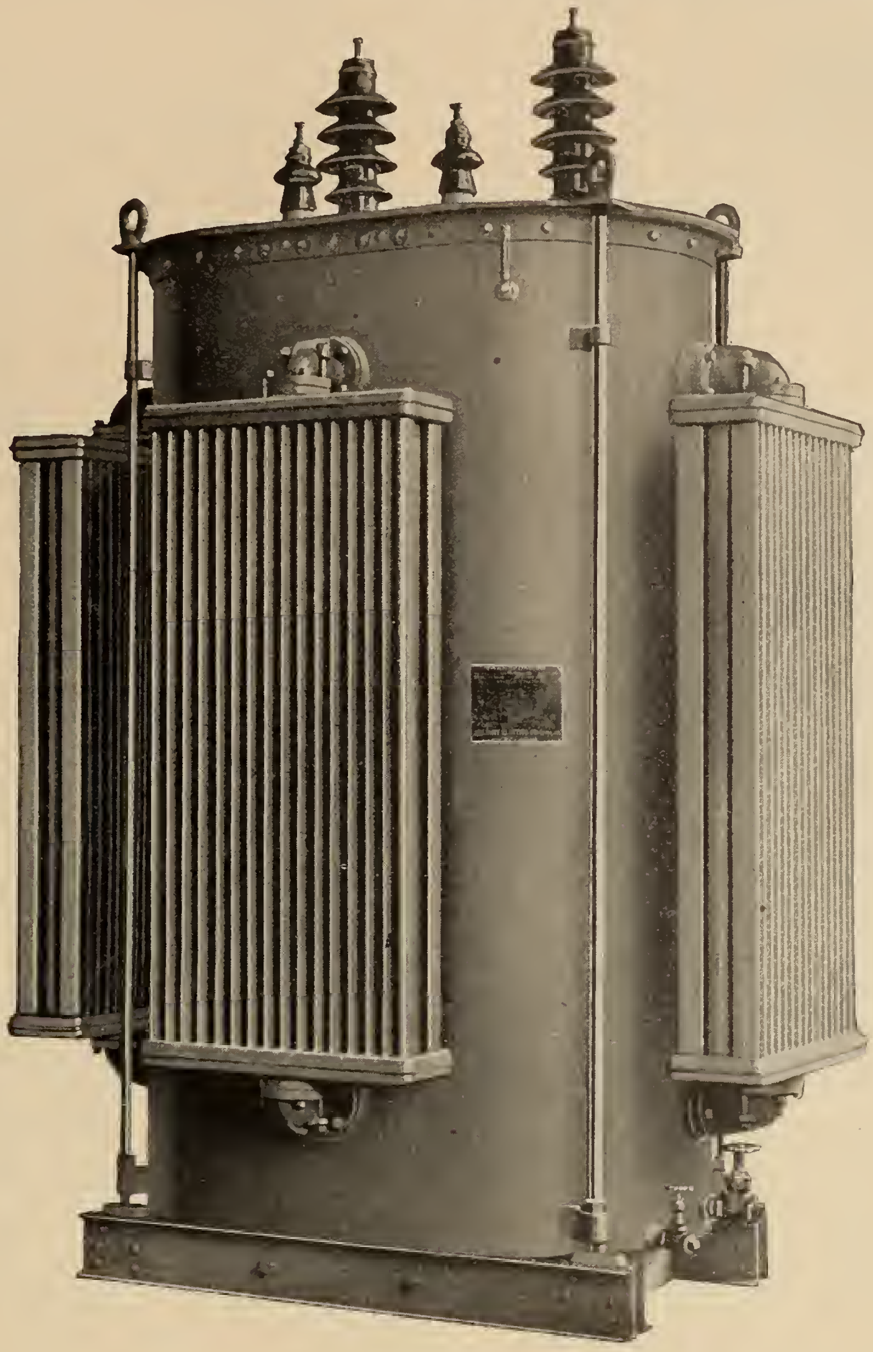

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ENGINEERING JOURNAL

THE JOURNAL OF THE ENGINEERING INSTITUTE OF CANADA

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AUGUST 1924

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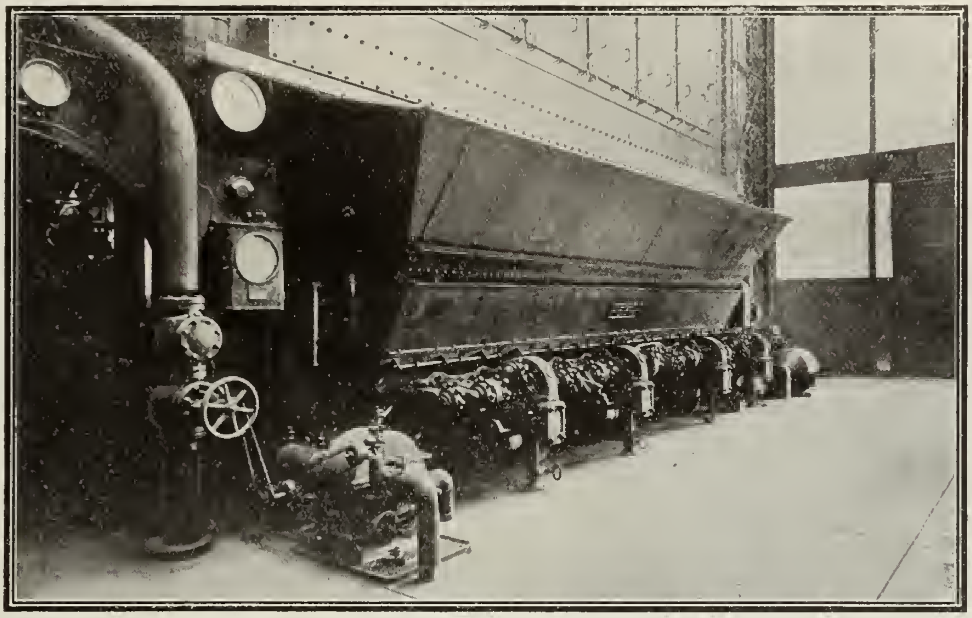
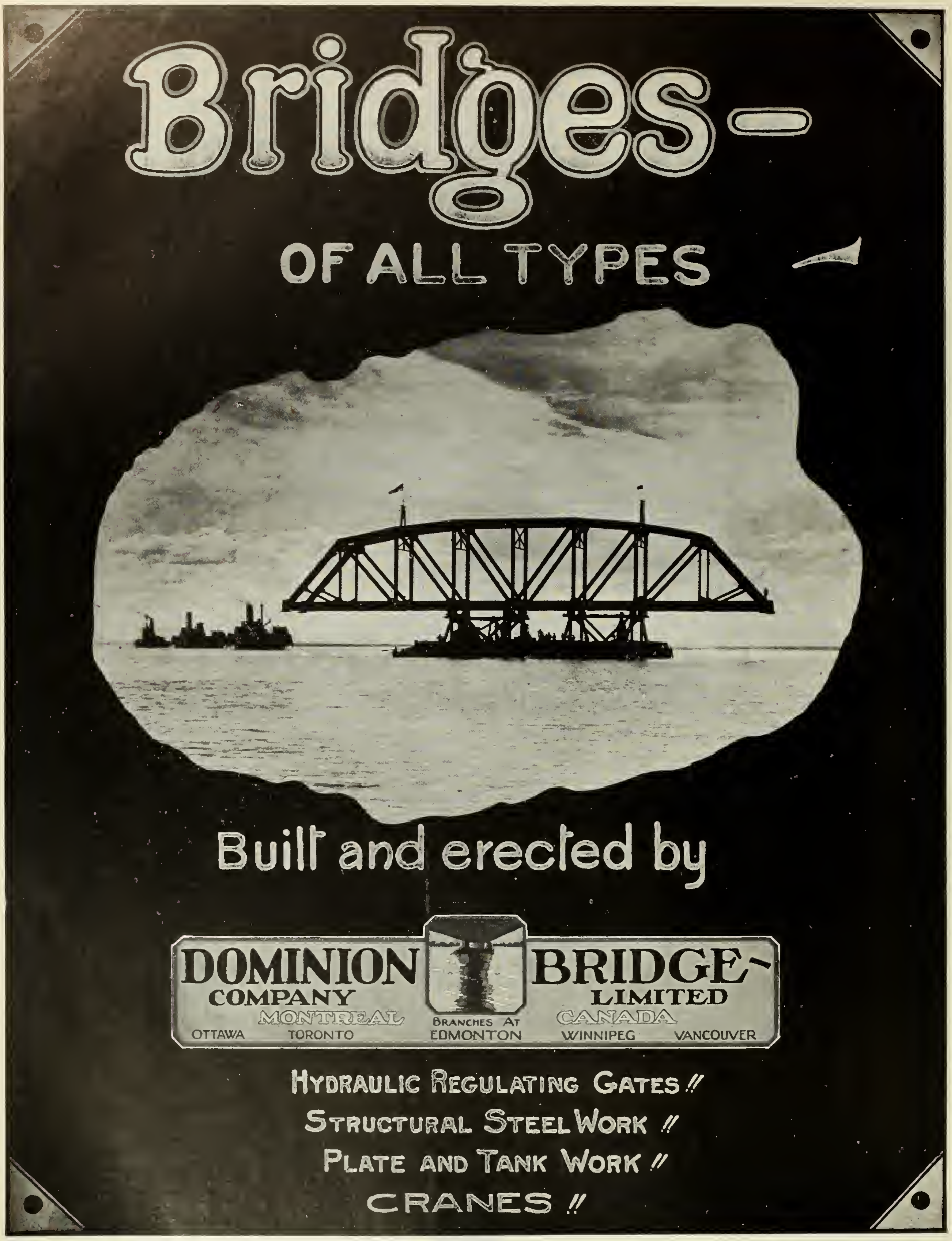
AT 176 MANSFIELD STREET, MONTREAL

Vol. VII No. 8





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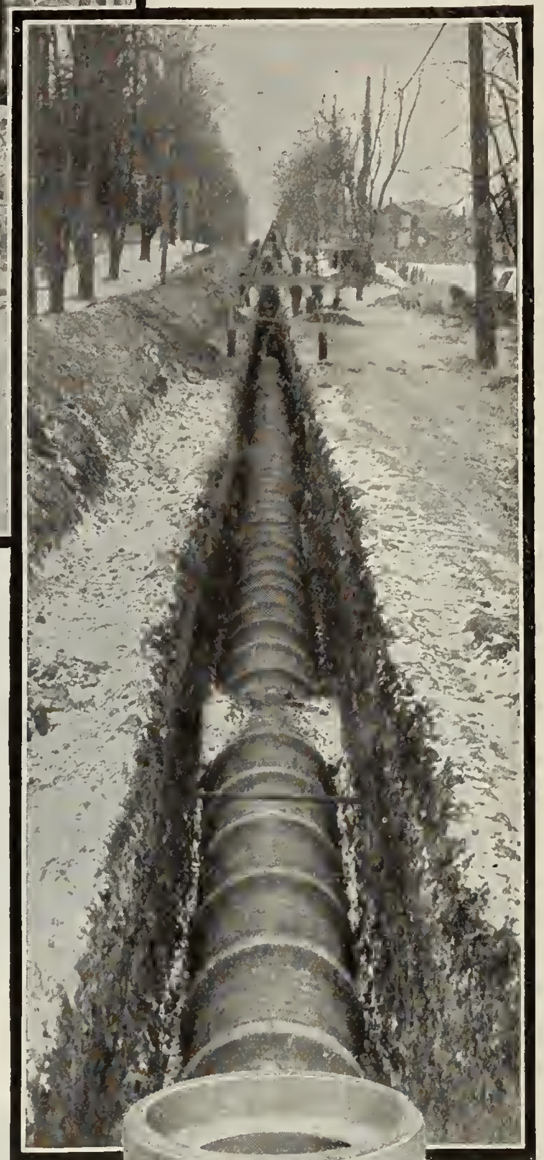

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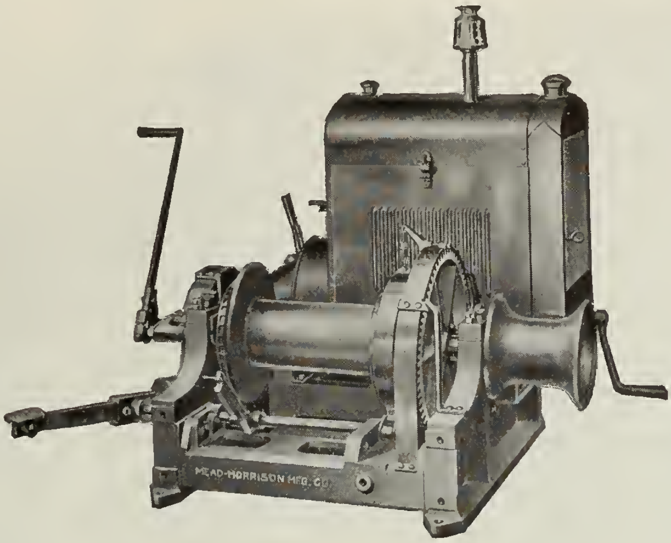

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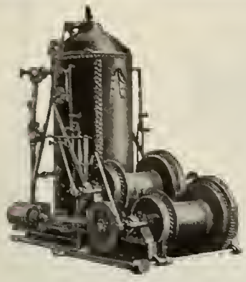

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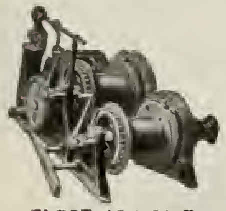

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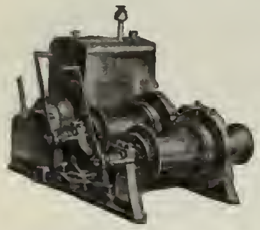

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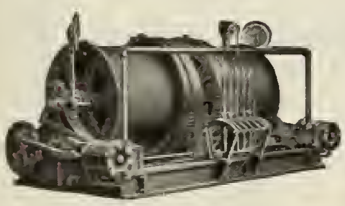

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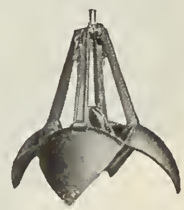

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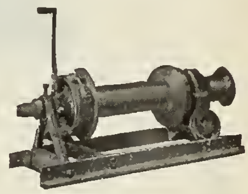

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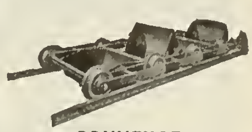

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Men who make their purchases from the standpoint of quality, durability and dependability, specify Genuine Jenkins valves because they have no equal.

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The upper illustration shows Concrete Pipe for a combined Sewer at Windsor, Ont., the lower shows a 12" sanitary sewer being laid with Concrete Pipe at Guelph, Ont.

From Sydney to Vancouver

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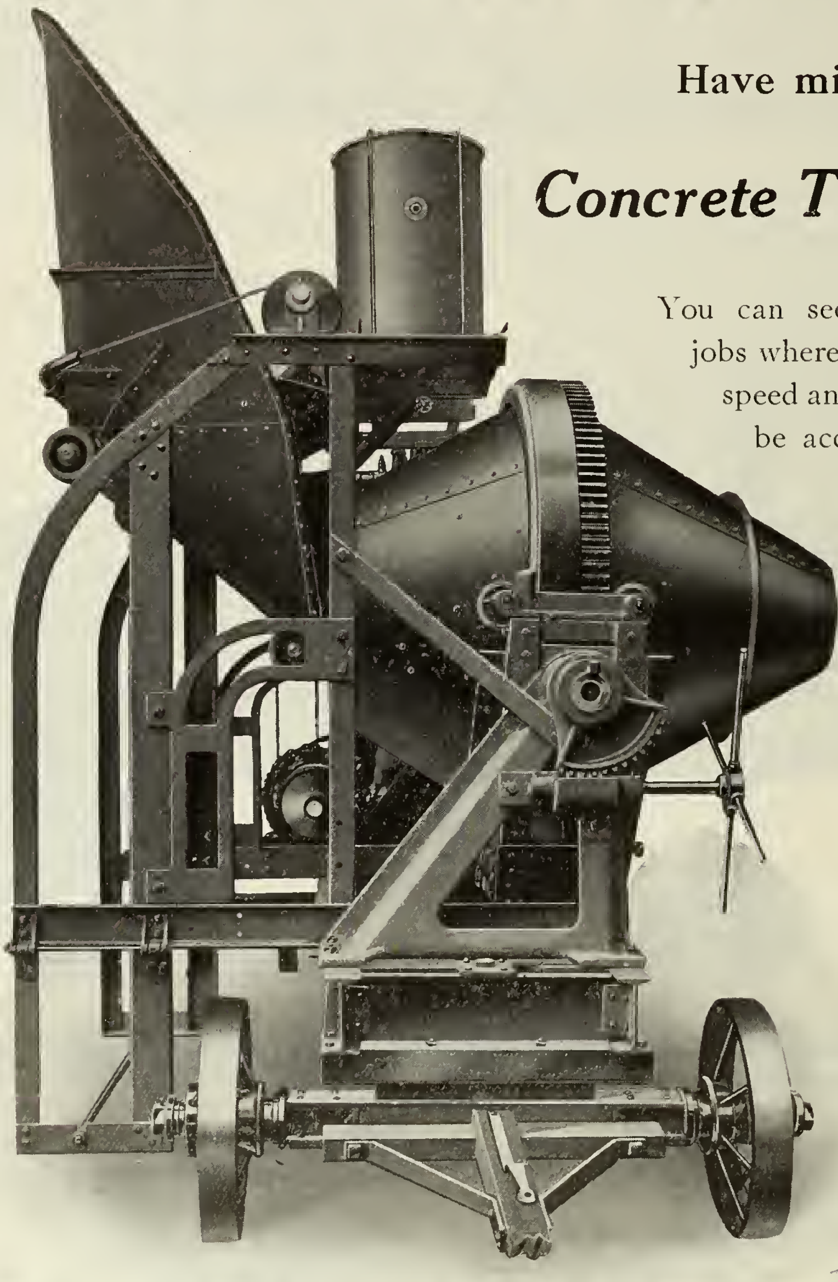

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Concrete That Endures

You can see them on all the big jobs where only thorough mixing, speed and general reliability will be accepted.

Designed for smooth operation—no racking or side strains—

That's why they last so long.

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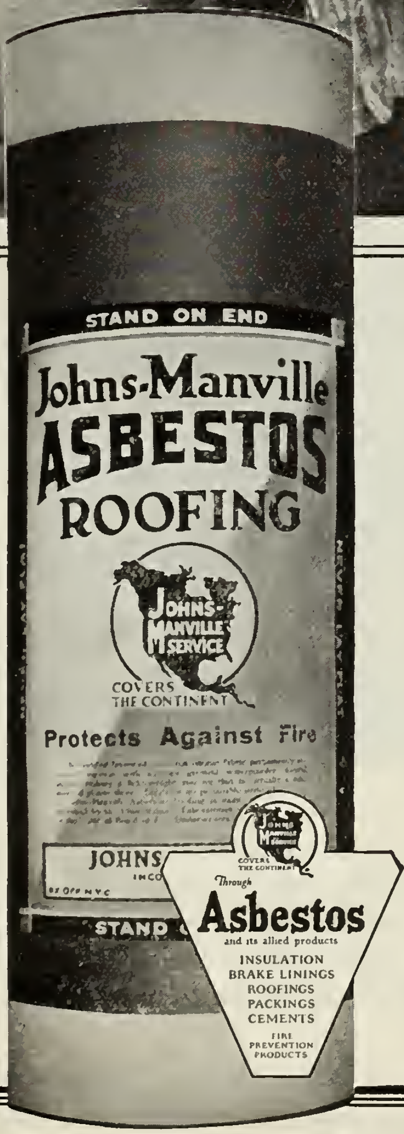

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THE money-saving welding out-fit that eliminates the scrap pile and turns waste into profits. In every industry where machines are used there is a constant loss through worn and broken parts. To carry a reserve stock of spare parts involves a heavy investment, and interest charges. The modern method is to rebuild worn and damaged machine parts by welding.

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WHY not replace that gang of men (and that's a great big pay roll nowadays) with a Link-Belt gasoline operated Crawler Crane, with an operator and perhaps an occasional helper. It is much cheaper, and you have speed when you want it, as it can do the work of 40 men.

Just think, you don't have to worry about keeping a large gang of men working, demurrage on cars, or filling your orders promptly.

It is gasoline operated, and needs no fireman or night watchman.

And then, don't forget how much better you can use your storage space, by more rapid handling, and piling the material higher.

In yards where it used to cost as much as 40c to 50c per cubic yard to handle material, they are now doing it for 5c to 10c with a Link-Belt Crawler Crane. And, besides, they have doubled their business because they are now able to take good care of their customers at all times.

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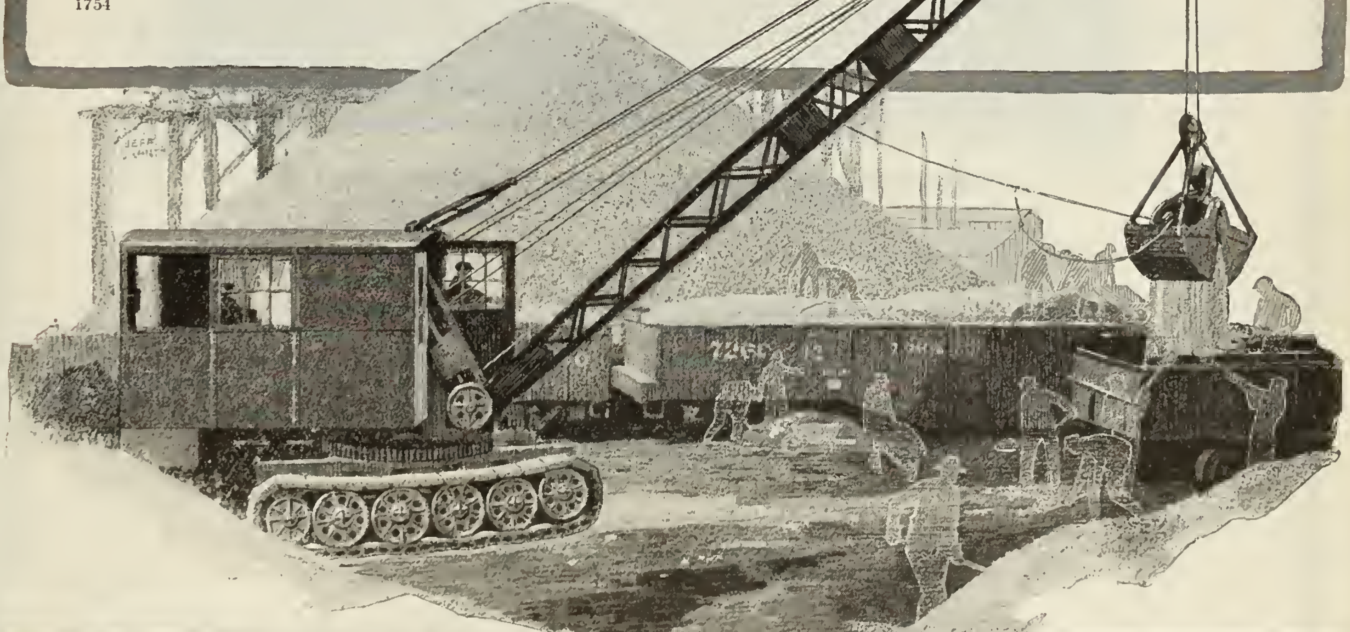
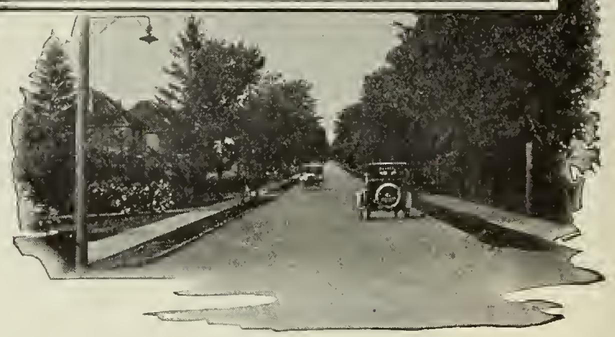


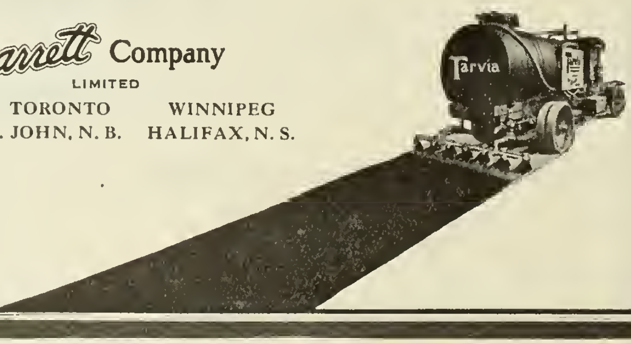
LINK-BELT CRAWLER CRANE

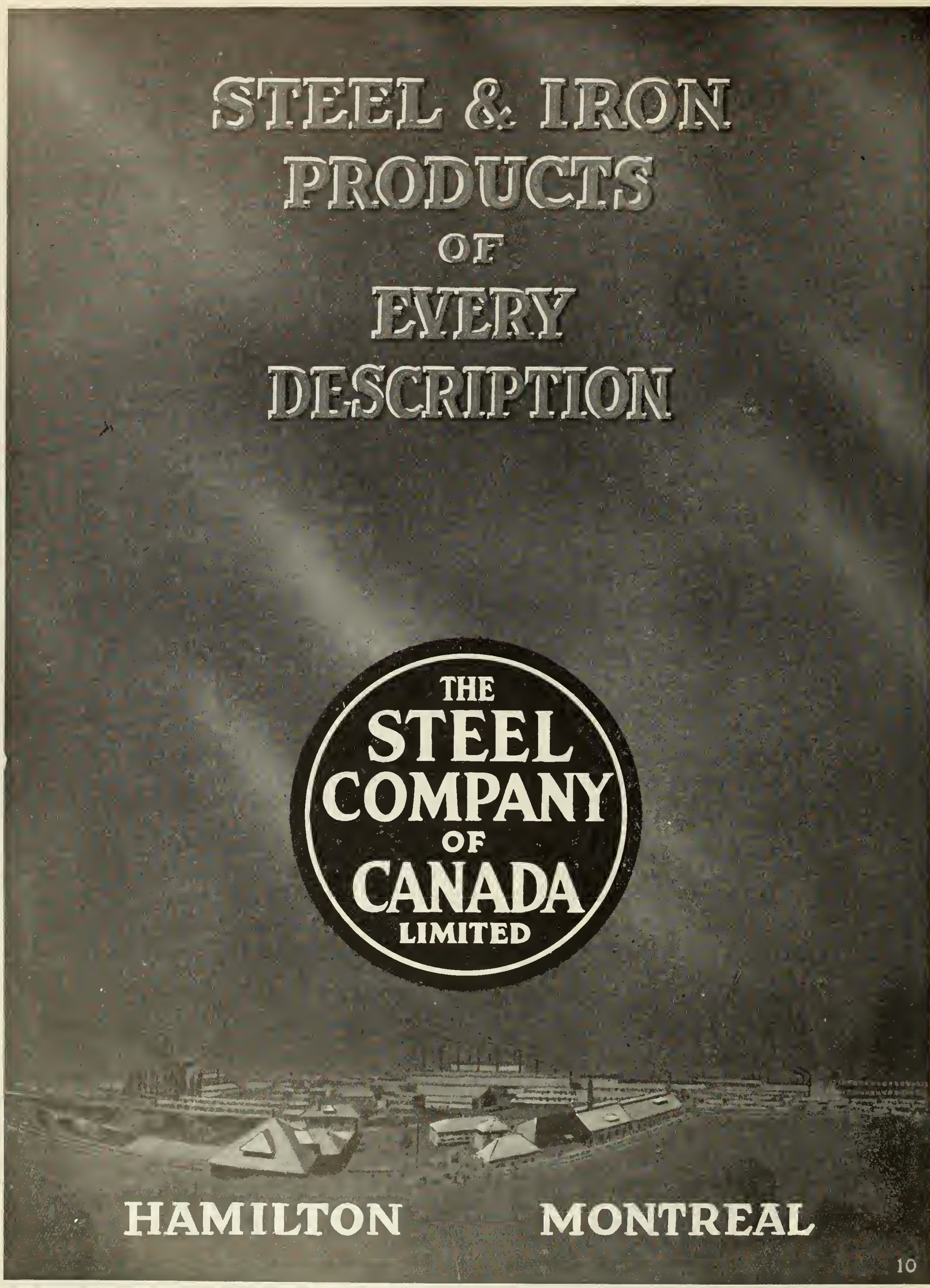
Wellington Street, Stratford, Ont., Tarvia-built 1913, in excellent condition after 11 years of traffic.

Cambria Street, another beautiful Tarvia street that lends added charm to Stratford, Ont.



Avondale Avenue, Stratford, Ont. Tarvia-built 1919. Modern, firm, smooth, frost- and thaw-proof pavement.

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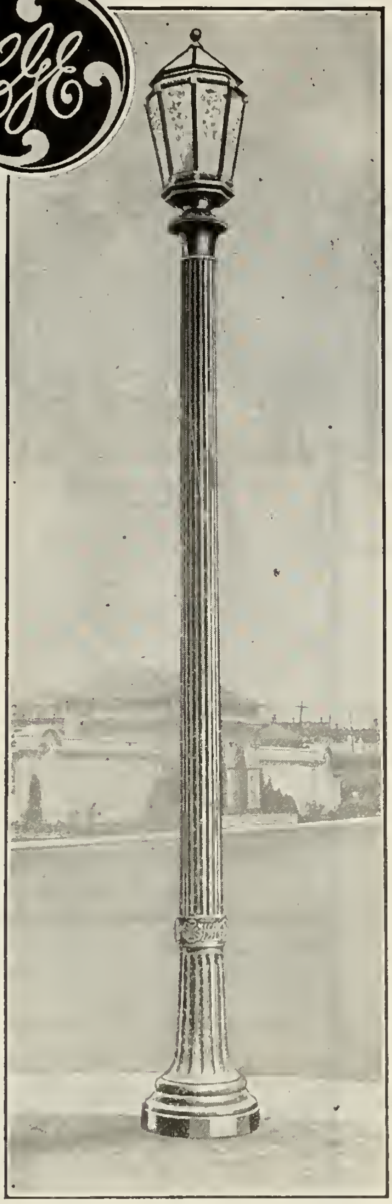

Sunnyside lantern mounted on Union metal steel standard.

Cross-section of Union metal steel standard, showing a series I. L. transformer mounted in base.

C.G.E. ornamental lighting equipment, with the most modern alabaster rippled glassware, designed and manufactured from specifications issued by the Street Lighting Department of the General Electric Company, and tested and approved by their illuminating laboratory.

The standards recommended with these units are the Union metal design, embodying the double ply copper-bearing fluted steel shaft, of which a very large choice of designs is obtainable.

Consult our nearest district office, and have a lighting specialist solve your street lighting problems.

Form 25 Novalux unit, with alabaster rippled globe, mounted on bishop's crook bracket.

Form 16 Novalux unit with alabaster rippled globe.

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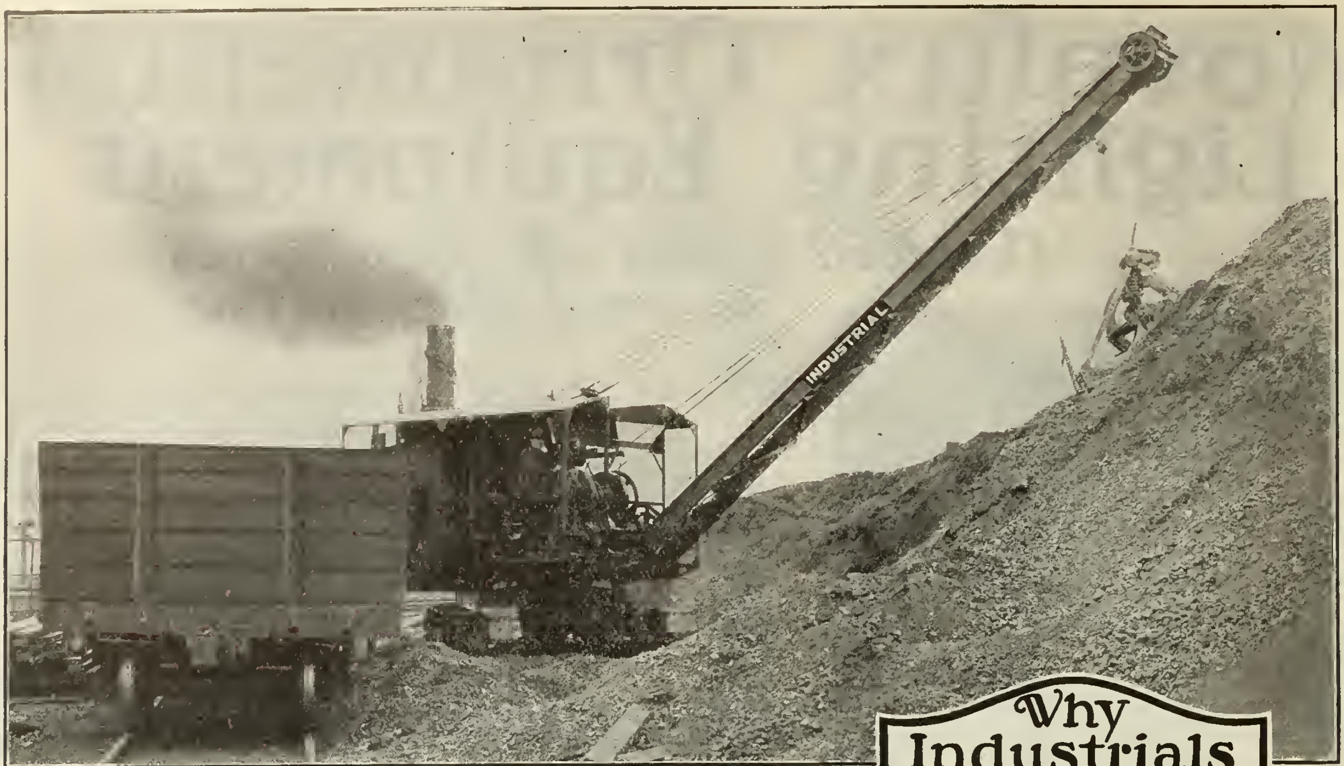

A 50-man-power masterpiece

THIS LATEST INDUSTRIAL crawling tractor locomotive crane is producing 50-man-power results in handling the heavy loads of industry. It is cutting deep into the high costs of manual material-handling and recovering a buried treasure of non-productive dollars.

The new type D is a masterpiece of design and construction. Its outstanding superiority is guaranteed by America's pioneer crane builders. Over fifty years of untarnished business integrity and highly specialized skill and experience form its background.

This newest INDUSTRIAL has a greater field of usefulness in industry than any other material-handling equipment on the market today. As a crawling tractor it goes everywhere. With its accessories, including clamshell bucket, electro-magnet, hook and block, shovel dipper arm, dragline bucket, wood grapple and pile driving loaders, it will conquer any material-handling problem at a tremendous saving in time and labor.

This latest INDUSTRIAL is fully illustrated and described in a 16-page bulletin just off the press. Ask for Book No. E-120 and it will be sent to you promptly.

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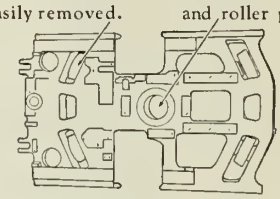
Why Industrials Excel

13 MASSIVE STEEL BASE

Without jacking up base, steel conical rollers easily removed.

Center pin nut adjusts all play between bedplate and roller path.

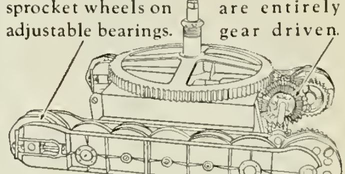


Entire upper machinery rests on a single massive steel rotating bedplate, insuring perfect alignment and preventing sticking clutches, undue gear wear and bent shafts.

14 HIGH TRACTOR ROLLERS

Big self-cleaning sprocket wheels on adjustable bearings.

Both tractors are entirely gear driven.



Tractor rollers, five on each side are 25 inches in diameter. These large rollers decrease the traveling friction and keep bearings high up out of all mud and dirt.

INDUSTRIAL

CRAWLING TRACTOR CRANES

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Metallurgical Re-Heating Furnaces for Blooms, Billets and Slabs

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A history of the development of modern re-heating furnaces would be very interesting indeed, but would require more time to prepare than the writer has found available. It is, therefore, necessary to deal with the subject matter as briefly as possible and for this reason it is proposed to treat it in the following order:

(1) A brief history in connection with the original bloom re-heating furnace installed in the Dominion Iron and Steel Company's rail mill in the year 1905.

(2) A discussion of modern types of metallurgical re-heating furnaces for blooms, billets and slabs.

(3) A description of the modern re-heating furnace for rail blooms installed in the Dominion Iron and Steel Company's rail mill in the year 1921.

Before proceeding perhaps it should be state that some familiarity with rolling mill work, is taken for granted.

Original Bloom Re-Heating Furnace installed in 1905

The mill proper consists of 3 stands of rolls arranged abreast, viz: 3-high roughing, 3-high intermediate and 2-high finishing. All rolls are 28 inches pitch diameter nominally, and there are 6 passes in the roughing, 4 in the intermediate and one in the finishing, or 11 passes in all to roll a finished rail from a bloom. The mill operates at 80 r.p.m., and was originally driven by a 54″ x 66″ Porter-Allen steam engine, which was replaced in 1920 by a 3,000-h.p., electric motor. Rails weighing from 60 to 100 pounds per yard can be rolled on this mill at an average production of 750 gross tons per 24 hours, although the mill has rolled repeatedly at a rate of double this tonnage. The size of the blooms used varies from 7¼ inches to 8 5/8 inches square, depending on the size of rail rolled, and while the old furnace was limited to a bloom length of 14 feet, the new furnace can take blooms up to 9 inches square and 17 feet in length.

It was the intention originally to roll the blooms, as they arrived from the blooming mill, direct into rails without re-heating. A furnace was installed, however, intended chiefly for re-heating such cold blooms as might accumulate from time to time owing to delays and breakdowns in the rail mill. In actual practice, however, practically all of the blooms were given a "wash-heat"; at least this was so during the first few years the mill operated.

The old furnace was of the continuous type, coal-fired by hand and of very poor design and construction, as we know it to-day. The method of handling the blooms to and from the furnace caused frequent delays in the mill, because the incoming material to the furnace interfered to a certain extent with the outgoing material to the mill.

Figure No. 1. shows a general arrangement of the old furnace, which was 15 feet wide inside by approximately 46 feet long overall. As stated before, it was coal-fired by hand, the grate being operated on the gas producer principle, primary air for combustion entering underneath the grate by natural draft, and secondary air being forced in, by a motor driven blower, underneath the hearth, thence along through cast iron piping into the admission box on the level with the bridge wall, all as shown on the drawing. Thus only the secondary air received a slight pre-heating.

The blooms to be reheated were pushed into the furnace at the low end and up the sloping furnace bed, by means of a hydraulic cylinder. Arriving at the crest of the gradient it was necessary to crow-bar the blooms, one at a time, down the hearth slope and after lying there for a short time for the purpose of removing the black spots on the bottom, caused by riding on the water-cooled skid pipes, an electrically operated ram bar pushed them out of the furnace on to a roller table, where an electric overhead crane picked them up and transported them to the rail mill approach table.

The products of combustion travelled over the blooms and down through the vertical flues at the charging end of the furnace, finally reaching the stack through a series of parallel, horizontal, flues underneath the furnace bed. A very small portion of the gas also found its way underneath the blooms, joining the bulk of the outgoing gases, on their way to the stack, in the vertical flues at the end of the furnace. The designer of the furnace intended, of course, that a fair percentage of the gases should travel under the blooms in order to give a certain amount of heating from the bottom, as well as from the top. Gases, however, have a tendency to hug the roof in a furnace and the percentage that can be induced to travel under the blooms is disappointingly small and cannot be controlled effectively.

It is an axiom in rolling mill practice that good rolling depends on, and is impossible without good heating. Wash-heating rail blooms is an absolute necessity in our case and has proved of great advantage. Without a furnace; i. e. without re-heating; the finishing temperature of the rails is so low that the cold rolling effect injures the structure of the steel in the rail, resulting in a high percentage of rejected rails. With well re-heated blooms this is obviated to a large extent and also cold blooms can be re-heated and rolled into rails, instead of being melted over again at the open hearth plant.

The old furnace, however, fell far short of the requirements of a good re-heating furnace, for reasons mentioned before and for numerous other reasons, and its use was abandoned in 1914, when the war came along and the mill rolled chiefly shell stock, which did not require to be re-heated. At the conclusion of the war, the furnace had been idle for over four years, and structurally it had suffered greatly during its period of idleness and was practically in a state of collapse by the end of 1918.

No further rail business developed until August 1921, but in the fall of 1920 it was decided to proceed immediately with the design and construction of a new re-heating furnace of the most modern type, in anticipation of such rail business as was to come in the future. Prior to arriving at this decision, we had an opportunity to cast about and thoroughly review the types of furnaces in use.

Modern types of Metallurgical Re-Heating Furnaces for Blooms, Billets and Slabs

While the new furnace to be installed in the "Disco" rail mill was intended chiefly for re-heating rail blooms, we had in mind that it should also be designed to re-heat billets, (small blooms), and slabs to a limited extent, should the occasion ever arise. Hence, we branch out here and embrace the principal features of re-heating furnaces for blooms, billets and slabs.

There are two main types of furnaces in use for this class of work:—(a) The continuous furnace; and (b) The non-continuous, or "batch" type.

Generally speaking, both types are now fired with either coke oven or producer gas. Furnaces with a hand coal-fired grate, operated by natural draft, are not built any more in modern steel plants because of their many deficiencies, such as, inability to regulate the flame, wholesale air leakage into the furnace on account of pressure inside being slightly below atmospheric, small production capacity, large scale loss and high coal consumption.

Stoker fired furnaces with forced draft are somewhat better in these respects and have the additional advantage, over gas fired furnaces, of comparatively lower first cost and smaller space occupied. However, they also have their objections and are built only where coal is relatively cheap and first cost of installation is a serious consideration.

Furnaces have also been installed which are fired with natural gas, some with oil and others with powdered coal, but these are in the minority and will not be dealt with here.

Blast furnace gas is also used for firing re-heating furnaces, but examples of this kind are chiefly confined to European installations, where the problem of conveying this gas through long pipe lines, without incurring explosion risks, seems to have been solved successfully.

Advantages of Gas Firing

There are several reasons why gas firing is superior to the direct firing of coal in furnace operations.

(I) *The attainment of practically perfect combustion and high heats.* Fuel in the gaseous form burns quickly and perfectly, carries no ashes into the furnace and permits any desired temperature to be reached and maintained.

(II) *Economy of fuel.* Gas firing permits the use of regenerators, or recuperators, for restoring a large part of the waste heat to the air before it enters the furnace and this fact, taken together with the perfect combustion secured, results in large fuel economy.

(III) *Easy regulation of the flame, uniformity and no delays.* When coal is fired direct in a furnace, (excepting stoker fired furnaces), there can be no steady maintenance of heat; it fluctuates continually, as the fires burn up or are freshly charged. This has a deteriorating effect on the furnace and diminishes output. Then there are always unavoidable delays in cleaning the fires, during which the furnace cools and the output is stopped.

Both of these drawbacks are avoided by gas firing, the conditions are always uniform, at their highest efficiency, and there are no delays in the regular operation.

(IV) *Less oxidation loss.* A substantial saving is effected in scale loss because with gas firing there need be little, if any, excess air and such little excess as must be present is kept where it can do the least harm, namely nearest the roof of the furnace.

(V) *Saving in labour.* This is obvious in the case of coke oven gas, because no firemen or coal and ash wheelers are required.

(VI) *Saving of by-products.* The by-products, in the case of coke oven gas, have been extracted from the coal during the coking process at the coke ovens, whereas with coal fired furnaces they are lost. Producer gas has the same objection in this respect as direct coal firing.

The sum of these advantages makes a grand total which is usually sufficient to entirely pay for a first class gas fired furnace installation in a comparatively short time.

Recuperators or Regenerators for Pre-Heating Gas and Air

The continuous furnace is generally provided with either recuperators, or regenerators, for pre-heating the combustion air only, whereas the batch furnace is always arranged with regenerators for pre-heating both gas and air, when producer gas is used, and air only when coke oven gas is the fuel. In the continuous furnace the flame travel is always in the same direction through the furnace, while in the batch furnace it is reversed from one end to the other every half hour, or more frequently when necessary.

When coke oven gas is used as fuel it is never pre-heated before entering the furnace, irrespective of whether the continuous or batch type is used, past experience

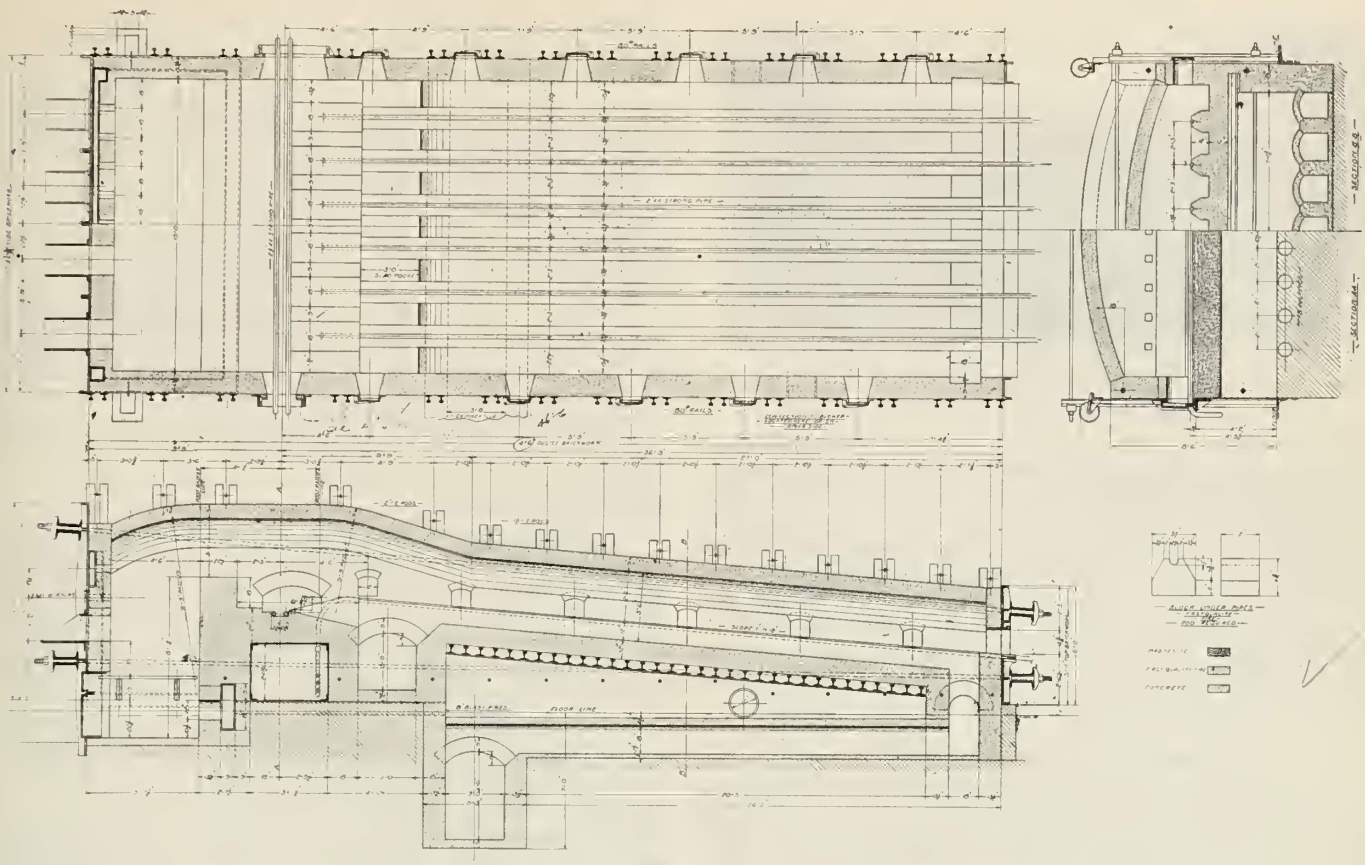

Figure No. 1,—General Arrangement of old Continuous Rail Bloom Heating Furnace.

having shown where pre-heating was attempted that a certain explosive risk is involved in view of the richness of this gas and also there has been trouble with the regenerators sooting up rather quickly; moreover, the saving which results from a preliminary heating of this gas is of little consequence. Besides this, even if, theoretically speaking, it were possible for the gas to traverse chambers heated to high temperatures without dissociation of the hydro-carbons, it would appear impossible to effect this in practice, and the increased sensible heat would be more than balanced by the loss in latent heat resulting from the dissociation. As a matter of fact, the simplification, both in the construction of the furnace and in its maintenance, as well as in its behavior during operation, is sufficient reason to lead coke oven gas into the furnace cold, which gas gives, in any case, a fully sufficient temperature of combustion.

Producer gas when used in continuous furnaces is never pre-heated, because it would be next to impossible to construct a reversing valve capable of resisting the ensuing high temperatures, nor could the resulting complication in construction and operation be justified. In batch furnaces it is, however, quite standard practice to pre-heat both gas and air, when using producer gas as fuel, and in consequence the heat radiation losses which are larger with this type of furnace than with the continuous type, are somewhat made up for. Pre-heating of producer gas can here be indulged in without detriment, because the inherent principle involved in the construction and operation of the batch furnace, (being reversing), is such that no extra complications are required, nor is it necessary for the pre-heated gas to travel through a reversing valve.

Typical Re-Heating Furnaces

Figure No. 2 shows a Morgan continuous suspension-roof furnace and continuous gas producer, for heating billets 1¾ inch to 2½ inches square by 30 feet long. Its bed usually measures 32 feet wide inside by 20 feet long. It slopes towards the hot, or discharging end, at a pitch of 2 inches to the foot. The upper part of the furnace bed consists of watercooled pipes or "skids" on which the billets rest. The central part of the furnace bed is formed with fire-brick; the lower, the hottest, part is paved with magnesite brick. The roof is turned in three arches, each having about 7 feet span. The hanging skew-backs for these arches are supported by 2-inch double extra heavy pipes, through which water is flowing These pipes are suspended from steel girders resting on the furnace walls. Special skew-back bricks, with semi-circular recesses, are placed over the pipe, and against the sloping faces of these bricks the roof arches rest. This construction has been in use since 1896, has proved very durable and satisfactory, and has a great advantage where used over a large, wide bed, *as it makes it possible for the roof to be brought as closely as desired to the bed, thus securing uniform heating of the 30 foot long billets.* Uniform heating is absolutely essential when heating small billets 30 feet long for continuous mill work, where the billet passes through fourteen stands of rolls at the same time, at an ever increasing speed. Above the arched and refractory roof, a hollow space is formed by a second roof of corrugated iron, covered with sand. At the lower end of the furnace air is admitted into this space, whence it is drawn by an exhaust fan. After passing through this fan, the air is returned to the space under the bed of the furnace. Here it passes around a recuperator, or stove,

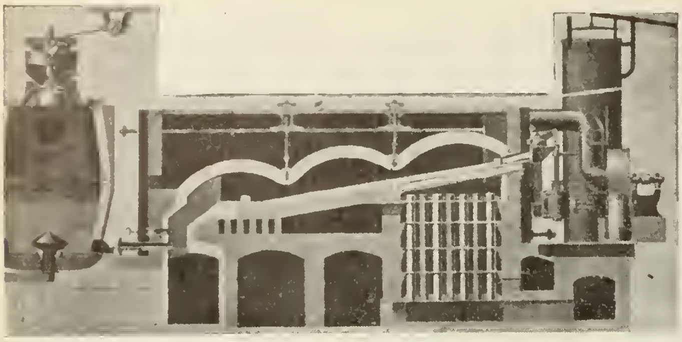

Figure No. 2,—Morgan Continuous Suspension Roof Furnace and Continuous Gas Producer.

built of iron pipes, through which the products of combustion from the furnace pass on their way to the smoke stack. The air is finally led under the bottom of the furnace hearth into the fourteen air ports; each port being about 4½ inches square, and controlled by its own valve. The producer gas enters through fourteen gas ports, 9 inches by 13½ inches in size, each controlled by its independent, water-cooled slide valve. The gas is delivered into these ports through short flues directly from the adjacent gas producers.

Methods of Charging the Furnaces

The draught is entirely regulated by the exhaust fan. The smoke stack is simply a flue for conveying the products of combustion out of the building. The billets are delivered at the upper corner of the furnace on rollers. At this point it is gripped between two pinching feed rollers, which are placed flush with the inside of the furnace wall. These are usually belt driven. When the billet has been carried through these rollers, it is fairly within the furnace. A steam cylinder fastened to the furnace binding on the upper, cold side of the furnace, turns a longitudinal shaft which is armed with five levers working push bars which enter into the interior of the furnace. By lowering the piston of this steam cylinder, the push bars are made to advance, pushing the billets forward. In this manner the furnace hearth is gradually covered by one continuous layer of billets.

In most other types of continuous furnaces the stock is charged into the furnace through the end, the opening and closing of the charging door being in some cases accomplished automatically by the charging pusher. While the door is opened, cold air enters into the gas off-takes to the smoke stack, influencing the draft, or when the pressure in the furnace is above atmospheric, combustion gases leak out into the building and hamper operation. Because of these objections it is the practice in some plants, more particularly where smaller stock is to be reheated, to charge the furnace in batches, thus dispensing with the frequent opening of the charging door. This practice is objectionable, however, because it requires a long stroke pusher if the gas off-takes are to be kept open, and where the billets are withdrawn from the furnace regularly they are not all equally well heated, a matter of considerable importance in the production of wire rods and strip material.

In the Morgan furnace these objectionable features are avoided by charging the billets into the furnace as described above. Thus, the charging opening is not much larger than the cross-section of the billet, therefore very small, and the same is true of the openings for push bars, which are kept reasonably closed by the push bars themselves. Interference with the furnace draft is, therefore, unknown and gas does not leak out at the charging end.

As the billets advance, they come into zones of higher temperature and are gradually and uniformly heated until they arrive at the bottom, or hot end of the furnace, thoroughly soaked and ready for rolling. This furnace contains about one hundred and twenty, 1¾-inch billets, and can, without forcing, deliver one hundred heated billets per hour; the billets always enter the furnace cold. This is roughly equal to 15 tons per hour. As long as the billets arrive at the mill fairly straight, the heating process is nearly automatic, one man feeding the furnace, another discharging the billets into the mill. The heater controls both furnace and gas producers. The working of the latter is indicated by gauges fastened to the furnace binding, close to the gas and air valves. Close to these gauges are valves for regulating the steam pressure used on the producers.

The delivery of the billet from the furnace into the mill is effected by a second pair of driven pinch rollers. Between these is entered a push bar, the forward end of which is placed against the rear end of the billet. By pressing the pinch rollers together against the push bar, the discharger forces the hot billet forward through a small door directly into the first pass of the mill.

It is desirable that the gas should enter the furnace as hot as possible and therefore the producers are placed as closely as practicable to the furnace.

As a definite record of the performance of the combined Morgan producer and furnace, it may be stated that the average quantity of coal used for heating one ton of cold 1¾ inch billets is in the vicinity of 150 pounds.

This furnace has been described rather fully because it is the best of its kind in the market. The Dominion Iron and Steel Company has two of these furnaces, one installed in 1904 and the other in 1913, and they have never given any trouble worth mentioning and are very economical and efficient in operation.

Figure No. 3 illustrates the so-called "Chantraine" patent continuous re-heating furnace for blooms, billets and slabs. This type of furnace has found great favour in England, France and Germany during recent years and is claimed to have a lower coal consumption than any other type.

As the illustration shows, it is provided with a multi-flame arch built over the final heating hearth. It is designed for an output of 6 tons per hour on medium size billets. The stock is pushed in at the front end and right through the furnace, riding on watercooled skid pipes to the crest of the hill from whence it falls down the inclined hearth. As the stock travels through the furnace it gradually increases in heat and reaches rolling temperature under the multi-flame arch. This furnace is designed with shallow recuperators underneath the hearth, attractive where foundation or drainage difficulties are encountered. Producer gas is the fuel used. The hot air from the recuperators is collected and taken to the air reservoir by a fire-brick lined steel pipe as shown. The producer gas comes in at the end forming a blanket through which the jets of air penetrate and form impinging flames, which cover the whole surface of the hearth and speedily and evenly heat the material with a minimum of oxidation. Forty per cent of the products of combustion after leaving the hearth goes to the recuperator. The remaining 60 per cent travels along the downward sloping hearth to the smoke stack. Dampers are provided in each case for simple regulation purposes.

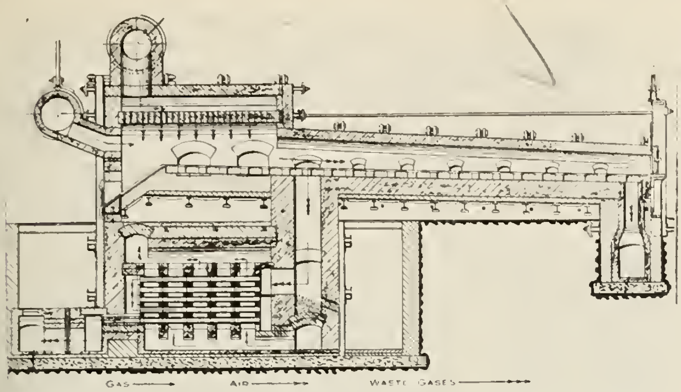

Figure No. 3,—Longitudinal Section of a Chantraine Patent Continuous Re-heating Furnace.

A picture of the recuperators is shown in figure No. 4, in perspective. It clearly indicates the method of building up the special tubular ducts of refractory material which are designed to heat the air to within 300°C., (572°F.), of the waste gas temperature. The solid base and side wall are shown, and a good idea is given of the strength and solidity of the construction. The end to end joints of each recuperator tube are shown staggered, the idea being to prevent leakage as far as possible.

Two Chapman-Stein continuous re-heating furnace for billets and slabs, are installed at the plant of the Youngstown Sheet and Tube Company; these are of the gravity discharge, recuperative type and are designed to use either producer or coke oven gas. Last year the writer saw these furnaces in operation and while they made a good impression, generally speaking, there were some points that would stand improving. A longitudinal cross-section through such a furnace is reproduced in figure No. 5, indicating also the recuperator arrangement for pre-heating the combustion air. The travel of the waste gases and air are shown by the arrows.

The Chapman-Stein Furnace Company claim that a good recuperative furnace will pre-heat the air required for combustion to a temperature about 250° to 350° F., less than the temperature of the spent furnace gases entering the recuperator. This usually means a saving of around 30 per cent of the fuel required as compared with no pre-heating of the air. This economy is brought about not only because of the heat units transferred from the spent gases to the incoming air, but because of the fact that the excess air which is always required for complete combustion is greatly reduced when the air is pre-heated, and thus oxidation losses are also decreased.

There is no question but that if a recuperative furnace could be designed for forced draft operation, with the recuperators remaining tight and free from leaks, it would be an ideal furnace. It would transform the so-called continuous air regenerative furnace into a real continuous type; reversing valves with their flues would fall away and a more uniform heat could be maintained throughout the furnace. This is due to the fact that immediately on reversing, the pre-heated air is at its highest temperature, which drops steadily as the stored heat is abstracted from the air checker chamber.

The recuperative furnace costs less to install and perhaps less to operate; it takes up less space, requires less skillful handling and much less attention, but Professor Trinks, an eminent authority on metallurgical re-heating furnaces, states in one of his articles on the subject of recuperative furnaces, as follows:—

"In practically all of the continuous slab and billet furnaces which I have inspected, the brick recuperators were either abandoned or were about to be abandoned.

"Leakage there is, and the amount is by no means negligible. From a test made some years ago the writer computed that 30 per cent of the air entering the recuperator leaked out before it reached the burners; and in another furnace in the Pittsburgh district, which was equipped with a tile recuperator, 65 per cent of the air leaked out.

"For variable rates of heating a tile recuperator is exposed to the danger of cracking."

Making due allowance for exaggeration and also keeping in mind that Professor Trinks' statements are probably based on "old-style" recuperators, it would appear difficult, in the long run, to keep even the tile recuperators of the Chapman-Stein furnace free from cracks and leaks, particularly as there are a good many joints involved and the wall thickness of the tile brick must be relatively thin in order to get good heat transfer.

Moreover, the recuperative furnace is not suited to conditions which demand a large overload capacity, on account of the absence of forced draft and because the brick volume in the recuperators is not sufficient for storing the necessary heat. Under such conditions the regenerative furnace with its great quantity of checker brick and forced draft is advisable. The recuperative furnace has, however, a very large number of applications, recent advices from the Chapman-Stein Furnace Company. (Mt. Vernon, Ohio) indicating that they have on order eight re-heating furnaces for ingots, blooms and slabs.

The features claimed for the Chapman-Stein recuperator are stated in their catalogue as follows:—

"The distinctive feature of the Stein recuperative furnace is that the recuperator air ducts are vertical and have no turns or off-sets. Sufficient natural draft is thus procured through the recuperator to give a slight pressure in the furnace without requiring a blower for the air. By eliminating a fan we avoid any excessive pressure in the air ducts of the recuperator. In fact the air ducts at the bottom are under a slight suction (about 1/10 inch). This practically balances the suction in the spent gas passages which is about 1/8 inch. There is thus practically no occasion for the air in the air passages to leak through into the spent gas passages. This, in the

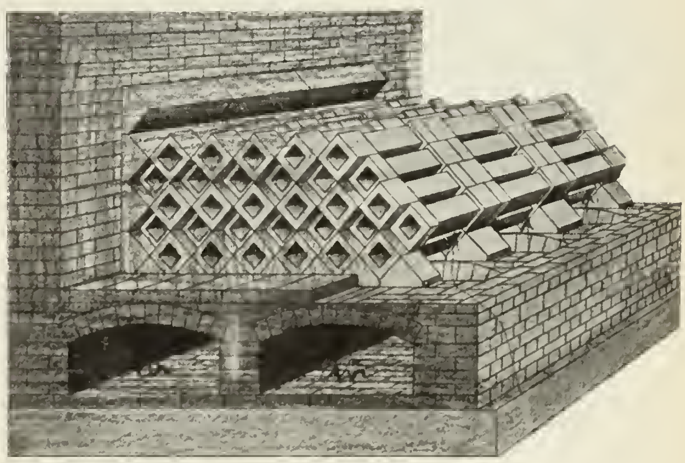

Figure No. 4,—Recuperators, showing the Method of Building up the Special Tubular Ducts of Refractory Material.

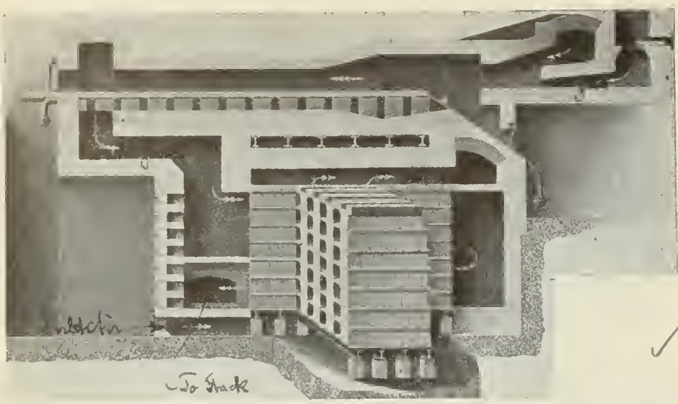

Figure No. 5,—Longitudinal Cross-section through a Chapman-Stein Continuous Re-heating Furnace.

past, has been the chief cause for failure in the recuperative furnace, for no tile joints could be made tight enough to withstand a positive air pressure from a fan on one side of the tile and the minus pressure of the spent gases on the other.

The Stein recuperator in addition to eliminating the air pressure in the tile reduces the stack draft around the tile by making fewer turns and larger passageways for the spent gases. In this way we obtain an approximately balanced draft on each side of the tile. Moreover the entire recuperator is made with overlapping joints doubly closed so as to permit expansion and contraction without leakage. It is thus made practically leakproof.

The special recuperator tile are held in place laterally by slabs that direct the flow of the spent gases and also serve to close the joints between the tile. These slabs in turn are held in place by lugs on the recuperator tile, another patented feature.

Each special recuperator tile is reinforced by two vertical partitions which permit the tile walls to be made only ¾ inch thick, thus making possible a very rapid heat transference. By making the vertical air passages very small we are able to heat the air much hotter as there is no room left in the center of the passage for a core of colder, slower moving air, as has been the case heretofore.

The tile are also made so as to break joints in every direction. In setting these tile, no attempt is made to produce a solid mass by using cement, so as to prevent leakage. The large amount of lap of the doubly closed joints, together with the fact that there is practically no difference in the air and waste gas pressures on either side of the tile, is adequate insurance against leakage. In many cases these recuperators have had to withstand for years the jar from heavy trip hammers located nearby and no harm has resulted."

"Two laws are vital in designing an efficient recuperator:

1. The air and spent gases must flow in opposite directions. This is the only way to bring the hottest air in contact with the hottest tile, thus raising the temperature of the air to the highest point.
2. The air to be heated must flow upward and the spent gases to be cooled must flow downward. This is absolutely necessary in order to keep the air in the recuperator until it is properly heated and to keep the spent gases in the recuperator until they have given up their heat. Otherwise some of the air would escape before it was properly heated and a portion of the spent gases would escape before they were cooled.

Only by scrupulously observing these two laws can correct circulation and good efficiency be obtained."

Another popular type of continuous furnace used in the United States for re-heating blooms, billets and slabs is the so-called Alex. Laughlin furnace, installed in a large number of rolling mills; similarly to the last two furnaces described, it is of the recuperative, gravity-discharge type and either coke oven or producer gas can be used as fuel. This furnace is installed at the 28-inch merchant mill of the Bethlehem Steel Company, at Sparrows Point. It is of the gravity-discharge type and fired with powdered coal, which enters the discharge end of the furnace through overhead pipes and burners, being conveyed through the pipes from the powdered coal preparation plant by means of the air required for combustion.

The batch furnace is similar in construction to a stationery open-hearth furnace, the direction of the flame travel across the hearth being periodically reversed and the furnace is generally always equipped with regenerative checker chambers for pre-heating the air used for combustion. When producer gas is used this is also pre-heated in the same manner as the air.

The blooms or slabs which this type of furnace usually heats are charged on the hearth of the furnace and remain in the one place until hot enough to roll. There is an open space between the stock to be heated, so that three sides are available for directly absorbing the heat from the products of combustion, or roof, while the fourth side is resting on the heated hearth of the furnace and absorbs from it a large amount of heat.

The Dominion Iron and Steel Company installed six batch type re-heating furnaces in connection with its 110 inches plate mill, in the year 1919. These have a hearth 9 feet wide inside by 34 feet long and are designed for heating with coke oven gas, the necessary combustion air being pre-heated in regenerative checker chambers.

Usually this type of furnace has a silica bottom, made by fusing sand in thin layers until the proper thickness is reached. Occasionally sintered magnesite is used instead, which is, perhaps, better but also more expensive. A slight slope toward the rear and center of the furnace permits of periodically drawing-off the slag, which forms, through spouts into slag buggies. The material to be heated is charged and withdrawn through large doors in the front wall of the furnace, in the manner described and illustrated above. Ports are provided at each end of the furnace, through which the gas and air are alternately admitted and withdrawn. Two regenerative checker chambers are located at each end of the furnace for pre-heating either the air, or air and gas, which ever the case might be. The checker chambers are connected to the smoke stack by underground flues containing valves and dampers, so arranged, that the direction of the flow of the hot gases across the hearth may be periodically reversed. In this manner the gas is first burned through one end of the furnace, while the waste gases leave at the opposite end, heating the checkers in their passage to the stack. The flow is reversed in 20 to 30 minutes, the gas is burned through the other end and the air for combustion is pre-heated in the checker chambers which have just received their heat from the waste gases.

Two or more of these furnaces are usually required for a rolling mill, depending on the production required. With one furnace containing heated steel and ready to roll, the first door is opened and the part of the hearth served by this door cleared of steel. Then the second door is started in the same manner, and while drawing the second door, the first is recharged. This is continued until all the hot steel has been drawn and the furnace refilled with cold blooms. The charging crane then moves to the second furnace and repeats the operation. By alternating the furnaces, little time is lost in waiting for hot steel.

Before concluding this part of the programme it should be stated that both, batch and continuous furnaces, can heat either blooms, billets or slabs, within certain limitations. The batch furnace can heat various sizes and shapes at the same time, but is not very economical, nor has it sufficient capacity on small stock. The continuous furnace has a much larger capacity as a rule, but is limited to even size blooms, billets or slabs; it cannot accommodate a mixture of different size stock because doubling up would surely occur in the furnace and make a mess of things.

Modern Re-Heating Furnace installed in 1921

Starting with the inception of the idea that a new modern furnace was required, we corresponded all over the country first to see what the other fellow had accomplished; ascertained his mistakes and shortcomings; listened to good advice; used common sense; spent a month in studying our own peculiar conditions and then went ahead with the design of the new furnace.

The new re-heating furnace referred is of the continuous gravity-discharge type, heated with coke oven gas and equipped with regenerative checker chambers for pre-heating the combustion air. The reasons for its selection, in preference to several furnaces of the batch type, might be listed as follows:—

(1) A capacity of 1,500 tons per 24 hour day was specified on wash heats, and 600 tons per 24 hour day on cold blooms. This would have required at least four furnaces of the batch type, demanding a space 180 feet wide by 160 feet long. It was impossible to find room in the vicinity of the rail. mill for this. Although the new rail mill furnace has practically a capacity equal to the six plate mill furnaces, (which are of the batch type), it requires only about one-third of the ground space of the latter.

Figure No. 6,—Discharging end of Bloom Re-heating Furnace for Rail Mill.

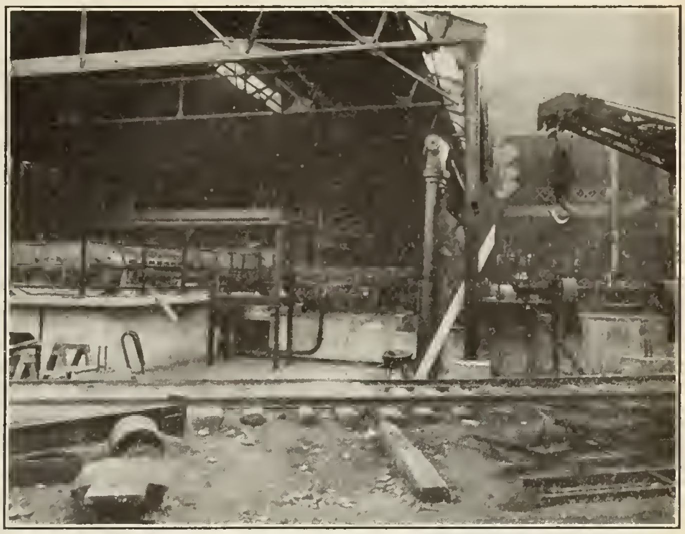

Figure No. 7,—Charging end of Bloom Re-heating Furnace for Rail Mill.

(2) The cost of four-batch type furnaces, complete with all accessories and ready for operation, would have been at least three times that of the continuous furnace actually built.

(3) Batch furnaces with 18 feet wide hearth inside, (the width of furnace required in our case), would involve structural and operating difficulties, because of roof span, heat intensity, and large door openings required on one side of furnace, weakening the roof structure. True, the Morgan type of water-cooled suspension roof might be used, but again we have extra complications.

(4) Overhead and operating charges on four batch furnaces would be considerably in excess of those for a continuous furnace.

(5) Fuel gas consumption of the batch furnaces, not counting standby losses, would easily be double that for a continuous furnace.

(6) Whenever rail mill is operated single shift, the standby losses of the batch furnaces would be far greater.

(7) Maintenance charges on such large batch furnaces, (with 18-feet roof span), particularly when subjected to alternate heating and cooling from day to night shift, and over Sundays, would naturally be more consequential.

(8) For re-heating dead-cold steel the batch furnace is absolutely wrong, because charging cold blooms into a reversing furnace, which is at a high even temperature all over, tends both to kill the flame and chill adjacent material probably just ready to draw. The continuous furnace is the only one to use in this case. Dead-cold steel needs a gradually growing heat, such as it gets in a continuous furnace.

The only advantages of batch furnaces are those of more flexibility and more uniform heating, i. e. they can more readily absorb the usual fluctuations resulting in the supply and demand of ingots and blooms between the open hearth, blooming and rail mills. They can also heat material of mixed sizes and shapes and there is no trouble in keeping the hearth in good condition and in running-off the slag in a molten state.

The continuous furnace gives a certain amount of trouble with accumulation of scale and cinder building up the hearth bottom, involving heavy labor at week-ends chipping it down with hammer and bar. The furnace temperature is not quite hot enough to melt the scale and draw it off in liquid form; if it were it would be too hot for the blooms and they would weld together, as they closely adjoin one another. With the continuous furnace, therefore, some expense will be incurred in cutting down the hearth bottom at week-ends, but we have now several continuous furnaces and never had any serious difficulty in keeping the hearths in shape, nor is there anybody with experience with both types of furnaces who would decide against the continuous furnace for this reason.

The few advantages cited above for the batch furnace are very important, but the price is high for them when continuous furnaces can be and are being successfully operated for reheating rail blooms, at several large steel plants.

Work on Design and Construction of New Furnace

The reasons for selecting the continuous type furnace having been stated, it might now be of interest to briefly review the items of work involved in the design and construction of the new furnace, with its accessories. Arranged in somewhat tabular form, they are:—

Clearing the old site, removing the abandoned furnace with stack, etc.

Preparation of approximately 184 full size drawings, 19 of which were studies.

Excavating 3,300 cubic yards of earthwork and old concrete.
Placing 1,500 cubic yards of new reinforced concrete.
Fabrication and erection of 200 tons of iron castings and Machinery.
Fabrication and erection of 80 tons of structural steel
" " " " 40 " " plates
" " " " 25 " " rails
Total....................345 tons

Laying 390 M fire brick (for furnaces, flues, valves and stack, etc.)

Laying 25 M silica brick (for furnace roof) since changed to clay brick.

Laying 20 M red brick (for filling).

Total 435 M brick (9-inch equivalent).

Laying 46 tons of gas and water piping.

Installation of and wiring for 12 electric motors and control equipment, totaling about 370 h.p.

Installation of a blower, sump pump, the special "Isley" reversing valve, etc.

It required approximately six months to prepare the 184 drawings referred to above and while material was ordered on shops for fabrication as fast as the drawings were completed, actual construction in the field was not started until June 1st, 1921 on account of bad weather conditions and other pressing work. However, the furnace began operating on the August 25th, 1921, or less than three months after commencing field construction. The speed of preparation of the drawings, as well as the time required for the fabrication and construction of the

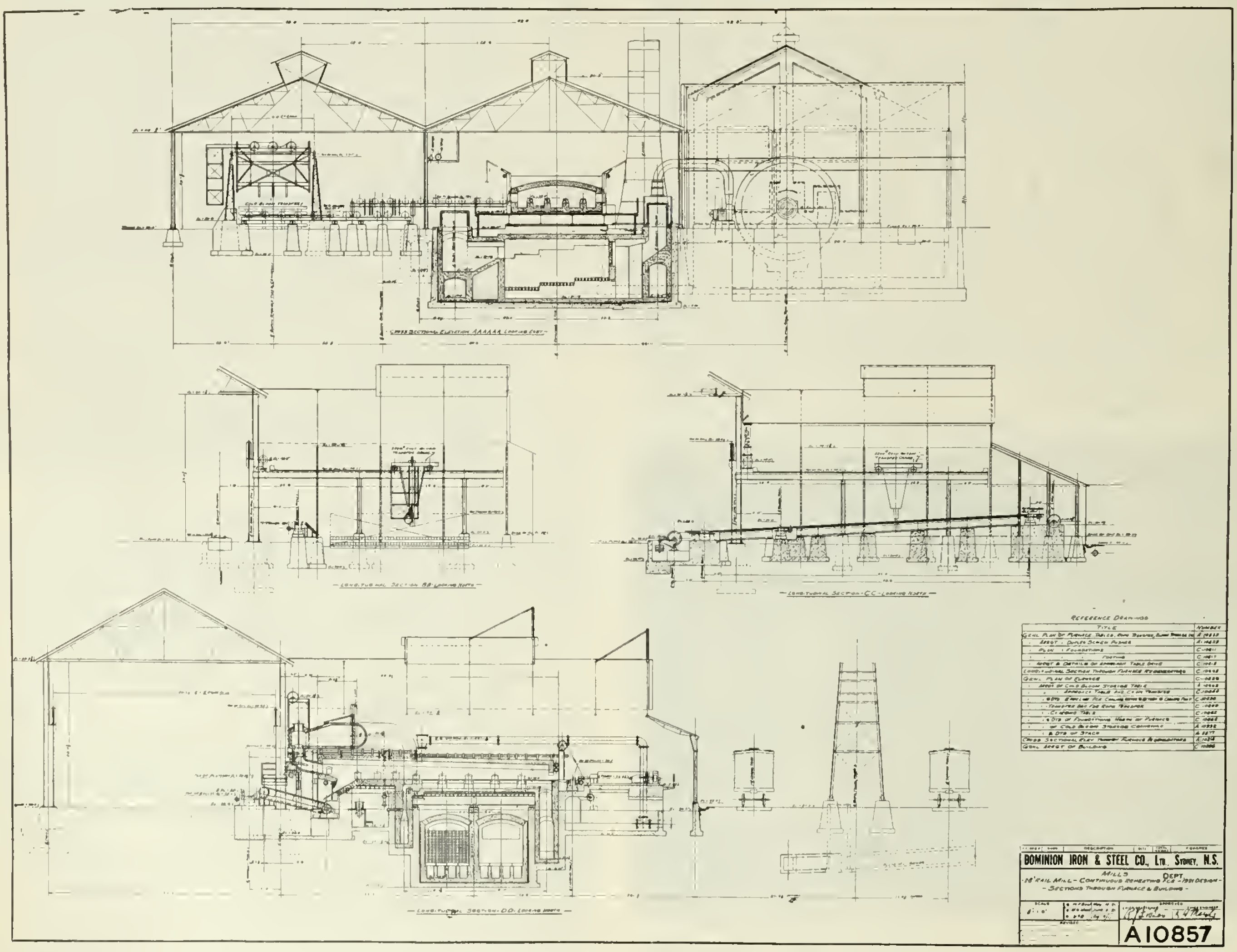

Figure No. 8,—Sections through Furnace and Building of 28-inch Rail Mill—Continuous Re-heating Furnace—1921 Design.

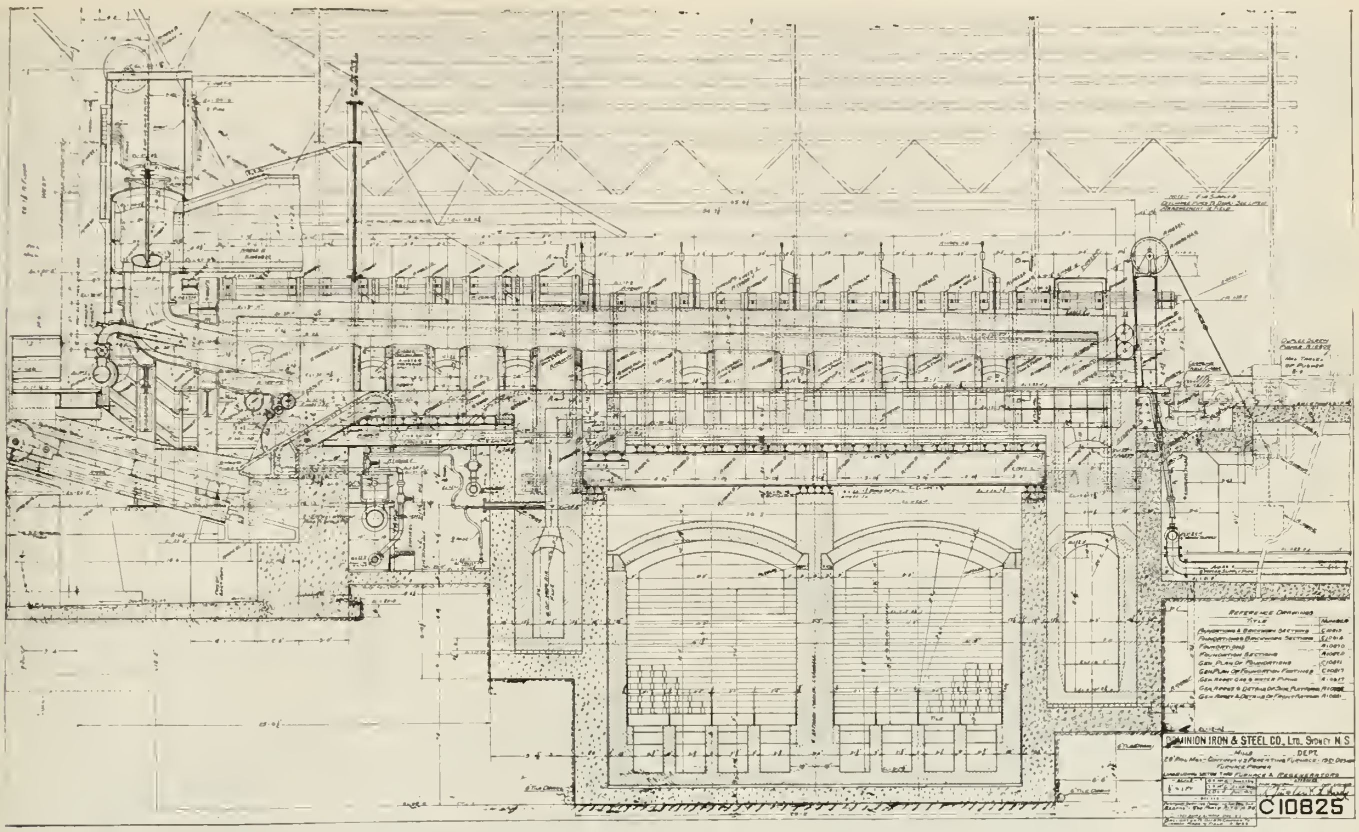

Figure No. 9,—Longitudinal Section through Furnace and Regenerators 28-inch Rail Mill—Continuous Re-heating Furnace—1921 Design.

furnace and its accessories constitute a record of which the personnel involved might well be proud. The actual total cost of the furnace with all accessories was approximately $250,000.

The furnace is heated with by-product coke oven gas having an approximate heat value of 585 B.t.u., per cubic foot. If an adequate supply of coke oven gas is available a furnace of this kind should always be heated with that gas in preference to producer gas, because:—

(1) It eliminates a great part of the first cost; such items as gas producers, with their large piping, coaling platform, etc., fall away entirely.

(2) The labour of operating the producers and for coal and ash handling is dispensed with, hence lower heating cost.

(3) Coke oven gas is a better fuel for such a furnace than producer gas, because it is more uniform in composition and heating value, and because of its cleanliness does not clog the checkerwork in the regenerators nearly so quickly.

(4) With coke oven gas the by-products have been extracted out of the coal, whereas with producer gas they are lost.

Of course, when coke oven gas is used the advisability of feeding it to the furnace at a uniform pressure is apparent and can readily be accomplished by installing a pressure regulator.

Figure No. 9 is a typical longitudinal cross-section through the furnace proper, which it will be noted is of the horizontal continuous gravity-discharge type, the blooms arriving on the furnace charging table, one at a time, from whence an electric pusher pushes them clear across the waste gas flue ports into the furnace, thus moving the entire furnace contents one bloom at a time with the result that at the furnace discharging end a bloom goes over the crest of the hill, thoroughly re-heated, and drops by gravity on to a short chain conveyor which conveys the bloom to the mill approach table. The furnace can re-heat either hot or cold blooms; for obvious reasons they should not be mixed but rather processed separately. Generally the blooms arrive at the furnace hot, direct from the blooming mill, at a temperature of from 1,500° to 1,800°F. They leave the furnace at rolling temperature probably about 2,100°F.

This furnace employs the regenerative principle for pre-heating the air, the coke oven gas being introduced into the furnace cold without pre-heating, for reasons mentioned before. The regenerative checkers were provided not so much for economy but to give maximum tonnage output, more particularly when re-heating cold blooms.

The furnace has a capacity of 1,500 tons on wash heats per 24 hours, or 62½ tons per hour; it could heat 600 tons of cold blooms per 24 hours, or 25 tons per hour. The largest size bloom it will take is 9 inches by 9 inches by 17 feet and the minimum length that can be handled is about 8 feet. The inside width of the furnace is 18 feet and its hearth length 42 feet, which when fully charged holds fifty-six 9-inch square blooms and these, when 17 feet long, would amount to 120 tons of material. At an output of 1,500 tons per 24 hours, (wash heats), the duration of the blooms in the furnace would be approximately 2 hours. On cold blooms this period would be increased to about 5 hours. In regard to the furnace hearth length it might be stated that 30 feet is generally considered sufficient for "wash heats", but for cold blooms a longer hearth, up to 45 feet is desirable. With a longer hearth better results are obtained, because it allows the heat to penetrate and soak into the steel, instead of being mere surface heat. On the other hand someone said jokingly that in a continuous furnace the difficulties increase with the cube of the length.

Professor Trinks states:—

"In designing continuous furnaces the greatest gain in efficiency is not made by lengthening the furnace so as to make the cool end cooler but by pre-heating the air so as to make the hot end hotter. The proper place to utilize heat is at the hot end, not the cold. This is due to the fact that furnaces are slow and the radiation losses correspondingly large if the flame temperature is not considerably in excess of the temperature required in the steel. For example, if the steel had to be heated to 2,200°F., in a furnace having a flame temperature of but 2,400°F., the furnace would be slow and inefficient, while if the air could be pre-heated so that a flame temperature of 2,800°F., could be obtained the furnace would be nearly three times as fast and much more efficient."

Explaining further the design, construction and operation of the furnace, it might be stated that primary combustion is arranged for at the discharging end, the coke oven gas entering through five 6-inch diameter burners at an average pressure of approximately 15 inches of water, mixing with the pre-heated air which has an average temperature of 800°F., and is admitted through five 20-inch diameter watercooled mushroom-type air valves. The products of the primary combustion then travel over the blooms the full length of the furnace to the charging end, where vertical down flues are provided for leading the waste gases to the "Isley" reversing valve, from thence through the checker chamber into the stack reversing valve and finally through the stack flue into the stack.

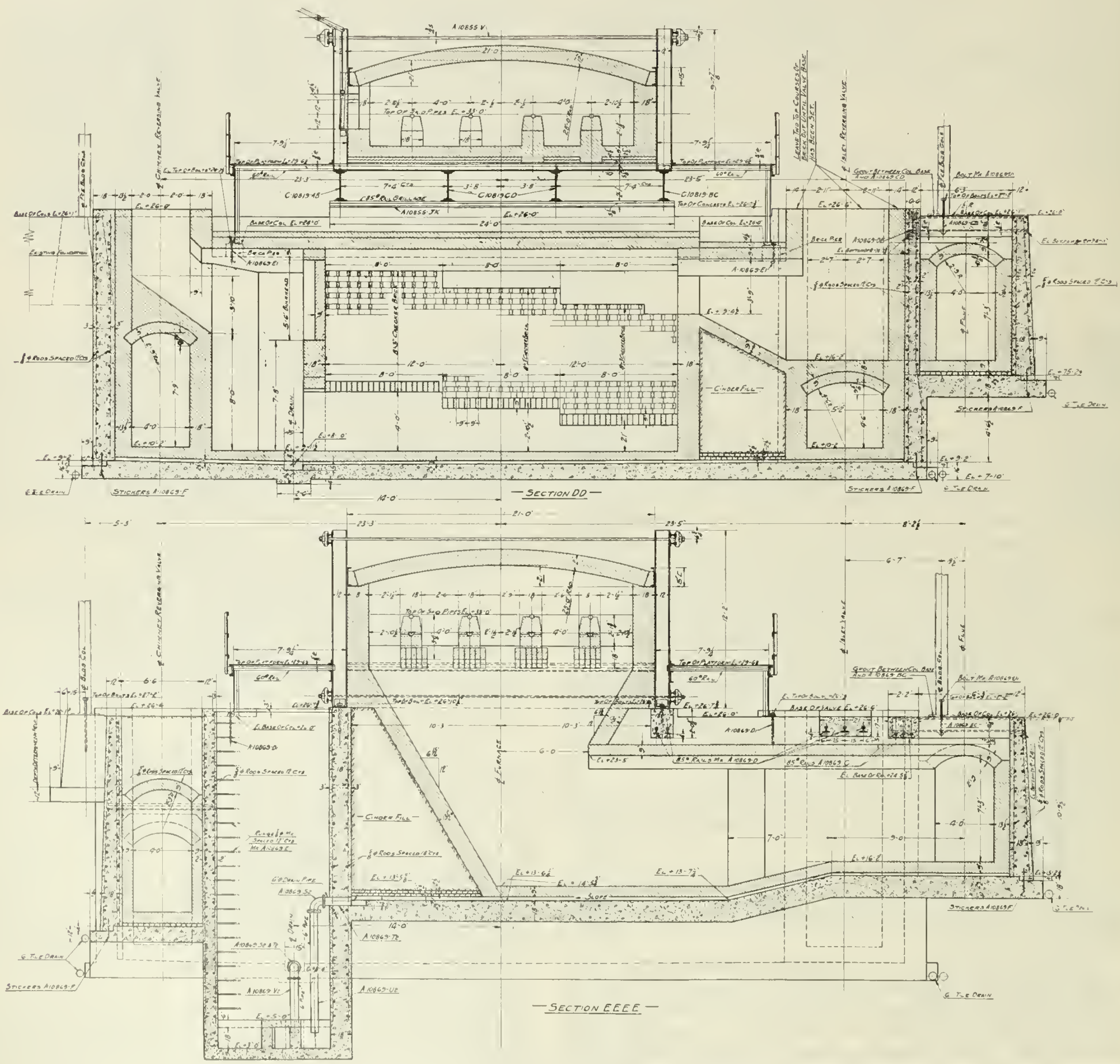

Figure No. 10,—Foundations and Brickwork of 28-inch Rail Mill—Continuous Re-heating Furnace—1921 Design.

Secondary combustion is arranged for underneath the blooms, the coke oven gas entering through four 3 inch diameter burners, the pre-heated combustion air being controlled by five watercooled slide valves, three of which measure 9″ by 2′-4½″ and the other two 9″ x 2′-0¼″. The products of the secondary combustion travel underneath the blooms and meet the products of the primary combustion in the vertical down flues at the charging end of the furnace.

The blooms ride through the furnace on four strands of 2½-inch double extra heavy skid pipes which are watercooled. There is, however, a break in these skid pipes for a distance of about 8 feet just before the blooms go over the top. This section is called the soaking hearth and its purpose is to remove the black spots from the underside of the blooms, caused by riding on the watercooled pipes. Considerable ingenuity has been exercised by others in designing and rolling special sections for watercooled skids for the blooms to ride on, but so far the 2½-inch double extra heavy pipe has survived. Suffice it to say that watercooled skids are a necessary evil.

Details of the Furnace and its Accessories

Other interesting facts in connection with the furnace and its accessories are as follows:—

Furnace dimensions, outside brickwork — 21′-0″ wide x 55′-9½″ long.

Mean height from skid pipes to spring of furnace roof arch — 2′-3″, to which add spring of arch = 21″.

Minimum free area in furnace for flow of gases — 45 sq. ft.

Size of coke oven gas main — 16″ dia.

Combustion air is supplied by motor driven fan capacity 12,000 cu. ft. per min. at 4 oz. (7″ water) pressure per sq. inch, requiring 35 h. p. motor to drive fan.

There are two regenerators (for pre-heating air only), the size of each checker chamber being 10′-3″ wide x 24′-0″ long x 13′-11″ high (all inside dimensions). The volume occupied by checker bricks is 2,030 cu. ft. per chamber. Depth of checker brick filling 8′-3″. Heating surface developed 7,320 sq. ft. per chamber. The quantity of checker brick works out to 4¾ bricks per cu. ft. of checker volume.

The stack is of steel plate construction, self-supporting, 5′-6″ dia. inside of brick lining and 150 ft. high above foundations. It might be said here that a good many furnaces suffer from a too small stack. The stack should be large enough to keep the gases within the furnace at the charging door end, otherwise the smoke and flame leak-out and burn up the castings and binding at this end of the furnace, or hamper the operation otherwise.

Coke oven gas required per ton of steel heated on "wash heats", approximately 1,666 cu. ft. (equivalent to 100 lbs. of coal).

Gas consumption on cold stock would be approximately 4,165 cu. ft. per ton of steel heated (equivalent to 250 lbs. of coal).

Thus the gas consumption per hr. would be 104,125 cu. ft. for either 1,500 tons production on "wash heats", or for 600 tons production on cold stock per 24 hrs. These fuel consumption figures are based on gas of 585 B. t.u., per cu. ft. and furnace working full capacity.

The amount of cooling water required by the Furnace for doors and skid pipes, etc. is 40,000 Imperial gallons per hr.

The inside lining of the furnace is built of "Woodland" clay brick and the roof of silica brick. (Since changed to silica brick).

As special features of the furnace might be listed the following:

(1) Coke oven gas fired with primary combustion over blooms and secondary combustion under blooms.

(2) Regenerative principle of pre-heating combustion air, thus making low fuel consumption and large output possible.

(3) A soaking hearth for elimination of black spots from blooms.

(4) Straight push-through, gravity discharge type, thus handling blooms with a minimum amount of labour and equipment.

(5) Electric double screw pusher for charging blooms into furnace with two motors having special control, working in series on forward stroke thus giving a maximum of power, and working in parallel on return stroke in order to get a quick return. Also the automatic door lifting device in connection with this pusher.

(6) The watercooled charging and discharging doors, as also the watercooled pipe buckstays at front and rear of furnace, and finally the watercooled side doors and door frames.

(7) The large operating platforms on both sides of the furnace.

(8) The facilities provided for the easy control of all necessary operations.

(9) The "Isley" and stack reversing valve design.

(10) The splendid manner in which the furnace is buckstayed and bound.

(11) The large, interlocked, refractory skid pipe supports.

Comparatively speaking, from the start the furnace and its accessories were remarkably free from the usual dose of infantile diseases generally accompanying a new venture of this kind. There have been some minor troubles to be sure, but we have received nothing but praise for the furnace and are proud of the fact.

Since the furnace commenced to operate in August 1921, and up to the present, it has heated about 140,000 tons, (gross), of assorted blooms for 60 lbs., 85 lbs., and 100 lbs., rails and for billets, practically all of which were delivered to the furnace hot from the blooming mill.

In regard to the best tonnage obtained, my information is that we have pushed 60 blooms, weighing about 1½ tons each, inside of one hour, say at the rate of 90 tons per hour of 8¼-inch square blooms on wash heats. When charging cold steel we have pushed thirty 8 ¼-inch square blooms per hour. The best daily tonnage we have obtained is 950 tons of blooms per 24 hours on "wash heats". Of course, in this case the furnace was not the limiting feature, the delays being due to shortage of steel and mill troubles. With everything going well the furnace should be able to easily handle 1,500 tons per 24 hours, which is all the present rail mill can handle.

The fuel consumption has been satisfactory, although it would have been better had the furnace been working up to capacity. The best run we obtained gave 1,950 cubic feet of coke oven gas per ton of blooms. This covered a period of 6 weeks and included all stoppages. The B.t.u., value of the gas averaged 585 cubic feet. We estimate that, with furnace handling 1,500 tons per 24 hours, the fuel consumption would be 1,400 cubic feet per ton of blooms, (wash heats).

While this furnace is not essentially a heat-treating furnace, and was not built with a view of changing the structure of the steel, via heat treatment, it nevertheless is instrumental in improving the finished product for the following reasons.

Before the furnace was installed the rails were rolled direct in one heat from ingot to finished rail. Now the steel is heated twice and therefore there should be less excuse for overheating or burning of the ingots in the pit furnaces, consequently the rail mill gets better blooms. Secondly, the blooms are heated uniformly and at about the same temperature. Previously, the corners and surface of the blooms became chilled before entering the rail mill. This prevented an even flow of metal in the roll passes, causing cracks and other defects in the finished rails. Thirdly, the heating of the blooms tends to relieve internal strains caused by heavy rolling in the blooming mill, giving a tougher rail.

The actual results obtained are that rails are singularly free from surface defects, (flaws, seamy heads and spongy flanges). Rejections due to these defects, since the furnace was installed, have been materially reduced to about as low as one-half of one per cent. As could be expected the grain structure of the rail remains about the same as before and the tensile strength of the finished steel is also very little different.

With the furnace the average production per hour in the rail mill has been materially increased and there should be less wear on the rolls; consequently the tonnage on rolls should be greater than before.

In view of irregularities in the delivery of heats from the open hearth department and interruptions due to breakdowns and delays at the blooming and rail mills, a considerable tonnage of cold blooms accumulated before the advent of the furnace, which blooms had to be cut-up and returned to the steel department for remelting. This represented an appreciable monetary loss which has been entirely overcome with the new furnace.

Last, but not least, the superior results accomplished in the rail mill, partly due to the new furnace, and partly due to the efforts of the present mill organization, have given us a better name with the railroads and the inspection bureaus than we ever had before, and this should be worth something.

The Deterioration and Preservative Treatment of Timber

The Preservation of Timber by Treatment viewed from an Economic Standpoint.

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Abstract of paper read before the Calgary and Lethbridge Branches, of The Engineering Institute of Canada, February 18th, 1924, and February 23rd, 1924, respectively.

Few economic problems of national importance are so vital to the industrial and agricultural welfare of the country as a constant supply of timber at a reasonable cost. Decay is a forest enemy ranking side-by-side with fire, though less spectacular; and it is just as important to arrest the ravages of wood decaying fungi as it is to prevent the forest fire. Each foot of timber saved by longer service means a lesser drain on the forest. Notwithstanding popular conception to the contrary, we are becoming each year more dependent on wood products, instead of less so. The introduction of substitutes does not keep pace with the new and extended uses of wood; the world's needs for forest products are greater than ever before, and they play a more and more important part in the every-day life of man.

Although many of us may seldom buy so much as a single piece of lumber, every individual in the country uses wood every day of their lives. Forest products are consumed in obtaining nearly every raw material; and in mostly every process of manufacture, movement of commerce, and activity of trade. Every ton of steel requires the consumption of wood in mining the ore and the coal used to make the steel. To manufacture cement, coal is used; and therefore wood. Copper and such materials cannot be made without consuming wood. Practically all food is produced with the aid of wood in some form; and much of it is shipped in containers made of wood. About 90 per cent of the paper used is made from wood; and the advance in price of pulp wood has helped to increase the cost of paper, books, periodicals, newspapers, and even advertising. Over 90 per cent of our rural dwellings and from 60 per cent to 90 per cent of our urban dwellings are of wood. The general public, therefore, pays a large portion of its bill for wood in the disguised form of the cost of food, clothing, and other articles that contain no wood at all; and our standards of living are essentially tied-in with adequate wood supplies.

Timber Requirements Increasing

The tendency of requirements for timber to increase is world-wide, in spite of the greater use of substitutes for wood. In the processes of displacing wood from its former use for construction purposes, the substitutes have involved new or enlarged uses of wood incidental to their employment, and chemical research is revealing new uses for wood that were not dreamed of a few years ago. Wood requirements normally increase with industrial progress and growth of population, and such must be met or largely offset by (1) silviculture, (2) a gradual substitution of other materials, (3) better utilization, (4) the saving of waste all the way from the forests to the consumer, (5) the reduction in losses through fire, insects, and disease, (6) the prevention of decay.

In the case of the United States, the present annual drain on their forests is estimated at 25 billion cubic feet, and the present annual growth is only 6¼ billion. The depletion of their supplies and the reduction of their forest area is indeed one of their National problems, and Canada, if not already, will soon be in the same position. An adequate supply of timber is essential to present day civilization. Fire protection, reforestration, scientific lumbering, and elimination of waste, are all necessary for the conservation of this great natural resource, but the waste through decay is equally important and can only be offset by some form of preservative treatment. The latter bears a close relationship to timber conservation and reforestration, since proper preservative treatment converts fast growing, non-durable species into superior durable timbers suitable for structural purposes, and makes possible the use of timber otherwise regarded as little more than worthless. It enables trees removed in thinning the forest to be put to a higher use than for fuel, and also admits of the top and inferior logs being used to better advantage than if left to rot or be sawn into inferior grades. It accelerates the removal of fire-killed and dead timber which is a prey to fire, and enables areas so denuded to be more rapidly re-forested and placed on a profitable basis. It has been truly stated that to a large extent our forests have been mined instead of cropped. They are not inexhaustible, and are being rapidly depleted by increased demands for domestic and foreign consumption.

Estimate of Canada's Timber Resources

The remaining timber supplies of Canada have recently been estimated as: 810,000 million feet b.m., soft wood, and 176,800 million feet b.m., hardwood, including all classes of timber, of which 560,000 million feet b.m., are of saw-timber size. In Canada there are approximately 150 different species and varieties of plants reaching tree size. Only 31 of these are coniferous, but these form 95 per cent of the forest products. The value of the products of the forests of Canada for 1922 were estimated at 550 millions, and this may be considered the second largest industry of the country, with an invested capital of over 231 millions. During the year 1920, the cut for lumber, lath, and shingles, was about 8 billion board feet, valued at 188 million dollars. For the fiscal year ending March 1921, the exports of wood, pulp, and paper, totalled $283,620,000, and were next in value to the exports of agricultural products. During 1922 the total cut for Canadian pulp and paper mills was nearly 4 million cords, and during the same year over one million were exported. Canada's total annual cut, is now estimated at 11 billion board feet, and actually exceeds the annual growth.

The United States uses more wood than any other country in the world, and about two-fifths of the total world consumption. Its per capita consumption is about 212 cubic feet. Their exports and imports about balance; but in addition to their annual cut there are the great losses from fire, wind-falls, disease, insects, and decay, as well as the losses from careless and uneconomical lumbering operations. The per capita annual consumption of timber in the United States steadily increased from 1840 to 1907, since when it has gradually declined on account of shortages and costs. All commodity costs taken at 100 in 1840 had increased to over 200 in 1920, and to 143 in 1921, but it would have required $510 in 1921 to buy the same quantity of a poorer grade of lumber than $100 would have bought in 1840.

Requirements of Railroad Companies

The wood requirements of the railroad companies are enormous for ties, buildings, structures, cars, boats, piles, poles, fences, etc., and are about one-quarter of all the timber cut. The ties in service on Canadian railways probably number 120,000,000. The annual replacements, without consider ng those used for extensions, probably average at least 12,000,000. Preservative treatment has been developed to a degree of effectiveness in various countries which makes it possible to double and even treble the life of many species of wood commonly used for ties, and it is apparent that if even the ties used for replacements were given one of the many well-established processes of preservative treatment, the saving on the annual cut of our forests would be very large, and the same remarks apply with greater force to the still larger quantities of construction timber annually used.

Prolonging the life of wood and increasing its utility through preservative treatment is a large factor in maintaining the net economic service now rendered, by the forests. The National timber supply situation is steadily creating greater interest in wood preservation; and the rising cost of high grade timber tends to decrease the proportionate cost of treatment in the final investment in the treated material. The greater the cost of untreated material, the more important it is to prolong the period of service. Forest conservation implies not only an adequate supply of timber for all requirements, but making timber of its greatest utility, and on both accounts wood preservation is an essential and integral part of conservation. Preservative treatment in making one stick serve where two sticks would otherwise be required, not only helps conserve the forests, but makes available local supplies of wood which are unsuitable for use without treatment.

The Growth, Usable Life and Durability of Timber

There have been erroneous ideas that the forests reproduce, themselves perennially, and that a new cut could be made every ten or twenty years, but as a matter of fact it takes from 60 to 100 years to produce a crop of good merchantable timber.

The usable life and durability of timber varies with its species, its age, the climatic conditions and altitude under which it is produced, the rate at which it has developed previous to being cut, the season at which cut, and in fact from the particular part of the tree from which the stick may have come. Subsequent to cutting, the life will also depend on several factors, such as seasoning, storing, and the handling which it is given during and after construction. The timber supplies of the world have been recklessly exploited, and the conservation and afforestration of these great resources is one of the most important matters with which present-day governments have to deal. The utility and value of timber being so greatly affected by its liability to destruction and decay, it is necessary to consider the sources of deterioration, and the possible avoidance or cures. Timber in service is subject to deterioration from many causes including decay, mechanical abrasion, fire, insects, and marine borers. Any timber placed in contact with the ground will decay at different rates, depending on the species of the wood, the character of the soil, and the climatic conditions of the district in which it is used. It is estimated that the damage to timber through insect attack in the United States alone, amounts to something over 130 million dollars per annum. Fire losses in the United States alone have exceeded 200 million dollars per year, and it is an established fact that in Canada ten trees are lost by fire each year for each one cut by the lumberman's axe.

Primary Causes of Decay in Timber

The primary causes of decay in timber are the presence of sap; exposure to conditions alternately wet and dry; and want of efficient ventilation, especially if accompanied by a warm and moist atmosphere. Some varieties last for an indefinite period when kept continuously under water, and for quite long periods if kept thoroughly dry and well ventilated.

Research has shown that the decay of timber is due to the functions of low forms of plant life termed "fungi". In order to live and develop, wood-destroying fungi require a temperature favourable for growth, and certain amounts of air, moisture, and food. If any of these are absent, the fungus growth is stopped or greatly retarded. Wood which is kept below the surface of water does not decay for lack of air. The interior finish and furniture of a house do not decay, for lack of moisture. Dry-rot and wet-rot are both the result of the decomposition of timber caused by decay; but the former is that chiefly met in practice.

The basic problem in wood preservation is, therefore, to eliminate one of the four essentials necessary to the growth of fungi; and the only one that can generally be eliminated is moisture. The other possibility is to poison the food-supply of the fungus with some toxic or poisonous substance which will readily penetrate it, and that will not readily volatilize or leach out. Fungus growth is started by the spores or reproductive bodies in the fungi, which correspond to the seeds in the higher order of plants, which are blown about by the wind, and find lodgment on the surface and in the cracks of the timber. By some chemical process the wood fibre is dissolved and serves as food for the fungus, thus causing decay; and different forms of fungi differ widely in their methods of attack.

Methods of Seasoning

In general, as soon as timber is cut it begins to lose the water it contains, and this is the first step of the "seasoning" process. Seasoning helps; (1) to prevent injury by insects and decay before service, (2) to increase its durability in service, (3) to prevent shrinking, checking, and warping, (4) to increase its strength, (5) to decrease its handling and shipping weight, (6) to make it more adaptable to injection with preservatives, and for other industrial purposes as well.

Five methods of seasoning or removing the natural moisture present in timber when cut are generally practised; (1) natural or open air, (2) seasoning by saturated steam and vacuum, (3) hot air, or kiln drying, (4) seasoning in superheated steam, (5) seasoning in hot oil. The first two of these are the most commonly practised, where the injection of a preservative is to follow. For the best results in treatment, the timber should first be thoroughly seasoned by some process, and special care should be exercised to see that decay has not already started. Subsequent seasoning is also desirable before the lumber is placed in service. The seasoning has an important effect on the amount of preservative absorbed during treatment, and also by diffusion or capilary action after treatment.

Development of Wood Preservation Industry

No method is known whereby all kinds of wood can be satisfactorily treated, but it is fortunate that the species best adapted to treatment are the most abundant, and possess certain properties both sylvical and commercial, which give them a decided advantage over others. The artificial preservation of wood has been practised from the earliest times. The wooden treasures buried in the tightly sealed tombs of the Egyptian patriarchs, and recently recovered in a perfect state of preservation from King Tutankhamen's resting place after three thousand years, indicate clearly that the ancients were skilled in the art of wood preservation. It was not, however, until the early part of the 19th century that the preservation of wood by the injection of chemicals became scientific in principle, and rapidly developed. The growth of wood preservation in the United States from 1838, when the first chestnut cross-ties were treated has been extraordinary. The greatest modern impulse to the wood preserving industry has been the steady advance in the cost of lumber, and the heavy cost of replacements in certain types of structures.

The growth of this industry in the United States will be apparent from the following figures: for the year 1922, with 128 plants operating, railway ties treated were 41,316,47. The piling treated was 11,085,000 lineal feet; the number of poles treated was 966,400; the wood-blocks treated included 503,880 square yards; the cross-arms treated were 604,758; the construction timber treated was 152,557,000 f.b.m.; and miscellaneous lumber treated was 13,560,430 f.b.m. This represented a consumption of preservative as follows: creosote 86,321,390 gallons, paving oil 1,414,682 gallons, zinc chloride 29,868,640 pounds. Other preservatives 2,176,840 gallons. Creosoting reached a maximum consumption of over 108 million gallons in 1913, and zinc chloride a maximum of over 51 million pounds in 1921, due to a shortage of creosote.

The most extensive use of preservatives has been in connection with construction timber, railway cross-ties, piles, telegraph and telephone poles and cross-arms, car lumber, mine timber, paving blocks, wood stave and wire wound conduits, under-ground conduits, silos, and shingles. There have been issued over 400 patents covering various processes incidental to the preservative treatment of structural timber in the United States alone. Scores of chemicals and compounds have been advocated and tested to preserve wood from decay, but only a comparative few of these possess sufficient merit to justify their use for such. The only successful preservatives are those which either keep the wood comparatively dry, or else impregnate the pores of the wood with a toxic antiseptic, so that the organisms attacking it are killed, or in other words the fungi or bacteria will be unable to develop, and the wood will remain sound. To be an efficient preservative, it must have at least two properties. It must be toxic, that is able to destroy or to inhibit the growth of the organisms that cause the destruction of timber; and it must be as nearly permanent as possible. Experience shows conclusively that coal-tar creosote possesses these properties to a marked degree.

Wood Preservatives Now in Use

Wood preservatives now in use are of two distinct types; (1) inorganic salts which are very soluble in water, such as zinc chloride, sodium fluoride, copper sulphate, and mercuric chloride, and (2) oils such as the creosotes, certain constituents of which are sufficiently soluble to make them poisonous to wood-destroyers.

The use of *zinc chloride* was greatly extended during the war owing to the difficulties in obtaining creosote-oils from England and Germany, and in 1921 amounted to over 51 million pounds in the United States alone. The process was patented in England in 1838, and its use is generally known as Burnettizing. Quite elaborate tests would indicate that as a preservative it will at least double the life of certain kinds of woods for use as railway ties.

Sodium fluoride is even more toxic than zinc chloride or creosote-oil, and is not so readily leached from wood.

It is generally conceded that it has great possibilities as an economical and satisfactory wood preservative.

The creosote oils are the most important wood preservatives now known, and are probably the best, as they are not affected by moisture or temperature, and have a certain lubricating effect on the wood which tends to prevent injury from mechanical wear. The coal tars are products obtained from bituminous or semi-bituminous coal in the process of the manufacture of coal gas, and of coke-oven tar by the by-product process. Dead oil of coal tar, or creosote oil as it is now generally known, is obtained by the distillation of coal tar.

Processes of Treatment

Although a great many processes have been, and are practised in protecting timber from decay, they may logically be divided into two rather distinct groups based on the character of the protection given, viz; superficial processes and impregnation processes, and there is a great diversity of opinion regarding these, both from the standpoint of first cost, and results obtained.

Superficial processes are those which aim to protect the wood by simply giving it a surface protection. This process, however, has much merit where comparatively small quantities of materials are to be treated; as it is cheaper, easily conducted, and under certain conditions efficient. Brush or spray treatments are more extensively practised than any other of the superficial processes. Where facilities are not available for the open-tank or dipping treatment, the results from the brush or spray methods are generally justified. The dipping treatment is acknowledged to give better results, as it permits of the preservative getting into the checks and cracks. A still more effective open-tank treatment consists in a prolonged bath in hot preservative, followed by a bath in cold preservative. Where the expense of some form of pressure treatment is not warranted, the open-tank treatment, using either hot bath only, or hot and cold baths, probably offers the next best method of securing maximum penetration and impregnation.

All *impregnation* processes aim, not only to protect the surface of the wood, but also to force the preservative deeply into it. The depth to which this penetration can be effected, depends on many factors, including the kind and condition of the wood, the character of the treatment, and the kind of preservative used. These processes require quite an elaborate equipment, and therefore cost more, but are generally acknowledged to be the most satisfactory in the end. The impregnation processes may be divided into two classes; non-pressure, or those using no artificial but only atmospheric pressure, and pressure processes using artificial pressure. The first is admirably adapted to the treatment of posts, poles, and mine timbers, where only a portion of the stick is required to be treated. There are about thirty of such plants in operation in the United States, and in many cases good results have been obtained. In general the best results are obtained by means of the pressure processes, which are those generally made use o where large quantities of material and heavy impregnations are involved. There are about two hundred and fifty such plants in operation in the United States to-day, with cylinders ranging from 72 inches to 132 inches in diameter, and up to 172 feet in length.

In Canada the industry is only in its infancy. The first treated ties were used in 1906, and the first commercial plant was erected in 1910. To-day there are six such plants in operation. Plants are also now being erected at three other points.

The pressure processes may be grouped into two general classes:—

(a) *Full-cell* processes, in which the intercellular spaces of the wood are filled as completely as practicable with the preservative.

(b) *Empty-cell* processes, in which a portion of the preservative is withdrawn after it has been forced into the wood as deeply and thoroughly as practicable.

The Economic Value of Preservative Treatment

Up to the present, wood for all purposes in this country has been so plentiful and procurable at such prices, that little thought has been given or steps taken to extend its life or conserve its use. The preservative treatment of timber, however, is not only a requisite to the proper utilization of the available supply of structural wood, but is a real financial economy. Many reckless expenditures have been made, however, because of an improper use of the word "permanence"; and a more correct term to have used and have worked under would have been "reasonable" or "economic" permanence. In any decision as to type of construction, the following features should receive consideration: (1) initial cost, (2) probable life, (3) maintenance expenses, (4) ease of erection, (5) availability of materials, (6) appearance (7) obsoleteness.

Although more lumber is used on farms than in any other one industry and although preventable decay is its greatest destroyer, it is, nevertheless true that farmers use proportionately a less amount of treated lumber than any other class of consumers.

The advantages to the railway companies would be both direct and indirect. The direct results would be reduction in annual cost of maintenance, improved conditions of track due to less frequency in disturbance of the ties, and better track resulting from the use of hardwoods which are well suited for treatment, thus releasing an equivalent quantity of valuable softwoods for other uses. The indirect results are the reduction of ties required by probably 50 per cent, or approximately 12 million ties per annum in Canada, and over 80 million in the United States. It is apparent however that the railway companies should interest themselves not only in the available supplies of ties, but in conserving those they use. Any use made of treated hardwood ties would result in utilizing what is now either used for fuel or left standing as a prey to forest fires, and at the same time admit of an equal quantity of the more valuable softwoods being made available for other purposes. During 1922 the railroads in the United States used about 85 per cent of the total output of the timber treating plants, and operated 22 per cent of them. Tie expenditures are generally considered the second largest material account of most railroads. In 1921 over 100 million ties were used, of which about 75 per cent were treated, and during many years this number reached 125 millions. During 1922, over one-half the ties placed in track by "class 1" railways in the United States were treated. With some companies who have not yet adopted treatment, it is probably a question of finance, or the adherence to an indefinite policy of low first cost, rather than a higher first cost with a lower average over a number of years.

In addition to the railroads many other large users of timber are alive to the economic and other advantages of treated lumber. Granting that any timber can be made more resistant to decay by preservative treatment, such treatment may not be economical, even though the

Table No. 1,—Annual Cost of Ties.

Lasting various lengths of time costing in place various sums, money figured at 6% interest.

Life in Years	COST IN PLACE											
	$0.40	$0.50	$0.60	$0.70	$0.80	$0.90	$1.00	$1.10	$1.20	$1.30	$1.40	$1.50
1	0.426	0.532	0.638									
2	0.219	0.273	0.328	0.383	0.437	0.492	0.546					
3	0.150	0.187	0.225	0.262	0.300	0.337	0.375	0.412	0.449			
4	0.116	0.145	0.173	0.202	0.231	0.260	0.289	0.318	0.347	0.376	0.405	0.434
5	0.095	0.119	0.143	0.166	0.190	0.214	0.238	0.261	0.285	0.309	0.333	0.356
6		0.102	0.122	0.143	0.163	0.183	0.204	0.224	0.244	0.265	0.285	0.305
7		0.090	0.108	0.126	0.144	0.162	0.180	0.197	0.215	0.233	0.251	0.269
8		0.081	0.097	0.113	0.129	0.145	0.161	0.177	0.193	0.210	0.226	0.242
9			0.088	0.103	0.118	0.132	0.147	0.162	0.176	0.191	0.206	0.221
10			0.082	0.095	0.109	0.122	0.136	0.149	0.163	0.177	0.190	0.204
11				0.089	0.102	0.114	0.127	0.140	0.152	0.165	0.178	0.190
12				0.084	0.095	0.107	0.119	0.131	0.143	0.155	0.167	0.179
13					0.090	0.102	0.113	0.124	0.136	0.147	0.158	0.169
14					0.086	0.097	0.108	0.118	0.129	0.140	0.151	0.161
15						0.093	0.103	0.113	0.124	0.134	0.144	0.154
16						0.089	0.099	0.109	0.119	0.129	0.138	0.148
17						0.086	0.095	0.105	0.115	0.124	0.134	0.143
18							0.092	0.102	0.111	0.120	0.129	0.139
19							0.090	0.099	0.108	0.116	0.125	0.134
20							0.087	0.096	0.105	0.113	0.122	0.131
21							0.085	0.094	0.102	0.111	0.119	0.128
22								0.091	0.100	0.108	0.116	0.125
23								0.089	0.098	0.106	0.114	0.122
24								0.088	0.096	0.104	0.112	0.120
25								0.086	0.094	0.102	0.110	0.117

timber is to be exposed to the most severe fungus attack, and is only to be in service a short time. If, however, the wood is naturally of low durability, and is to be used in a permanent location, preservative treatment will show marked savings.

Records of Results from Treatment of Timber

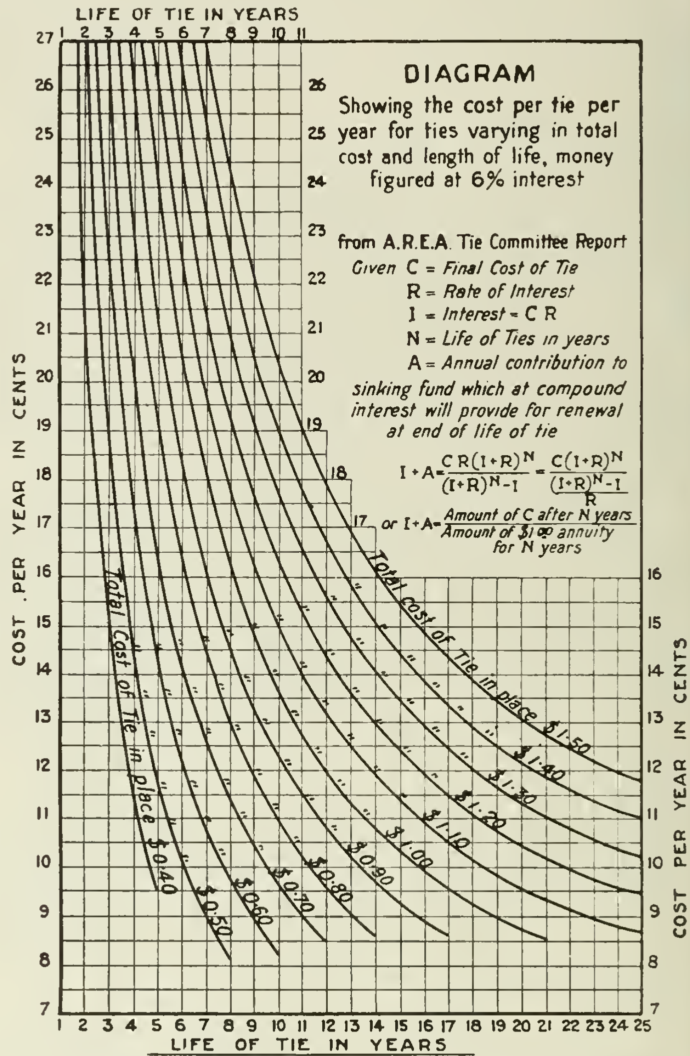
Ties treated by certain processes have now been in use on various railways in the United States for over forty years, and by various creosoting processes for over twenty years. Unfortunately the service records of such have not been as complete as was warranted, as quite a number of the companies discontinued their tests and records after having been convinced of the economic values of treatment. The results of track tests to date indicate however that the best treatments are probably zinc chloride, (Burnettizing); zinc chloride and creosote, (Card Process); and straight creosote.

If the mechanical life of a tie is likely to be shorter than the life to be expected from a full-cell creosote treatment, the cost of the latter may not at the present time be warranted. A decision on the proper treatment to be used must however be regarded largely as an investment problem, and should in the first analysis consist in comparing the life being obtained from untreated ties, with an analysis of the probable fixed annual charges, as against treated ties with a life which has been shown to be a minimum from authentic data available. It is now generally admitted that the use of treated ties of one kind or another for permanent track construction has not only become an economic necessity but an economic duty, except possibly where quantities of naturally long-lived woods are still readily available.

Cost of Treatment compared with Increased Life

If we assume that the cost of creosoting a tie is about equal to its initial cost untreated, and that such treatment would increase its service life from 8 to 25 years, the reduction in annual charges on a 6 per cent basis on the replacements of half the ties in use on Canadian main line railways would represent over 2 million dollars, or 6 per cent interest charges on nearly 40 millions. Or if we assume that the cost of treating such ties by a zinc chloride process were about half the cost of a creosote treatment, and by such treatment the life were extended from 8 to 20 years, the reduction in annual charges above referred to, would be about 3½ million dollars, or the annual interest charges on over 60 millions. Ideal treatment would be one in which the ties failed from decay and wear at the same time.

If the wood is refractory and difficult to treat, heavy treatment of straight creosote is probably best. If, however, the wood is porous and easily treated, some cheaper



EXAMPLE:— C = $1·40 .... N = 20 Years ... R = 6%

From Tables $(1+R)^N$ = 3·20714 .... Log = 0·5061180

" " $\frac{(1+R)^N - 1}{R}$ = 36·7857 .... Log = 1·5656786

$\bar{2}$·9404394

C = $ 1·40 .... Log = 0·1461280

A + I = 0·12234 .... Log = $\bar{1}$·0865674

Figure No. 1,—Cost per Tie per year for Ties varying in Total Cost and Length of Life.

honorary degree of Master of Arts bestowed on him recently at the twenty-fifth anniversary of the founding of Sacred Heart College, Bathurst, N.B. Mr. Thériault was the first graduate to receive the degree of B.A. from this institution.

W. H. Breithaupt, M.E.I.C., of Kitchener, Ont., was elected president of the Ontario Historical Society at their annual meeting in Kitchener recently. In volume XXI of the society's "Papers and Records" is a contribution by Mr. Breithaupt entitled "Dundas Street and Other Early Upper Canada Roads". Mr. Breithaupt is also president of the Waterloo County Society.

Horace L. Seymour, M.E.I.C., town planning engineer of Toronto, has entered into a contract with the council of the township of Waterloo for the planning of the township, which comprises some 120 square miles. The work will include proposals for the improvement of the highway and road system, suggestions for park and parkway development, and the location of public buildings together with zoning and building by-laws.

R. P. Donkin, A.M.E.I.C., assistant professor of mechanical engineering at Nova Scotia Technical College, Halifax, N.S., has resumed his work as consulting mechanical engineer for the Parsons Ocean Power Company, Limited, and is at present engaged in designing and fabricating their large scale experimental plant which is to be installed at Herring Cove, Halifax County, this summer.

John G. Hall, S.E.I.C., who has been assistant superintendent of the Back River Paper Company, Montreal, for the past three years, has been appointed manager of the Winnipeg office of the Combustion Engineering Corporation, Limited. Another recent appointment with this company is that of H. J. McCreery, formerly manager of the Toronto office of the Canadian Sirocco Company, Limited, who becomes manager of the Vancouver office.

E. A. Markham, A.M.E.I.C., has moved to Vancouver where he is managing director of the Vancouver branch of the Poole Construction Company. Mr. Markham is at present engaged for his company on the new Bank of Montreal Building costing $400,000. Mr. Markham was formerly superintendent of construction for the company in Regina and was engaged in recent years on the Weyburn Mental Hospital costing $2,500,000 and the Saskatchewan Co-operative Creameries building.

E. M. Archibald, A.M.E.I.C, has resigned his position with the Provincial Highways Board of Nova Scotia, and entered into partnership with E. F. Powers of St. John to form the firm of E. F. Powers Construction Company, Limited. This firm has recently started work on their contract to dig the canal for the Rugh Falls Development of the Sheet Harbor system of the Nova Scotia Power Commission. The value of the contract is about $200,000.

D. Walter Munn, A.M.E.I.C., professor of mechanical engineering at Nova Scotia Technical College, and consulting mechanical engineer, is superintending the modernizing of the cold storage and fish freezing plant of the North Atlantic Fisheries, Limited, at Halifax, Nova Scotia. The old steam driven equipment is being discarded to a large extent because of its age and lack of capacity for handling the business offering. The new equipment includes two new refrigerating machines, new direct expansion piping in main freezer, new centrifugal circulating and brine pumps, and complete electrical drive for all machinery. Steam driving equipment is being retained as reserve and stand-by. Total cost including minor changes to buildings and wharves will exceed $25,000. Contracts call for the completion of work by 21st of August. With these changes the North Atlantic Fisheries, Limited, will have the most up-to-date and largest general cold storage and fish freezing plant in the city.

Acting City Engineer and Manager, Outremont

Emile Lacroix, A.M.E.I.C., of Outremont, assistant city engineer, was appointed acting city engineer and manager of the city of Outremont, to fill the vacancy occurring through the resignation of Major J. A. Duchastel de Montrouge, who recently accepted the position of general manager of the Quebec Forest Industries Association, Limited. Although a number of applications for the vacancy had been received, the city council was unanimously in favour of Mr. Lacroix's promotion. Mr. Lacroix was born in Montreal in 1885, and following his graduation from Mount St. Louis Institute in commercial and scientific courses, in 1906, he entered Ecole Polytechnique, from which he graduated in 1910. The same year he was appointed assistant city engineer of Outremont, from which position he has just been promoted.

H. M. Scott, M.E.I.C., enters Contracting Field

H. M. Scott, M.E.I.C., has opened an office at 1108 Federal Building, Toronto, under the name of H. M. Scott and Company, general contractors; Mr. Scott has had extensive experience in construction work, having been connected with the P. Lyall and Sons Construction Company, Limited, since 1909. From 1909 to 1911 he was assistant superintendent on various contracts. He was then appointed superintendent in charge of the construction of the Transportation building in Montreal. During 1912 and 1913 he was Toronto manager, and the following year he was appointed western manager for the company. In 1915 he was placed in charge of the company's munitions department, and at the close of the war was made manager of the mechanical department. His most recent work has been on the construction of the Welland Ship Canal.

H. B. Muckleston, M.E.I.C., affiliated with Dr. J. A. L. Waddell, M.E.I.C.

H. B. Muckleston, M.E.I.C., consulting engineer of Vancouver, B.C., announces his affiliation with Dr. J.A.L. Waddell, M.E.I.C., consulting engineer of New York City, for the design and supervision of construction of bridges in Alberta and British Columbia.

Dr. Waddell enjoys an international reputation as an expert in bridge design and economics, having to his credit in Canada and the United States hundreds of bridges of all kinds. He has also designed and constructed many important and difficult bridge structures in Mexico, Japan, New Zealand, Russia, and Cuba.

While Mr. Muckleston has not hitherto specialized in bridge work, he has had a large and varied experience in important and difficult construction, involving complex problems in design and execution, and under the arrangement, Dr. Waddell will make the economic studies, estimates and layout, and will prepare the complete drawings and specifications for such bridge work as is undertaken, and Mr. Muckleston will inspect and supervise construction for the client.

Awarded First Strathcona Memorial Fellowship

Victor Topping, C.E., A.M.E.I.C., of Toronto, has been awarded the first Strathcona Memorial Fellowship, created under the will of the Late Lord Strathcona, for research work, in transportation at Yale University. Mr. Topping is a graduate of the University of Toronto, and has the degrees of M.A., B.A.Sc., and C.E., the latter having been conferred upon him this year. He was born in England and came to this country with his parents in 1912 when he was sixteen years of age. From early in 1912 until December 1913, he was with the Canadian Pacific Railway, and from 1914 to 1917 he was resident engineer on the western sections of the Toronto harbour improvements, during which time he pursued his studies, taking a four years' course in three years. In 1917 he went overseas with the Royal Flying Corps, and while there was badly burned in a flying accident in 1918, when his machine took fire and came crashing to the ground. For the next four years he was in hospital, and since his return in 1922 he has been connected with the Toronto Transportation Commission, with which he holds the position of engineer of traffic analysis. The honour which Mr. Topping has recently received is the result of various studies which he has made in transportation problems.

MAJOR J. A. DUCHASTEL De MONTROUGE, M.E.I.C.

Major J. A. Duchastel de Montrouge resigns as General Manager of Outremont

Major J. A. Duchastel de Montrouge, M.E.I.C., general manager and city engineer of Outremont, Que., has resigned to accept the position of general manager of the Quebec Forest Industries Association. Major Duchastel has been in the services of the city of Outremont for some eighteen years, first as town engineer and latterly in the combined posts of general manager and city engineer, an amendment to the city charter having been made five or six years ago to permit his appointment to the managership. Under his care the city has made immense strides in the efficiency of its public services.

Major Duchastel is a graduate of Ecole Polytechnique, Montreal and Laval University. His early work prior to entering the services of the city of Outremont, was with the Canadian Pacific Railway, and as assistant engineer with H. E. Vautelet, M.E.I.C., on bridge and steel construction.

Major Duchastel has held many public offices. He is a past-president of the Royal Automobile Club of Canada; past-president of Canadian Good Roads Association, and a past district-vice-president of the American Road Builders' Association of New York. In *The Institute* he has been councillor for the past three years.

Canadian Delegate to International Conference on Geodesy and Geophysics

Noel J. Ogilvie, M.E.I.C., director of the Geodetic Survey of Canada, Department of the Interior, has been elected delegate by the National Committee of Canada on Geodesy and Geophysics to attend the Second General Conference of the International Union of Geodesy and Geophysics to be held at Madrid, Spain, from September 24th, to October 10th, 1924.

The National Committee of Canada was formed by the Honorary Advisory Council for Scientific and Industrial Research in 1920, for the promotion and co-ordination in Canada of the study of the various branches of geodesy and geophysics, more especially in relation to their international requirements. The committee has as its aims and organization first, to co-operate with other

NOEL OGILVIE, M.E.I.C.

investigators in the British Empire; to unify and co-ordinate all results with those of the United States and Mexico, so as to build up one complete whole over North America, and secondly, to co-operate as much as possible with all other countries in the obtaining of uniform results and methods which can be used for scientific purposes.

Association of Professional Engineers of Nova Scotia

The Association of Professional Engineers of the province of Nova Scotia will hold a summer meeting at the Norfolk Hotel in New Glasgow on the first Thursday in September. In the morning there will be a business session. In the afternoon there will be an outing arranged by the members of the association residing in New Glasgow and vicinity.

Trade Publication

The Canadian Ingersoll-Rand Company, Limited, 260 St. James St., Montreal, announce the publication of bulletins K-317, Ingersoll-Rand Class "PRE" Duplex Direct Connected Synchronous Motor Driven Air or Gas Compressors and K-318, Ingersoll-Rand Class "ER" and "FR" Belt and Steam Driven Straight Line Air or Gas Compressors. Each of these new forms contains 32 pages and is of standard letter head size. They are profusely illustrated with views of complete machines, parts, cross sections and typical installations in various parts of the Dominion.

full-cell process, or even some empty-cell process might be preferable. It is, however, now generally conceded that any preservative process which will double the natural life of the tie at a total cost for the handling and treatment not exceeding the cost of an untreated tie, is a paying proposition for any railway company. Extensive tests also indicate that the item of cost is of equal importance to that of increased life; that ties treated by inferior processes or preservatives may be less economical than hardy untreated ties, and that ties from less durable woods treated with a mixture of creosote oil with other less expensive toxic agents may be more economical than those treated with straight creosote, notwithstanding the longer life of the latter.

The actual problem involved is one of economics. What is wanted is a reduced cost per year per tie; and the question is how much more life the treated tie will have over the untreated one, and how this extra life will compare with the cost of treatment. One of the principal items influencing the comparative economy of ties is that of making the length of the physical and mechanical life the same. In regard to tie material in Canada, tamarac and oak are rapidly becoming extinct, and future requirements will have to be largely filled by spruce, jackpine, birch, beech, hemlock, fir and maple. Some species of the cotton woods and the poplars treated with straight creosote have been proven to make first-class ties, with a very long life, and will no doubt be used in large quantities.

There are probably 6½ million cubic feet of timber used per annum in connection with mining operations in Canada. In Europe, treated timber has been extensively used in mining for many years; and the reason for apparent lack of interest in timber preservation by the mine operators is that mining timber in most localities has been plentiful and comparatively cheap, and the timber situation not sufficiently acute to cause the mine operators to seriously consider the benefits to be derived from its adoption.

With regard to telegraph, telephone and electrica service poles, the portion of the pole that needs protection from fungi is the section immediately above and below the ground line, i.e., where the air, moisture, heat, food and other conditions for decay are at an optimum. Of the three million poles annually used in the United States over 66 per cent are cedar, and 14 per cent chestnut, or 80 per cent from two kinds of wood. With treatment, however, there is no reason why the pines, spruces, and firs could not be drawn on to a large extent. There are considerably over one-half million poles on telegraph, telephone, and electrical service lines in Alberta alone, and if we assume that even one-tenth of these are annually replaced, the possibility for large savings through doubling their service life cannot but be apparent.

On the basis of 6 per cent interest, an expenditure of $7.36 would require an annual payment or charge of $1.00, if the life of a timber were 10 years, while if the life were increased to 25 years the expenditure could be $12.77 and the annual charge would still remain the same. In regard to the general run of construction timber, it is probable that the annual charges on such could be reduced from $2.00 to $2.50 per m.f.b.m., as a result of a creosote treatment properly selected to meet the particular conditions of service to which the material was to be subjected.

It is probable that in the near future one will be able to procure treated, framed, and dimensioned material, i.e., fabricated creosoted lumber, just as readily as fabricated steel. Structures built of such should give efficient service, and would possess a factor of flexibility which admits of revision, necessary through changed conditions of service, as so often occur in connection with piers, docks, wharves, etc., where not only new types of ships and cargoes have to be taken care of, but new mechanical handling-systems as well.

The subject as a whole is one of National economics, and is vital to the social, industrial, and agricultural welfare of Canada, which since the commencement of the world war has been looked upon as the largest and most important source of coniferous timber within the Empire; and the preservative treatment of wood, exposed to decay and attack of insects or marine borers is becoming an economic necessity.

The writer believes that the day is not far distant when several large treating plants will be established in western Canada; that it will be common practice to treat most of the timber used; and that this will result in large quantities of the timber of northern Alberta, Saskatchewan, and Manitoba, including the poplars and cottonwoods, being used for purposes it is not now considered suitable for; or in more general terms, the preservative treatment of timber, by lengthening its life and by permitting the use of other species of lumber, not only helps conserve a timber-users resources, but the Nation's timber supply as well.

First World Power Conference

Held at Palace of Industry, Wembley Exhibition Grounds. Gathering a Notable Success. Delegates welcomed by H.R.H. Prince of Wales, Hon.M.E.I.C. Canadians take Prominent Part.

Whatever may be the outcome of the World Power Conference, it is quite evident that not only the leading men in the engineering and industrial field in Great Britain but those occupying high place in the political and financial life of the nation consider that the Conference has been an epochal event in the history of nations. On account of the splendid story which Canada had to tell, and due to the able manner in which it was presented by members of the Canadian Delegation, a most favourable impression was created toward Canada which amply justifies any effort necessary in preparing and presenting the various Canadian papers and in the sending of the delegation from the Dominion.

According to those responsible for organizing the Conference, it was a serious effort to obtain international co-operation, not only in experience but also in practical knowledge so that a practical basis might be established for the great events of the future. In a brochure devoted to the Conference they state that it has become more and more evident that the economic prosperity depends on the closer co-operation of engineers, scientists and economists, since the productive value of any theory or any principle depends on its translation into a scheme of development which can be immediately used either to improve the industrial equipment of any country or to make a more scientific use of the natural resources at its disposal and also that it is quite useless to base any scheme of radical improvement solely on the advice of politicians, social theorists or even financiers since under present conditions there is no lack of capital for financing plans provided they have been elaborated in every detail and found to have a direct productive value. Continuing, the booklet states:—

"The real wealth of any country lies in the capacity of the resources at its disposal to make every sphere of activity economically justifiable, the experiences of the last five years have proved that potential or actual industrial equipment is of infinitely greater value than an immense accumulation of capital which is not being used. The kilowatt-hour may be a more reliable symbol of value than any monetary unit, since the latter represents a potential and the former a real value. International co-operation would prepared the way for a closer connection between finance and natural resources, translate one into terms of the other, and ensure a levelling up of all means of production under modern conditions.

A further aspect of the question of natural power resources lies in the realization in a different sphere of the ideal of imperial unity advocated at the Imperial Economic Conference. In the event of international action being impossible, Britain could show, through a closer financial understanding with the Dominions, based on legislation similar to the Trade Facilities Act, that the development of natural power resources may be carried out according to a definite policy for a 'bloc' of countries, in much the same way as international development should take place. This aspect of the problem has been examined by Sir Ernest Harvey, R. P. Wilson, Sir Philip Greame, and certain broad conclusions have been drawn which may be usefully applied. Before any imperial development scheme can be adopted, however, there is necessity for legislation with a broader financial basis than anything hitherto evolved.

The purpose of the World Power Conference was to consider how the industrial and scientific sources of power may be adjusted nationally and internationally:—

By considering the potential resources of each country in hydro-electric power, oil and minerals.

By comparing experiences in the development of scientific agriculture, irrigation, and transportation by land, air and water.

By conferences of civil, electrical, mechanical, marine and mining engineers, technical experts, and authorities on scientific and industrial research.

By consultations of the consumers of power and the manufacturers of the instruments of production.

By conferences on technical education to review the educational methods in different countries, and to consider means by which existing facilities may be improved.

By discussions on the financial and economic aspects of industry, nationally and internationally.

By conferences on the possibility of establishing a permanent world bureau for the collection of data, the preparation of inventories of the world's resources, and the exchange of industrial and scientific information through appointed representatives in the various countries.

Prince of Wales welcomes Delegation

The Conference was inaugurated by an afternoon session at the Palace of Industry, Wembly, and a banquet at Queens Hall in the evening of June 30th, both of which were presided over by Lord Derby, Chairman of the British National Committee. At the former the Prince of Wales, as President of the Exhibition, extended a welcome. His address and those by notable Britishers in the evening revealed to the visitors that England was taking the Conference seriously, believing that in it lay great possibilities for the future economic development of the world.

In his address the Prince said:—

"It is with great pleasure that, as President of the British Empire Exhibition, I now welcome the delegates who are assembled in session to discuss the many vital problems connected with the first World Power Conference. I feel this to be an occasion of great importance, for it may prove the beginning of a series of conferences whereby the combined knowledge and judgment of the world may be devoted to the solution of the many difficulties confronting, not only science and research, but also economic progress throughout the world. We have become accustomed to the idea of an international clearing-house for many things, and in the League of Nations, with its Labour Office and International Court of Justice, have seen international co-operation at work in political and labour questions, and in law; but the deeper questions connected with industrial progress and equipment, with natural resources, with the conservation of energy and of fuel, and with standardization in design and manufacture, have hitherto, I believe, been examined by each country in isolation, with results that are apparent to everyone. In the effort to create for industry, and especially power, what the League of Nations intends for politics, lies, I think, the true significance of the World Power Conference, and in the belief that something more fundamental than merely technical discussions will result, I extend a cordial welcome to the distinguished representatives here to-day. (*cheers.*)

"The study of power, even if we consider the technical aspect, is still in a comparatively elementary stage, and no effort has hitherto been made to find out on what foundations our present industrial structure is built and what part power plays in this structure. It is difficult to conceive any modern industry where power in some shape or form does not play a part — steam, gas, oil, or electricity, it forms the one great instrument in the possession of man by which he is capable of extracting from Nature everything of value that Nature can offer, and of converting this material wealth into something of immediate use. As one expert says:—'The social structure itself is, in a sense, bound up with the effective use of power for industrial purposes, and there are many reasons to support the view that the weakness of the social structure in an industrial state is due to inefficient or inadequate utilization of power. You are all familiar with the main objects of the World Power Conference, and have each, in your own degree, contributed to our knowledge of certain aspects, so that it is unnecessary for me to discuss the matter in detail, but there is one consideration which has specially appealed to me. You each represent the views of the main countries of the world on certain questions attached to power, and though your individual views may not necessarily coincide, the mere fact of discussion in an atmosphere of cordial appreciation must do much to tighten those personal contacts which form the inspiring motive of progress in every great activity connected with the modern industrial state, in finance as well as in science, and in research. (*Cheers.*) All three, finance, science, and research, are universal, but the utilization of the results derived from those three activities is not universal, and in this disparity lies one of the greatest obstacles to progress.

"We should find inspiration in the vision of over 30 countries here contributing, each in its highest capacity, to the discussion of one subject of more than merely temporary importance. You are at grips with fundamentals, and from your deliberations will result the first enunciation of a policy applied internationally which may contribute very largely to the harmony and economic progress of the world. You have before you, in the reports submitted to the World Power Conference, the raw material for a survey of the power resources of the world; you can now explore many countries which have hitherto been veiled in mystery, and assess at their true value the possibilities of an immense industrial development in many of them; you may, from this material, erect the structure which will go beyond the confines of one country, or group of countries, and include all those parts of the world where man can hope to prosper. International co-operation may emerge from the realm of the ideal into the realm of practical utilization as the result of your deliberations, and I sincerely trust that full success will attend them." (*Renewed cheers.*)

Sir Joseph Cook, acknowledging on behalf of the Dominions the Prince's welcome, said that the Dominions represented the greatest untapped reservoirs of power and resources generally in the world. The Dominions aimed at producing something more than the raw materials of Empire, and to confine oneself to that side only was equivalent to a bird trying to fly on one wing. They had in the Dominions everything which ministered to the wants of man, and therefore were proud to take their place in this conference on the development of the resources of power in general. Europe was still sick and in trouble, and what was wanted to-day was a balance of accounts more than one of power. That would never be obtained by going back to pre-war standards, but by seeking and developing new sources of power, as at present the actual development of power was not sufficient either for the needs of the individual or the State. The secrets of nature were age old, but she would surrender them if they knocked at the door long enough. They were grateful to the Prince of Wales for that able speech, and they were under a permanent obligation to him for the interest he gave the great matters of Imperial concern. (*Cheers.*) Sir Guido Semenza, president of the Italian Committee acknowledged the Prince's welcome on behalf of the European nations. He hoped the spirit of co-operation would be reinforced as the Conference continued. He stressed the influence of power in the development of civilization pointing out that ancient civilizations failed to progress because they failed to discover new sources of power. Dr. Kamo, speaking for Japan, said they were at the Conference rather to listen than contribute information. O. C. Merrill, chairman of the American Delegation spoke on behalf of the United States and of South America. He said that electrical energy was the greatest power ever placed in the hands of man. Ancient civilizations were serfdom and slavedom while modern civilization was a progressive liberation of mankind by the utilization of the resources of nature. The Conference, by bringing peoples of different nations into contact, would bring about a mutual understanding which was what the world needed most to-day, for contact between people such as those represented at the Conference rather than between governments counted most heavily in the scale. M. Guillaume, Director of Mines, France, speaking on behalf of his country, expressed the pleasure they felt at the presence of the Prince of Wales. He believed the Conference would be a great benefit in contributing to solve the world problem of power utilization.

The Queens Hall Banquet

At this function many of the visitors who were in England for the first time had their first introduction to British entertainment and hospitality, which throughout the Conference was generous in the extreme. Since the British have been engaged in entertaining for centuries and from generation to generation in their homeland they have developed a true instinct which makes them past masters of the art. This was apparent at the first banquet and was more and more evident as the convention proceded. There were over 600 present: The banquet was given by the Grand Council of the British Committee to all the visitors. In proposing the toast of the First World Power Conference, The Right Hon. Earl Derby, K.G., sounded a buoyant keynote of great expectations for the Conference. He prophesized that from the present Conference would come a fund of knowledge which would advance science to a large extent. The Conference was bringing to a common fund the intelligence and scientific knowledge of the electrical world from all parts of the globe and was bringing with it a desire to contribute something for the common good. Out of it must come something of value to all the countries of the world. Responses were made by M. Arbelot, vice-president of the National Committee, France, and by M. F. V. Hansen, chairman of the National Committee, Sweden, who said that in their earliest geography lessons they learned that Great Britain and her Dominions were a world power. Nevertheless their visit to the Great Exhibition had overwhelmed them. Dr. S. Z. de Ferranti proposed the toast to our guests. He stated that one of the things which would be remarked on in the future would be how very little electricity had been made use of at the present time. Mr. Frank Hodges, M.P., Civil Lord of the Admiralty, in replying, said that those assembled were framing more or less the future of the world. He had always felt that the scientific mind was the dynamic mind of the world and the political mind ought always to be subservient to it. He believed that the Conference would be written down as the starting point in the sharing out of the world's knowledge, not so much for any particular nation's advantage as for the service of mankind. The same sentiment was expressed by M. J. G. Dellaar Spruijt, vice-president of the National Committee of the Netherlands and by Col. The Hon. Sir James Allen, chairman of National Committee, New Zealand. Mr. A. Munro Grier, K.C., Hon. vice-chairman of the National Committee, Canada, proposed in eloquent terms the toast to the chairman, to which Lord Derby replied in humourous vein.

The Technical Sessions

Participation of Canadian Delegates in Conference Sessions

Under the chairmanship of Sir John Snell, the first technical session, on Tuesday morning, July 1st, was devoted to the "Resources of the British Empire and the United States". At this session twenty papers were presented, the first dealing with the "Power Resources of Australia", in which it was pointed out that ample natural resources were available for the production of the necessary energy for the development of the pastoral and mineral industries, and there were abundant supplies not only of black coal, but of brown coal, and of water power up to 10,000,000 h. p.

The paper on "The Coal Resources of the World", by Sir Richard Redmayne, discussed primarily the eventual exhaustion of this source of power, next proceeding to a study of the means whereby the utilization of this power could be more economically effected, and the means necessary for preventing its waste.

In a paper on "The Physical and Chemical Survey of the National Coal Resources of Great Britain", Dr. C. H. Lander examined in a general way the possibility of heavy oil being utilized as a source of power. The United States was mentioned as being the world centre for the production, consumption and exploitation of petrol, between 70 and 80 per cent of the world's production of this material being controlled by that country.

Professor A. H. Gibson, in a paper on "A Review of the Water Power Problem in Great Britain and Ireland", gave an account of the work of the Water Power Resources Committees, and remarked that in Great Britain and Ireland the State did not exercise any proprietary rights of the water power, and that all development that had taken place had been by private enterprise. An examination showed that in Great Britain there remained 210,000 k.w., and in Ireland 280,000 k.w., of water power still undeveloped. Of the water power utilized, 74 per cent was employed for general industrial purposes, 14 per cent in the electro-chemical industry, while 9 per cent was used for public supply, and 3 per cent in agriculture.

In a paper on "National Review of the Water Power Resources of the Indian Empire", Mr. J. W. Meares pointed out that in a tropical and semi-tropical country such as India, the development of water power depended essentially on the storage facilities. The total power now utilized was about 147,000 k.w. Construction was being undertaken to utilize a further 109,500 k.w., and projects with possibilities amounting to not less than 1,158,000 k.w. were under examination.

"The Water Power Resources in New Zealand" were discussed by Mr. Lawrence Birks. Water powers were available in falls from 1,000 h.p. and upwards, rising to 770,000 h.p. in the North Island, and as much as 4,100,000 h.p. in the South Island. Its development of water power had been largely a matter of private enterprise, though in 1903 legislation reserved to the Crown the sole right of developing any new source of power. After a careful study of the whole situation, it was decided in 1918 to adopt as a basis of power requirements 1/5 h.p. per inhabitant, and on this basis, allowing for losses, the total power necessary had been estimated as 160,000 h.p. in the North Island, and 110,000 h.p. in the South Island. In the North Island this power was being developed in three stations which would eventually be inter-connected by a complete system of transmission lines working at 110,000 volts, with a total length of 1,112 miles. There would also be secondary transmission lines operating at lower voltage, with a total length of 309 miles. This programme would be completed within ten years at a cost which would allow power to be produced at £6 per h.p. year, and would lead to an economy of 1,000,000 tons of coal per annum. In the South Island the system of development had not yet been finally determined, but at present 77,000 h.p. were under survey or in course of development.

The entire second day's sessions of the conference were devoted to the Economic Aspect of Power Resources, — Economical and Financial, under the chairmanship of the Right Hon. Sir Robert Horne, G.B.E. He professed to believe the practical point of view the most important aspect of a great subject. The world could only be saved from its present chaotic condition, he stated, by increasing the wealth of the world and by enormously adding to its production.

Major General Sir Philip M. Nash, in presenting a paper on the "Economic and Financial Problems of World Power", made the prophecy that as engineers and industrialists we were only now at the beginning of great developments which might in time change the whole economic aspect of the world. He said the value of an international power policy was evident and that the British Empire constituted the most valuable field in the world, but that, so far as the development of its protentialities had been left to the enterprise of the Dominions themselves. He believed it was time that this vast economic unit should be administered or rather developed by a system of cordial co-operation between the governments concerned, financial and technical.

The Canadians selected to speak at these sessions were Frederick B. Brown and G. Gordon Gale.

Sir Ernest Harvey, director of the British Columbia Electric Company, discussed the subject and suggested that currency depreciation and international financial conditions had had a most adverse effect on the capacity of London to help the development of Empire power and the aid of London was essential if reasonable terms were to be obtained.

The Economic Aspect of Power Resources

Owing to the fact that sixty papers were presented at the conference on Thursday, July 3rd, the conference was divided into three sections with meetings in Halls 1, 2, and 3, the sessions being devoted to Economic Aspect of Power Resources — Legal and Government Policy; Steam Generation — Utilization of Fuels; and Preparation of Fuels — Fuels Generally and Coal.

The subject in Hall 1, for both morning and afternoon session, was "Water Power Production — Economic and Legal". In the morning session Messrs E. A. Cleveland, K. H. Smith and John Murphy took part in the discussion.

Sir Philip Lloyd Greame, M.P., dealing with the functions which belong to the State, said that the central government of a country would best secure rapid and efficient development of power undertakings, not by itself creating and operating projects of this character, but by encouraging and assisting the enterprise of others.

The government departments concerned should create and maintain conditions in which power undertakings could operate to the best advantage. It should be the object of the government to assist companies to raise capital, on the ground that the undertaking which had the financial capacity and the sense of security to enable and justify it in constantly spending money on renewals and replacement and on fresh developments, was the undertaking which would be able to produce and sell power at the lowest rate. In normal times the functions of governments might be limited to the extent indicated, but to-day something more was required, and governments should be ready to use their credit, and, where necessary, even to make direct financial contributions, to secure the development of power projects. By a decision reached at the Economic Conference, either Dominion governments or local authorities or companies within the Empire could now obtain financial aid.

Herbert Hoover, secretary of commerce, United States, presented a contribution, which stated that the work of the centralization of power development and distribution, through the medium of great power systems, would make possible the decentralization of industry, and eliminate the crowded urban conditions and congested terminals which had been brought into existence by the use of direct steam power in factories and workshops. The function of government was to provide an open road for the exercise of individual initiative, to regulate and control, but not to manage or operate.

In discussing the "Economic Aspect of Power Resources", K. H. Smith, M.E.I.C., outlined briefly the situation of the Dominion of Canada, pointing out that the situation is somewhat complicated by the fact that the Dominion of Canada is a federal of nine sovereign provinces and that the federal government has a proprietory interest in the resources of only three provinces organized since confederation and an unorganized territory. The Dominion has a regulatory interest in matters affecting navigation and on international streams. Referring to a previous speaker, in which he strenuously upheld the principle of private against public ownership, Mr. Smith held that as engineers we should make results subservient to principles. He observed that different circumstances required different treatment and pointed out the benefit public ownership had been to the province of Nova Scotia. Mr. Smith's remarks appear in full in another section of issue.

E. A. Cleveland, M.E.I.C., also contributed some pertinent remarks on the subject which are given in full under the heading of discussion.

Canada's International Waterways' Commission

When the chairman opened the meeting on Thursday morning, he announced as the first paper "Canada's International Waterways' Commission", written by the secretary of the commission, Mr. Burpee, but the latter not being in London, the paper was about to be taken as read, when John Murphy, M.E.I.C., stepped into the breach, stating although he had not seen the paper in question he desired to impress upon the representatives of all countries the advisability of reading it carefully because Canada's International Joint Commission was one of the greatest means of promoting and maintaining close, friendly and satisfactory relations between the United States and Canada. While primarily a waterways' commission, almost any question might be submitted to it for investigation and report. Three Americans and three Canadians make up the commission, a citizen of the country where each meeting is held being the chairman. There is never an unbalanced representation because each country has always three votes. Their conclusions and recommendations are usually unanimous because they hold sittings wherever facts or evidence bearing upon their problems may be secured. It is only after thoroughly canvassing the whole problem that they then commence to prepare their conclusions and recommendations to their respective governments. Getting so close, as they thus do, to the intimate details affecting the matters submitted to them, they are in an excellent position to report on the facts, and the thoroughness of their work prevents the possibility of misunderstandings between the peoples concerned.

Preparation of Fuels

"Preparation of Fuels" was discussed on the presentation of the following papers on the morning and afternoon of Thursday July 3rd and on Friday morning July 4th.

Dr. D. S. Jacobus, of New Jersey, U.S.A., was chairman of the morning session; B. F. Haanel (Canada) of the afternoon session and Oscar Taussig of Austria, chairman on the morning of July 4th. At the morning sessions devoted to the preparation of fuels, on July 3rd and 4th, Mr. Haanel represented the Canadian delegation. He opened the discussion on the "Utilization of Powdered Coal for the Generation of Steam", and the discussion continued for some time and was continued on the morning of July 4th. Much favourable information was elicited concerning the value of burning fuel in the powdered form, not only for the generation of power in stationary plants but in locomotives. It was stated that locomotives burning fuel in a powdered form were operated in Chili, Brazil, Japan, and Australia, and that there was a likelihood that the application of powdered fuel for railway purposes will be adopted in other countries at an early date. Lignite in a powdered form can be successfully burned with a moisture up to 23 per cent. This is unusual and indicates a wide field for the utilization of Canadian lignites for railway and other purposes.

In the discussion which followed the presentation of Dr. Franz Fischer's paper on the conversion of coals into oils, Dr. Fischer stated it is his opinion that processes which have so far been developed tried out on a technical and commercial scale were not as yet a commercial success. The opinion of other speakers conversant in this was that any chance of success for the commercial application of these processes was very remote. This was one of the subjects on which Mr. Haanel was especially desirous to have a discussion, since great hopes have been entertained by many that this might be a solution of the liquid fuel problem which will shortly become very grave.

The carbonization of lignite coals and other fuels was discussed at considerable length. Mr. Haanel described the work which had been conducted in Canada concerning the low temperature carbonization and briquetting of Canadian lignites and pointed out Canadian lignites were in no sense similar in chemical and physical properties to those of the European countries and that processes which were capable of successfully treating European lignites could not be employed for treating Canadian lignites. Mr. Haanel brought to the attention of the delegates present at this session that Canada was far advanced in the character and quality of research work which has been conducted by the Fuel Testing

Division of the Federal Department of Mines, and laid great stress on the valuable work being performed by the Dominion Fuel Board and by the Canadian Peat Commission.

The concensus of opinion was that the days for the utilization of raw coal were numbered; that all countries would have to utilize some process which would first extract the valuable by-products such as oils, etc., leaving a practically carbon residue which would be suitable for domestic and other purposes.

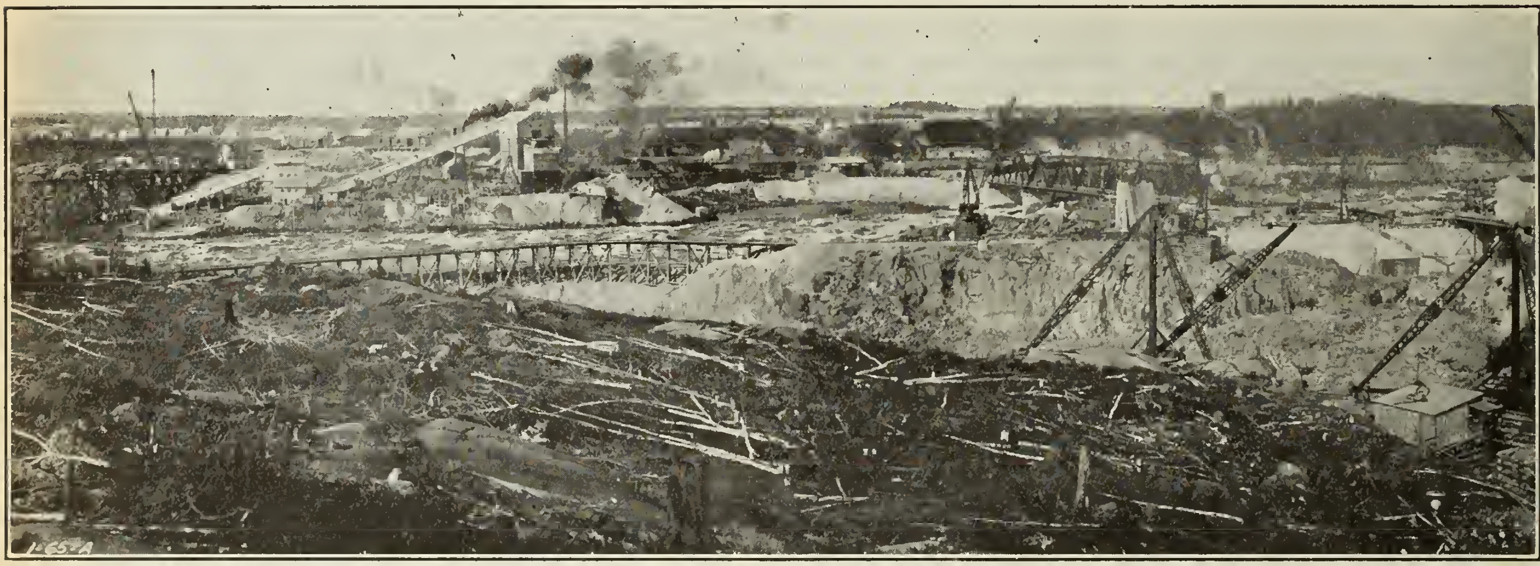
In this connection Mr. Haanel pointed out that Canada was fully alive to this phase of the utilization of coals which despite the enormous fuel resources lying within the boundaries of Canada was of the utmost importance. He described the work which the Dominion Fuel Board is performing in its endeavour to obtain a substitute fuel for the anthracite now used almost entirely for domestic purposes. He stated that findings showed that by the establishment of large by-products recovery coke-oven plants at strategic points, not only would it be economically possible to manufacture an entirely successful domestic fuel from Nova Scotia coals, but a gas which could be used with entire satisfaction for domestic purposes to replace that which is now manufactured in gas retorts.

A paper presented by Prof. Pierce F. Purcell on the "Winning and Utilization of Peat" provoked considerable discussion. Mr. Purcell stated that in his opinion the only process which had ever been devised for manufacturing peat fuel that could be considered economic was the Air-Dried-Machine-Peat process and he stated further as his opinion that he did not believe any processes depending upon mechanical pressing and artificial drying and briquetting would ever be economic, at least not for many generations. Mr. Haanel stated that he was in entire agreement with this opinion and drew the attention of those present to the necessity of having a conference of engineers conducting investigations entirely in this line of endeavour to get together and carefully consider all the processes which have been devised from time to time for manufacturing peat fuel with a view to forming an opinion which should be broadcasted regarding the legitimate lines of investigation which should be followed and those which should be discouraged.

The Generation of Hydro-Electric Power

Dr. F. A. Gaby, M.E.I.C., presided over the afternoon session and the paper of Dr. H. G. Acres, M.E.I.C., on the "Generation of Hydro-Electric Power in Canada" was presented. In presenting this paper Dr. Acres made a short statement with regard to the basis upon which it was conceived and drew particular attention to the fact that the inaugural gathering of the World Power Conference could not be regarded as a fitting occasion upon which to go into minute academic detail on such a broad subject as generation of hydro-electric power and that consequently his paper had been framed with the idea of viewing the situation in general prospective with the inclusion that only so much detail and descriptive theory as might be necessary to elucidate the reasons for various important events in the progress of the hydraulic art in Canada during the last twenty years.

There was no discussion on this paper but at the conclusion of the session the chairman, Dr. Gaby gave a general resume of the water power situation in Canada which was listened to with great interest and was very well received.



Panoramic View of Grand Discharge Power Development, at

The sessions on Friday, July 4th, were a continuation of the subjects under discussion on the previous day. The Canadian speakers were Dr. F. A. Gaby, Dr. H. G. Acres, B. F. Hannel, Prof. Greig and K. H. Smith. In the afternoon session "Water Power Production" was discussed as well as "Illumination" and "Power from Other Sources", under the chairmanship of Dr. A. Russell, president of the Institute of Electrical Engineers. A paper on "Alcohol as a Source of Power", presented by Sir Charles Bedford, attracted considerable attention. He said that alcohol is the hope of the future when the problem of supplies of fuels from internal combustion engines becomes acute. Sir Charles Parsons, pioneer of the modern turbines entertained at the dissertation on that important agent of power. It is estimated that the output of steam turbines, both land and marine, now reached the great total of over 120,000,000 h.p.

Sub-committee on Hydraulic Standards

On Friday, July 4th, K. H. Smith, M.E.I.C., was the Canadian representative at a sub-committee of the World Power Conference to consider hydraulic standards. The meeting was called under the chairmanship of Col. Norrie. Dr. Guido Semenza of Italy was made the chairman of the meeting. He was present for the particular purpose of outlining the work done on hydraulic standards by the International Electrical Technical Commission. In his capacity as president of the commission, he offered the facilities of the commission in co-operation of hydraulic experts of all countries interested for a further consideration of this matters.

Transmission of Power

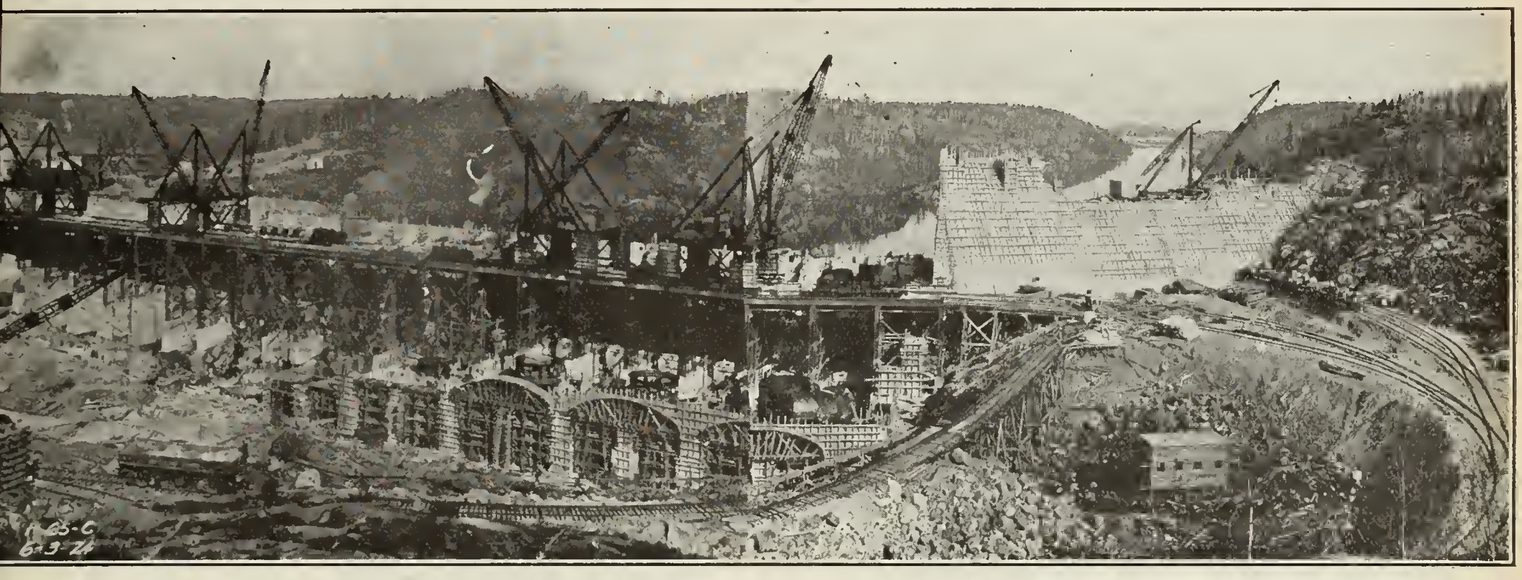
At the session on the "Transmission of Power" on Monday, July 7th, John Murphy, M.E.I.C., described how Canada's Railway Commission looked after the safety features of high tension and other wires when they came near or across railways, telephone or telegraph wires and all other kinds of wires.

The Railway Commission's powers are very broad and no wire can even be brought near federally incorporated railways without its consent. The commission insists on providing extra factors of safety both electrical and mechanical, in all power lines at points where they cross over other lines or wires. Without boasting, Mr. Murphy pointed to the notable fact that no wire crossing which was erected and maintained in accordance with the Railway Commission's regulations had ever failed and those regulations have been in force eighteen years.

John R. Freeman, who presided at this session, announced that a special exhibition of Mr. John Murphy's frazil and anchor ice pictures would be arranged for in the Cinema Theatre of the Engineering Building at Wembley during the week. He told the members that frazil caused much trouble at hydraulic plants in cold climates and those unique moving pictures showed how the ice was formed and how it could be overcomed.

Manufacture of Gas

The fuel session, in the morning and afternoon of Monday, July 7th, was devoted to the discussion of the manufacture of gas by low and high temperature carbonization processes; its utilization for industrial and domestic purposes and the necessity for treating coals in this manner in order to increase the efficiency of the use of fuels for both power and heating purposes. The papers read in the discussion which followed, indicated that the personal element was foremost and that the problem was not being attacked from an impartial point of view, that is, with a view to serving the interests of the countries at large to the best advantage. After much discussion concerning the relative merits of this method for gasifying coal, it was pointed out by a representative of the British Fuel Research Board and Dr. Lessing, (an eminent fuel chemist), that before attempting to weigh the relative economies to be derived from any method of carbonization employing low temperature especially, it would be well to thoroughly investigate ways and means for purifying coal, that is, reducing to the greatest possible extent its ash content. This, it was pointed out, is of the utmost importance in connection with research work and development work in connection with the carbonization of coals in-as-much as the presence of mineral ash has a serious effect, or at least an important one, on the results obtained when coal is submitted to a low or a high temperature carbonization and that the real effect of low or high temperature carbonization can not be determined when ash to a large amount is present. Again, it was pointed out that the necessity for removing the ash from the coal before using it for any purpose was very urgent in view of the congested state of the railways and the labour and expense of removing the ash from power plants after the coal had been burned. The purification of a coal high in ash appears to be especially necessary when the coal is burned in the pulverized state under a boiler for the generation of steam, since when coal is burned in this manner the larger portion of the ash contents of the coal passes out through the chimney. The efficient use of the fuel, however, no matter for what purpose it is used, will be greatly enhanced if the fuel is first purified. This appeared to be the most valuable contribution to the discussion which took place at this session.



St. Joseph d'Alma, Saguenay River, showing progress of work.

On Tuesday July 8th, the morning session on "Internal Combustion Engines" was presided over by Frederick B. Brown, M.E.I.C.

The chairman opened the meeting by a reference to the conditions in Canada outlining the field of application for internal combustion engines, as compared with the possibility of hydro-electric and other power sources. There were discussions from nine different countries by twenty-three representatives, reviewing the present practice of internal combustion engine development.

Prof. Greig, M.E.I.C., Saskatchewan, gave a most interesting contribution showing the best application of internal combustion engines to the conditions as found in the prairie provinces and elaborated on the desirablity of having available tractors and passenger automobiles for the use of the farming community which is so widely scattered that, without these means of transport and cultivation, social intercommunication would be practically prohibited and farming on a large scale impossible.

The chairman emphazied the importance of getting better acquainted with the delegates from other countries and pointed out the value of the personal contact as one of the best results to be looked for from the conference. This was greeted with applause and resulted in considerable fraternization, amongst the delegates present, following the meeting.

John Murphy, M.E.I.C., was the chairman of the meeting on Wednesday July 9th, when "Power in Electro-Metallurgy" was the topic. Papers relating to that subject were presented by delegates from the United States, England, France and Germany. The chairman gave a short review of Canadian enterprises. During the war they were of great magnitude and importance and Canada's water powers and electrical distribution systems played an important part in this work. At present zinc areas are reduced electrolytically in British Columbia and Quebec. The Niagara Peninsula and the Shawinigan district are the chief centres for the electrical manufacture of carbide, cyanamid, aluminum, acetic acid, carborundum as well as other electro-chemical products—many of which, on a smaller scale, are also made in Montreal and Toronto.

There are about 5,000 men employed in those industries; the capital invested in them is about $33,000,000. and the gross revenue from that investment amounts to $27,000,000. With large water power developments approaching the construction stage, Canada's future is very bright in the field of electro-metallurgy.

Exhibition of Ice Pictures

After the regular sessions of the conference were completed on July 9th, the delegates gathered at the Cinema theatre in the Palace of Engineering where John Murphy, M.E.I.C., exhibited his ice pictures and gave a short address explaining how easy it is to prevent frazil, or anchor ice, as it is popularly called, from stopping waterwheels or any other hydraulic works when advantage is taken of the results of experience and scientific research. Canada leads the world in its solutions of ice problems.

Memorandum and Resolutions

At the last meeting of the Conference, the following memorandum and resolutions were presented and passed, having been previously approved by the International Executive Committee.

Actuated by a common desire for the conservation and development of power resources throughout the world, the study of power problems, and generally for the carrying on of the work begun at the First World Power Conference, London, 1924, the foregoing* have, for themselves and the respective national committees in the various countries signed their names hereto.

*Representatives of the various countries, forming the International Executive Committee.

1. It is desirable that the work of the First World Power Conference shall be continued and that consideration shall be given to the advisability of forming a permanent Institution at a later stage under such title as may be found best to fit its activities: and to that end—
2. Each country participating in the First World Power Conference is invited to create and or maintain a permanent National Committee, as far as possible representative of its interests in all aspects of power.
3. The existing representatives of the International Executive Committee of the First World Power Conference shall continue for the time being to carry out the necessary work arising out of the conference as set forth in this memorandum.
4. Each National Committee shall be entitled to appoint one delegate to represent it on the International Committee and such appointments shall be made within six months from the date of this memorandum.
5. In countries where it is not immediately convenient to appoint National Committees a correspondent may be appointed to keep in touch with the International Committee until such time as a National Committee can be appointed.
6. A meeting of the International Committee shall be convened within a reasonable time to decide upon the line on which it would seem advisable to them (after conferring with their National Committees) to further the objects of the First World Power Conference, and in considering their scheme to arrange that there be no interference or overlapping with the functions of any existing International Organization.
7. The present organizing director and his staff shall, for the time being, be the medium of communication between the countries represented on the International Committee of the World Power Conference for all purposes of the conference.
8. The next meeting of the World Power Conference shall be held at a time and place to be determined by the International Committee, subject to the approval of the respective National Committees. So far as practicable future conferences should be held in different countries.

RESOLVED :

(1) That this conference is of the opinion that the world's most crying need to-day is greater production and manufacturing activity among its peoples under conditions which will promote individual prosperity and happiness, and that this can be largely achieved by the fuller development of national power resources and by the establishment of the most economical means for the general distribution and utilization of energy.

(2) The International Executive Committee of the First World Power Conference desires to place on record its thanks to authors of all countries who contributed papers to the conference.

(3) The International Executive Committee of the First World Power Conference desires to express its thanks to the chairmen who presided at the various sessions of the conference.

(4) That the visiting delegates to the First World Power Conference express their deep appreciation of the efficient manner in which the conference has been organized and conducted by Mr. D. N. Dunlop and his associates, and their further appreciation of the gracious courtesies and generous hospitality so abundantly extended to them by their British associates.

(5) The British Executive Committee desires to tender its sincere thanks to the officials and secretaries of the National Committees and to representatives of all countries participating in the First World Power Conference whose effective co-operation contributed so greatly to its ultimate success.

Standard Test Code for Hydraulic Power Plants

At a meeting of the Institution of Mechanical Engineers on Saturday morning July 5th, to consider a draft standard test code for hydraulic power plants drawn up by a Joint Committee of the Institutions of Civil and Mechanical Engineers, there were representatives from the various national delegations to the First World Power Conference.

J. B. Challies, M.E.I.C., as vice-president of *The Engineering Institute of Canada*, was called upon for an opinion. He said that the matter of a standard test code for hydraulic power plants was of great importance to engineering practice in Canada because there were at the present time over three and a quarter million hydraulic horse power installations in use which was being increased annually by over one-quarter million.

Canadian engineers had found the standard test code evolved by the American engineers of great value. It had, however, to be adapted to meet local conditions. Canadian engineers practice had already evolved a technique in connection with hydraulic tests which should be permitted to articulate before a firm decision is taken in connection with standard test code that was intended to be of universal use. Mr. Challies suggested that the best way of securing a considered opinion from Canadian engineers in this important matter would be by appropriate request for advice and assistance from *The Engineering Institute of Canada.*

Dominion Day Dinner

Every member of the Canadian Delegation was present at the Dominion Day Dinner held on July 1st, at the Hotel Cecil with the Hon. P. C. Larkin, High Commissioner for Canada in the chair. The Prince of Wales was the principal guest. In his reply to the toast to the King, the Queen, Queen Alexandra and the other members of the Royal Family, the Prince said he was grateful to be present at the Dominion Day banquet as it gave him an opportunity of meeting, so many representative Canadians who were in London. He expressed his love for Canada and announced that he hoped to visit his ranch again during the coming fall.

The toast to the Dominion of Canada was proposed by the Hon. Newton W. Rowell, K. C., and responded to by the Right Hon. J. H. Thomas, M.P., Secretary of State for the Colonies. He said he was proud of the Empire and was trying to understand and realize all it meant. The remarkable position held by the British Empire to-day was illustrated by a recent speech delivered in the Canadian Parliament, which showed that we are not only a free people but that our strength rested on the fact that we could talk plainly to each other. The Empire was greater than party and the great empire problems should be discussed free from party prejudice. He made the important announcement that the government was taking the necessary steps to get all the Dominions around the table to discuss their problems not from a party point of view and not in the interests of any particular class but to consider them in the interests of the Empire as a whole. Our Guests was proposed by the Hon. Charles Dunning, Premier of Saskatchewan, which was responded to by the Right Hon. Winston Churchill who said the Tories nearly lost the Empire in trying to keep it and the Liberals kept it in trying to throw it away. He did not think there was sufficient material to enable him to describe the Labour Party. So far as the Labour Party was concerned, so long as they endeavoured to keep together the great mass interests of the Empire and safeguard its lasting value they would deserve the respect of all His Majesty' subjects. The Hon. E. H. Armstrong, Premier of Nova Scotia, in proposing the toast of the chairman, speaking of the Homeland, said her troubles seemed to have left her great, and referred to the closeness of the tie of sympathy between here and Canada. The High Commissioner responded briefly.

The American Dinner

The American Committee were the hosts at a splendid dinner given at the Hotel Cecil on the evening of Thursday July 3rd, to which they invited all the World Power Delegates and at which were present about 600 men and women. O. C. Merrill, general chairman of the Committee presided and expressed on behalf of the American Delegation their appreciation of the courtesy extended to the delegation by the people of Great Britain. The Conference, he said, was dealing with the problem which was vital to civilization and it was the result of the vision of one man, Mr. D. N. Dunlop of London, England.

Dr. Arthur T. Hadley, a former president of Yale, gave an address of welcome to the guests. Replying for Great Britain, P. J. Pybus spoke of the credit due Mr. Dunlop the organizer of the Conference for the spirit of idealism which enabled him to conceive this great international gathering of engineers. If there was in the whole range of politics, arts and science any subject which was in essence truly international, it was the conservation of the power resources of the world as a whole. Dr. M. Kamo of Japan and E. Uytborck of Belgium and John Murphy of Canada also spoke. Mr. Murphy was selected by the delegates from Canada and the other British Dominions as their spokesman. He pointed out that there is only an imaginary line running across the continent separating Canada from the United States, without any weapon of an offensive or defensive character upon it. The continuous crossing of that line by the peoples of the two countries in friendly intercourse and in the exchange of engineering as well as other ideas and experiences all tended to make for peace and goodwill between them.

Canadian Delegation Luncheon

As a diversion from their deliberations on technical matters the delegates to the World Power Conference at Wembley, on July 4th, attended a luncheon arranged in their honour by the Canadian Committee at the Hotel Victoria, Northumberland Avenue, at which the Hon. Peter C. Larkin, High Commissioner for Canada, presided over a company of nearly 300. As the delegates have come from all over the world the toast to "The King" was followed by that of "The Sovereigns of the Kingdoms and the Presidents of the Republics represented here to-day."

The chairman, in welcoming the visitors on behalf of the Canadian Committee, observed that it had been well said that the man who could make two blades of grass grow where one had grown before was a great public benefactor; in the same way, those who had drawn electrical power from the waters which had run waste for countless centuries had increased the production of the world and placed the necessities of life before vast numbers of people. This work had been beneficial not only from the economic point of view but also from that of bringing the nations together. No doubt questions would arise when a stretch of water ran through two countries and was capable of being harnessed for power, but he was sure from their experiences in Canada with their neighbours of the south that, as in the case of North America, these problems could be solved in a friendly way by the nations of Europe.

Mr. A. Monro Grier, K.C., vice-chairman of the committee, in submitting the toast of the Grand Council of the conference and the delegates, referred to the fact that they were meeting on Independence Day. England and America had a particular bond in the Fourth of July and he would say to all their foreign visitors that not only was the union of these two countries eminently desirable, but the closer attachment of other nations to one another would be an equally happy thing to bring about.

Mr. D. N. Dunlop, the organizing director of the conference, returned thanks on behalf of the guests, and announced that he had just welcomed the Russian delegates, who had made a late arrival by aeroplane.

They had been considering, he continued, how they might capture the forces of Nature for the service of humanity, and as a practical idealist he believed that these forces would be liberated only when man no longer wanted to use them for the destruction of peace.

The chairman's health was drunk at the call of Signor Guido Semenza of Italy, who declared that his countrymen admired Canada, not only because of her immense resources and possibilities, but also because of her wonderful loyalty to her great mother, Great Britain.

Amongst those present were: Lord Ashfield, Baron E. Quillaume, Sir James Allen, Sir John A. F. Aspinall, Sir Adam Beck, Sir Joseph Cook, Sir James Devonshire, Sir John Dewrance, Sir Philip Dawson, Sir T. O. Callender, Sir Dugald Clerk, Sir Robert Hadfield, Sir James Kempal, Sir Philip Lloyd Greams, Sir Charles Morgan, Major Gen. Sir Philip Nash, Sir Charles Parsons, Sir Richard Tremayne, Sir John Snell, Sir Edgar Walton, The Right Hon. T. P. O'Connor, M. P., The Hon. E. H. Armstrong, The Hon. R.B. Bennett, Mr. J. B. Challies, Mr. John R. Freeman, Mr. B. Longbottom, Mr. O. C. Merrill, Mr. John Murphy, Mr. W. H. Patchell, Mr. Calvert Townley, Mr. Douglas Vicker, Dr. George Otis Smith and Dr. Don Louis Cuervo Marquez.

Their Majesty's Afternoon Party

Through the courtesy of the Canadian High Commissioner and the British Grand Council co-operated by the Engineering Institutions, the entire Canadian Delegation was invited to the King's Garden Party at Buckingham Palace on the afternoon of Saturday July 5th. This party was notable in that from the Canadian viewpoint it was attended by the greatest number of Dominion visitors that were present on any previous similar occasion. On this occasion Mr. and Mrs. J. B. Challies and Dr. and Mrs. Gaby were presented to their Majesties.

Discussion at World Power Conference

Water Power Production.—Civil and Mechanical Engineering

Major W. Hamilton Munro, M.E.I.C., of the Canadian Delegation, in opening the discussion of papers read on Friday morning, July 5th, before the Water Power section of the World Power Conference, said,—

The introduction of some friendly controversy to these discussions may have a tonic effect, for example, — The subject of this morning's meeting is given in the agenda as, "Water Power Production, — *Civil* and *Mechanical* Engineering".

The relative costs of the civil engineering construction work, and the mechanical equipment of an hydraulic power plant were roughly seven to one, and yet, with the exception of the excellent papers dealing exclusively with dams, which had been presented this morning, there were none which aimed particularly at the reduction in cost of the civil engineering work. The papers were almost exclusively mechanical.

Had not the mechanical engineer outdistanced the civil engineer in the common duty of reducing the cost and improving the quality of their respective parts in making cheap power available? Had not the mechanical engineer spent his money on testing laboratories, his time and thought in calculations and inventions, and tests on his turbines and their accessories? Had he not greatly increased the specific speed and was continuing to do so? Was not the speed regulation vastly better than it had been? Had he not improved design and construction until in reliability of operation the turbines were probably the most dependable items in the whole range of apparatus involved? Had he not increased turbine efficiencies to a point where small possible margin for further improvement remained? Did not the mechanical engineer take less profit for the manufacture of his equipment than any other contributor to the construction of an hydro-electric power plant?

And yet the mechanical equipment with its accessories cost only about 6 per cent of the whole, and the civil work anything from 40 per cent to 60 per cent of the whole. The cost of the civil engineering in hydro-electric installations was, owing to circumstances, less subject to competition than the mechanical, and less open to criticism, its sheltered position had had a bad effect upon it.

Is not a stronger effort in that large field of possible cost reduction a reasonable demand; undoubtedly so, especially when one thinks of those cases where the question of whether a steam, oil or gas plant is to be installed on the one hand, or a possible water power site made use of on the other. If the cost of the hydraulic power alternative is brought in as evidence to barely turn the scale against it, a natural resource is thereby lost to the community for many years, because in small and medium sized systems once a steam or oil station is embarked upon it is a great temptation to meet increments of load by the small first cost of an additional boiler or engine rather than to turn again to the hydraulic power site. Such economic losses might be prevented by the possible reduction in cost on the civil engineering side.

Major Munro hoped the civil engineers would argue the case.

Power in Electro-Chemistry

On Wednesday morning, July 9th, Sven Svenningson, M.E.I.C., took part in the discussion on "Power in Electro-Chemistry" as follows:

It is not my intention here to-day to attempt to add anything to the technical discussion regarding the application of power in the electro-chemical industries, but mainly in a sketchy way to give you a picture of how the development of water power and the development of electro-chemical industries have progressed in that part of the province of Quebec generally known as the St. Maurice valley and mainly at Shawinigan Falls.

The St. Maurice river is one of the largest rivers in Canada, with a drainage area at Shawinigan Falls of approximately 18,000 square miles. The total drop of this river over a distance of 250 miles is about 1,250 feet, of which approximately 300 feet takes place within 20 miles of its outlet.

Up to the latter part of the nineties practically no industrial development had taken place along this river with the exception of a few scattered saw mills. Around the year 1900, the first power plant was built at Shawinigan Falls. This plant had to start with only one unit of approximately 5,000 h.p. capacity, which in those days was considered a fairly large unit. By the end of year 1910, the capacity of the original plant had grown to approximately 60,000 h.p. Two other plants, with a total capacity of 30,000 h.p. had been built. These latter plants were both equipped with d.c. generators and were delivering power to the Northern Aluminium Company only. During this period, between the years 1900 and 1910, a calcium carbide plant was erected by interests not directly connected with the power company. This plant, which to start with was not particularly successful, was finally taken over by the power interests and operated by them. Between 1910 and 1914, the power company had erected a second power plant of 100,000 h.p., capacity but the electro-chemical load had not increased to any extent.

At the outbreak of the world war, however, the demand for power for furnace work became very pressing, and fortunately the power companies in the province of Quebec were able to meet the demand, due to the fact that the two large hydro-electric plants at Cedars rapids on the St. Lawrence river and Grand Mere on the St. Maurice river were put into service with a combined capacity of 220,000 h.p. This added power to the Quebec systems allowed the Shawinigan Water and Power Company to greatly increase the capacity of the carbide plant as well as to sell an additional 10,000 k.w., to the Northern Aluminium Company. To the carbide plant, which at that time had five furnaces with a total capacity of approximately 30,000 h.p., was added two 7,500-k.w. units.

At the same time the Shawinigan Water and Power Company, under the name of the Canadian Electric Products Company, erected a chemical plant producing acetic acid. This latter plant was doubled in capacity during 1918. Besides the above mentioned plants other electro-chemical industries producing carborundum, alexite, furco, silicien, magnesium and steel, were erected at Shawinigan Falls, so by the end of the year 1918 the total load and the Shawinigan system for electro-chemical purposes had reached in round figures 105,000 h.p.

During the termination of hostilities this load was considerably reduced due to the fact that some of the industries were running at reduced capacity and others entirely shut down. During the last two years the conditions have greatly improved and the prospect for the future seems fairly good.

In this conclusion it may be of interest to some of the gentlemen present to know that during the period of industrial depression, that not only the entire capacity of generating plants were utilized to the good advantage, but that new equipment was added to all the plants and new generating stations were built. This was done by the installation of large electric-steam boilers in some of the local paper mills. Several of these steam units have a capacity of 25,000 k.w., and the total approximate electric steam load on the Shawinigan system alone runs at times as high as 100,000 to 120,000 k.w.

It is needless to say that loads of this kind greatly help to improve the load factor.

Water Power Resources

Discussion by K. H. Smith, M.E.I.C., and E. A. Cleveland, M.E.I.C.

I desire to outline briefly, in the limited time at my disposal, the situation in the Dominion of Canada as regards the subject under discussion. While as already stated at this conference, Canada has vast fuel power resources, I will limit my contribution to a discussion of water power resources as is appropriate since by far the greater part of central station development in Canada to-day is water power. Complete details of this subject so far as Canada is concerned may be found in section III of paper No. 8, Water Powers of Canada, their nature, extent and administration, which I commend to your careful attention.

The situation is somewhat complicated by the fact that the Dominion of Canada is a federation of nine sovereign provinces. The Federal government has a' proprietory interest only in those three provinces organized since the original confederation and in unorganized territory. It has a regulatory interest throughout the whole Dominion in matters affecting navigation and on International streams, the latter forming a most important factor in the Dominion power resources.

Unrestricted development of power resources in Canada, except in a very minor way, is unknown. There is first of all corporate organization, except in the rare instances of development by single individuals, either by special charter or act of the provincial legislation concerned or under the existing general company laws. In the second place, a license covering the specific site which it is proposed to develop must be obtained from the proper administrative authorities. These licenses while varying in detail all rest on the same fundamental principle of public control and recapture. They involve limited tenure, cancellation and for the most part nominal rentals. Lastly, in the cases of development for public utility purposes, financial arrangements and power rates are subject to control and regulation by public bodies of one kind or another in the various provinces.

Speaking of government policy in general, it is obvious that no question arises as to actual development by the federal government. Its aim is to furnish comprehensive and dependable information as a basis for economically sound and adequate power development schemes and to stimulate development in so far as its own jurisdiction is concerned by reasonable regulations tending to protect both the investor and the public. In this respect it is succeeding to a remarkable degree.

The provincial governments are in a position to actually carry out power development or to render direct assistance and there is a wide divergence of policy among them in that respect.

The government of the province of British Columbia takes no active part whatever in actual power development. The same is true in Alberta and Saskatchewan. In Manitoba, the provincial government has recently instituted a system of power transmission.

In Ontario, we have the enormous generating and transmission system of the Hydro-Electric Power Commission of that province, involving the largest generating station in the world. This is a purely public enterprise, based on the co-operation of the vast number of municipalities involved, with the liabilities underwritten by the provincial government and in a large measure financed by the government directly.

In Quebec, development is wholly by private enterprise. In recent years, however, the provincial government has built and operates enormous storage reservoirs for the benefit of private developments, from which adequate rentals are collected.

In New Brunswick and Nova Scotia, development during recent years is for the most part carried on by public commissions under government auspices. However, in Nova Scotia particularly, development by private enterprise is encouraged. The Nova Scotia Power Commission generates and transmits energy in bulk to public or private corporations for general distribution or immediate use as the case may be.

It is of interest to note that throughout the whole Dominion, the results obtained as to availability and cost under similar conditions are much the same notwithstanding the divergence in policy. It would seem that in each case that policy has been adopted which best meets the conditions obtaining.

Mr. chairman, this is all I had intended to say, but with your kind permission, I would like to make an observation with reference to the remarks of a previous speaker, in which he strenuously upheld the principle of private versus public ownership.

It seems to me, that as engineers, we should make results subservient to principles, and from the results obtained in Canada under widely divergent policy as I have indicated, it may well be that different circumstances require different treatment.

I may illustrate from the province of Nova Scotia where I am particularly engaged at the present time. A careful study of the situation in this old province some time ago led to the opinion that some direct governmental action was necessary if the province was to benefit by the considerable water power resources revealed. Developments involved extensive diversions, long conduits and generally very extensive interference with large numbers of riparian owners in this province of long established and relatively small land holdings. The difficulties involved seemed almost insuperable to other than public agencies. In corroboration of this opinion, it was observed that in the face of ample physical possibilities no considerable development had taken place.

Accordingly a commission was organized as contrasted with a government department and has made very considerable progress in the generation and transmission of hydro-electric energy. It does not seek to supplant existing private public utility corporations, but rather to supplement and co-operate with them. In the case of the city of Halifax, the capital city of the province, for example, the Nova Scotia Power Commission furnishes energy in bulk to the private company which has long been the sole operator of electricity, tramway and gas facilities throughout the city. This company previous to the advent of hydro-electric energy operated a steam station which is still maintained for stand-by and auxiliary purposes.

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The First World Power Conference

At the moment of writing this, the World Power Conference has not completed its sessions nor have the final conclusions of the Conference itself been reduced to a definite commitment as to either a programme for the future or an analysis of the benefit the Conference has been and will be to the world as a whole. Sufficient let it be for the present that the conference, ideal in its conception and vast in the breadth of its programme, has been an unqualified success. Canadian engineers will learn with no small pride that at the gathering of experts on power in its many phases, the Canadian participants made a marked impression and played a proud part in the entire gathering, the result of which cannot be otherwise than of lasting benefit to the Dominion of Canada.

At nearly every session Canada took part and added a quota to the general fund of information. Those participating at the conference were impressed by the fact that Canada is a great power producing country and that Canadian Engineers had been pioneers on long distance and high tension distribution in the use of large units both hydraulic and electric, and that in the latter Canadian practice had reached a stage surpassed by no other nation.

At a technical conference lasting for ten days both morning and afternoon sessions, and for the most part meetings being held in three different halls, it is impossible for anyone to attempt to fully state what took place. The broader aspects of the conference, however, may well be summarized in the statement made in relation thereto by outstanding men:—

"In the effort to create for industry, and especially for power what the League of Nations intends for politics, lies the true significance of the World Power Conference."....*The Prince of Wales.*

"The study of power is still in a comparatively elementary stage, and no effort has been made to find out on what foundations our present industrial structure is built and what part power plays in this structure.".... *The Prince of Wales.*

"From the present conference will come a fund of knowledge which will advance science to a large extent. We are bringing to a common fund the intelligence and scientific knowledge of the electrical world from all parts of the globe and we are bringing it with a desire to contribute something for the common good. Out of it must come something of value to all the countries of the world.".... *The Earl of Derby, President of the Conference.*

"The scientific mind is the dynamic mind in the world and the political mind ought always to be subservient to it." *Mr. Frank Hodges, First Lord of the Admiralty.*

"Electrical energy is the greatest power ever placed in the hands of man. Modern civilization is one progressive liberation of mankind by the utilization of the sources of nature through the medium of machinery so that we may reduce human labour, increase its productivity and add to the amount and lessen the cost of material things and, at the same time, provide the people with leisure by which alone the intellectual capacity can be developed." *Mr. O. C. Merrill, Chairman of the American Delegation.*

"Modern sources of power are engaged in a struggle with matter and in that battle matter is gradually being overcome." *M. Guillaume, Director of Mines, France.*

"I cannot forget that it was an Englishman who, thirty-five years ago, taught us that the proper place for central station was not the place of consumption but the place where there was ample water supply and the facilities for transportation were good, for those things were essential to low cost. It was from him also we learned that it is a necessity to have the energy conveyed at high voltage to the place of consumption." *Mr. Samuel Insull.*

"It is a great inspiration to those whose history spans three short half centuries to come to the Homeland whence springs our language and laws and our engineering." *Mr. F. R. Low, President, American Society of Mechanical Engineers.*

"The forces which are working to make civilization great and which are doing the most to advance civilization are those developed to the production and distribution of power." *Mr. John R. Freeman.*

Speaking of the urge to bring about an international engineering organization and referring to the fact that there were so many engineering societies of the different countries, Mr. W. H. Patchell, president of the Institution of Mechanical Engineers, said: "In Canada, thank God, they were all under one roof".

Those Canadian engineers who are in London for the first time have enjoyed a marvellous experience. It is not often that one finds the people of London eulogizing their city but the following sentiment was expressed in a paragraph which appeared in the *Daily Mail* on Friday July 4th: — "Never before has London seemed more full of interest and delight than in this summer of the great Empire Exhibition at Wembley. To the Londoner, accustomed to take the city and her marvels for granted, the exhibition stands out, but to the visitor from the country or from over-seas the exhibition is but one of the innumerable unique attractions.

"For there are no cities in the world that can really hold a candle to London or give to their visitors such varied wealth of entertainment. Comparing London with all other cities, she is far above and beyond them in offering almost every conceivable kind of amusement and diversion.

"Where else, indeed, could one find within easy reach such brilliant scenes of sport as Wimbledon, Henley, and Lords can show, and where are such new attractions offered every week throughout the season, leading up in regular procession to the glories of Goodwood and Cowes?

"The pageant of London in summer — her crowds thronging the streets or taking the air in the parks, her historic buildings, her famous river — make a sight bewildering in its rich variety and worthy of the greatest city on earth.

"Altogether, England may well be proud of her capital. London is the magnet which draws all travellers and her fame grows mightier every year."

London, England, July 8th, 1924.

Canadian Engineers in London

In order to complete final arrangements for Canadian participation in the Conference, J. B. Challies, vice-president of *The Institute* left Quebec on May 30th, to proceed to London.

The party of Canadian delegates which sailed from Quebec on the Empress of France, on June 18th, reached London on June 25th, and consisted of the following:— The Hon. E. H. Armstrong, Frederick B. Brown, M.E.I.C., G. Gordon Gale, M.E.I.C., F. A. Gaby, M.E.I.C., H. G. Acres, M.E.I.C., K. H. Smith, M.E.I.C., Frank Sawford, E. A. Cleveland, M.E.I.C., and the secretary, Fraser S. Keith, M.E.I.C.

On their arrival they found every detail completed for the conference, and an array of social functions arranged extending over two weeks, including the events associated with the Kelvin Centennial.

On June 26th Mr. Challies called a meeting which took the form of a luncheon in the Oak Room of the Victoria Hotel over which he presided. There were present John Murphy, M.E.I.C., E. A. Cleveland, M.E.I.C., G. Gordon Gale, M.E.I.C., H. G. Acres, M.E.I.C., W. H. Munro, M.E.I.C., F. A. Gaby, M.E.I.C., Frederick B. Brown, Brown, M.E.I.C., B. F. Haanel, M.E.I.C., K. H. Smith, M.E.I.C., and Fraser S. Keith, M.E.I.C. At this meeting a working committee of the Canadian delegation of the World Power Conference was constituted under the chairmanship of the Hon. P. C. Larkin, High Commissioner for Canada, with Mr. Challies as vice-chairman.

Detailed information was given by Mr. Challies of the arrangements made for the Canadian luncheon to be held at the Victoria Hotel on Friday July 4th, at which the Canadian Government would act as host to the visitors. Information was also given by Mr. Challies concerning the arrangements made for the luncheon to be held in Paris on July 17th, under the chairmanship of M. Honoré Roy, the Canadian Commissioner in Paris.

The committee approved of a suggestion from Dr. Camsell that a booklet on Canada be available at the luncheon for those who desired a copy.

Owing to the splendid co-operation of Mr. Dunlop, the organizing director of the conference, it was resolved that the committee present him with a leatherbound copy of the Coat of Arms of the Provinces of Canada, suitably engrossed.

It was the unanimous opinion of those present that the Canadian delegation should favour London as the headquarters for a Secretariat on World Power Affairs, and that the Canadians should use their influence towards that end, insisting on an equal vote with the other nations when it came to a decision on the matter.

It was unanimously resolved that J. B. Challies, secretary of the Canadian Management Committee, be the official Canadian representative on the international committee and that he represent the Canadian delegation at the opening ceremonies, Monday, June 30th.

The second meeting of the committee was held at Kinniard House, office of the Canadian High Commissioner, at which were present J. B. Challies, in the chair, Frederick B. Brown, F. A. Gaby, G. Gordon Gale, John Murphy, K. H. Smith, Prof. Greig, E. A. Cleveland, B. F. Haanel and Fraser S. Keith. It was unanimously resolved that Messrs. B. F. Haanel and F. A. Gaby be nominated as the official speakers at the first session of the conference on Tuesday July 1st, with Messrs. John Murphy and Frederick B. Brown as additional speakers if the opportunity presented itself.

At the meeting there was considerable enthusiasm regarding the part that Canada was to take in the Conference, arising out of the discussion on which it was resolved to present the following programme to the International Committee as the Canadian participation at the various sessions.

Wednesday, July 2nd. Morning

Hall 1. Economic Aspect of Power Resources.
Frederick B. Brown, — *reserve speaker.*

Afternoon

Hall 2. Economic Aspect of Power Resources.
G. Gordon Gale, — *opening speaker.*

Thursday, July 3rd. Morning

Hall 1. Economic Aspect of Power Resources.
E. A. Cleveland and K. H. Smith, — *reserve speakers.*

Hall 2. Steam Generation.
Prof. A. R. Greig.

Hall 3. Preparation of Fuels
B. F. Haanel.

Afternoon

Hall 1. Water Power Production
F. A. Gaby,
H. G. Acres, — *opening speaker.*
K. H. Smith, — *reserve speaker.*

Hall 3. Preparation of Fuels
B. F. Haanel, — *chairman.*

Friday, July 4th. Morning

Hall 1. Water Power Production
W. H. Munro, — *opening speaker.*
F. A. Gaby, H. G. Acres and K. H. Smith,— *reserve speakers.*

Hall 2. Steam Utilization
Prof. A. R. Greig.

Hall 3. Preparation of Fuels
B. F. Haanel.

Afternoon

Hall 1. Water Power Production
John Murphy.

Saturday, July 5th. Morning

Monday, July 7th. Morning

Hall 1. Power Transmission and Distribution
Sven Svenningson.

Hall 2. Gas and Fuel Section
B. F. Haanel.

Afternoon

Hall 1. Power Transmission and Distribution
F. A. Gaby, — *reserve speaker.*

Hall 3. Research

Wednesday, July 9th. Morning

Hall 1. Power in Domestic Use and in Agriculture
F. A. Gaby, — *reserve speaker.*

Hall 2. Power in Electro-Chemistry
Sven Svenningson.

Afternoon

Hall 1. Power for Rail Transport
F. A. Gaby.

Hall 2. Power in Electro-Metallurgy
John Murphy, — *chairman.*

Hall 3. Publicity. Fraser S. Keith.

Thursday, July 10th. Morning

Hall 1. Power for Rail Transport
G. Gordon Gale and John Murphy.

Hall 2. Power for Water Transport
F. A. Gaby.

Hall 3. Education, Technical and Commercial
Prof. A. R. Greig and Fraser S. Keith, — *reserve speakers.*

Afternoon

Hall 1. Standardization
John Murphy, — *opening speaker.*
Frederick B. Brown, — *reserve speaker.*

Hall 3. Education, Technical and Commercial
Prof. A. R. Greig and Fraser S. Keith, — *reserve speakers.*

Standard Tests Code for Hydraulic Power Plants

Mr. Challies read a letter from the Institution of Mechanical Engineers extending an invitation to a discussion on the proposed Standard Test Code for Hydraulic Power Plants. It was considered advisable that Canada be well represented and F. A. Gaby, H. G. Acres and Frederick B. Brown were appointed.

The Centenary of Lord Kelvin

The members of *The Engineering Institute of Canada* are honoured in the opportunity which has been offered to them, of paying a public homage to the memory of Lord Kelvin.

The study of Lord Kelvin's life, and more particularly of his achievements, leaves one in admiration at the comprehensiveness of his genius and at the untiringness of his energy. It would require a mind almost as well developed as that of Lord Kelvin himself to appraise at their true value his discoveries and his inventions.

It is a matter of pride to us as Canadians in our loyalty to the British Empire to feel that as we have derived our language, our literature and our traditions from the Mother country, so do we owe also to the great men of science in Great Britain the broad foundation upon which our engineering knowledge rests. We realize fully that to the conception of the master minds of this country which made possible the great development of our modern civilization and particularly to that supreme genius whose memory at this time we so greatly cherish, the world owes a great debt of gratitude. We cannot forget that it was Lord Kelvin's research work on the application of electricity to submarine telegraphy which made possible the laying of the transatlantic cable. Thus it was he who enabled us to establish rapid communication with the Motherland, drawing us closer together in the bonds of empire union.

As Canadians also, we like to remember that Sir William Thomson was a member of the International Niagara Falls Commission, established in London in 1890 for the purpose of studying the methods in use in the old world for the production and for the transmission of electricity. In this as in every problem he approached, he left the lasting mark of the master mind and again it can be truly said that we owe to him a heritage which has made possible the great power development which we in Canada to-day enjoy.

Presented by Mr. J. B. Challies, C.E., M.E.I.C.,
Vice-president of The Engineering Institute of Canada.

OBITUARY

Charles M. Odell, M.E.I.C.

On Tuesday, June 24, 1924, Charles Monserratt Odell, M.E.I.C., died at his residence in Sydney, Nova Scotia. He had been in ill-health for the past two years, but, except for periods when under the immediate care of his physician, he attended his office until within a few weeks previous to his death.

Mr. Odell was sixty-three years of age, having been born in 1861 at Sarnia, Ontario, the son of James Odell of Fredericton, N.B., and Sarah Monserratt Odell, of Ireland.

At the early age of eighteen he entered the civil engineering profession, when, in 1879, he went to Winnipeg to engage in railway construction work. His work in this connection for the next few years carried him all through the western provinces. In 1886 he came to Cape Breton, still on railway work, and in 1893 he entered the employ of the Dominion Coal Company with supervision over their Sydney and Louisburg Railway. Four years later he was appointed resident engineer of that company, a position he held at the time of his death.

CHARLES M. ODELL, M.E.I.C.

He was not a charter member of the Canadian Society of Civil Engineers, but he joined that Society during the year it was founded. On the formation of the Cape Breton Branch of *The Engineering Institute of Canada*, in 1921, he was elected first chairman and re-elected to that office in 1922. Throughout this life-long membership, his really active interest was of no little benefit to *The Institute* at large and the Cape Breton Branch in particular. Mr. Odell was also an active member of the Mining Society of Nova Scotia, of which he was president for the year 1923. He was re-elected to this office just a few hours before his death.

Throughout the province, and indeed throughout the country, Mr. Odell was known and esteemed. His was a remarkable character. His excellent memory, great sense of humour and never-failing wit, coupled with his ability as raconteur made him popular at gatherings of all kinds.

He is survived by his wife, formerly Miss Emma Vooght, daughter of the late John Vooght of North Sydney, and by one son and two daughters.

The large number of floral tributes, and of friends who attended his funeral testified to the great esteem in which he was held. The Cape Breton Branch attended as a unit, walking in front of the hearse.

Presentations to the Library

Presented by W. Bell Dawson, M.E.I.C.

Instructions to Engineers, by Sir Sandford Fleming, dated 1875.

Presented by L. H. Cole, M.E.I.C.

Mineral Resources of the United States, 1909, Part 2, Nonmetals; 1911, Parts 1 and 2, Metals and Nonmetals; 1912, Parts 1 and 2, Metals and Nonmetals; 1914, Part 1, Metals; 1915, Parts 1 and 2, Metals and Nonmetals.

Presented by A. G. Jeffreys, A.M.E.I.C.

Dictionary of Applied Physics, by Sir Richard Glazebrook; Volume 1, Mechanics Engineering Heat; Volume 2, Electricity; Volume 3, Meteorology, Metrology and Measuring Apparatus; Volume 4, Light Sound Radiology; Volume 5, Aeronautics, Metallurgy, General Index.

PERSONALS

J. D. Murray, S.E.I.C., has joined the staff of the Bell Telephone Company of Canada, at Ottawa.

W. P. Copp, A.M.E.I.C., professor of engineering at Dalhousie University is on bridge inspection during the summer for the province of Nova Scotia.

Lieut. Col. A. C. Garner, M.E.I.C., and J. N. DeStein, M.E.I.C., have been appointed members of the Regina Town Planning Board.

Walter K. Scott, A.M.E.I.C., has accepted a position in the structural department of Canadian Vickers, Limited, and is located at Maisonneuve, Que.

C. O. Whitman, A.M.E.I.C., has been appointed principal of the Thetford Mines Academy, Thetford Mines, Que., and will take up his new duties in the fall.

Col. J. Houliston, A.M.E.I.C., for several years past Officer Commanding Military District No. 7, New Brunswick, has recently been retired and is residing at Ottawa.

F. S. Kuhns, A.M.E.I.C., who was sales manager for the Bishopric Manufacturing Company, of Ottawa, is now in Florida representing the company.

E. J. Peal, S.E.I.C., who graduated this year from Queen's University, is now located in Cleveland, Ohio, with the Bailey Meter Company.

J. R. Freeman, M.E.I.C., has lately removed from Halifax, N.S., to St. John, N.B., on his promotion to senior assistant engineer with Public Works, Canada.

J. W. Wyse, S.E.I.C., who graduated from McGill University this spring, in civil engineering, is at present in Detroit, Michigan, with a construction contractor.

W. L. Reford Stewart, S.E.I.C., is located with the Newton-Dakin Construction Company, Limited, at St. Angele, Que. Mr. Stewart is a graduate of the Royal Military College of Kingston, Ont.

O. R. Harvey, Jr.E.I.C., formerly wire and cable sales engineer with the Northern Electric Company, Limited, at Winnipeg, Man., has joined the company's staff at their Montreal office.

Roy C. Leslie, S.E.I.C., has accepted the position of structural draughtsman with the Dominion Bridge Company, Limited, Lachine, Que. Mr. Leslie received the degree of B.A.Sc. from the University of Toronto in 1923.

J. B. Pringle, S.E.I.C., is with the production department of the Northern Electric Company, Limited, Montreal. Mr. Pringle received his B.Sc. degree this spring from McGill University.

R. McD. Richardson, S.E.I.C., of the class of '24, McGill University, is employed in the plant department of the Bell Telephone Company of Canada in Montreal. Mr. Richardson is a graduate in electrical engineering.

Robert Wood, S.E.I.C., is on transmission work at Victoriaville, Que., for the Shawinigan Water and Power Company. Mr. Wood is an electrical graduate of this year from McGill University.

D. L. Stewart, S.E.I.C., who graduated in mechanical engineering this spring from McGill University, is with the engineering department of the Bell Telephone Company of Canada.

L. S. Cossitt, S.E.I.C., who graduated in mechanical engineering from McGill University this spring, is with the Northern Electric Company, Limited, Montreal, in the planning department.

V. J. Dick, Jr.E.I.C., has been transferred from the Calgary office of the Canadian Westinghouse Company, Limited, and is now in charge of the company's Edmonton office.

J. M. Anderson, A.M.E.I.C., has been appointed resident engineer with the Department of Highways, Edmonton, Alberta. Mr. Anderson was previously with the Edmonton, Dunvegan, and British Columbia Railway.

W. B. Pennock, Jr.E.I.C., has severed his connection with the Canadian Fairbanks-Morse Company, Limited, to enter private practice in Windsor, Ont. Mr. Pennock received his B.Sc. degree in 1915 from McGill University.

M. L. Thompson, S.E.I.C., in now with the installation department of the Northern Electric Company, Limited, being located at Toronto, Ont. Mr. Thompson is a graduate of this year from Queen's University.

F. W. Elliott, S.E.I.C., who until recently was with the Canadian Westinghouse Company, Limited, at Hamilton, Ont., has accepted a position with the Bell Telephone Company of Canada, in Montreal.

W. H. G. Flay, A.M.E.I.C., has resigned from the staff of the Ottawa Public School Board to accept a position on the engineering staff of the Dominion Reinforcing Company of Ottawa and Montreal.

George M. Dick, S.E.I.C., who recently graduated in mechanical engineering from McGill University, has been appointed to the engineering staff of Babcock-Wilcox and Goldie-McCulloch, Limited, of Galt, Ont.

C. J. Yorath, A.M.E.I.C., formerly city commissioner for Edmonton, Alta., has resigned to become president and general manager of the Northwestern Utilities Limited, Edmonton. This company operates the natural gas franchise of that city.

James F. Pedder, S.E.I.C., is at present taking the graduate course of the Westinghouse Electric and Manufacturing Company of East Pittsburgh. Mr. Pedder received his B.A.Sc., degree with honours from the University of Toronto, this spring.

F. Jno. Bell, M.E.I.C., of Toronto, widely known in the Electrical Industry throughout Canada, has been appointed Canadian representative for C. A. Parsons and Company, builders of steam turbines and heavy electrical apparatus, with works at Newcastle-on-Tyne, England.

H. Edwards, M.E.I.C., has recently been appointed to the staff of the construction and engineering division of Stone and Webster, Incorporated, at Boston, Mass. Mr. Edwards was formerly with the New England Telephone and Telegraph Company, Lawrence, Mass.

J. B. Nelson, A.M.E.I.C., is representing the sales and service departments of the A. B. Ormsby Company, Limited, of Toronto, in the Toronto and Hamilton districts. Mr. Nelson was for a time with the Standard Steel Construction Company, Limited, of Welland, Ont.

L. S. Dixon, M.E.I.C., previously manager of engineering with the Eddy Paper Corporation of Three Rivers and White Pigeon, Michigan, is at present with the Riordon Pulp Corporation, Limited, at Temiskaming, Que., as consulting engineer.

W. C. McLaren, A.M.E.I.C., formerly with the construction department of the Canadian National Railways, with offices at Winnipeg, Man., has resigned to accept the position of estimating engineer with the Southern Pacific Lines, Kirkford, Oregon.

Allan T. Bone, A.M.E.I.C., has rejoined the George A. Fuller Company, Limited, Montreal, as estimating engineer. Mr. Bone has recently been with the Shawinigan Engineering Company on design of equipment and plant layout on the new development at La Gabelle.

J. O. McNally, S.E.I.C., of Fredericton, N.B., is at present with the Western Electric Company of New York City in the research laboratories. Mr. McNally graduated from the University of New Brunswick with the class of 1924.

Henri Gauthier, A.M.E.I.C., has resigned from the position of road materials engineer with the Mines Branch, Ottawa, to accept the position of inspector and technologist in the Mines Branch of the Department of Colonization, Mines and Fisheries of the province of Quebec.

J. O'Halloran, Jr.E.I.C., has been appointed to the staff of Price Brothers and Company, Limited, at Kenogami, Que., and will enter upon his new duties early during the present month. Mr. O'Halloran is a graduate of McGill University with the class of '21.

A. L. Mieville, A.M.E.I.C., who has been associated with the firm of Robert Morris and Company, of Farnworth, England, has been appointed general manager for the Howden-Ljungstrom Preheaters (Land) Limited. Govan, Glasgow.

W. F. McKnight, A.M.E.I.C., professor of electrical engineering at Nova Scotia Technical College, Halifax, N.S., and vice-chairman of the Halifax Branch. has gone to Toronto for the summer and is working on the revision of the Canadian Electrical code.

F. R. Faulkner, M.E.I.C., immediate past-chairman of the Halifax Branch, and professor of civil engineering at Nova Scotia Technical College, Halifax, N.S., has entered the engineering department of Stone and Webster, Incorporated, Boston, Mass., for the summer months as designing structural engineer.

W. G. Hardy, A M.E.I.C., assistant professor of civil engineering, Nova Scotia Technical College, Halifax, N.S., left Halifax May 15th for New York to take a boat trip through the Panama canal to California in search of health. He has not yet recovered his strength after his siege of rheumatic fever in the summer of 1923.

R. W. McCullough, A.M.E.I.C., has been promoted to the position of chief engineer of the Provincial Highways Board of the province of Nova Scotia left vacant since the death of the late W. A. Hendry, M.E.I.C. At present he is combining the duties of chief engineer with those of his former position of chief inspecting engineer.

A. A. Paoli, A.M.E.I.C., is at present with the Canadian Ingersoll-Rand Company, Limited, in Sydney, N.S., as sales engineer for Nova Scotia, Prince Edward Island and Newfoundland. Mr. Paoli received his B.A. degree from Queen's University in 1915, and his B.Sc. from the same university, in 1922.

F. W. W. Doane, M.E.I.C., former city engineer of Halifax, N.S., who is now in private practice, has in preparation a plan of the town of Pictou, N.S., where he has recently made a survey, and is to make a report of the municipal lighting system of the town of Antigonish, N.S.

R. M. Robertson, Jr.E.I.C., until recently with the bridge department of the Canadian Pacific Railway, has accepted a position in the designing department of the Dominion Bridge Company, Limited. Mr. Robertson is a graduate from McGill University with the class of 1920.

L. L. Thériault, M.E.I.C., district highway engineer, Public Works Department, New Brunswick, had the

ELECTIONS AND TRANSFERS

On June 7th, 1924, a ballot was canvassed and the following elections and transfers were effected:—

Members

BARNES, Howard Turner, B.A.Sc., M.A.Sc., D.Sc. (McGill Univ.), F.R.S., of Montreal, Que.

BROCK, Reginald Walter, M.A., LL.D. (Queen's Univ.), dean of the faculty of applied science, University of British Columbia, Vancouver, B.C.

HYNDMAN, Walter Eardley, district engr., Dept. Public Works, Canada, Charlottetown, P.E.I.

ROBINSON, Arthur Herbert Ashburner, B.A.Sc. (Univ. of Tor.), mineral technologist, Dept. of Mines, Ottawa, Ont.

Associate Members

BARRY, William Henry, private practice, architect and constructional engr., Peterborough, Ont.

BREEN, Joseph Melville, B.A.Sc. (Univ. of Tor.), roadways engr. for Ontario for Canada Cement Company, Toronto, Ont.

CARMICHAEL, Frederick Norman Dubourdien, B.A.Sc. (Univ. of Tor.), engr., plan examination branch, city arch'ts. dept., City Hall, Toronto. Ont.

COOPER, Herbert Johnstone, Bach. Engrg. (Thomason Civil Engrg. College, India), asst. hydraulic engr. in charge of surveys for the Reclamation Service, Dept. of the Interior, Calgary, Alta.

CUNNINGHAM, William John, supt. power and pumping plants, City of Edmonton, Alta.

KELLY, Edward Arthur, of Lethbridge, Alta., asst. engr. on constrn., C.P.R., Kipp, Alta. to Little Bow River.

KEWIN, George Edwin, B.A.Sc. (Univ. of Tor.), res. elect'l. engr., Queenston-Chippawa Development, H.E.P.C. of Ontario, Niagara Falls South. Ont.

LEGER, Oswald Ernest, sales engr., Canadian Vickers, Limited, Montreal, Que.

LOGAN, Robert Archibald, manager, mapping division, Fairchild Aerial Camera Corporation, New York City.

STEEL, William Arthur, B.A.Sc. (Univ. of Tor.), tech. officer for the Royal Canadian Corps of Signals, Ottawa, Ont.

TAYLOR, Gilbert Ferguson, struct'l. engr. in charge of design and supervision of bridges, works dept., City Hall, Ottawa, Ont.

Juniors

TAKER, Frank Oliver, surveyor on engrg. staff, Hollinger Consolidated Gold Mines, Ltd., Timmins, Ont.

TRUEMAN, James Cobden, B.Sc. (Univ. of Man.), 721 Shuter Street, Montreal, Que.

WILSON, James Moir, B.Sc. (McGill Univ.), of Lachine, Que.

Affiliates

LOCKWOOD, Walter Holmes, dfting., designing and estimating, Waterman Waterbury Mfg. Co. Ltd., Regina, Sask.

McLACHLIN, Dan. manager of an extensive lumber plant at Arnprior, Ont.

Transferred from the class of Associate Member to that of Member

GRAY, Francis William, asst. to the president, British Empire Steel Corporation, Sydney, N.S.

PICKARD, Kenneth Stockton, B.Sc. (McGill Univ.), private practice, Sackville, N.B.

SHANLY, Coote Nisbitt, in charge of special investigations of hydraulic works, Price Bros. & Co. Ltd., Kenogami, Que.

Transferred from the class of Junior to that of Associate Member

BISHOP, Arthur Leonard, (Grad. R.M.C.), 50 Ontario Street, St. Catharines, Ont.

CALKINS, Harold A., B.Sc. (McGill Univ.), of Montreal, Que.

CREIGHTON, Charles Sydney, B.Sc. (N.S. Tech. Coll.), mgr., Creighton Woodworking Co., Woodside, Dartmouth, N.S.

CROSSING, William Berkley, transitman on location, C.P.R., Winnipeg, Man.

GRAY, Earl Alexander, engr. in charge design and special constrn. dept., Public Utilities Commission, London, Ont.

MORRISEY, Thomas Sydney, (Grad. R.M.C.), of 85 Church Hill, Westmount, Que.

NASH, Abram Leland Stanley, B.A.Sc. (Univ. of Tor.), partner, Messrs. Lee and Nash, Brantford, Ont.

REID, John Herbert, B.Sc. (McGill Univ.), asst. professor of elec. engrg., N.S. Tech. Coll., Halifax, N.S.

VANCE, James Alfred, general contractor, Woodstock, Ont.

Transferred from the class of Student to that of Junior

FRY, John Dawson, B.Sc. (McGill Univ.), asst. engr., McDougall, Pease and Friedman, Consulting Engineers, Montreal, Que.

GILBERT, Edgar Valentine, B.Sc. (McGill Univ.), dftsman. at Hemmings' Falls, for Southern Canada Power Company, Montreal, Que.

IRVIN, Wilfrid F., B.A.Sc. (Univ. of Tor.), asst. engr. on traffic study, Toronto Transportation Commission, Toronto, Ont.

PERRITON, Douglas E., B.Sc. (McGill Univ.), checker, Dominion Bridge Company, Lachine, Que.

PREVOST, Edouard, B.S. (Univ. of Montreal), field engr. for the Atlas Construction Co., and dftsman., Messrs. Beaubien, Busfield & Co., Montreal, Que.

ROSE, Hugh Grant, B.A.Sc. (Univ. of Tor.), Geodetic Survey of Canada, Ottawa, Ont.

WHITFORD, Joseph Arthur Hugh, dftsman. on bldg. design, chief engr's. office, C.N.R., Moncton, N.B.

WILLIAMS, Stephen, B.A.Sc. (Univ. of Tor.), Grad. R.M.C., dftsman., Imperial Oil Refineries, Limited, Sarnia, Ont.

WINTER, Thomas Hinton, B.Sc. (N.S. Tech. Coll.), chief asst. to engr. in charge pipe line and forebay constrn., Sir W. G. Armstrong Whitworth & Co. Ltd., Deer Lake, Nfld.

ZEALAND, Edward Lamport, B.A.Sc. (Univ. of Tor.), junior engr., Quebec Development Co. Ltd., St. Joseph d'Alma, Que.

On June 24th, 1924, a ballot was canvassed and the following elections and transfers were effected:—

Members

CALDWELL, Alexander Clyde, (Grad. R.M.C.), Director, Engineer Services, Department National Defence, Ottawa, Ont.

ROY, Georges, B.Sc. (Laval Univ.), officer administering the Royal Canadian Artillery and staff officer for artillery. Chairman, Standing Arms Committee, Ottawa, Ont.

Associate Members

BABBITT, Archie Randolph, B.Sc. (Univ. of N.B.), Provincial Highways Board, Halifax, N.S.

CHAMBERS, Edward Coulthurst Gibbons, captain and adjutant, Royal Canadian Engineers, Ottawa, Ont.

CHETWYND, George Rowland, District Engineer Officer, M.D. No. 12, Regina, Sask.

COOK, William Henry, chief dftsman., mech. bldg. and mtce., Canadian Consolidated Rubber Co., Ltd., Montreal, Que.

CUNNINGHAM, Roy Herbert, B.A.Sc. (Univ. of Tor.), R. H. Cunningham & Company, Industrial Engineers, London, Ont.

Affiliate

DAW, Joseph, engr., Brown Corporation, Quebec, Que.

Transferred from the class of Junior to that of Associate Member

MacNEIL, Hector, res. engr., constrn., C.N.R., Longlac, Ont.

McLEAN, Howard Joseph, field and office engr., Dominion Water Power Branch, Calgary, Alta.

Transferred from the class of Student to that of Junior

BENNETT, Willard Erlandson, B.A.Sc. (Univ. of Tor.), res. engr., Swastika-Wendigo Lake Branch, Nipissing Central Railway, Larder Lake, Ont.

KIRKPATRICK, Harold Thompson, B.Sc. (McGill Univ.), dftsman., Dominion Tar & Chemical Co., Montreal, Que.

OLIVER, Cuthbert Jack, B.Sc. (McGill Univ.), power house layout and design work, Messrs. Kerry & Chace, Ltd., Toronto, Ont.

At the meeting of Council held on May 27th, 1924, the following students were admitted:—

McCAW, John Blaiklock, Staff House, Kenogami, Que.

PHIPPS, Charles Ferdinand, Cascade Inn, Shawinigan Falls, Que.

REID, Kenneth, 348 Sherbrooke Street West, Montreal, Que.

British Columbia's Lumber Exhibit at Wembley

Loren L. Brown, A.M.E.I.C., British Columbia Timber Commissioner

Three thousand people per hour pouring through the British Columbia bungalow illustrates the love of every human being for a *Home* and proves the wisdom of exhibiting our woods in the form of the finished product. Exterior woodwork, shingle siding and roofing, flooring, wall and ceiling panelling, sash and doors incorporated into a home receive infinitely more attention than when shown by themselves in a miscellaneous museum-like collection of exhibits.

One of the main objects of the British Columbia exhibit is to increase the United Kingdom market for our clear grades of fir, hemlock, cedar and spruce and that it will do so is certain if the interest in the exhibit is an indication.

The bungalow consists of two rooms only, a living room and dining room and is in a very prominent position inside of the Canadian building. Both rooms are floored with edge-grained Douglas fir. The living room walls are panelled with Douglas fir. The panels themselves being 3-ply veneer and the stiles and rails being edge-grained strips. The ceiling which is greatly admired, is of Douglas fir with cottonwood panels. This room has a built-in ingle-nook with a fireplace.

The dining room walls are panelled in British Columbia hemlock in the solid. The ceiling is beamed with solid red cedar beams having cottonwood panels between. This room also contains a fireplace which has built-in china cabinets with leaded glass doors on either side of it. The two doorways have been very artistically treated the overhang in each case being carried on carved cedar brackets.

In the chimney stack has been inset a plaster cast of the British Columbia coat-of-arms with the words British Columbia. As this is directly in the centre of the main aisle, no one who visits the Canadian building can fail to realize that British Columbia is very much on the map.

On an adjoining space is shown a miscellaneous exhibit of British Columbia forest products comprising, sash and doors, cedar and cottonwood panelling and sample mouldings and boards.

The Dominion Government exhibit which comprises woods from all the provinces affords generous space to those from British Columbia.

In addition there are a number of exhibits by commercial firms featuring British Columbia woods.

Beside all this an automatic cinema with a daylight screen tells the story of the British Columbia lumber industry and of the province generally twelve hours per day. British Columbia in general and the lumber industry in particular are well represented at Wembley.

In view of the tremendous housing programme which is now well under way the exhibit is very timely and affords the best possible means of showing the many varied and valuable uses of British Columbia timbers to the British timber-merchant, architect and builder and to the ultimate consumer.

British Columbia Lumber Exhibit at Wembly, Exterior and Interior View of Bungalow.

Progress of Work of Canadian Engineering Standards Association

First half year 1924

Branch of Industry and Subject		Stage of Progress
A — *Civil Engineering and Construction:*		
Steel Railway Bridges	A1-1922	6
Portland Cement	A5-1922	6
Steel Highway Bridges	A6-1922	6
Reinforcing Materials for Concrete	A9-1923	6
Movable Bridges		3
Steel Structures for Buildings		4
Road Materials and Construction		1
Concrete and Reinforced Concrete		2
B — *Mechanical Engineering:*		
Wire Rope for Mining, Dredging and Steam Shovel Purposes	B4-1921	6
Galvanized Steel Wire Strand	B12-1924	6
Screw Threads		1
Gearing		1
Cast Iron Pipe		2
Stove Bolts		1
C — *Electrical Engineering:*		
Galvanized Telegraph and Telephone Wire	C3-1921	6
Distribution Type Transformers	C 2-1920	6
Regular Tungsten Incandescent Lamps	C10-1923	6
Station Type Transformers		1
Watthour Meters		4
Wood Poles for Transmission Lines		4
Concrete Poles for Transmission Lines		4
Rating and Testing Rules for Electrical Machinery		1
Canadian Electrical Code		1
Electrical Overhead Crossings		1
D — *Automotive Engineering:*		
Flexible Steel Wire Rope and Strand for Aircraft	D 7-1922	6
Report on Gasoline for Automotive Work	D11-1924	6
Traffic Signals for Highways		2
E — *Railway Work:*		
Rails		1
Fences and Gates for Railways		4
G — *Ferrous Metallurgy:*		
Commercial Bar Steels	G 8-1923	6
Tests for Heavy Steel Castings		1
M — *Mining:*		
Mining Drill Chucks and Steel		1

Stages of progress. — 1. Decision made to undertake standardization; 2. Draft proposal under consideration; 3. Sent out for criticism; 4. Submitted for approval; 5. Approved for publication; 6. Published. The letter R following the number of stage of progress indicates that the respective specification is under revision.

BRANCH NEWS

St. John Branch

W. J. Johnston, A.M.E.I.C., Secretary-Treasurer

On the evening of May 30th, the members of the St. John Branch, tendered a farewell banquet at the Dunlop Hotel, to E. G. Cameron, A.M.E.I.C.

C. C. Kirby, M.E.I.C. in proposing the toast to the guest of the evening expressed the regret of the members of the St. John Branch at losing Mr. Cameron, but wished him the best of success in his new position as assistant to the chief engineer on Welland Ship Canal.

In reply Mr. Cameron thanked his friends for their expressions of good wishes and briefly reviewed his six years' stay in St. John. He modestly disclaimed undue credit for the St. John drydock now completed (and built largely under his supervision as chief engineer) but generously gave the credit to his predecessors and assistants. Unfortunately Mr. Cameron left himself open to future trouble when in an unguarded moment he issued an invitation to the members of the St. John Branch to visit him at St. Catharines, Ont.

The toast to *The Institute* was moved by F. P. Vaughan, M.E.I.C. The growth of *The Institute* in recent years and particularly in the past year was mentioned by the speaker. Reference was made to several members who had left the branch territory recently, including V. S. Chesnut, A.M.E.I.C. and other members of the St. John drydock staff, H. F. Bennett, A.M.E.I.C. to Halifax, N. F. Nutter, A.M.E.I.C. to Truro, F. G. Goodspeed, M.E.I.C. to Winnipeg. C. L. Roach, S.E.I.C., a member of *The Institute* for three weeks, replied to this toast.

F. M. Ross, Affiliate of St. John Branch, general manager St. John Drydock and Shipbuilding Company, spoke of his associations with Mr. Cameron and of his regret at losing him, and including in this all the men on the job.

J. L. Rannie, M.E.I.C., chairman Ottawa Branch, tendered the good wishes of the Ottawa Branch to the St. John Branch. Those present gained a clearer idea of the work *The Institute* is doing in making engineers better acquainted throughout Canada, and of more that could be done in this respect from Mr. Rannie's remarks. Forty-one members were present and singing by entertainers and the whole crowd, and recitations were other features of the evening. "Good-Bye, Good-Luck to You !" those present read on their menu cards and repeated this sentiment when later they separately bade farewell to Mr. Cameron.

Moncton Branch

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

The annual meeting of Moncton Branch was held on Thursday evening, May 15th 1924, with F. O. Condon, M.E.I.C., vice-chairman, presiding

Annual Report of the Executive Committee

The third annual meeting of Moncton Branch was held on June 1st, 1923.

The attendance at our meetings during the past year has been very good considering that we have lost several of our most active members who were transferred to Montreal or other cities at the time of the re-organization of the Canadian National Railways.

During the year there were seven meetings of the branch. The executive committee held five meetings during the branch year and considerable business was transacted.

Papers were read, addresses given and important business transacted as follows:—

1923

Dec. 18—W. R. Pearce, M.E.I.C., chief engineer of the New Brunswick Telephone Co., St. John, read a paper on "*The Telephone*".

1924

Jan. 24—Mr. Hutchinson of the Meteorological Observatory, St. John delivered an address on "*The Winds and Weather*".

Feb. 4—Dr. Howard T. Barnes, of McGill University, Montreal, addressed the members on "*Ice Formation and Prevention*".

Feb. 26—A meeting was held at Mount Allison University, Sackville, N.B., at which A. E. Oulton, A.M.E.I.C., of the Bridge Dep't. Canadian National Railways, Moncton, delivered an address on "*An Outline of Bridge Design*".

Mar. 7—Nominations of officers for the year 1924-25 were held.

Mar. 18—Doctor Bigelow of Mount Allison University addressed the members on "*The Natural Resources of the Province of New Brunswick*".

Apr. 25—Vice-president F. A. Bowman, M.E.I.C., of Halifax, gave a short address of interest to the members of the maritime provinces, and Professor H. W. McKiel, M.E.I.C., addressed the members on "*Canada's Mineral Resources*".

During the past year our membership has decreased owing, as mentioned before, to the transfer of several of our most active members. In May, 1923, we had 86, we have now 79, which number includes the non-resident members. The membership is as follows:—

Resident—............	Members	10	
	Associate Members	26	
	Juniors	5	
	Students	20	
	Affiliate	1	62
Non-resident—.........	Members	1	
	Associate Members	10	
	Juniors	4	
	Students	2	17
	Total..............		79

The sincere thanks of the members of Moncton Branch are due to Major McKie and the ladies and gentlemen who so kindly provided entertainment at our supper-meetings.

The financial statement will show a surplus of $87.66, which amount includes balance in bank after all outstanding bills are paid and rebates for January, February and March due from headquarters.

The thanks of the executive are due G. C. Torrens, A.M.E.I.C., chairman of the Papers Committee; G. E. Smith, A.M.E.I.C., and J. R. Freeman, M.E.I.C., of the Entertainment Committee; M. A. McCabe, Jr.E.I.C., associate editor of the Journal and L. T. Tingley, official stenographer, who have all worked faithfully towards the general welfare of the branch during the past year.

(Signed) M. J. Murphy, A.M.E.I.C., *Secretary-Treasury.*
Fred. Condon, M.E.I.C., *Vice-chairman.*

Financial Statement for Annual Meeting May 15th, 1924

Receipts

Balance in Bank	$ 40.33
Rebates from H. Q.	119.21
Affiliates subscription to Journal	2.00
Bank Interest	2.37
Supper-meetings	101.25
	$265.16

Expenditures

Christmas presents	$ 8.00
Expenses supper-meetings	161.87
Affiliates subscription to Journal	2.00
Printing	23.03
Stamps	6.45
Bank discount	.30
Telegraph and telephone	3.40
Miscellaneous	8.88
Cash in bank	51.23
	$265.16

Assets

Balloptican lantern	$ 60.00
Attache case	18.00
Rubber stamp	1.00
Stamps on hand	1.77
Cash in bank	51.23
	$132.00

Liabilities

Bills outstanding—		
Printing		$ 15.12
Telephone		.30
Expenses supper-meeting		1.00
		$16.42
Balance in Bank	$ 51.23	
Rebates due from Headquarters	52.85	
	$104.08	
Bills outstanding	16.42	
Balance	$ 87.66	

Election of Officers

The following officers were elected for the ensuing year:

F. O. Condon, M.E.I.C., Engineer, Maintenance of Way, C.N.R., Chairman.

C. S. G. Rogers, A.M.E.I.C., Bridge Engineer, C.N.R., Vice Chairman

M. J. Murphy, A.M.E.I.C., Assistant Engineer, C.N.R., Secretary-Treasurer.

Executive Committee:—
F. B. Fripp, A.M.E.I.C., Harbour Engineer, C.N.R.
G. C. Torrens, A.M.E.I.C., Division Engineer, C.N.R.
G. E. Smith, A.M.E.I.C., Draughtsman, C.N.R.

The following members of the Executive Committee hold office for another year.
H. J. Crudge, A.M.E.I.C., Building-Engineer, C.N.R.
E. G. Evans, M.E.I.C., District Engineer, C.N.R.
J. D. McBeath, M.E.I.C., City Engineer.
A. F. Stewart, M.E.I.C., Chief Engineer, C.N.R., Ex-officio.
W. B. MacKenzie, M.E.I.C., Consulting Engineer, Ex-officio.

Committee Appointments

At a meeting of the Executive Committee held June 12th, the following Committees were appointed for the year 1924-25.

Entertainment Committee:—G. E. Smith, A.M.E.I.C.
J. R. Freeman, M.E.I.C.
Papers Committee:—Prof. H. W. McKiel, M.E.I.C., chairman.
A. C. Selig, M.E.I.C.
A. E. Oulton, A.M.E.I.C.
R. H. Emmerson, A.M.E.I.C.
Auditors:—H. J. Crudge, A.M.E.I.C.
C. S. Rogers, A.M.E.I.C.

M. J. Murphy, A.M.E.I.C.
Moncton, N.B., June 11, 1924. *Secretary-Treasurer.*

Saskatchewan Branch

J. W. D. Farrell, A.M.E.I.C., Secretary-Treasurer

Congratulations are in order to Professor C. J. Mackenzie, M.E.I.C., dean of the faculty of engineering, University of Saskatchewan, on his recent marriage. The wedding took place in Holy Trinity Church, Edmonton, June 11th, when Geraldine Gallon, daughter of Mr. and Mrs. W. J. Gallon, became the bride of Professor Mackenzie.

Professor Mackenzie is chairman of the Saskatchewan Branch, and the members join in extending to him their best wishes at this time.

Special Meeting

A special meeting of the branch was held April 24th, at the Parliament Buildings' dining room, Lieut. Col. Garner, M.E.I.C., past chairman, presiding in the absence of Mr. Blackburn. The meeting commenced with a dinner, at which approximately twenty members were present, several other members coming in later. Following the dinner a communication was read from Mr. E. W. Francis, Jr.E.I.C., a son of the late Walter J. Francis, President of *The Institute,* thanking the branch for its message of sympathy and for the floral tribute. P. C. Perry, A.M.E.I.C., who was to have given a paper on "Development of New Methods and Appliances in Railway Maintenance" was unavoidably detained and could not give his paper.

The Panama Canal

The Chairman then called on Mr. Patton for his paper on the Panama Canal. Mr. Patton gave a very interesting talk on the canal, giving an outline of the history of the canal, a brief account of construction data and difficulties, present day maintenance and operating practices. By means of a map and figures Mr. Patton showed how the canal route was related to the world's traffic routes and within what limits it was economical to pay canal tolls. Mr. Patton also showed a profile of the canal, a relief map of the Zone and an excellent collection of slides made from photos taken during his trip last winter. In closing Mr. Patton suggested that the construction and operation of the Panama canal should, in his opinion, indicate that the successful operation of the Hudson Bay route was quite attainable. In the discussion which followed Mr. Patton answered the questions of members and brought out some interesting points.

Problems of Telephone Maintenance

T. Leach, of the department of telephones, then gave an interesting talk on the problems of telephone maintenance engineering. Mr. Leach outlined the routine work in connection with giving continuous service to the subscribers of the system, touching on methods of repair and the use of instruments in locating line trouble. Mr. Leach also touched on the economics of distributing from a central exchange as compared with several branch exchanges. A general discussion took place which at one time threatened to break out into the electrolysis controversy between Messrs. McGuinness and Parker.

Health Engineering

R. H. Murray, A.M.E.I.C., then gave a talk on health engineering. Mr. Murray, using data referring to our own province, said that within the whole province there were some thirty-six municipalities with a total population of 100,000 with municipal water supplies; also that there were some eighteen municipalities with sewage disposal systems. From these facts it was pointed out that the provincial department of public health was chiefly concerned in assisting small communities and farmers in obtaining safe water supplies and making a sanitary disposal of waste matter. Mr. Murray also touched on milk supplies and bovine tuberculosis. It was shown that the province had a problem of very serious dimensions in this matter and that a wide range of action on the part of the health of animals branch of the Dominion government was urgently needed. The cities of the province are receiving good protection in this matter but this protection needed to be extended throughout the province. The paper was discussed generally, several members giving anecdotes relating to the subject.

Victoria Branch

E. P. Girdwood, M.E.I.C., Secretary-Treasurer

The members of the Victoria Branch were the guests of the officers of H.M.S. Hood on board the battleship while at Victoria, on June 21st. Accompanied by their wives and a number of friends, the members were afforded an opportunity of making a tour of inspection of the Hood. The party which consisted of one hundred and seventy-five and included practically all the prominent engineers of Victoria, had a most interesting and enjoyable time.

Niagara Peninsula Branch

R. W. Downie, A.M.E.I.C., Secretary-Treasurer.

R. Hogg, Jr. E.I.C., Branch News Editor.

Speaking before the annual meeting of the branch, Russell Yuill, A.M.E.I.C., of the St. Lawrence Ship Canal staff, gave a description of the St. Lawrence river together with detailed results of investigations of the ice conditions in the river.

Mr. Yuill has done considerable work on this latter problem during the past winter, and his figures and facts were "straight from the barbed wire" so to speak.

Mr. Yuill's address, and the large assortment of slides with which it was illustrated, were much appreciated by the members present, who, whether of the Department of Railways and Canals, or under the banner of the Hydro Commission, are all equally interested in this projected development.

A feature which added much to the enjoyment of the evening was the rendering of selections of classical music by the Welland Ship Canal Instrumental Trio.

The Branch News Editor was the happy recipient of a handsome pipe "*a real Dunhill,*" presented to him by F. W. Clark, A.M.E.I.C., on behalf of the branch. He appreciates very much the gift itself and the kind thought which prompted it.

Annual Picnic

About seventy members, their wives and guests, attended the annual picnic of the branch, held on July 16th, at the Queens Royal Hotel, Niagara-on-the-Lake.

A tennis tournament, golf and bathing occupied the afternoon. Then came dinner, a pleasant and satisfying affair, followed by the presentation of prizes to the winners of the tennis tournament. First prizes were carried off by J. R. Bond, A.M.E.I.C., and G. Kewin, A.M.E.I.C. while the runners-up were C. H. Mathewson, A.M.E.I.C., and O. B. Bourne, A.M.E.I.C.

S. R. Frost, A.M.E.I.C., past chairman, expressed keen regret at the loss to the branch of A. C. D. Blanchard, M.E.I.C., who leaves this district on August 1st to take a position as chief hydraulic engineer with the New Brunswick Power Commission. Mr. Blanchard has worked energetically for the good of the branch ever since its inception, and has earned the name given him by Mr. Frost, of "Father of the Branch". F. S. Lazier, M.E.I.C., in a few remarks endorsed the sentiments expressed by the former speaker. R. W. Downie, A.M.E.I.C., secretary-treasurer, asked for and received authority from the branch to show some mark of appreciation of the efforts of F.W. Clark, A.M.E.I.C. towards furthering its interests. Mr. Clark has always been a hard worker, both in the council and the executive. He was transferred recently from the Chippawa canal to Shaws falls on the Ottawa, where a preliminary survey for hydro development is being made.

A thunder storm which started during dinner caused the indefinite postponement of a soft ball game which was scheduled to be played between the St. Catharines members and those from the Falls.

The rain that came to the rescue of the Niagara Falls team, and at the same time robbed the St. Kitts team of a victory, did not, however, interfere with a very enjoyable dance in the Hotel pavilion, where the majority of the guests remained till near midnight, when they found their several ways homeward through a heavy downpour, damp in the flesh, but undamped in the spirit.

OTHER SOCIETIES NEWS

Meeting of The British Association for the Advancement of Science

The British Association for the advancement of science will hold its 92nd annual meeting in Toronto, Canada, from the 6th to the 13th of August.

A cordial invitation is extended to all who are interested in science to become members for this meeting. No technical qualifications are required for membership.

The Association, which was founded in 1831, meets annually for one week or longer at important centres, other than London, in England, and it occasionally meets in other parts of the British Empire. The Association has met in Canada on three previous occasions, viz. in 1884, 1897 and 1909. Other overseas meetings have been held once each in South Africa 1905 and Australia 1914.

Scientific Meetings

The inaugural general meeting will be held on Wednesday, August 6th, when Major-General Sir David Bruce, K.C.B., F.R.S., will assume the presidency of the association in succession to Professor Sir Ernest Rutherford, F.R.S., and will deliver the presidential address.

The association is organized in thirteen sections designated as follows:—

	President for 1924.
A. Mathematical and Physical Science,	Sir Wm. Bragg, K.B.E., F.R.S.
B. Chemistry,	Sir Robert Robertson, K.B.E.
C. Geology,	Prof. W. W. Watts, F.R.S.
D. Zoology,	Prof. G. Elliot Smith, F.R.S.
E. Geography,	Prof. J. W. Gregory, F.R.S.
F. Economic Science and Statistics,	Sir William Ashley.
G. Engineering,	Prof. G. W. O. Howe.
H. Anthropology,	Dr. F. C. S. Shrubsall.
I. Physiology,	Dr. H. H. Dale, C.B.E., F.R.S.
J. Psychology,	Prof. W. McDougall, F.R.S.
K. Botany,	Prof. V. H. Blackman, F.R.S.
L. Educational Science,	Principal Ernest Barker.
M. Agriculture,	Sir John Russell, F.R.S.

Addresses will be delivered by the sectional presidents of the respective sections and papers will be read on and after Thursday, August 7th, until the conclusion of the meeting.

Joint meetings of various sections will be held also at which the following are among the subjects to be discussed.

Section.	*Subject.*
A and B	Crystal Structure and Colloid Solutions.
A and G	Optical Study of Elasticity.
B and I	Vitamines and the relation of light to their action.
B and G	Liquid and powdered Fuels.
C and E	Changes of Sea-level in relation to Gravitation, Continental Shelves and Coral Islands.
I and J	Physiological and Psychological Factors of Muscular Efficiency in Industry.
D and K	Species Concept.
D and M	Soil Population.
J and L	Tests for Scholarship and Promotion.
F and M	Diminishing Returns in Agriculture.
H and J	Racial Mental Differences.

During the week of the meetings a number of popular lectures will be delivered by prominent visitors.

Nova Scotia Mining Society Annual Meeting

The thirty-second annual meeting of the Nova Scotia Mining Society was held in New Glasgow, N.S., commencing June 23rd, and proved to be one of the most successful in the long history of the organization. Members of the Society from all sections of Nova Scotia were present, and a series of very interesting papers on mining and geological subjects were presented.

The news of the death of C. M. Odell, president of the Society, on June 24th, the day following his re-election to that high office, came as a great shock to the members. The late Mr. Odell has for years been most energetic in the interests of the Nova Scotia Mining Society.

The officers elected for the ensuing year are: — First vice-president, Alex. S. MacNeil, general colliery superintendent, British Empire Steel Corporation, Glace Bay; second vice-president, F. W. Gray, A.M.E.I.C., assistant to the president of the British Empire Steel Corporation; and E. C. H. Hanrahan, secretary-treasurer.

The executive council of the Society for the present year includes the following members of *The Engineering Institute of Canada:* T. J. Brown, M.E.I.C., J. S. Whyte, M.E.I.C., H. B. Gillis, M.E.I.C., Walter Herd, M.E.I.C., D. H. McDougall, M.E.I.C., and J. J. McDougall, A.M.E.I.C.

EMPLOYMENT BUREAU

Situations Wanted

Technical Assistant

Graduate applied chemistry. Five years experience coke oven works, thoroughly familiar with operation and scientific control, desires change with prospects in similar work or allied industries. Apply box No. 148-W.

Civil Engineer

University graduate, A.M.E.I.C., nine years experience in highway and building construction, wants position with a firm of contractors or manufacturers. Apply box No. 149-W.

Electrical Engineer

Graduate electrical engineer with nineteen years experience, including six years as chief engineer of large power organization in Canada, wishes to secure position as executive or on construction work, either electrical or mechanical. Location immaterial. Knowledge of French, Italian, German and Spanish. Apply box No. 150-W.

Situations Vacant

Senior Electrical Engineer

Senior electrical engineer for temporary employment for the St. Lawrence Canal Enlargement Branch, Department of Railways and Canals. Salary $4,200. per annum. Qualifications: graduation with high standing in electrical engineering from a recognized university, or its equivalent; extensive and recent experience in designing power plants of large size with special reference to electrical and mechanical equipment; extensive experience in the shops and testing laboratories and designing offices of companies who build generators, transformers, and switching apparatus. Candidates must be British subjects with at least three years' residence in Canada. Apply to the Civil Service Commission, Ottawa, not later than August 7th.

Draughtsmen

A paper company in Quebec requires the services of two experienced draughtsmen, preferably men who have worked in paper mills. Salary between $175 and $200. Apply box No. 114-W.

Industrial Engineer

Public utility company in Montreal has an opening for a qualified engineer who has had experience in building and plant maintenance, with a thorough grounding in mechanical engineering, and a general knowledge of construction and architectural work preferred although not essential. Work will entail the general management of a number of buildings of the company. Apply box No. 117-V.

Mechanical Engineer

There is an opening for a mechanical engineer with four or five years experience in engineering practice, who is well up in theory, for the position of assistant to the chief engineer of a pulp and paper company in Ontario. Salary between $300 and $350 per month. Apply box No. 118-V.

Architectural Draughtsmen

One or two architectural draughtsmen with four or five years experience in the design of large buildings. Reply giving full statement of experience and qualifications. Apply box No. 119-V.

Representative

Société Nouvelle des Établissements; Decauville Aîné of Paris (France) manufacturer of permanent and portable railway material would like to secure as representative for Canada reliable firm well established, having store and yard at Montreal.

Write giving particulars and references to:

DECAUVILLE Aîné, 66, Chaussée d'Antin, PARIS.

Recent Additions to the Library

Transactions, Proceedings, etc.

Presented by the Societies.

Transactions of The Institution of Engineers, Australia, Volume 2, 1921.
Year Book of The American Society of Civil Engineers, March 1924.
Transactions and Year Book of The University of Toronto Engineering Society, April 1924.
Transactions of The Society of Naval Architects and Marine Engineers, 1923. Volume XXXI.
Directory of The American Institute of Mining and Metallurgical Engineers, Incorporated, corrected to April 7th, 1924.
Transactions of the Institution of Water Engineers, Volume XXVIII. 1923.

Reports, etc.

Presented by United States Department of Commerce.

Recommended Minimum Requirements for Plumbing in Dwellings and similar buildings, final report of sub-committee on plumbing of the Building Code Committee.
Elimination of Waste, Simplified Practice, Hollow Building Tile.

Presented by The Rockefeller Foundation.

A Review for 1923, by George E. Vincent, President of the Foundation.

Presented by The American Society of Mechanical Engineers.

The Engineering Index, 1923.

Presented by The Dominion Bureau of Statistics, Canada.

Census of Industry, 1922, Central Electric Stations in Canada.

Presented by Corps of Engineers, United States Army.

Statistical Report of Lake Commerce passing through Canals at Sault Ste. Marie, Michigan and Ontario, during the season of 1923.

Presented by the Keeper of Public Records, Dominion of Canada.

Report of the Public Archives for the Year 1923.

Presented by the Technical Association of the Pulp and Paper Industry.

Decayed Wood for Pulp — at a Profit, by John D. Rue.

Presented by Mines Branch, Dept. of the Interior, Ottawa.

The Mineral Industries of Canada, British Empire Exhibition Edition, 1924.

Presented by the Commissioner of Public Works, Boston, U.S.A.

Annual Report of the Public Works Department, City of Boston, 1922.

Presented by the Dominion Bureau of Statistics.

The Canada Year Book, 1922-1923.

Presented by Department of Trade & Commerce, Dominion of Canada.

Annual Report of the Trade of Canada, fiscal year ending March 31st, 1923.

Technical Books.

Presented by Chapman and Hall, Limited, London, England.

Coal and Oil Fired Boilers, by Engineer-Commander, F. J. Drover, R.N.
Constructional Steelwork, by Harry Atkin.

Presented by Williams and Wilkins Company, Baltimore, Md.

Popular Research Narratives, tales of Discovery, Invention and Research.

Presented by Industrial and Educational Publishing Company.

A Handbook of Prospecting, by W. L. Goodwin, D.Sc., LL.D. First Edition.

Current Wages in the Building Trades in Canadian Centres, July 1924

	Brick-layers	Masons	Marble and Tile Setters	Cement finishers	Stone Cutters	Plasterers	Carpenters	Lathers	Painters	Electricians	Sheet Metal Workers	Slate and Tile Roofers	Struct'l Steel Men	Plumbers and Steam-fitters	Hoisting Engineers	Hod Carriers	Laborers
Nova Scotia																	
HALIFAX	.90-1.00	90-1.00	...	.90-1.00	.90-1.00	.90-1.00	.57	.57	.57	.60	60	57	.60	60	.64	.35	25-35
New Brunswick																	
FREDERICTON	.90-1.00	1.00	1.25	.90	.90	1.00	.50-.65	40	.70	.70	.70	...	...	.70	60	40	.30-35
MONCTON	.91	.91	.91	.60	.80	.91	.60	.60	60	.60	60	.60	60	.60	.60	40	35
ST. JOHN	1.00	1.00	.70	1.00	.80	1.00	.50-.60	$3.00 per 1,000	.50-60	.50	.60		50-55	60	45	.30-35	.30-35
Quebec																	
MONTREAL	up to 1.00	up to 1.00	.70-.75	up to .70	.75	.80-1.00	.65-75	.50-65	.50-.70	65-80	48-70	55-65	60-90	75	50-60	.37½ & .40	.35
QUEBEC	.90	.80	.80-.90	.45-.60	.45-.60	85	.45-55	$3.00 per 1,000	42-60	45-.55	45-55	45-55	.65	45-.55	50	40-45	40
SHERBROOKE	.85	.60	...	40	...	.75	50	.50	45	.70	.75	.75	...	75	...	35	30
Ontario																	
BELLEVILLE	.80-1.00	.80-1.00	...	.75	...	.80-.90	.60-.75	...	65	...	...	...	...	.75	...	40	.30-40
BRANTFORD	1 00	1 00	1.00	50-75	1 00	1.00	80	.80	50-65	.75	50-75	50-.75		60-80	70	45-.55	40-50
BROCKVILLE	90	90	...	.90	90	.90	.60-.75		65-75	70	75		...	.70		40-.45	.30-45
COBOURG	1 00	1 00	...	70	1.00	85	.70		50	80			...			.45	40
GALT	1 00	1 00	...	.50	1 00	1.00	.60-70	75	.55-65	60-75	...	...	...	60-.75	75	45	35-45
GUELPH	1 10	1.10	...	50-60	1 10	1 10	80	...	60	60	60	...	...	60-70		50	35-40
HAMILTON	1 12½	1.12½	1 00	55-60	1 00	1 12½	80	75-.87½	70	75	80	.80	.70	85	75	45-50	40-45
KINGSTON	.85-1.00	.85-1.00	.85-1.00	.85-1.00	75-90	.85-1.00	75	75	65	.65 & .70	.80 & 85	80		80 & .85		35-50	25-45
KITCHENER	1 00	1.00		.50-1.00	80	1 00	60-90	.70 & 75				...	75	...	...	50-60	.25-40
LONDON	1 00	1 00	1.00	65-80	1 00	1 00	60-85	80	65	60-80	80-85	.50		75-90	.85	50-60	.40-60
NIAGARA FALLS	1 25	1 25	1 25	70	1.25	1 25	85	8c. per yd.	75	75	1 00	.75	1 00	1 00	.75-1.00	70	.45 .70
OTTAWA	1 10	1 10	1.00-1.10	50	1 00	85	75	75	60-75	70-80	75	75	75	80	75	45	.45
PETERBOROUGH	1 00	1 00	90	.80	1.00	.90	.65-85	.75	55	65	65-.75	.75		.75	.80	.45-50	.35-40
ST. CATHARINES	1 00	1 00	...			1 00		...					...			...	.40-50
ST. THOMAS	1 00	1 00	.90-1.00	.65	90	85-90	.50-75	90	60-70	65	70-85	85	85	75-85	1 00	50	40-45
SARNIA	1 00	1 00	...	70	75	1 00	.70-80	70	65-75	.60-1.00	70		60-80	75-80	70	50	45
SAULT STE. MARIE	1 10	1.10	1 25	.75	1.10	1 25	.85	75	70		1 00	1.00	.75	1 00	1 00	.50	35-40
STRATFORD	1 00	1 00	1 00	.55-60	90	.70-1.00	.50-65	60-75	50-70	60-.70	60-70	60	50-60	50-75		35-55	30-55
TORONTO	1 25	1 25	1.25 & 1.07½	.70-90	1.00	1 25	90	1.00-1.12½	.65-.75	80	80	6-90	65-.75	1 00	70 85	55-75	40-60
WELLAND	1.10	1 10	...	.65	1.10	1.10	.75-.90	7c yard	.65	.65	70	65	80 1 00	1.20	...	.60	40-45
WINDSOR (Border Cities)	1.35	1 35	1.25-1.35	.80-1.00	1 25	1 50	1 00	1 25	.85-1.00	1.00	.90-1.00	.90-1.00	.80-90	1 15	1 00	40-70	40-60
Manitoba																	
BRANDON	1.00-1.10	1.00-1.10	...	.50	1.00-1.10	1.00	.75	75	60	65	65	...		80	...	45	.35-40
WINNIPEG	1.25	1.25	1 05	.70	1.07½	1 07½	85	80	.75	65-85	80	1 10	90	1 00	.85-1.00	50-55	.35 42½
Saskatchewan																	
MOOSE JAW	1.15-1.50	1.15-1.35	1 00	.60-.85	1.00-1.25	1.15-1.50	.70-80	9c. yd	.70	80	80-85	1 00	90	.90-1.00	70-85	50	40-50
PRINCE ALBERT	1.00	1.00	1 00	.90	...	.90	.65-.70	6c yard	60	.70	.60	...	...	.70	...	.40	.35
REGINA	1.25	1.25	1 25	1.00 & 1.20	1.00	1.15-1.20	75	6-9c. per yd.	.70-.75	.85	80	...	...	90	60-75		40-.50
SASKATOON	1.25	1 25	1 25	1.00-1.25	1.10-1.25	1.25	.70-75	7c. yd.	65-90	.65-85	85-90	80	.90	1.00	.75	60	35-40
Alberta																	
CALGARY	1.15	1 15	1.10	1 15	1 10	1.15	80	4.00 per 1,000	.75	90	90	..	1.00	1 00	92½	65	40-50
EDMONTON	1.25	1 00	1.00-1.15	1.00	1.00	1.15	.80	85	80	.80-85	85	..	1 00	1 00	.95-1.00	50	40-45
LETHBRIDGE	1.15	1 15	1 15	.55	1.15	1.15	.80	.80	.80	.75	.80	.75	.90	90	75	50-55	45-50
British Columbia																	
VANCOUVER	1.12½	1.12½	1 12½	.75-.87½	.93¾	1.12½	.87½	1 00	.75	80	1 00	...	1.12½	1 00	.87½-1.00	62½	.50-.56¼
VICTORIA	1.00	1 00	1 12½	56½	1 00	1 00	.75	.75	.62½	87½	90	90	1 00-1.25	80	80	62½	50

Rates per hour, as supplied to the Association of Canadian Building and Construction Industries.

Preliminary Notice

of Applications for Admission and for Transfer

July 4th, 1924.

The By-laws now provide that the Council of the Institute shall approve, classify and elect candidates to membership and transfer from one grade of membership to a higher.

It is also provided that there shall be issued to all corporate members a list of the new applicants for admission and for transfer, containing a concise statement of the record of each applicant and the names of his references.

In order that the Council may determine justly the eligibility of each candidate, every member is asked to read carefully the list submitted herewith and to report promptly to the Secretary any facts which may affect the classification and election of any of the candidates. In cases where the professional career of an applicant is known to any member, such member is specially invited to make a definite recommendation as to the proper classification of the candidate.*

If to your knowledge facts exist which are derogatory to the personal reputation of any applicant, should be promptly communicated.

Communications relating to applicants are considered by the Council as strictly confidential.

The Council will consider the applications herein described in August, 1924.

FRASER S. KEITH, Secretary.

*The professional requirements are as follows:—

Member shall be at least thirty-five years of age, and shall have been engaged in some branch of engineering for at least twelve years, which period may include apprenticeship or pupilage in a qualified engineer's office, or a term of instruction in a school of engineering recognized by the council. The term of twelve years may, at the discretion of the council, be reduced to ten years in the case of a candidate for election who has graduated from a school of engineering recognized by the council. In every case the candidate shall have held a position in which he had responsible charge for at least five years as an engineer qualified to design, direct or report on engineering projects. The occupancy of a chair as a professor in a faculty of applied science or engineering, after the candidate has attained the age of thirty years, shall be considered as responsible charge.

An Associate Member shall be at least twenty-seven years of age, and shall have been engaged in some branch of engineering for at least six years, which period may include apprenticeship or pupilage in a qualified engineer's office or a term of instruction in a school of engineering recognized by the council. In every case a candidate for election shall have held a position of professional responsibility, in charge of work as principal or assistant, for at least two years. The occupancy of n chair as an assistant professor or associate professor in a faculty of applied science of engineering, after the candidate has attained the age of twenty-seven years, shall be considered as professional responsibility.

Every candidate who has not graduated from a school of engineering recognized by the council, shall be required to pass an examination before a board of examiners appointed by the council. The candidate shall be examined on the theory and practice of engineering with special reference to the branch of engineering in which he has been engaged. This examination may be waived at the discretion of the council if the candidate has held a position of professional responsibility for five or more years.

A Junior shall be at least twenty-one years of age, and shall have been engaged in some branch of engineering for at least four years. This period may be reduced to one year, at the discretion of the council, if the candidate for election has graduated from a school of engineering recognized by the council. He shall not remain in the class of Junior after he has attained the age of thirty-three years.

Every candidate who has not graduated from a school of engineering recognized by the council, or has not passed the examinations of the first year in such a course, shall be required to pass an examination in the following subjects: geography, history (that of Canada in particular), arithmetic, geometry, euclid (books I, IV and VI), trigonometry, algebra up to and including quadratic equations.

A Student shall be at least seventeen years of age, and shall present a certificate of having passed successfully an examination equivalent to the final examination of a high school or the matriculation of an arts or science course. He shall either be pursuing a course of instruction in a school of engineering recognized by the council, in which case he shall not remain in the class of student for more than two years after graduation; or he shall be receiving a practical training in the profession, in which case he shall pass an examination equal to that prescribed for admission to the grade of Junior in the foregoing section and he shall not remain in the class of Student after he has attained the age of twenty-seven years.

An Affiliate shall be one who is not an engineer by profession but whose pursuits, scientific attainments or practical experience, qualify him to co-operate with engineers in the advancement of professional knowledge.

The fact that candidates give the names of certain members as references does not necessarily mean that their applications are endorsed by such members.

FOR ADMISSION

ANDERSON—NORMAN RUSSELL, of Camp Borden, Ont. Born at Walkerton, Ont., April 29th, 1893; Educ., High School; Oct. 1916, joined R.F.C.; Dec. 1917 to Aug. 1918, employed as instructor of special flying; July 1920, promoted Flight-Lieut., C.A.F.; Sept. 1921, promoted Squadron Leader, C.A F., and employed as certificate examiner under Air Board; April 1923, appointed Second in Command, Royal Canadian Air Force Station, Camp Borden, and O. i/c Training.

References: H. F. J. Lambart, E. W. Stedman, A. Ferrier, A. G. L. McNaughton, R. B. McKay.

BARKER—WILLIAM GEORGE, of Ottawa, Ont. Born at Dauphin, Man., Nov. 3rd, 1894; Educ., Matric., Dauphin Collegiate; April 1916, joined R.F.C.; May 1917, promoted Captain; July 1918, promoted Major and appointed to Command No. 139 Squadron; 1919-20, engaged in commercial aviation; Oct. 1922, appointed Wing Commander, C.A.F.; Nov. 1922, appointed to command R.C.A.F. Station, Camp Borden; Jan. 1924, appointed Acting Director, R.C.A.F.

References: A. G. L. McNaughton, H. F. H. Hertzberg, G. J. Desbarats, A. F. Duguid, W. P. Anderson.

BREADNER—LLOYD SAMUEL, of Ottawa, Ont. Born at Carleton Place, Ont., July 14th, 1894; Educ., Collegiate Institute and private tuition; Dec. 1915, joined Royal Naval Air Service; Dec. 1916, promoted Flight-Lieut.; June 1917, promoted Flight-Commander; Nov. 1917, promoted, Squadron Commander; April 1920, appointed cert. examiner under Air Board; Jan. 1921, appointed Acting Controller Civil Aviation; Jan. 1924, promoted Wing Commander and appointed to command R.C.A.F. Station, Camp Borden.

References: A. G. L. McNaughton, D. R. Cameron, H. F. J. Lambart, E. W. Stedman, A. Ferrier.

CASSELS—WESTCOTE LEWIS LYTTLETON, of 18 Rideau Street, Ottawa, Ont. Born at Ottawa, April 18th, 1888; Educ., B.Sc., McGill Univ. 1913; O.L.S., Q.L.S., D.L.S.; 1914-15, with Farley & Cassels, engrs., etc.; 1915-19, overseas. Capt., Can. Engrs.; 1919-24, with Farley and Cassels, and Cassels and McDougall on varied surveying and engrg. work with exception of one year with the N.W.T. and Y. branch, Dept. of the Interior as senior engrg. clerk. At present partner in above mentioned firms.

References: O. S. Finnie, J. P. McRae, S. E. Farley, S. G. McDougall.

CROIL—GEORGE MITCHELL, of Ottawa, Ont. Born at Milwaukee, Wis., June 5th, 1893; Educ., Robert Gordon's College, Aberdeen, Scotland; passed studentship examination of Inst. C.E. England; Jan. 1915, commissioned 5th Battn., Gordon Highlanders T.F.; Oct. 1915, promoted Captain, Gordon Highlanders; July 1916, transferred to R.F.C.; June 1917, promoted Flight-Commander, R.F.C.; April 1918, promoted Major R.A.F.; Aug. 1918, appointed to command 19th Training Depot Station; Dec. 1918, placed in command Headquarters 69th Training Wing; June 1920, appointed Air Station Supt. in command Air Board Air Station in Alberta; Nov. 1923, appointed Staff Officer, Civil Operations, R.A.F.C., Headquarters, Ottawa.

References: A. G. L. McNaughton, D. R. Cameron, H. F. J. Lambart, E. W. Stedman, A. Ferrier.

CUFFE—ALBERT LAWSON, of High River, Alta. Born at Mayo, Ireland, May 2nd, 1895; Educ., Sligo Grammar School and Civil Service College, Dublin; May 1917, joined Royal Flying Corps; April 1918, promoted Captain; Aug. 1918 to June 1919, employed as instructor of special flying; Aug. 1920, appointed Flight-Lieut., C.A.F.; Feb. 1922, promoted Squadron Leader; Nov. 1923, appointed to command Royal Canadian Air Force Station, High River, Alta.

References: A. G. L. McNaughton, D. R. Cameron, E. W. Stedman, H. F. J. Lambart, A. Ferrier.

DELISLE—JOSEPH LORENZO, of Chicoutimi, Que. Born at Chicoutimi, Jan. 21st, 1888; Educ., B.A.Sc., Univ. of Toronto, 1916; surveying and machine shop practice during summer vacations; 1916-17, design — constrn. — erection of steel penstock, two turbines and installation of two generators at Ha Ha Bay. Erection of two turbines and ten grinders and other machinery at Val Jalbert; 1917-19, complete design and constrn. of mill No. 4, Chicoutimi Pulp Co. Also installation of all machinery in above mill. Also reconstrn. of Pont Arnault power house; 1919-22, design and constrn. of machine shop and foundry, Chicoutimi Pulp Co.; 1922 to date, in charge of electrical and mechanical dept., Chicoutimi Pulp Co.

References: E. Lavoie, H. B. Pelletier, J. E. A. McConville, J. F. Grenon, C. N. Shanly, A. Duperron, G. E. Lamothe.

GORDON—JAMES LINDSAY, of Ottawa, Ont. Born at Montreal, Dec. 11th, 1892; Educ., 2 years science, McGill Univ.; Jan. 1916, joined Royal Naval Air Service; June 1918 promoted Captain ,R.A.F.; Oct. 1918, promoted Major R.A.F., and appointed to command No. 232 Squadron; Mar. 1920, appointed supt. of Flying, Air Board; Sept. 1921, promoted, Wing Commander, C.A.F., and appointed to command C.A.F. Training Station, Camp Borden; May 1922, appointed Acting Director, Royal Canadian Air Force.

References: A. G. L. McNaughton, D. R. Cameron, E. W. Stedman, R. B. McKay, A. Ferrier.

HOBBS—BASIL DEACON, of Winnipeg, Man. Born at Arlington, Berkshire, England Dec. 20th, 1895; Educ., Prep. School, Business Course; Dec. 1915, Royal Naval Air Service; June 1917, promoted Flight-Lieut.; Jan. 1918, promoted Flight-Commander; April 1918, Captain, R.A.F.; May 1918, promoted Major, and appointed to British Aviation Mission, U.S.A.; Feb. 1919, appointed to Command No. 213 Squadron, R.A.F.; April 1920, appointed cert. examiner under Air Board; April 1921, appointed supt., Victoria Beach Air Station; May 1922, appointed Squadron Leader, Commanding R.C.A.F. Units, Manitoba.

References: A. G. L. McNaughton, D. R. Cameron, H. F. J. Lambart, A. Ferrier, R. B. McKay.

JOHNSON—GEORGE OWEN, of Ottawa, Ont. Born at Woodstock, Ont., Jan. 24th, 1896; Educ., Honour Matric., Ontario, and 1st Class professional teacher, Alberta; April 1917, joined R.F.C.; April 1918, promoted Captain, R.A.F.; July 1919 to Jan. 1920, O. i/c Canadian Air Force Detachment in Canada; Jan. 1920, appointed supt., Camp Borden Air Station; Oct. 1920, appointed to staff, Air Board, Ottawa; Sept. 1921, promoted Squadron Leader,R.C.A.F.; May 1922,appointed Acting Assistant Director, R.C.A.F., and at present Squadron Leader engaged in co-operative work with engineers of the Dept. of the Interior.

References: R. B. McKay, A. G. L. McNaughton, E. W. Stedman, A. Ferrier, D. R. Cameron.

JOHNSON—LANCELOT LLEWELLYN, of Calgary, Alta. Born at Cwmbran, Monmouthshire, England, Nov. 17th, 1883; Educ., Civil Engr., Renss. Polytech. Inst., Troy, N.Y., 1907; 1900-01, engrg. work, ap'tice mechanic, General Electric Co., Schenectady, N.Y.; 1902-03, mechanic, Westinghouse Electric Co., East Pittsburgh, Pa.; 1904 (summer), bridge foreman, rebuilding bridges over Hudson, Poughkeepsie, N.Y.; 1905 (summer), mechanic, Westinghouse Electric Co., East Pittsburgh;

1907-08, mech. engr., Cohoes Rolling Mills Co., Cohoes, N.Y.; 1909, chief dftsman., Carpenter's Steel Co., Reading, Pa.; 1911, Heddon Constrn. Co., Denver Post Office Bldg., Denver, Col.; 1910, highway and bridge work, State of New Jersey & Penn.; 1912-1913, engr., Wardell & Harrington, Kansas City, on C.N.R. railroad bridges over Thompson's River at Wallachine, B.C.; 1913-14, partner, J. L. Lacompte, Lake Wood, New Jersey, builder of state highways and bridges, N.J. and Pa.; 1915-17, Lieut., Can. Engrs.; 1918, A/District Vocational Officer, Prov. of B.C., D.S.C.R.; 1918-20, Vocational Officer, Prov. of Alta., D.S.C.R.; 1921 to date, Unit Director of Administration for Prov. of Alberta, D.S.C.R.

References: N. F. Parkinson, H. E. T. Haultain, A. G. Willson, V. M. Meek, N. E. Waddell.

KENNY—WALTER ROBERT, of Ottawa, Ont. Born at Ottawa, Sept. 18th, 1885; Educ., High School and Business College; Dec. 1915, commissioned in the Royal Naval Air Service; April 1917, promoted Flight-Lieut. and appointed second in command H.M. Seaplane Base, Dundee; April 1918, Captain, R.A.F. in charge of Squadron Flying Boats; May 1920, appointed supt., Roberval Air Station under Air Board; April 1924, promoted Squadron Leader, R.C.A.F., and appointed to the staff.

References: E. W. Stedman, A. G. L. McNaughton, A. Ferrier, J. A. Wilson, E. Wilson.

LAURIE—WILLIAM LITTLE, of Edmonton, Alta. Born at Malvern, Ont., Dec. 4th, 1896; Educ., B.A.Sc., Univ. of Toronto, 1924; Summer work — 1920-21, Marconi operator, Great Lakes; 1922, in charge, Radio Dept., David A. McGowan, manufacturer, Toronto; 1923, i/c radio system, R.C.C.S., in Manitoba with R.C.A.F.; At present, i/c Edmonton Detachment, R.C.C.S., North West Territories Radio System.

References: A. G. L. McNaughton, C. H. Mitchell, C. R. Young, E. Forde, T. R. Loudon.

MARCH—JOSEPH WADE, of Bridgewater, N.S. Born at Bridgewater, N.S., March 28th, 1896; Educ., B.Sc. in C.E., N.S. Tech. Coll. 1923; Summer work: 1912-13, chaining and rodding for Highways Board; 1914, chaining and rodding for land surveying and town work, and inspecting installation of culverts for S. E. March of Highways Commission; 1919, inspecting constrn. of 1¼ miles of tar bound macadam road at Bridgewater and inspecting constrn. of concrete roads and side walks in Lunenburg under S. E. March; 1921, inspecting installation of wood stove pipe water supply main at Bridgewater; 1922, land surveying and town engrg. work; May 1923 to date, transmission line work under R. P. Freeman, for Nova Scotia Power Commission.

References: F. R. Faulkner, W. G. Hardy, D. W. Munn, W. F. McKnight, R. P. Freeman, J. F. Lumsden, H. S. Johnston.

ROSS—DONALD GRANT, of Halifax, N.S. Born at St. John, N.B. May 12th, 1896; Educ., B.Sc. Dalhousie Univ. 1922; Private study, 1922-24; 1914-15, minor positions on survey parties and office work; 1916-19, overseas; 1923 (June-July), instr'man., N.S. Highways Board; 1923 (Aug.-Dec.), asst. to res. engr., Parrsboro-Five Island contract, N.S. Highways Board; At present, engr. in charge of constrn., section 2, transmission line, with Sir W. G. Armstrong Whitworth & Co., Humber development scheme, Newfoundland.

References: W. P. Copp, R. W. McColough, C. G. Read, R. A. Major, A. R. Spencer, H. F. Bennett.

STEWART—ROBERT MELDRUM, of Ottawa, Ont. Born at Gladstone, Man., Dec. 15th, 1878; Educ., B.A. Univ. of Toronto, 1902. Gold Medallist in Physics, M.A., Univ. of Toronto, 1903; 1902-05, time observations and reductions; experimental work in time service; longitude observations at Ottawa and their reduction; 1905-09, in charge of time service at Observatory; also of Ottawa observations for longitude work; installation of meridian circle; experimental work in connection with this and allied subjects. "Supt. of Time Service"; 1909-18, astronomer in charge of meridian work and time service (including field astronomical work), Dominion Observatory; 1918-24, asst. director, Dominion Observatory, and at the present time, director.

References: N. J. Ogilvie, J. L. Rannie, O. S. Finnie, C. P. Edwards, W. J. Stewart, T. Shanks.

THOMAS—GEORGE NEVIL, of 231 Wychwood Avenue, Toronto, Ont. Born at Pocklington, Yorkshire, England, May 10th, 1878; Educ., Certificate, (Elec. and mech. engrg.), Armstrong College, Durham Univ., 1903; 1899-1902, British Thomson Houston Co. Ltd., Rugby, England — testing dept. — Central London railway tests — technical dept. — testing dept. — direct current designing dept.; 1903-04, returned to direct current designing dept., with the above firm; 1904, engr. in contract dept., Bruce Peebles & Co. Ltd., Edinburgh, Scotland; 1904-06, with same company in charge of constrn. Sunderland and District Tramways contract; 1906, res. engr. in charge of constrn., Durham Collieries, power scheme; 1907 to date, with Canadian General Electric Co. Ltd., Toronto, first as senior engr. contract section: 1917, in charge of contract section: 1919, contract engr.: 1921, supt. of constrn. and in charge of construction estimating.

References: J. L. Brower, W. A. Bucke, A. B. Cooper, P. E. Hart, C. E. Sisson.

TUDHOPE—JOHN HENRY, of Dartmouth, N.S. Born at Johannesburg, South Africa, April 17th, 1891; Educ., English Public School; mech. dfting. and ap'tice engr., Randfontein Estates Gold Mining Co., South Africa; April 1917, joined R.F.C.; Nov. 1917, promoted Captain; Aug. 1921, Air Pilot Navigator under Air Board; Sept. 1921, promoted Squadron Leader, C.A.F.; June 1923, pilot and substation supt., Laurentide Air Service Ltd.; Nov. 1923, appointed to command R.C.A.F. Station, Dartmouth, N.S.

References: H. F. J. Lambart, A. G. L. McNaughton, E. W. Stedman, R. B. McKay, A. Ferrier.

VALIQUETTE—ADRIEN, of 344 Rachel Street East, Montreal, Que. Born at Compton, Que., Sept. 20th, 1890; Educ., civil engineer and B.Sc.A., Univ. of Montreal, 1914; 1912-13 (summers), geol. survey in Abitibi for the Dept. of Mines, Quebec; 1914-20, engineer, sewer and roads depts., City of Montreal; 1920 to date, with Quebec Streams Commission, last year in charge of a surveying party for a project of dam reservoirs at Lake Blanchet (made plans for this project during the winter).

References: O. O. Lefebvre, H. Massue, A. Duperron, J. H. Valiquette, H. T. Ortiz J A. Bernier.

FOR TRANSFER FROM CLASS OF ASSOCIATE MEMBER TO THAT OF MEMBER

JEFFREYS—ARTHUR GERALD, of Port Arthur, Ont. Born at Pinner, Middlesex, England, July 12th, 1871; Educ., Preparatory and Radley College, England, 1888. 1888-1900, in Switzerland for French, German, chemistry and allied subjects; 1891-94, articled to Messrs. Drake and Gorham, elec. ,mech. and hydraulic engrs., London, England, and from 1884-95, with same firm testing and inspecting elect'l. installations; 1895-97, private practice, London, England; 1897-1901, in charge of shops and field repair work, Messrs. Renwick & Co., Portable Sugar Mill Mfgrs , Lakhsmanhati, Bengal, India; 1901-03, misc. elect'l. and mech'l. work and representing brother of New York City in connection with steam boiler specialties; 1903-04, design of electric elevators, etc., Marine Engine and Machine Co., Newark, N.J.; 1904-06, constrn. dept., C.P.R., field dftsman. on location of double track, Fort William to Winnipeg, and from 1906-09 in charge of the compiling of the engineering records in connection with the above work; 1909-10, Central Railroad of New Jersey, New York City, special drawings of rly. track devices for reproduction in the Journal of the International Railway Conference held at Berne, Switzerland, May 1910; 1910 (Jan.-Aug.), dftsman., plant map dept., American Telephone and Telegraph Co.: 1910-11, with Messrs. Byron & Reynolds, Civil Engineers of London, England, parliamentary surveys for railway tube extensions north of London, etc.; 1911-13, dftsman.with Mackenzie & Mann on constrn. of Canadian Northern Ontario Railway between Sudbury and Port Arthur; 1913-15, private practice in Port Arthur; 1915-17, office engr., Dominion Public Works, Port Arthur District; Dec. 1917 to date, with Port Arthur Shipbuilding Co. Ltd., Port Arthur, Ont., (since July 1918 senior asst. engr.).

References: J. R. C. Macredie, L. M. Jones, J. Antonisen, F. Y. Harcourt, W. T. M[illegible]die, G. H. Burbidge.

MacNAUGHTON—WILLIAM GILBERT, of New York, N.Y. Born at Huntingdon, Que., August 24th, 1874; Educ., B.A. 1901, B.Sc. 1904, McGill Univ. First Rank Honours, Natural Sciences Logan Gold Medal, 1901; 1902 (summer), asst. engr., double tracking, G.T.R., Oshawa, Ont.; 1903 (summer), asst. chemist, Canada Paper Co., Windsor Mills, Que.; 1905-08, chemist, Canadian Consolidated Rubber Co. Also supervision of rubber cement dept. and crude rubber preparation; Sept. 1908-1912, chemist, and 1912-17, plant manager, Nekovsa Edwards Paper Co., Port Edwards, Wis.; 1917-20, gen. mgr., Inland Empire Paper Co., Spokane, Wash.; 1920-21, mgr., Spruce Falls, Co., Kapuskasing, Ont.; Nov. 1921 to date, secretary, Technical Association of Pulp and Paper Industry, New York, N.Y.

References: J. A. DeCew, A. A. McDiarmid, C. P. Howrigan, F. B. Brown, F. S. Keith, G. G. Gale, H. O. Keay, W. G. Mitchell, H. S. Taylor.

FOR TRANSFER FROM CLASS OF JUNIOR TO HIGHER GRADE

MOORE—CHARLES MELBOURNE, of Calgary, Alta. Born at Hartington, Ont., Dec. 20th, 1895; Educ., B.Sc. (C.E.), Queen's Univ. 1919; 1912-14, rodman, instr'man., C.P.R. constrn. dept., Ontario and Quebec; 1916 (May-Oct.), asst., dept. of Mines, Sask.; 1917-18, transitman, light rly. location, Belgium and France; Sept. 1919 to date, inspecting engr., reclamation service, Dom. Govt., Calgary, Alta.

References: A. L. Ford, D. W. Hays, G. N. Houston, P. J. Jennings, V. M. Meek, F. H. Peters, J. S. Tempest.

FOR TRANSFER FROM CLASS OF STUDENT TO HIGHER GRADE

ABEL—JOHN STEWART, of Winnipeg, Man. Born at Paramaribo, Dutch Guiana, S.A., Dec. 13th, 1895; Educ., B.Sc. (Civil), Univ. of Man. 1921; 1915, jr. inspr., Greater Winnipeg Water Dist.; 1916-17 and 1919-20, dftsman., Canada Cement Co.; 1917-19, Lieut., R.A.F.; 1921, dftsman., Man. Power Commn.; 1921-22, demonstrator, Univ. of Man.; 1922-23, dftsman., steel and concrete design, Man. Power Commn.; April 1923 to date, asst. engr. way and structures, Winnipeg Electric Railway, Winnipeg, Man.

References: E. V. Caton, J. M. Morton, G. L. Guy, J. N. Finlayson, D. L. McLean.

DOIDGE—HENRY GEORGE, of Winnipeg, Man. Born at Winnipeg, Man., Jan. 23rd, 1900; Educ., B.Sc. (C.E.), Univ. of Man., 1922; 1921 (summer), rodman and leveller, road constrn., Rockwood Munic., Man.; 1922 (summer), dftsman., Cowin & Co., struct'l. engrs., Winnipeg; 1922-23, demonstrator, physics dept., Univ. of Man.; 1923 (June-Oct.), checker, sidewalk, sewer and water main constrn., city engr's. dept., Winnipeg; Nov. 1923 to date, instructor, science dept., Royal Military College, Kingston.

References: J. N. Finlayson, D. L. McLean, D. M. Mawhinney, A. L. Cavanagh, H. B. Henderson.

FESSENDEN—FRANCIS EDWARD, of 90 Homewood Avenue, Hamilton, Ont. Born at Hamilton, Ont., May 4th, 1901; Educ., partial matric. Hamilton Collegiate Institute. I.C.S.; 1917-18, rodman on location, hydro-electric power canal, Niagara Falls; 1918-19, instr'man., Toronto, Hamilton & Buffalo Rly.; 1919 (Aug.-Dec.), rodman and concrete inspr., C.N.R., Capreol, Ont.; 1920-22, rodman, jr. instr'man., rock scaling, drilling and concrete inspr., hydro-electric power canal, Niagara Falls, Ont.; Dec. 1922 to date, rodman and instr'man., Steel Company of Canada, Hamilton, Ont.

References: W. S. Orr, K. C. Fellowes, C. J. Nicholson, E. R. Logie, F. W. Hubbard.

MELVILLE—JOHN, of 1030 Tenth Avenue East, Vancouver, B.C. Born at Tayport, Fife, Scotland, August 5th, 1900; Educ., B.A.Sc. Univ. of B.C. 1921. 1921-22, bursary. 1922-23, studentship under Advisory Research Council, Ottawa. M.A.Sc. Univ. of B.C. 1923; Summer work: 1917, Vancouver Mach. Depot; 1918, mine sampler, Anyox, B.C.; 1919, operator, American Nitrogen Products Ltd., Lake Buntzen, B.C.; 1920, pulp grader, Whalen Pulp & Paper Mill, Ltd., Port Alice, B.C.; 1923, pulp grader, Whalen Company, Swanson Bay, B.C.; Jan. to Mar. 1924, asst. chemist, Port Alice, B.C., and May 1924 to date, chemist, Giant Powder Company, Nanoose Bay, B.C.

References: E. G. Matherson, W. Powell, W. L. Ketchen.

HALL—JOHN G., of Montreal, Que. Born at Cornwall, Ont., Sept. 2nd, 1891; Educ., B.Sc., McGill Univ. 1921; 1911-12 (summers), student apprentice, G.T.R.; 1915-17, asst. foreman and material man, G.T.R. car dept., Chicago; 1917-19: asst. supt., United States Shipping Board, Cleveland, Ohio and Montreal, Que.; 1921 to date, asst. supt., Back River Power Company, Montreal.

References: J. T. Farmer, C. M. McKergow, H. W. B. Swabey, A. R. Roberts, F. S. B. Heward.

RYAN—CHARLES CEDRIC, of Vancouver, B.C. Born at Sackville, N.B., May 4th, 1890; Educ., B.Sc. 1913, M.Sc. 1914, McGill Univ.; 3 years, moulder, fitter, steam engr., Fawcett Company, Sackville; 1912, Cadillac Motor Car Co., Detroit, as machinist; 1915-19, overseas. Royal Field Artillery and Heavy Artillery. a/Major, and Permanent rank, Capt. Awarded M.C. 1916; From 1919 to date with the University of British Columbia as follows: June 1919, asst. to gen. mgr., S.C.R. and asst. professor mechanical engrg., until Oct. 1920. From that date until Oct. 1921, acted as associate professor of mech. engrg. and acting head of the dept. of mech. engrg. 1921-22, associate professor of mech. engrg. Sept. 1922. to date, acting head of the dept. of mech. engrg. and associate professor of mech. engrg.

References: F. W. McCrady, C. R. Crysdale, A. E. Foreman, J. R. Grant, G. A. Walkem, J. Muirhead.

WELDON—HAROLD STANLEY, of 35 Maple Avenue, St. Lambert, Que. Born at Little Britain, Ont., June 10th, 1894; Educ., B.A.Sc., Univ. of Toronto, 1922; 1913-14, test. dept., Can. Gen. Elec. Co., Peterborough, Ont.; 1915-19, overseas. Lieut. and Capt., 6th Battn., Can. Engrs.; 1921 (June-Oct.), and May 1922 to May 1924, engr. in charge, electrical test, Canadian Inspection & Testing Co. Ltd., Toronto, and at present district manager, Montreal office of this firm.

References: R. J. Marshall, C. R. Young, J. R. Cockburn, H. B. Stuart, P. Gillespie. W. P. Wilgar.

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A

AIR

Dustiness Measurement. The Production and Measurement of Air Dustiness, M. Ingels. Am. Soc. Heat & Vent. Engrs.—Jl., vol. 30, no. 2, Feb. 1924, pp. 133-152. 15 figs. Describes dust liberator, an apparatus developed for adding dust to room air, for testing purposes; tests Anderson and Armspach Dust Determinator for measuring efficiency of air cleaning equipment; gives dust chart and explains its use; sampling moving air.

AIR COMPRESSORS

Cylinder Lubrication. Air Compressor Cylinder Lubrication. Lubrication, vol. 10, no. 3, Mar. 1924, pp. 25-36, 14 figs. Temperatures involved; basic construction features of several types of air compressors; compressor-oil requirements; methods of air-cylinder lubrication, air-compressor explosions.

Portable Sets. Portable Air Compressor Sets. Engineering, vol. 117, no. 3039, Mar. 28, 1924, pp. 398-400, 8 figs. Modifications introduced by Globe Pneumatic Eng. Co., Lond., including new type of light-weight set on much improved frame and carriage, specially designed to conform to regulations regarding trailer vehicles.

AIR CONDITIONING

Air Cleaners. Determining the Efficiency of Air Cleaners, A. M. Goodloe. Am. Soc. Heat. & Vent. Engrs.—Jl., vol. 30, no. 2, Feb. 1924, pp. 115-119, 5 figs. Describes apparatus and method for determining by weight efficiency of average commercial cleaner, devised primarily for purpose of making a forced efficiency test of air cleaners in a laboratory or shop.

AIRCRAFT CONSTRUCTION MATERIALS

Metallic. Some Materials in Aircraft Construction. Roy. Aeronautical Soc.—Jl., vol. 28, no. 160, Apr. 1924, pp. 226-248 and (discussion) 248-259, 6 figs. First article, by J. D. North, discusses materials which should be used to give lightest structure. Second article, by L. Aitchison, deals with properties of metallic aircraft materials.

Steel and Duralumin Tubing. Torsional Strength of Nickel Steel and Duralumin Tubing as Affected by the Ratio of Diameter to Gage Thickness, N. S. Otey. Nat. Advisory Committee for Aeronautics—Tech. Notes, no. 189, Apr. 1924, 8 pp., 15 figs. on supp. plates. Tests to determine extent of variations of torsional modulus of rupture with ratio of diameter to gage thickness.

AIRPLANE ENGINES

Evolution. The Evolution of Aircraft Engines (L'évolution des moteurs d'aviation), Martinot-Lagarde. Technique Moderne, vol. 16, no. 7, Apr. 1, 1924, pp. 195-207, 19 figs. General characteristics; principal types—water-cooled and air-cooled engines; rôle of light metals; factors influencing efficiency of engines; compression; engines for high altitudes and high speeds; means of reducing power loss with altitude; setting and installation of engines; technical details of cylinder construction; new cycles for automobiles and aviation.

French Developments. The Great Efforts of French Industry towards Development of New Engines (Le grand effort de l'industrie française vers les moteurs nouveaux). Aérophile, vol. 32, nos. 3-4 and 5-6, Feb. 1-15 and Mar. 1-15, 1924, pp. 61-64 and 102-105, 10 figs. Review of progress made in design of airplane engines and examination of different types, including nearly all of well-known French makes.

AIRPLANE PROPELLERS

Design and Tests. The Analysis of Free Flight Propeller Tests and Its Application to Design, M. M. Munk. Nat. Advisory Committee for Aeronautics—Report, no. 183, 1924, 12 pp., 20 figs. New and useful method suitable for design of propellers and for interpretation of tests with propellers.

AIRPLANES

Beams, Deflection of. Deflection of Beams with Special Reference to Shear Deformations, J. A. Newlin and G. W. Trayer. Nat. Advisory Committee for Aeronautics—Report, no. 180, 1924, 19 pp. 8 figs. Influence of form of wooden beam on its stiffness and strength.

Metal. Metal Airplane Construction (Ueber Metallflugzeugbau). Motorwagen, vol. 27, no. 11, Apr. 20, 1924, pp. 190-194. Comparisons between metal and wooden airplanes, showing advantages of former; properties of metals employed; heat treatment for annealing and for refining. Abstracted and translated into German from Russian journal, Westnik Wosduschnogo Flota.

Performance. Comparing the Performance of Geometrically Similar Airplanes, M. M. Munk. Nat. Advisory Committee for Aeronautics—Tech. Notes, no. 190, Apr. 1924, 27 pp. Deals with model rules relating to aeronautical problems, and shows how characteristics of one airplane can be determined from those of another of different weight or size, and of similar type.

Stability. Utilization of Laboratory Charts for Study of the Stability and Centering of Airplanes (L'Utilisation des Courbes de Laboratoire pour l'étude de la stabilité et du centrage des avions), J. Kernéis. Aérophile, vol. 32, nos. 3-4 and 5-6, Feb. 1-15 and Mar. 1-15, 1924, pp. 54-57 and 89-93, 12 figs. It is shown that with regard to stability, laboratory curves lead in very simple manner to desired result; it is essential, before using them, to change them with regard to center of gravity, which can be accomplished by aid of simple graphic method.

Wings. Further Notes on the Design of Wing Spar Sections, E. P. Warner. Aviation, vol. 16, no. 14, Apr. 7, 1924, pp. 358-360, 2 figs. Supplementary to article by author in same journal, May, 29, 1922, and to critical remarks by A. J. Sutton Pippard, July 17, 1922.

AIRSHIPS

Aerodynamic Forces on Hulls. The Aerodynamic Forces on Airship Hulls, M. M. Munk. Nat. Advisory Committee for Aeronautics—Report, no. 184, 1924, 20 pp., 4 figs. New method for making computations in connection with study of rigid airships, used in investigation of Navy's ZR-1; attempt is made to develop results from very fundamental of mechanics, without reference to some of modern highly developed conceptions.

ALLOYS

Aluminum. *See Aluminum Alloys.*

Bearing Metals. *See Bearing Metals.*

Brass. *See Brass.*

Light. Light Alloys for Pistons and Connecting-Rods, L. Aitchison. Automobile Engr., vol. 14, no. 189, May 1924, pp. 148-155, 5 figs. Discusses advantages and disadvantages of light alloys for automobile-engine pistons and connecting rods.

Recent Progress in Light Alloys (Les alliages légers, leurs récents progrès), L. Guillet. Revue Universelle des Mines, vol. 67, no. 1, Apr. 1, 1924, pp. 7-36, 14 figs. Examination of alloys of aluminum and magnesium, their properties, influence of impurities, etc.

ALUMINUM ALLOYS

Aluminum-Copper. Heat Treatment of Aluminum-Copper Alloys, A. Portevin and F. Le Chatelier. Am. Soc. Steel Treating—Trans., vol. 5, no. 5, May 1924, pp. 457-478, 14 figs. Study of properties of light aluminum alloys containing varying proportions of copper, manganese and magnesium; discusses characteristics of alloys containing copper, with and without magnesium; heat treatment and aging, and their effect upon physical properties; hypotheses explaining constitution of aluminum-copper-manganese-magnesium alloys.

Aluminum-Silicon. Aluminum-Silicon Alloys, J. B. Swan. Automobile Engr., vol. 14, no. 188, Apr. 1924, pp. 102-105, 10 figs. Their properties and limitations; aluminum-silicon binary system; making up and casting alloy; reversion; aluminum-silicon as forging and cold-worked metal; effects of heat treatment.

Castings, Hard Spots in. Study Aluminum Hard Spots. A. J. Lyon. Foundry, vol. 52, no. 10, May 15, 1924, pp. 396-397. Methods employed to identify inclusions, and determine effect on mechanical properties, and metallographic structure of oxidizing aluminum cast alloys during melting.

AMMONIA

Anhydrous. Is Anhydrous Ammonia Combustible?, W. F. Schaphorst. Nat. Engr., vol. 28, no. 5, May 1924, pp. 220-221. Opinions of authorities and experts, from which it appears that it is feebly combustible under certain conditions but normally incombustible and actually a retardent of combustion in many cases.

AMMONIA COMPRESSORS

Compound Compression. Effect of Compound Compression of Ammonia, J. E. Starr. Power Plant Eng., vol. 28, No. 8, Apr., 15, 1924, pp. 445-446, 1 fig. Cost of extra equipment, it is claimed, will in most cases offset thermodynamic gains which would result from compound compression.

ASH HANDLING

Power Plants. The Disposal of Ashes in Power Plants, E. K. Scott. Power Engr., vol. 19, nos. 215, 216 and 217, Feb., Mar. and Apr., 1924, pp. 55-56, 90-92 and 145-147, 16 figs. Survey of present practice. Feb.: Trucks and skips; bucket and tray conveyors; scraper and belt conveyor. Mar.: Sluicing ash conveyor.

ATOMS

Theories and Experiments. Outline of the Investigations of the Atom During the Last Decade (Grundragen av det senaste artiondets atomforskning), A. Westgren. Teknisk Tidskrift, vol. 54, no. 13, Mar. 29, 1924, pp. 104-108, (Allmanna Avdelningen), 5 figs. Reports theories and experiments, particularly those of Ernest Rutherford in Cambridge, Eng.

AUTOMOBILE ENGINES

CORROSION. Undue Wear of Engine Parts is Caused by Rust. Automotive Industries, vol. 50, no. 18, May 1, 1924, pp. 956-958, 2 figs. Three hypotheses analyzed in research work conducted in Gen. Motors Corp., namely, acid, oxide and electrolytic theory, all of which agree that presence of moisture is necessary.

OIL RECTIFIERS. Rickenbacker Incorporates Skinner Rectifier in All New Models. Automotive Industries, vol. 50, no. 20, May 15, 1924, pp. 1086-1087, 2 figs. Oil drawn from around piston by inlet suction is subject to distillation process by hot exhaust gases, fuel driven off being returned to intake manifold.

AUTOMOBILE FUELS

LIGNITE AS SOURCE OF. Lignites and the Manufacture of Automobile Fuel (Les lignites et la fabrication des carburants), E. Marcotte. Revue Industrielle, vol. 54, no. 2178, May 1924, pp. 85-94, 5 figs. Notes on extraction of light products; classification of possible treatments; recovery of benzol; objections against distillation of lignite; hydrogenation; Bergius process and its industrial application; liquefaction direct from coal; Mélamid process; Fischer and Schrader processes.

AUTOMOBILES

BODIES, FINISHING. High Brake Pre-Enameled Panels Used in Body Construction. Automotive Mfr., vol. 66, no. 1, Apr. 1924, pp. 9-11, 4 figs. Details of new type of construction which permits easy application of hard permanent finish to metals panels applied over conventional wood frame.

Ultra-Violet Rays Used to Test Body Fabrics and Finishes, W. L. Carver. Automotive Industries, vol. 50, no. 19, May 8, 1924, pp. 1011-1014, 5 figs. Few hours of exposure under suitable conditions may be equal to many months of natural weathering; utilization of quartz-tube mercury-vapor damp which emits ultra-violet rays, which may also be employed to dry varnish.

BRAKES. Study of Gripper Brakes for Automobiles and Lifting Devices (L'étude des freins à machoires pour automobiles et appareils de levage). Génie Civil, vol. 84, no. 19, May 10, 1924, pp. 452-454, 4 figs. General considerations on functioning of brakes; elementary calculation; distribution of pressure; determination of bending.

BRAKES, FOUR-WHEEL. Four-Wheel Braking Systems, F. A. Stepney Acres. Automobile Engr., vol. 14, no. 188, Apr. 1924, pp. 115-118, 4 figs. Arrangement of brakes; brake-power ration; mechanical difficulties; pedal leverage; central steering; compensation; mechanical difficulties; front springs; brake-rod layout.

CHASSIS LUBRICATION. Chassis Lubrication Is Simplified by Bowen System. Automotive Industries, vol. 50, no. 16, Apr. 17, 1924, pp. 876-878, 9 figs. Designed to deliver accurately measured quantities of oil to each bearing slowly for several hours after pump plunger is depressed; air domes over each header valve serve important purpose in metering and controlling flow; special tubing used.

GEAR BOXES. New Morris Production Methods. Machy. (Lond.), vol. 24, no. 602, Apr. 10, 1924, pp. 33-38, 11 figs. Machines and methods used by Morris Engines, Ltd., Coventry, in grinding spline shafts and gears for automobile gear boxes.

AVIATION

NIGHT-FLYING EQUIPMENT. Night-Flying Equipment and Operation, H. R. Harris and D. L. Bruner. Mech. Eng., vol. 46, no. 5, May 1924, pp. 274-278, 9 figs. Non-mathematical discussion of portion work carried on by Engineering Division of Air Service; much of equipment developed has been adapted by Air Mail Service. (Abridged.)

TERMINALS. The Future of the Air Terminal, D. Huntington. Aviation, vol. 16, no. 16, Apr. 21, 1924, pp. 423-425, 3 figs. Importance of air terminals; influence of carriers on terminal design; evolution of field-type terminal; location with respect to community; ideal location of airport; municipal-termina lidea; detail problems.

B

BEARING METALS

BABBITTING BRASSES. Babbitting Brasses for Subway Trains, F. H. Colvin. Am. Mach., vol. 60, no. 17, Apr. 24, 1924, pp. 629-630, 4 figs. Methods and equipment in babbitting room of New York 148th St. shop; simple mandrels used for holding brasses in position for babbitting; two men handle four tons of babbitt per month.

DUREX. Durex, a Bearing Material Which Holds Oil Like a Sponge. Automotive Industries, vol. 50, no. 20, May 15, 1924, pp. 1072-1074, 14 figs. Copper-tin-graphite bronze which absorbs up to one-fourth its own volume by capillarity through myriads of tiny, evenly distributed pores, and maintains oily bushing surface; offers insurance against shortage or stoppage of lubrication.

BEARINGS

ANTI-FRICTION. Anti-Friction Bearings Lower Transportation Costs from Face to Railroad Car, F. H. Kneeland. Coal Age, vol. 25, no. 17, Apr. 24, 1924, pp. 603-606, 5 figs. Need only one-fourth as many applications of lubricant as plain bearings and have nearly twice as long life; lubrication cost reduced by two-thirds; save power and equipment.

CYLINDRICAL. The Design and Performance of Complete Cylindrical Bearings from Mathematical Theory of Lubrication, G. B. Upton. Sibley Jl. of Eng., vol. 38, nos. 3 and 4, Mar. and Apr. 1924, pp. 56-60 and 76, and 97-100, 6 figs. Presentation and discussion of Harrison's equations; and modifications brought about by finite length and its consequences in end leakage of lubricant and lengthwise variation of pressure in lubricating film.

EXPERIMENTS. Some Bearing Investigations, E. G. Gilson. Gen. Elec Rev., vol. 27, no. 5, May 1924, pp. 318-327, 20 figs. Results of investigation made by Research Laboratory of Gen. Elec. Co. into phenomena of bearings.

BEARINGS, BALL

LIFE. The Life of Ball Bearings (Die Lebensdauer von Kugellagern), A. Palmgren. Zeit. des Vereines deutscher Ingenieure, vol. 68, no. 14, Apr. 5, 1924, pp. 339-341. Shows that life of ball bearings subjected to axial or combined stresses depends partly on maximum developed ball pressure and partly on fatigue phenomena which have changed in comparison to conditions with purely radial load.

BEARINGS, ROLLER

BRIDGE. Repairing a Skewed and Displaced Bridge Roller Bearing, Chas. F. Draper. Eng. News-Rec., vol. 92, no. 19, May 8, 1924, p. 810, 2 figs. New rollers placed in bearing of 250-ft. span with cam teeth engaging shoe plates to maintain alignment.

BITUMINOUS SAND

ALBERTA, CANADA. Bituminous Sands of Northern Alberta, S. C. Ells. Can. Min. Jl., vol. 45, nos. 13 and 17, Mar. 28 and Apr. 25, 1924, pp. 298-304 and 400-403, 5 figs. General description of area underlaid by bituminous sand; general description of deposits; prospecting; sampling and laboratory determination; characteristics of sand; use of bituminous materials for pavement construction; recovery of hydrocarbons and bitumen; production of petroleum. Pub. with permission Ottawa, Can., Dept. Mines. See also Petroleum Wld., vol. 21, no. 283, Apr. 1924, p. 152.

BLAST FURNACES

CHARGE, BEHAVIOR OF. The Behavior of the Charge in Blast Furnaces (Ueber das Verhalten der Beschickung im Hochofen), E. Diepschlag. Stahl u. Eisen, vol. 44, no. 16, Apr. 17, 1924, pp. 430-432. Heating and reactions; lowering and suspension of charges; wastes.

REGENERATORS, REVERSING. Theoretical Considerations Respecting Certain Features in the Working and Efficiency of Reversing Regenerators, J. Seigle. Iron & Steel Inst.—advance paper, no. 14, for mtg. May 1924, 47 pp., 28 figs. Author seeks to show that certain relations which have been accepted in metallurgical investigations on influence of mass of refractory bricks of checkerwork, and on amount of calories which are exchanged per sq. m. of heated surface, have been somewhat too roughly approximate.

BLOWERS

REGULATIONS. Report of Committee on Blower Systems. Nat. Fire Protection Assn., Advance Publication, 1924, 13 pp., 6 figs. Regulations for installation of blower and exhaust systems for heating and ventilating systems, systems for removal of flammable vapors, and stock and refuse conveying systems, presented for final adoption.

BOILER FIRING

GAS. Gas Firing—Flame Control, A. C. Ionides, Jr. Gas Jl., vol. 166, no. 3179, Apr. 16, 1924, pp. 176-178 and (discussion) 178-179, 2 figs. Author claims that principles of gas firing mostly employed hitherto are fundamentally wrong; discloses grounds for such a conclusion and establishes an alternative method. See also Gas Wld., vol. 80, no. 2073, Apr. 12, 1924, pp. 334-336 and (discussion) 336-337, 1 fig.

BOILER FURNACES

DESIGN. Problems in Boiler Furnace Design, E. B. Ricketts. Power Plant Eng., vol. 28, no. 9, May 1, 1924, pp. 473-476, 5 figs. Changes in stoker design, high ratings, high capacities, etc.; value of air heaters; materials for furnace-wall construction; effect of high combustion efficiency on superheat; mixing of boiler-furnace gases. Paper presented before Metropolitan Section of A.S.M.E.

INDUCED-DRAFT INSTALLATIONS. Calculation of Induced-Draft Installations (Berechnung einer Saugzug-Anlage), H. R. Karg. Fördertechnik u. Frachtverkehr, vol. 17, no. 6, Mar. 20, 1924, pp. 76-79. Calculation of induced-draft plant and auxiliary exhaustor; determination of excess air.

BOILER PLANTS

FLUE-DUST CONVEYORS. Pneumatic Flue Dust Conveyors, K. Wagner. Eng. Progress, vol. 5, no. 4, Apr. 1924, pp. 61-64, 7 figs. Suction plant designed by Seck Bros., Dresden, erected in boiler room; experienced gained in service.

BOILER PLATES

STRENGTH OF. The Distribution of Strength Properties in a Sheet-Iron Plate (Die Verteilung der Festigkeitseigenschaften innerhalb einer Blechtafel), E. Koch. Zeit. des Bayerischen Revisions-Vereins. vol. 28, nos. 3-4, 5 and 6, Feb. 29, Mar. 15 and 31, 1924, pp. 13-19, 33-38, and 44-47, 17 figs. Results of experimental investigation begun two years ago and still in progress; account of tests carried out in ammonia works of Dr. Wyszomirsky in Merseburg. Contains appendix, giving supplementary test regulations for boiler plate.

TESTING. The Testing of Boiler Plates, Chas. L. Huston. Power, vol. 59, no. 21, May 20, 1924, pp. 820-822, 3 figs. Proposed revival of Tetmayer formula for using unit stresses instead of factor of safety in determining allowable stresses on steel boiler plate in construction of steam boilers and other pressure vessels.

BOILER ROOMS

OPERATION. Boiler-Room Practice, J. Bruce. Elec. Rev., vol. 94, nos. 2414 and 2415, Feb. 29 and Mar. 7, 1924, pp. 324-325 and 365-367, 3 figs. Use of boiler-room instruments for efficient operation.

BOILERMAKING

BABCOCK & WILCOX PLANT, FRANCE. The French Babcock and Wilcox Boiler Works, G. L. Carden. Boiler Maker, vol. 24, no. 4, Apr. 1924, pp. 95-98, 4 figs. Description of plant located at La Courneuve on northern outskirts of Paris.

STANDARDS. Standards Adopted by the American Boiler Manufacturers' Association. Boiler Maker, vol. 24, no. 4, Apr. 1924, pp. 107-109 and 123-124. Report presented at meeting of Am. Boiler Mfrs.' Assn.

BOILERS

DEVELOPMENT. An Outline of Boiler Development, H. Webster. Refrig. Eng., vol. 10, no. 10, Apr. 1924, pp. 367-369. Considers briefly multiplicity of fuels available for steam generation, great number of methods of burning such fuels which have been developed, and the various feedwater conditions that have been encountered, and outline of development of boiler.

FEEDING ARRANGEMENTS. Important Factors in Boiler Feeding, Chas. F. Wade. Power Engr., vol. 19, no. 217, Apr. 1924, pp. 136-137, 1 fig. Aspects of boiler-feeding arrangements which are often overlooked.

LOCOMOTIVE. *See Locomotive Boilers.*

MERCURY. *See Mercury-Vapor Process.*

SETTINGS. Construction of Boiler Settings in Devon Station (Conn.). Power, vol. 59, no. 20, May 13, 1924, pp. 763-765, 6 figs. Furnace walls for 16,800-sq. ft. boilers constructed entirely of firebrick; arches built in walls to relieve loading on brick; expansion joints filled with asbestos fiber divide walls into vertical sections and allow for horizontal expansion; no heat-insulating bricks are used below lower tube line.

3,060 HP. Boilers at Cleveland Rate 3,060 hp. Power Plant Eng., vol. 28, no. 10, May 15, 1924, pp. 517-524, 8 figs. New boilers in Cleveland Elec. Illuminating Co. plant have 30,592-sq. ft. heating surface requiring 8 mi. of tubes; fired by pulverized coal; automatic-combustion control by steam pressure and flow-meters.

BORING MACHINES

LARGE ELECTRICAL MACHINERY. Giant Boring Mill Built in Canada. Iron Age, vol. 113, no. 21, May 22, 1924, pp. 1508-1510, 7 figs. Machine of unusual size for use in manufacture of electrical generating equipment; massive design and convenient control.

BRASS

LEAD AND TIN, INFLUENCE OF. Lead and Tin in Brass (Blei und Zinn im Messing Ms 60), K. Hanser. Zeit. für Metallkunde, vol. 16, no. 3, Mar. 1924, pp. 91-95, 7 figs. Based on existing investigations and author's own tests, influence of lead and tin on strength, elongation, shrinkage, hardness, and hot and cold working of 60/40 brass is shown.

BRIDGES, HIGHWAY

DESIGN. Outstanding Problems in Highway Bridge Design, E. F. Kelley. Good Roads, vol. 66, no. 4, Apr. 1924, pp. 106-108. Deals with live load specifications, future requirements, width of roadway, bridge approaches, bridge floors, wearing surfaces, junction of bridge with highway, and protection of structures and traffic. Paper read before Am. Road Bldr.'s Assn. convention.

BUILDING CONSTRUCTION

Reinforced-Concrete. A Note on Concrete Buildings, M. Ayrton. Roy. Inst. Brit. Architects—Jl., vol. 31, no. 10, Mar. 22, 1924, pp. 298-302, 6 figs. Discusses problems of reinforced-concrete building construction.

C

CABLEWAYS

Types. Cableways (Drahtseilbahnen), Fr. Wernekke. Praktische Maschinen-Konstrukteur, vol. 57, no. 8, Mar. 1, 1924, pp. 79-81, 4 figs. Development of transportation on wire rope is discussed and a few successful installations described, both for passenger and material haulage.

CALORIMETERS

Measuring. Small Heat Intensities Measurement of Small Heat Intensities: Use of Compensating Microcalorimeter (Mesure des intensités des petites sources de chaleur: emploi d'un microcalorimètre à compensation), A. Tian. Académie des Sciences). Comptes Rendus, vol. 178, no. 8, Feb. 18, 1924, pp. 705-707. Thermally insulated vessel immersed in bath at constant temperature serves as calorimeter; temperature differences between bath and vessel are measured using thermopile and galvanometer.

CALORIMETRY

Saturated Fluids. Calorimetry of Saturated Fluids, N. S. Osborne. Optical Soc. Am.—Jl., vol. 8, no. 4, Apr. 1924, pp. 519-540. Deals with theory of certain calorimetric processes for determination of important thermal properties of saturated fluids, and with interpretation of theory as bearing upon its experimental application.

CARS

Cast-Steel Castings, Reclamation by Arc Welding. Reclamation of Cast-Steel Car Castings by Arc Welding, H. R. Pennington. Am. Welding Soc.—Jl., vol. 3, no. 4, Apr. 1924, pp. 28-35, 6 figs. Examples of potential savings in reclamation of such parts as coupler bodies, knuckles, truck sides and bolsters for railways, and practice for reclamation of such parts.

Construction Methods. Railway Carriage and Wagon Building. Machy. (Lond.), vol. 24, no. 601, Apr., 3, 1924, pp. 1-4, 5 figs. Practice of Cammell Laird & Co.; making buffer forgings—upsetting forging machines; buffer forging operations.

CARS, FREIGHT

Box. Single Sheathed Box Cars for the D. T. & I. Ry. Mech. Engr., vol. 98, no. 5, May 1924, pp. 279-281, 4 figs. U. S. Railroad Administration design modified to provide 1 ft. added height and 1 ft. wider door opening.

CARS, REFRIGERATOR

Improved Design. New Refrigerator Cars for the Rock Island. Ry. Mech. Engr., vol. 98, no. 5, May 1924, pp. 286-289, 7 figs. Improved side construction has reduced maintenance costs and improved refrigerating efficiency; new method of insulation; Acme ventilation system used.

Insulation. Economical Thickness of Insulation in Refrigerator Cars, A. J. Wood and P. X. Rice. Refrig. Eng., vol. 10, no. 10, Apr. 1924, pp. 357-362 and (discussion) 362-366, 10 figs. Explains a reasonably simple method for determining quickly and accurately most economical thickness of insulation, and discusses factors which enter into economical design of insulated walls.

CAST IRON

Graphitization. Notes Properties of Cast Iron, E. Touceda. Foundry, vol. 52, no. 9, May 1, 1924, pp. 345-347, 1 fig. Manner and conditions under which graphitization takes place in cast iron has profound influence upon chemical and physical properties of metal; describes special metal made by Ross-Meehan Foundries, Chattanooga, Tenn., called mechanite metal. See also Iron Trade Rev., vol. 74, no. 19, May 8, 1924, pp. 1244-1246, 1 fig.

High-Temperature Growth. High-Temperature Growth of Special Cast Irons, J. H. Andrew and H. Hyman. Iron & Steel Inst.—advance paper, no. 2, for mtg. May 1924, 10 pp., 11 figs. Investigation to ascertain whether presence of silicon is necessary factor for growth; what exactly happens to graphite at end of 50 heats; and whether growth can be mitigated or retarded by presence of certain special elements, especially carbide-forming elements, such as chromium and vanadium in small quantities.

Manufacture. The Influence of Composition and Rate of Cooling upon the Microstructure and Physical Properties of Cast Iron. H. H. Beeny. Foundry Trade Jl., vol. 29, nos. 401 and 402, Apr. 24 and May 1, 1924, pp. 333-340 and (discussion) 365-366, 24 figs. Deals with constitution and physical properties of iron-carbon alloys as a whole, commencing with pure iron, passing through steels, and ending finally with white cast iron; microstructure of each broad type illustrated. Iron-carbide system, and influence of silicon and other elements, and rates of cooling upon this system.

Physical Changes. Physical Changes in Cast Iron due to (i) American Practice; (ii) Secondary Temperatures. Metal Industry (Lond.), vol. 24, no. 10, Mar. 7, 1924, pp. 227-228, 5 figs. Discusses influence of casting into chill pig molds and water spraying, as in American blast-furnace practice, and influence of secondary or foundry temperatures, that is, remelting iron and subsequent casting.

Test Bars, Transverse. Transverse Test-Bars and Engineering Formulae, G. S. Bell and C. H. Adamson. Iron & Steel Inst.—advance paper, no. 4, for mtg. May 1924, 15 pp., 11 figs. Test results show that generally accepted engineering formulas for conversion of transverse test on one sized bar to that on another sized bar do not hold when applied to cast-iron test bars of different sizes; results of tensile and hardness tests.

CEMENT

Alumina. The Action of Frost on Ciment Fondu. Engineering, vol. 117, no. 3039, Mar. 28, 1924, p. 393. Results of tests show that elevation of temperature from normal, which is taken as 64 up to 86 deg. fahr., tends to retard actual setting time of ciment fondu.

CENTRAL-STATIONS

Boiler-Feedwater Circuits. Boiler Feed-Water Circuits in Power Stations, J. G. Weir. Ingenieur, vol. 39, no. 18, May 3, 1924, pp. 332-338 and (discussion) 338-339, 18 figs. Importance of use of regenerative principles is emphasized and a number of possible circuits are described, illustrated and analyzed. (In English.)

Brooklyn Edison, Hudson Ave. Hudson Avenue Station. Elec. World, vol. 83, no. 18, May 3, 1924, pp. 867-876, 13 figs. Unusual features incorporated in design of new 400,000-kw. power house of Brooklyn Edison Co.; vertical-phase isolation used; details of coal-handling facilities, heat-balance arrangements, boilers and stokers, fans and feed pumps, turbines (which are largest in world), signaling system, etc.

Hudson Ave. Plant in Operation. Power Plant Eng., vol. 28, no. 10, May 15, 1924, pp. 549-553, 12 figs. Superpower station embodies refinement in heat balance, electric equipment and mechanical control; first section comprises two 50,000-kw. turbines and 8 boilers each with 19,650 sq. ft. heating surface; condensers with 70,000 sq. ft. cooling surface. See also description in Power, vol. 59, no. 20, May 13, 1924, pp. 750-758, 14 figs.

Combustion Control, Centralized. Centralized Combustion Control in Lowellville, Jos. F. Shadgen. Power, vol. 59, no. 18, Apr. 29, 1924, pp. 676-679, 2 figs. One of first complete remote-machine-regulated combustion systems in large power plants; fuel efficiency main object; pneumatic dispatch system of master controller and individual regulators; novel central-control house with unique instrument board.

Construction Metods. Construction Procedure for a Steam Power Station. Eng. News-Rec., vol. 92, no. 18, May 1, 1924, pp. 754-757, 7 figs. Connecticut Light & Power completes 75,000-kva. unit at Devon; concreting continued through winter; many parts fabricated in field shops.

Diesel-Enginen. Converting a Loser into Profit-Making Plant. Power, vol. 59, no. 20, May 13, 1924, pp. 772-775, 6 figs. Central station at Caruthersville, Mo., supplying both electricity and ice, cut its generating cost from over 6 to less than 1 per cent per kw-hr. by replacing an obsolete steam plant with Diesel engines; waste-heat recovery is employed in nearby house-heating service.

Paper Mills, Kalamazoo. New Power Plant of the Bryant Paper Co. Power, vol. 59, no. 19, May 6, 1924, pp. 710-715, 6 figs. Central plant of 8,000-kw. ultimate capacity, designed to supply power, steam and hot water to four divisions of large paper mill in Kalamazoo, Mich., replaces combination of individual boiler plants and scattered engine units; special features are balancing of power and heating steam, special coal and ash handling, automatic control and complete metering facilities.

Reheating in. Reheating in Central Stations, W. J. Wohlenberg. Mech. Eng., vol. 46, no. 5, May 1924, pp. 259-262, 11 figs. Influence of amounts of energy added in reheating, number of reheating stages, and points in expansion at which reheating should begin; comparison of reheating, regenerative, and combination cycles combining both reheating and bleeding stages; shows that, because of influence on internal machine efficiency thereby, reheating properly applied may lead to higher efficiencies than bleeding; also that combination cycles give promise of realization in practice of appreciably higher efficiencies than would be case for other cycles investigated. Abridged.

Units in Parallel, Efficiency of. Maximum Operating Efficiency of Power Units in Parallel, A. P. Strom. Nat. Engr., vol. 28, no. 5, May 1924, pp. 210-212, 2 figs. Water rates of individual units plotted on a combined chart showing total water rate for any combination of units for various loads; most efficient combination of units can at once be determined by reference to chart. Serves equally well for distribution of load in hydro-electric plants.

CHAIN DRIVE

Efficiency. The Efficiency of Chains as a Power Transmitting Agent, H. Seymour. Elec. Rev., vol. 94, no. 2418, Mar. 28, 1924, pp. 484-486, 5 figs. Advantages of chain drive; suggestions for efficiency operation.

CHAINS

Malleable-Iron. Malleable Iron Chain, J. W. Gardom. Foundry Trade Jl., vol. 29, no. 398, Apr. 3, 1924, pp. 269-272, 8 figs. Description of manufacturing methods, including molding and annealing, and metallurgical considerations. See also discussion in no. 399, Apr. 3, 1924, pp. 301-304.

CIRCUIT BREAKERS

Oil Type. High-Voltage Oil Circuit Breaker Tests, Alabama Power Company. System J. B. MacNeill. Am. Inst. Elec. Engrs.—Jl., vol. 43, no. 5, May 1924, pp. 436-441, 16 figs. Series of 50 high-voltage oil-circuit-breaker tests made during May and June of 1922.

Tests. Circuit Breaker Tests at Bessemer, Ala., J. D. Hilliard. Am. Inst. Elec. Engrs.—Jl., vol. 43, no. 5, May 1924, pp. 430-435, 13 figs. Tests on 300-ampere, 110,000-volt breakers, and on plain break and explosion-chamber 44,-000-volt breakers.

CITY PLANNING

Street Capacity, Increasing. Increasing the Capacity of Existing Streets, A. S. Tuttle. Am. Soc. Civ. Engrs.—Proc., vol. 50, no. 5, May 1924, pp. 593-605, 5 figs. Consideration of following expedients for City of New York: Requiring new buildings to be set back to lines proposed as ultimate limits of widened streets; widening of roadways; more drastic traffic regulations; removal of roadway encroachments; by-passing of traffic; introduction of arcades.

CLUTCHES

Electrically Operated. Electrically-Operated Clutches, M. H. Sabine. Machy. (Lond.), vol. 24, no. 602, Apr. 10, 1924, pp. 44-45, 7 figs. Improved design of solenoid clutch for use where control of power unit from distant position is required.

Friction. Considerations in Friction Clutch Design, A. Clegg. Machy. (N. Y.), vol. 30, no. 9, May 1924, p. 669-670. Factors involved in design; allowable bearing pressures; calculating horse power; types of friction clutches; single-plate, coil, and double-plate clutches.

COAL

Anthracite, Ash Content of. Ash in Anthracite, O. P. Hood. U. S. Bur. Mines, Reports of Investigations, No. 2571, Feb. 1924, 2 pp. Results of tests made by Bur. of Mines on 127 samples of 1,000 lb. each, representing nearly 30,000 tons of anthracite in dealers' yards in 17 cities in State of Massachusetts.

Pulverized. *See Pulverized Coal.*

Testing. A Float-and-Sink Method for Testing Coarse Size Coal, E. R. McMillan and B. M. Bird. Coal Industry, vol. 7, no. 4, Apr. 1924, pp. 164-169, 2 figs. Methods and apparatus used in testing coals; developed at Northwest experiment station of Bur. of Mines in co-operative research work with Univ. of Washington.

Volatile Matter and Ash Content. The Volatile Matter and Ash Contents of Samples of Coal from the Same Seam, T. J. Drakeley and J. R. I. Hepburn. Chem. & Industry, vol. 43, no. 18, May 2, 1924, pp. 134T-137T. Gives equation for calculating, on average samples of dry coal containing no iron pyrites, volatile-matter content of coal on ash-free basis; percentage of volatile-matter yielded by dry shale appears to vary considerably; variations may be due to different methods employed in initial drying of shale; modified equations for calculating volatile-matter content of coal on ash-free bases, for crude-coal samples containing iron pyrites, etc.

COAL HANDLING

Boiler Plants. Coal Handling in Small Boiler Plants. Power Engr., vol. 19, no. 218, May 1924, pp. 171-172, 4 figs. Notes concerning plant with but one or two boilers.

Lowering Down Hillsides. Lowering Coal Down Hillsides with Minimum Breakage, M. L. O'Neale. Coal Age, vol. 25, no. 20, May 15, 1924, pp. 715-721, 12 figs. Points out that type of conveyor to be chosen depends chiefly on such factors as length and inclination of hillside.

COAL MINES

Tunneling. Tunnel Problems Simplified. Sci. & Art of Min., vol. 34, no. 19, Mar 29, 1924, pp. 274-275, 2 figs. Examples illustrating application of simplest or ideas to solution of such problems as arise in connection with practice of tunneling in coal mines and showing that application of principles rather than an attempt to use formulas is essential to correct solution of such problems.

COAL MINING

CUTTING BY MACHINERY. Coal Stripper Uses Ice Harvesters' Method, D. M. Sutor. Coal Age, vol. 25, no. 12, Mar. 20, 1924, pp. 415-417, 4 figs. Turns longwall cutting machine on edge, "sawing" 28-in. seam into panels 12 ft. wide so that pop shots make less screenings; scheme reduces over-all cost of coal.

LONGWALL SYSTEM. Undersea Longwall Mining, J. Moffat. Coal Industry, vol. 7, no. 4, Apr. 1924, pp. 140-142, 1 fig. At distance of 2½ mi. undersea and with cover of 1,350 ft., Nova Scotia mine has changed from room and pillar to longwall with great success.

COAL STORAGE

ECONOMY. Economic Phases of Coal Storage, F. G. Tryon and W. F. McKenney. Universal Engr., vol. 39, no. 4, Apr. 1924, pp. 19-25, 2 figs. Extent to which practice of storage has already been adopted; inducements to store offered by periodic fluctuations in price and supply of coal.

COKE HANDLING

HOISTS FOR. Automatic Coke Hoist, D. Cleave Cross. Gas Wld., vol. 80, no. 2071, Mar. 29, 1924, pp. 292-293, 2 figs. Describes a somewhat novel coke hoist erected at Lea Bridge gas works for use with water-gas plant. Paper read before Lond. & Southern District Jr. Gas Assn.

COMPRESSED AIR

MEASUREMENT. A New Compressed-Air Measuring Method (Ein neues Druckluft-Messverfahren), E. Stach. Glückauf, vol. 60, no. 14, Apr. 5, 1924, pp. 260-262, 3 figs. New method for and equipment determining compressed-air consumption in relation to suction volume in a pipe line or a machine; pressure fluctuations are without influence on measurement results.

CONDENSERS, STEAM

AIR COOLING, EFFECT ON. How External Air Cooling Increases the Effectiveness of Condenser-Tube Surface, P. Bancel. Power, vol. 59, no. 20, May 13, 1924, pp. 769-771, 4 figs. Points out that two distinct processes ordinarily occur inside of surface condensers, namely, steam condensing, which goes on at high rate of heat transfer, and devaporizing air-steam mixture, which is carried out at very low rate of heat transfer; when air coolers are provided outside of condenser to handle latter process, condenser tubes may operate at much higher efficiency.

BAROMETRIC, VACUUM-PUMP CAPACITY. Calculating the Amount of Air Liberated in Barometric Condensers, C. M. Reed. Power, vol. 59, no. 10, Mar. 4, 1924, pp. 370-372, 4 figs. Air enters with cooling water, steam and by leakage, which may be easily calculated from charts.

EJECTOR-AIR. Ejector-Air Condenser (L'Ejecteau-Air Condenseur). Génie Civil, vol. 84, no. 10, Mar. 8, 1924, pp. 234-235, 6 figs. Describes apparatus and principle upon which it is based; output depends solely upon speed of steam transmission in apparatus, and is expressed in function of ratio of weight of steam to cross-section of ejector inlet.

SURFACE. Tendencies in Surface Condenser Practice. Power Plant Eng., vol. 28, no. 10, May 15, 1924, pp. 530-533, 4 figs. Points out that elimination of dead tube space, multiple air-suction openings and variable water supply are important factors in condenser design and application.

CONDENSERS, ELECTRIC

OSCILLATIONS, OVERDAMPED. Overdamped Condenser Oscillations, Chas. P. Steinmetz. Am. Inst. Elec. Engrs.—Jl., vol. 43, no. 5, May 1924, pp. 424-428, 9 figs. Shows effect of condenser leakage on discharge wave.

POWER LOSS, WITH LIQUID DIELECTRICS. The Power Loss in Condensers with Liquid Dielectrics, L. S. McDowell. Physical Rev., vol. 23, no. 4, Apr. 1924, pp. 507-517, 5 figs. Power loss in condensers with liquid dielectrics; variation of equivalent series resistance and capacity with frequency, 600 to 3,500 cycles.

CONDUITS

BACKWATER AND DROP-DOWN CURVES. New Method of Computing Backwater and Drop-Down Curves, A. G. Husted. Eng. News-Rec., vol. 92, no. 17, Apr. 24, 1924, pp. 719-722, 4 figs. Modification of channel subdivision method with elimination of trial calculations; applicable to canals, sewers, etc., under uniform hydraulic conditions.

CONSTRUCTION WORK

HYDRAULIC CARTRIDGE. Hydraulic Cartridge Does Away with Explosives in Construction Operations. Contract Rec. & Eng. Rev., vol. 38, no. 17, Apr. 23, 1924, pp. 396-397, 1 fig. Details of new British machine, known as "hydraulic mining cartridge", especially applicable to removal of heavy concrete where effect of explosives cannot be accurately controlled. Wide range of usefulness.

CONVEYORS

MEDIUM-SIZED SHOPS. Increasing Production by Power Conveyors, Chas. O. Herb. Machy. (N. Y.), vol. 30, no. 9, May 1924, pp. 706-709, 5 figs. Conveyor installations that have proved their economy in plant manufacturing small parts; japanning conveyors; conveyors for cleaning work before nickel-plating, and rinsing and drying afterward; assembly conveyors.

[*See also Ash Handling.*]

COST ACCOUNTING

CAPITAL CONTROL. Capital Requirements and Control, J. H. Bliss. Mgt. & Administration, vol. 7, no. 5, May 1924, pp. 529-532. Surplus and its constructive application.

POINT METHOD. Getting at Costs by the "Point Method," R. E. Roesler. Factory, vol. 32, no. 5, May 1924, pp. 662-663, 2 figs. Describes point cost method and its applications.

CRANES

ELECTRIC CURRENT FOR, CHOICE OF. Choice of Current for Hoists with Special Regard to Harbor Cranes (Wahl der Stromart für Hebezeuge unter besonderer Berücksichtigung der Hafenkrane), H. Gettert. Elektrotechnische Zeit., vol. 45, no. 16, Apr. 17, 1924, pp. 353-359, 17 figs. Author seeks to ascertain which kind of current is most economical with regard to energy consumption.

ELECTRIC EQUIPMENT. Modern Single-Phase Crane Equipment of Brown, Boveri & Cie (Moderne Einphasen-Kran-Ausrüstungen der Brown, Boveri & Cie., A.-G.), H. Gettert. Fördertechnik u. Frachtverkehr, vol. 17, no. 5, Mar. 3, 1924, pp. 59-65, 28 figs. Advantages of Deri motors for drive of hoists; design and operation of motors; selection of control apparatus and arrangement of control for different types of cranes; control of Deri motors with controller and resistance.

CUPOLAS

TILTING DEVICE. Tilting Device Has Advantages on Small Cupola. Can. Foundryman, vol. 15, no. 3, Mar. 1924, p. 16, 1 fig. Shell hung on trunions for convenience in preparing instead of workman getting inside.

D

DAMS

FRENCH REGULATIONS. New French Instructions for the Building of High Dams as Gravity Dams (Neue französksche Instruktion zum Bay hoher Talsperren als Gewichtsmauern), A. Zeerleder. Schweizerische Bauzeitung, vol. 83, no. 16, Apr. 19, 1924, pp. 181-183. Rules and regulations issued by French Minister of Buildings in 1923.

MULTIPLE-ARCH. Reinforced Multi-Arch Dam Design Adopted by Swedish Engineers, Johnstone-Taylor. Concrete, vol. 24, no. 4, Apr. 1924, pp. 152-153, 6 figs. In connection with damming of Great Lule river in Lapland for water power purposes, multiple-arch design constructed of reinforced concrete was decided upon as most economical. Particulars of structures, of which they are two, one having 23 arches and one 15 arches.

DIES

DRAWING, DESIGN OF. Designing Drawing Dies, F. Heller. Machy. (N. Y.), vol. 30, no. 9, May 1924, pp. 687-691, 7 figs. Problems encountered in determining size of blank necessary to produce shell of given dimensions and number of drawing operations required to complete work.

DIESEL ENGINES

BEARDMORE-TOSI, MACHINING. Building Marine Diesel Engines. Machy. (Lond.), vols. 23 and 24, nos. 600 and 601, Mar. 27 and Apr. 3, 1924, pp. 825-828 and 17-21, 25 figs. Machining operations on Beardmore-Tosi Engine.

BETHLEHEM. Types of Modern Power-Plant Oil Engines. Oil Engine Power, vol. 2, no. 3, Mar. 1924, pp. 152-156 and 161, 8 figs. Critique of design features of Bethlehem 2,900-b.hp. 2-cycle unit, and complete details relating to design and method of operation of its axial scavenging valve.

LUBRICATION. Lubricating Diesel Engines and Auxiliary Machinery. Mar. Eng., vol. 29, no. 5, May 1924, pp. 298-300. General rules for selecting lubricants and methods of applying them to promote economy.

The Lubrication of Diesel Engines (Ueber Dieselmaschinen-Schmierfragen), W. Ernst. Zeit. des Vereines deutscher Ingenieure, vol. 68, no. 18, May 3, 1924, pp. 451-454, 14 figs. Points out that in view of the different parts to be lubricated, use of different oils for various applications is desirable, but it is sometimes necessary to use a unit lubricating oil which has to be adapted to the various applications including that of cooling pistons; gives examples of difficulties encountered in lubrication of Diesel engines with a unit oil.

MARINE. Latest Developments in Diesel-Engine Ship Propulsion (Neueste Bestrebungen beim Schiffsantrieb durch Dieselmotoren), E. Goos. Zeit. des Vereines deutscher Ingenieure, vol. 68, no. 18, May 3, 1924, pp. 435-441, 18 figs. Discusses present tendencies in development of marine Diesel engines; examples and practical results; measures for increasing efficiency and improving operating safety and economy; drive of auxiliary machinery; heating and motor oils.

DYNAMOMETERS

BELT. Some Power Studies Through Use of the Ohio Recording Belt Dynamometer, G. W. McCuen. Agricultural Eng., vol. 5, no. 3, Mar. 1924, pp. 51-55, 13 figs. Describes dynamometer that will record power requirements and performance of belt-driven machines; prime mover, in a cradle, swings to make possible recording of a torque due to resistance in a belt. Studies in threshing and baling straw. Tests on effect of sharpness of knives.

E

ELECTRIC ARC

HIGH-INTENSITY. Studies in the Projection of Light. The High-Intensity Arc and the Parabolic Mirror, F. Benford. Gen. Elec. Rev., vol. 27, nos. 3 and 4, Mar. and Apr., 1924, pp. 199-207 and 252-260, 34 figs. Describes 150-amp. arc; its essential feature is a deep and well formed crater that is constantly filled with a highly luminous gas whose temperature is about 5,500 deg. A. Computations and curves on high-intensity arc, in which specific case of a 60-in. high-intensity searchlight is largely used.

ELECTRIC CIRCUITS

GRAPHICAL TREATMENT. The Graphical Treatment of Circuits Containing Iron Core Reactances and Capacity, L. Fleischmann. Gen. Elec. Rev., vol. 27, no. 4, Apr. 1924, pp. 260-262, 11 figs. Graphic method for analytic treatment of circuits possessing variable self induction and capacity.

ELECTRIC DISTRIBUTION SYSTEMS

LOAD DISPATCHING, CENTRALIZED. Load Dispatching System of P. G. & L. Co., C. W. Geiger. Power Plant Eng., vol. 28, no. 10, May 15, 1924, pp. 543-545, 3 figs. Control is centralized in one office; carrier-current system in continuous use.

NETWORKS, ANALYTICAL SOLUTION OF. Analytical Solution of Networks, R. D. Evans. Elec. Jl., vol. 21, nos. 4 and 5, Apr. and May 1924, pp. 149-154 and 207-213, 23 figs. Explanation of how calculations may be made of short-circuit currents for different locations on power system, for proper application of circuit breakers and to secure best operation of relay systems.

SHORT-CIRCUITS, EFFECT AND PREVENTION. Effect and Prevention of Short Circuits, B. G. Jamieson. Elec. World, vol. 83, no. 17, Apr. 26, 1924, pp. 815-817, 3 figs. By extending isolation of phases beyond generating stations to primary distribution points saving of investment and greater reliability will be gained even on small interconnected systems.

ELECTRIC FURNACES

ACID. The Manufacture of Acid Electric Steel for Commercial Castings, L. J. Barton. Am. Soc. Steel Treating—Trans., vol. 5, no. 4, Apr. 1924, pp. 379-398, 8 figs. Discusses manufacture of acid as made in electric furnace, for use in production of commercial castings; selection, segregation and use of scrap metal; details of charging melting furnace; melting-down conditions involved, and various types of slags obtained in both good and bad practices; production of special steels and various alloy steels.

CONTROL GEAR. An Electric Furnace Regulating Gear, H. J. Seymour. Power Engr., vol. 19, no. 218, May 1924, pp. 174-175, 2 figs. Describes one type of automatic apparatus for regulation of 2-phase electric furnaces.

DEVELOPMENTS. Electric Furnace Developments, F. Hodson. Foundry Trade Jl., vol. 29, no. 398, Apr. 3, 1924, pp. 273-274. Growth of electric melting furnace industry. Soderberg electrode. See also Iron & Coal Trades Rev., vol. 108, no. 2928, Apr. 11, 1924, p. 596.

INCREASING CAPACITY FOR LARGE CASTING. Nine Tons in a 3-Ton Furnace, L. J. Barton. Foundry, vol. 52, no. 10, May 15, 1924, pp. 401-403, 9 figs. Capacity of electric furnace increased to melt sufficient iron to pour large gear wheel; operating door banked up about 10 in. with cement made of white sand and sodium silicate; operation at plant of Dibert, Bancroft & Ross Co., New Orleans.

ELECTRIC LAMPS, INCANDESCENT

NEON. The Application of the Neon Lamp to the Comparison of Capacities and High Resistances, J. Taylor and W. Clarkson. Jl. Sci. Instruments, vol. 1, no. 6, May 1924, pp. 173-182, 9 figs. Deals with application of "flashing" of neon discharge tube to measurement of capacities and high resistances; extension of method utilizes beats between two neon lamp circuits "flashing" at high frequencies, for measurement of small capacities.

ELECTRIC LOCOMOTIVES

0-4-4-0 TYPE. Electric Goods Locomotive, Victorian Government Railways. Ry. Gaz., vol. 40, no. 17, Apr. 25, 1924, pp. 596-597. 3 figs. Particulars of two locomotives to be used for service in Melbourne metropolitan railway yards and for hauling goods trains within Melbourne suburban electrified railway area; wheel arrangement 0-4-4-0; voltage and system 1,500 d.c., individual single-geared drive, maximum tractive effort 26,000 lb.

OIL-ENGINE-DRIVEN. New Type Electric Locomotive. Aera, vol. 12, no. 10, May 1924, pp. 1729-1732, 4 figs. Describes locomotive using oil for its fuel, built jointly by Gen. Elec. Co. and Ingersoll-Rand Co., and especially designed for switching service; fuel-oil engine operates d. c. generator supplying current to motors without intervening accelerating resistance; fuel cost exceedingly low, and new engine is smokeless.

Oil-Electric Locomotive with Injection Type Engine. Ry. Age, vol. 76, no. 23, May 10, 1924, p. 1159, 2 figs. Electric locomotive driven by fuel-oil engine built jointly by Gen. Elec. Co. and Ingersoll-Rand Co. See also Ry. Rev., vol. 74, no. 19, May 10, 1924, pp. 846-847, 3 figs.

PARALLEL-CRANK DRIVE. Vibrations of Electric Locomotive with Crank Drive (Die Schüttelschwingungen elektrischer Lokomotiven mit Stangenantrieb), A. Winkler. Elektrotechnik u. Maschinenbau, vol. 42, nos. 16 and 17, Apr. 20 and 27, 1924, pp. 241-248 and 261-265, 7 figs. Problem of parallel-crank drive and its history; ideal parallel-crank drive; forced oscillations of practical parallel-crank drive; elasticity of shafts; play of bearings; quasi- and pseudo-harmonic oscillations; gear springs; damping of systems with rigid speed characteristics; subsequent calculation of actual locomotives with special consideration of gear springs and damping.

PIT AND QUARRY HAULAGE. Locomotives for Haulage at Pits and Quarries, H. H. Johnston. Pit and Quarry, vol. 8, no. 7, Apr. 1924, pp. 97-100, 4 figs. Notes on different types of electric locomotives, and electric equipment for haulage systems.

TURBO-ELECTRIC. *See Locomotives, Turbo-Electric.*

ELECTRIC METERS

KVA.-DEMAND. A New Electricity Meter. Engineer, vol. 137, no. 3567, May 9, 1924, pp. 519-520, 7 figs. A.c. meter which gives direct reading of power factor, total kilowatt-hours, kilovolt-ampere hours, and kilowatt and kilovolt-ampere demand for any predetermined period, and also power factor for over any period; introduced by Am. Westinghouse & Mfg. Co.

ELECTRIC MOTORS, A.C.

CRAWLING. Crawling of Three-Phase Squirrel-Cage Induction Motors, T. F. Wall. World Power, vol. 1, no. 4, Apr. 1924, pp. 224-233, 7 figs. Discusses phenomenon of crawling, i.e., running up of motor to some speed which is only fraction of normal synchronous speed and remaining running at that low speed; cause and remedies.

ELECTRIC TRANSMISSION LINES

CONSTRUCTION. Report of A.R.E.A. Committee on Electricity. Ry. Elec. Engr., vol. 15, no. 4, Apr. 1924, pp. 123-125. Report presented at 25th annual convention giving specifications for electric power transmission and distribution pole lines.

DESIGN AND CONSTRUCTION. Electric Pole Lines. Power Engr., vol. 19, no. 217, Apr. 1924, pp. 131-135, 10 figs. Design and construction of overhead transmission lines, with special reference to smaller industrial lines.

High-TENSION. High-tension Transmission Lines, E. V. Pannell. Engineer, vol. 137, nos. 3559, 3560, 3561, 3562, 3563 and 3564, Mar. 14, 21, 28, Apr. 4, 11 and 18, 1924, pp. 272-273, 300-302, 328-331, 352-354, 378-379 and 418-419, 26 figs. Study of engineering elements of modern transmission lines, grouped under following heads: conductors, insulators, supports; study of general subject of mechanical design; survey of construction economy.

STRINGING CONDUCTORS. Stringing Transmission Cable, O. Davidson. Elec. World, vol. 83, no. 17, Apr. 26, 1924, pp. 819-821, 7 figs. Nature of preliminary study, special equipment and methods employed on Indiana Elec. Corp.'s 74-mi., 132-kv. line between Terre Haute and Indianapolis.

SURVEYS AND FIELD ENGINEERING. Transmission Line Surveys and Field Engineering, O. Davidson. Eng. News-Rec., vol. 92, no. 19, May 8, 1924, pp. 808-809. Preliminary paper location; instrument surveys, records and mapping; two parallel profiles; office and field location of towers; Work of engineers on construction of new 75-mi. high-tension transmission line from Terre Haute to Indianapolis.

VOLTAGE DROP. The Voltage Drop in a Three-Phase Transmission Line with Unsymmetrically Arranged Conductors, H. Cotton. World Power, vol. 1, no. 4, Apr. 1924, pp. 211-215, 5 figs. Calculation of drop due to resistance and inductance.

ELECTRIC WELDING

MACHINES AND PROCESSES. Recent Developments of Electric Welding Machines (Die neuere Entwicklung der elektrischen Schweissmaschinen), A. Neuburger. Elektrotechnik u. Maschinenbau, vol. 42, nos. 14 and 15, Apr. 6 and 13, 1924, pp. 214-219 and 230-235, 20 figs. Description of modern processes and machines, with special reference to resistance welding.

ELECTRIC WELDING, ARC

CAST IRON. Arc Welding Cast Iron. Welding Engr., vol. 9, no. 4, Apr. 1924, pp. 22-23, 3 figs. How to use monel-metal electrode.

COPPER. Summary of Information on Arc Welding of Copper, Brass and Bronze in the Literature Up to March 1923. Am. Welding Soc.—Jl., vol. 3, no. 3, Mar. 1924, pp. 9-15. Digest of literature made by sub-committee of Electric Arc Welding Committee of Am. Bur. Welding.

MANGANESE STEEL. Correct Welding Procedure Retains Qualities of Manganese Steel, H. H. George. Elec. Ry. Jl., vol. 63, no. 16, Apr. 19, 1924, pp. 611-613. By use of arc welding in the field, life of manganese steel special work can be increased one to five years. Type of welding rod, technique employed and speed of cooling affect physical characteristics of welded material.

F

FACTORIES

INSPECTION. Some Problems of Factory Inspection. Int. Labour Rev., vol. 9, no. 3, Mar. 1924, pp. 372-386. Brief account of main lines of development of factory inspection, both in theory and practice, taking as basis reports prepared by Int. Labor Office.

FANS

EXHAUST. Things to Know About Fan Application, H. W. Pfeer. Sheet Metal Worker, vol. 15, no. 8, May 9, 1924, pp. 283-285 and 309, 3 figs. Important truths essential to a complete understanding of how to lay out a successful exhaust system; capacities to figure on; air velocities needed; pipe sizes; general suggestions.

MINE. The Change of Air Supply in Mine Fans, A. Latsinsky. Russian Min. Jl., vol. 100, no. 1, Jan. 1924, pp. 31-34. (In Russian.)

FLIGHT

ELEMENTS OF, CALCULATION. General Method and Chart for Calculating Elements of Airplane Flight (Méthode générale et abaque pour calculer les éléments du vol d'un avion), G. Delanghe. Génie Civil, vol. 84, no. 2169, Mar. 8, 1924, pp. 222-226, 8 figs. Describes new method developed by author.

FLOTATION

ORE. Selective Flotation, C. S. Parsons. Can. Min. Jl., vol. 45, no. 17, Apr. 25, 1924, pp. 404-407. Separation by flotation of one mineral from another, where two or more flotative minerals are present in an ore. Reviews in general way results of investigations conducted in Ore Dressing and Metallurgical Laboratories of Dept. Mines at Ottawa, that have reference to selective flotation as applied to Canadian ores.

FLOW IN PIPES

WATER AND AIR SIMULTANEOUSLY. Simultaneous Flow of Water and Air in Pipes, L. S. O'Bannon. Am. Soc. Heat & Vent. Engrs.—Jl., vol. 30, no. 3, Mar. 1924, pp. 225-234, 14 figs. Describes experiments made to find capacity of pipes for carrying water and air simultaneously, within conditions of steady flow; results and methods of running experiments described under four following heads: Flow of water, flow of air, parallel flow of water and air, and counter flow of water and air.

FLOW OF FLUIDS

DYNAMIC SIMILARITY, PRINCIPLE OF. The Principle of Dynamical Similarity, with Special Reference to Model Experiments, A. H. Gibson. Engineering, vol. 117, nos. 3037, 3038, 3039 and 3040, Mar. 14, 21, 28 and Apr. 4, 1924, pp. 325-327, 357-359, 391-393 and 422-423, 6 figs. Discusses application of principles to flow of fluid through pipes, resistance of wholly submerged and partially submerged bodies; model experiments on resistance of ships; resistance of smooth wires and cylinders; estuary model experiments; surge tanks; sea-going qualities of vessels in rough sea; suction of interaction between passing vessels; critical speed and torsional vibration of shafts.

FLOW OF GASES

MEASUREMENT. Measuring Flow of Gases, Chas. P. Turner and B. W. Winship. Chem. & Met. Eng., vol. 30, no. 16, Apr. 21, 1924, pp. 633-635, 4 figs. Results of application of mixture method, suggested by salt-solution method for measuring flow of water, show that it is of value in related problems of fluid flow.

FLOW OF STEAM

PIPES. Critical Velocity of Steam and Condensate Mixtures in Horizontal, Vertical, and Inclined Pipes, F. C. Houghton and R. L. Lincoln. Am. Soc. Heat. & Vent. Engrs.—Jl., vol. 30, no. 2, Feb. 1924, pp. 153-168, 19 figs. Details of experiments made to obtain a thorough understanding and complete knowledge of factors entering into, and effects taking place when steam is sent through a pipe in which there is a counterflow of condensate. Effect of length and size of pipe and type of entrance, upon critical velocity.

FLOW OF WATER

DISCHARGE MEASUREMENTS. Discharge Measurements for the Control Section Weir, J. L. Savage. Eng. News-Rec., vol. 92, no. 20, May 15, 1924, p. 842, 3 figs. Observations check closely theoretical rating curve; results of set of experiments made by Bur. Reclamation upon new type of measuring structure for which name control section weir has been proposed.

GROUNDWATER, MOVEMENT OF. Geometrical Investigation of the Theory of Movement of Groundwater in Rubble and Water Filtration Through Sand (Geometrische Untersuchung der Theorie der Bewegung des Grundwassers im Gerölle und der Wasserfilterung durch Sand), L. Burmester. Zeit. für angewandte Mathematik u. Mechanik, vol. 4, no. 1, Feb. 1924, pp. 33-52, 28 figs. on supp. plate. Investigation of theory and its practical application.

STREAMS, ICE-COVERED. Effect of Ice on Flow of Mississippi River at Keokuk, Iowa, A. Davis. Stone & Webster Jl., vol. 34, no. 4, Apr. 1924, pp. 475-480, 1 fig. Describes ice effect at Keokuk with idea that it may throw light on general problem of flow under ice cover in other locations.

TURBULENT AND NON-TURBULENT. The Laws of Industrial Hydraulics (Sur les régimes hydrauliques industriels), C. Camichel and M. Ricaud. Technique Moderne, vol. 16, no. 5, Mar. 1, 1924, pp. 129-137, 30 figs. Author seeks to explain certain characteristics of hydraulic flow, showing existence of turbulent flow independent of form of obstacles; transition from one flow to another has its origin frequently in formation of surfaces of discontinuity; study of surfaces of discontinuity.

FLYWHEELS

MANUFACTURE. Maxwell Methods in Flywheel Work, F. H. Colvin. Am. Mach., vol. 60, no. 20, May 15, 1924, pp. 729-730, 5 figs. Machine equipment, together with some of tooling fixtures and handling devices; drilling and tapping in multi-spindle machines; balancing machine.

FORGING

STEAM VS. AIR HAMMERS. Steam vs. Air in Forging-Hammer Practice (Dampf oder Luft für den Hammerbetrieb), F. Beleke. Maschinenbau, vol. 3, no. 12, Mar. 27, 1924, pp. 389-394, 18 figs. Comparison of economy of steam, pneumatic and air hammers; points out applications for which each type is most adaptable.

FORGINGS

HEAVY. The Production of Heavy Forgings. Mech. Eng., vol. 46, no. 5, May 1924, pp. 241-247 and 307, 15 figs. Survey of status of industry in America at present time, together with data helpful to engineer ordering forgings.

FOUNDRIES

BRASS. The Operation of a Brass Foundry under Scientific Control, F. W. Rowe. Foundry Trade Jl., vol. 29, no. 399, Apr. 10, 1924, pp. 291-294 and (discussion) 294-296, 5 figs. Layout of brass foundries, provision of suitable stores, recording stocks, charge sheets, inspection of castings of new design, melting and casting procedure, casting temperature, etc.

COSTS. Why Foundry Costs Vary on Rough Castings, A. Lueuberg. Can. Foundryman, vol. 15, no. 3, Mar. 1924, pp. 14-15, 3 figs. Uniform cost-finding method for foundries; individual cost of castings based on actual time prevents confusion in locating leaks.

Modern Practice. Recent Evolution in Foundry Practice (Evolution récente de la fonderie), E. Ronceray. Revue de Métallurgie, vol. 21, nos. 1, 2 and 3, Jan., Feb. and Mar., 1924, pp. 4-11, 112-120 and 183-194, 16 figs. Jan.: General progress; semi-steel; fuels; American malleable; light metals; melting apparatus; heating furnaces. Feb.: Molding and casting; dry-sand and chill casting; molding machines. Mar.: Core and patternmaking; general layout of foundries.

FUELS

Colloidal. Experimental Preparation of Colloidal Fuel, A. V. Sapoznikow and M. N. Kalinin. Petroleum & Oil-Shale Industry, vol. 5, no. 11-12, Nov.-Dec. 1923, pp. 652-654. (In Russian.)

Combustion, Maximum Temperatures and Pressures in. An Investigation of the Maximum Temperatures and Pressures Attainable in the Combustion of Gaseous and Liquid Fuels, G. A. Goodenough and G. T. Felbeck. Univ. of Ill. Bul., no. 139, Mar. 1924, 158 pp., 27 figs. Résumé of important laws of gas mixtures; general theory of chemical equilibrium, and derivation of equilibrium equations for various reactions; develops energy equation, and shows method of solving system of equations for maximum temperature; comparisons and applications of theory.

Lignite and Bituminous Mixtures. Burning Mixtures of Lignite and Bituminous, A. Canfield. Power Plant Eng., vol. 28, no. 9, May 1, 1924, pp. 476-477, 4 figs. Experiments carried out at power plant of State Mill & Elevator, Grand Forks, N. Dak., during past six months to determine most economical ratio of lignite to be burned with Eastern bituminous.

Lignite Char. Tests of Lignite Char as Reduction Fuel in the Smelting of Zinc Ores, B. M. O'Harra. U. S. Bur. Mines, Reports of Investigations, No. 2575, Feb. 1924, 7 pp. Analysis and characteristics of and experiments made with "char", the fuel produced by a simple carbonizing oven devised by Bur. of Mines which is essentially a vertical shaft with means for supplying raw lignite at top and discharging carbonized lignite at lower end. From Zinc Inst. Bul., Jan. 1924.

Pulpwood Bark. Utilization of Pulpwood Bark for Fuel, J. D. Rue and E. P. Gleason. Paper Trade Jl., vol. 78, no. 16, Apr. 17, 1924, pp. 40-50, 10 figs. Final report of Sub-Committee on Utilization of Bark, Committee on Waste of Technical Assn. Pulp & Paper Industry, dealing with possible methods of utilization, present practice in barking, bark presses, and furnaces for burning bark.

Solid, Cemical Constitution. Modern Theories on the Chemical Constitution of Solid Fuels (Les théories modernes sur la constitution chimique des combustibles solides), E. Audibert and A. Raineau. Chimie & Industrie, vol. 11, nos. 2 and 3, Feb. and Mar. 1924, pp. 229-247 and 434-448, 1 fig. Review of works on this subject during recent years: Constituents of higher plants: carbon hydrates; natural state, properties and constitution of lignines; humic acids; conversion from plant to humic acid and from humic acid to humic substances; investigations tends to confirm existing lack of knowledge on subject of chemical constitution of solid fuels. See also Revue de l'industrie Minérale, no. 78, Mar. 15, 1924, pp. 127-171, 1 fig.

See also Coal; Lignite; Oil Fuel; Pulverized Coal.

FURNACES, INDUSTRIAL

Electricity, Use of. Furnaces and Heat Sources, E. F. Collins. Fuels & Furnaces, vol. 2, no. 5, May 1924, pp. 479-483. Reasons for wider and more general adoption of electric heat in past few years. Some fundamental considerations which determine when electric heat should be used.

Recuperation, Advantages of. Recuperation—Its Advantages, E. R. Posnack. Combustion, vol. 10, no. 5, May 1924, pp. 362-363. Advantages of recuperation in industrial furnaces.

G

GAGES

Hydrostatic. How to Compensate for Temperature Effects on Hydrostatic Gages, J. P. Nikonow. Automotive Industries, vol. 50, no. 18, May 1, 1924, pp. 964-966, 3 figs. Fluctuations in atmospheric temperature change volume of entrapped air and thus vary readings; practical method of balancing this factor is worked out.

GARBAGE DISPOSAL

New Process. New Process of Garbage Disposal at Lebanon, Pa., C. R. Fox and Wm. S. Davis. Eng. News-Rec., vol. 92, no. 20, May 15, 1924, pp. 857. After being ground in bone mill, material will be sent two miles through sewer to Imhoff tanks.

GAS ENGINES

Foundations. Foundations for Gas Engines. Power Engr., vol. 19, no. 217, Apr. 1924, pp. 125-127, 8 figs. Design and construction of foundations suitable for internal-combustion engines, and particularly gas plants.

Ignition Equipment. Ignition Equipment for a 7,500-Hp. Gas Engine. Engineering, vol. 117, no. 3039, Mar. 28, 1924, pp. 394-395, 4 figs. Set of equipment supplied by Lodge Bros. & Co. for gas engine; details of contact maker, igniter, timing unit and sparking plug.

GAS PRODUCERS

Bituminous Coal as Fuel. Central District Bituminous Coals as Water-Gas Generator Fuel, W. E. Odell and W. A. Dunkley. U. S. Bur. Mines, Bul. 203, 1924, 92 pp., 11 figs. Results of investigation made which consists of study of practice already developed and difficulties encountered, development of operating methods that would obviate these difficulties, testing various coals of Central District to determine which might be considered for this purpose, and study of technical conditions involved in manufacture of water gas from bituminous coals.

Regulation. Test on Regulation of Gas Producers and Open-Hearth Furnaces (Versuche zur Einregelung von Gaserzeuger und Siemens-Martin-Ofen), Geo. Bulle. Stahl u. Eisen, vol. 44, no. 15, Apr. 10, 1924, pp. 397-403, 6 figs. Summary of measurements carried out on 7 producer plants and 3 open-hearth works; determination of influence of varying steam consumption, load and treatment on producers; tests on open-hearth furnaces to ascertain correct quantity of air and best mixing conditions of coke-oven and producer gas; description of necessary measuring equipment.

GAS TURBINES

Developments. The Gas Turbine, F. Dollin. Instn. Mech. Engrs.—Proc., vol. 2, no. 6, 1923, pp. 1121-1135, 2 figs. Account of most noteworthy attempts to produce efficient and reliable gas turbine; summary of results obtained and indication of possible future developments. (Abridged.)

GASES

Combustion at High Pressure. Gaseous Combustion at High Pressures, Wm. A. Bone, D. M. Newitt and D. T. A. Townend. Roy. Soc.—Proc., vol. 105, no. A732, Apr. 1, 1924, pp. 406-433, 6 figs. Influence of varying initial pressures upon rate of pressure development and activation of nitrogen in carbon monoxide-air explosions.

GEAR CUTTING

Hobbing Machines. Gould & Eberhardt No. 72-H Automatic Gear Hobbing Machine. Am. Mach., vol. 60, May 1, 1924, pp. 669-670, 2 figs. Adapted for cutting of gears up to 27 in. in diam.

GEARS

Bevel. Spiral Bevel Gears. Machy. (Lond.), vol. 24, no. 605, May 1, 1924, pp. 138-141, 6 figs. Deals with type produced on Gleason principle in which, owing to spiral effect tooth thickness cannot be measured on outer circumference as can be done in case of straight-tooth bevel gears, but should be measured across normal section of tooth.

Differential. Methods of Machine Tool Design, A. L. De Leeuw. Am. Mach., vol. 60, no. 17, Apr. 24, 1924, pp. 621-624, 5 figs. Differential gearing finds its principal machine-tool application in feed mechanism; differential indexing mechanisms.

GRINDING MACHINES

Disk. The Use of Fixtures in Disk-Grinding, H. Campbell. Am. Mach., vol. 60, no. 21, May 22, 1924, pp. 759-761, 9 figs. Grinding production determined largely by types of fixture used; recently developed work holders; grinding piston rings automatically; better work and higher production which less labour.

High-Traverse. New Landis Grinder Has Stationary Head. Automotive Industries, vol. 50, no. 19, May 8, 1924, p. 1017, 2 figs. Designed to meet demand for oversize precision grinding with long-lived speed production; number of pieces ground per dressing of wheel said to offset higher initial cost.

Internal. Productive Internal Grinding. Brit. Machine Tool Eng., vol. 3, no. 26, Mar.-Apr. 1924, pp. 30-32, 5 figs. Describes internal-grinding machine made by Churchill Machine Tool Co., adapted to suit special piece of work; main features and operation.

H

HARDNESS

Ball Hardness Testing. The Accurate Determination of the Hardness of Metals. Engineering, vol. 117, no. 3043, Apr. 25, 1924, pp. 518-519, 5 figs. Investigation of Brinell test with object in view of designing method of testing which yields Brinell hardness numerals of thoroughly reliable order, free from irregularities to which Brinell test is exposed when carried out in ordinary way.

Indentation. In the Indentation Hardness of Metals, K. Honda and K. Takahasi. Iron & Steel Inst.—advance paper, no. 10, for mtg. May 1924, 11 pp., 6 figs. Points out that Brinell hardness, when impression is measured during application of load, is quite correct, and much less than that by usual method of measurement; new definition of hardness is given.

Magnetic Tests. A Correlation between the Mechanical Hardness and the Magneto-restrictive Effects of Ferromagnetic Substances, S. R. Williams. Am. Soc. Steel Treating—Trans., vol. 5, no. 4, Apr. 1924, pp. 362-368, 3 figs. Method of determining physical properties of metals through magnetic means; relative merits of X-ray and magnetic means of determining flaws in metals; Joule effect; discusses experiments wherein endeavour was made to relate magnetostriction and hardness of ferro-magnetic substances.

Steel Balls, Magnetic Test. Hardness of Steel Balls by Magnetic Tests, S. R. Williams. Am. Soc. Steel Treating—Trans., vol. 5, no. 5, May 1924, pp. 479-484, 4 figs. Rapid method of determining magnetically hardness of steel balls; with this method it is possible to conduct 100-per cent inspection on balls for hardness, with considerable rapidity; illustrations showing schematic arrangement of author's apparatus, and set-up and graphs of certain tests made upon balls having different degrees of hardness.

HEAT TRANSMISSION

Boilers. The Transmission of Heat in Boilers, W. N. Booth. Gas Wld., vol. 80, no. 2071, Mar. 29, 1924, pp. 288-290, 6 figs. Conditions which affect flow of gas adjacent to a solid surface; conduction and convection; transmission of heat through boiler plates. Paper read before Lond. & Southern District Jr. Gas Assn. See also Gas Jl., vol. 166, no. 3177, Apr. 2, 1924, pp. 36-38, 6 figs.

Buildings. An Improved Method of Determining the Heat Transfer Through Wall, Floor, and Roof Sections, R. F. Norris, H. H. Germond and C. M. Tuttle. Am. Soc. Heat. & Vent. Engrs.—Jl., vol. 30, no. 2, Feb. 1924, pp. 109-114, 1 fig. Describes method developed in Burgess laboratories and apparatus used.

Problems. Heat Transfer Symposium. Indust. Eng. Chem., vol. 16, no. 5, May 1924. Contains following articles: Heat Transmission from Bare and Insulated Pipes, R. H. Heilman, pp. 451-458, 10 figs.; Heat Transmission in an Inclined Rapid Circulation Type Vacuum Evaporator, D. J. Van Marie, pp. 458-459, 2 figs.; Forced Convention of Heat in Gases and Liquids, Chester W. Rice, pp. 460-467, 4 figs.; Optimum Operating Conditions for Pipe Heating and Cooling Equipment, W. K. Lewis, J. T. Ward and E. Voss, pp. 467-468; Heat Transfer in Enamel-Lined Apparatus, E. P. Poste, pp. 469-470; Characteristics of Air-Blast Heaters, F. R. Ellis and J. D. White, pp. 471-473, 8 figs.; Studies in Evaporator Design—Effect of Surface Conditions, L. A. Pridgeon and W. L. Badger, pp. 474-478, 3 figs.; Evaporator Scale Formation, W. L. McCabe and C. S. Robinson, pp. 478-479, 3 figs.; The Film Concept of Heat Transmission Applied to a Commercial Water Heater, D. K. Dean, pp. 479-483, 3 figs.; Loss of Heat from Furnace Walls, Robt. Calvert and L. Caldwell, pp. 483-490, 11 figs.; A Heat Transmission Meter, P. Nicholls, pp. 490-493, 3 figs.

HEATING AND VENTILATING

Air Leakage in Buildings. Air Leakage Through the Openings in Buildings, F. C. Houghten. Am. Soc. Heat. & Vent. Engrs.—Jl., vol. 30, no. 2, Feb. 1924, pp. 121-134, 11 figs. Method employed in investigation of double hung windows, 2 ft. 8 in. by 5 ft. 2 in. by 1— in., in a 13-in. brick wall, plastered on inside with cement plaster; results are given for leakage, through such a window without weatherstripping and with two types of weather stripping, around frame, and through brick wall itself.

HEATING, HOUSE

Oil-Fired-Boiler Efficiency. Efficiency of the House-Heating Oil-Fired Boiler, J. L. Breese, Jr. Heat. & Vent. Mag., vol. 21, no. 5, May 1924, pp. 51-54. Difficulties which have to be met and overcome in this new field, based upon experiences of an oil-burning boiler manufacturer. From paper read before Am. Assn. Oil Burner Mfrs.

HELIUM

Electrical Properties. Electrical Properties of Helium, J. S. Townsend and S. P. McCallum. Lond., Edinburgh, & Dublin Philosophical Mag. & Jl. Sci., vol. 47, no. 279, May 1924, pp. 577-583, 6 figs. Investigation of conductivity of gases, in order to decide by direct experiment whether there are any additional electrons set free from negative electrode by radiation from molecules of gas, using potentials and gas pressures as in parallel plate experiments where current increases with distances between plates in accordance with given formula.

HIGHWAYS

Cost Keeping. Cost Keeping on County Highway Work, A. K. Hay. Eng. & Contracting (Roads & Streets), vol. 61, no. 4, Apr. 2, 1924, pp. 741-745, 9 figs. System used by Ottawa Suburban Roads Commission, Ottawa, Ont.. Paper read at Annual Conference on Road Construction at Toronto, Ont.

HOTELS

Design. Architect and Engineer Unite in Design of Hotel, G. H. Lippert. Eng. News-Rec., vol. 92, no. 19, May 8, 1924, p. 813. New Belmont hotel at Madison, Wis., has concrete frame, cantilever footings and irregular column spacing; heavy loads of material piled on floors.

HOUSES

Concrete-Brick. Temperature and Moisture Observations on a Concrete Hollow-Brick House (Temperatur- und Feuchtigkeitsbeobachtungen an einem Bau aus Betonhohlsteinen), A. Hummel. Beton u. Eisen, vol. 23, no. 4, Feb. 20, 1924, pp. 43-46, 6 figs. Results of observations carried out for duration of a year show that use of described concrete hollow-brick construction for dwelling houses meets atmospheric requirements of masonry structures with entire satisfaction.

HYDRAULIC MACHINERY

Glycerine, Use in. Study on the Use of Glycerine in Hydraulic Machinery (Etude sur l'emploi de la glycérine dans les appareils hydrauliques), F. Mercier. Revue Industrielle, vol. 54, no. 2177, Apr. 1924, pp. 52-57, 4 figs. Study of properties of glycerine and its action on metals, based on experience of 30 years extending over more than 1,200 apparatus; author concludes that hydraulic or hydropneumatic apparatus of any kind, making use of glycerine, should be constructed so that in no case glycerine can come in contact with surfaces of different metallic nature.

HYDRAULIC TURBINES

Bearings and Vibration Conditions. Experience with Bearings and Vibration Conditions of Large Hydro-electric Units, J. Harisberger. Am. Inst. Elec. Engrs.—Jl., vol. 43, no. 5, May 1924, pp. 428-429, 1 fig. Troubles experienced with hydraulic turbines installed at Snoqualmie Falls and White River power stations, and remedies applied.

Efficiency Tests. Hydraulic Turbine Efficiency, F. Johnstone-Taylor. Power Plant Eng., vol. 28, no. 8, Apr. 15, 1924, pp. 436-437, 3 figs. Describes methods of conducting efficiency tests and gives test results.

Large Installations. Two Modern Turbine Installations (Zwei moderne Turbinenanlagen), R. Hofmann. Zeit. des Vereines deutscher Ingenieure, vol. 68, no. 16, Apr. 19, 1924, pp. 397-400, 12 figs. 14,300-h.p Pelton turbines of the Amsteg hydro-electric plant of the Swiss Federal Ry., and large Francis high-speed turbines of Mauzac hydro-electric plant, France; details of governors, safety arrangements, etc.

Machining Cast-Steel Casings. Machining Massive Parts of the World's Largest Prime Movers, E. J. Armstrong. Mech. Eng., vol. 46, no. 5, May 1924, pp. 263-267, 9 figs. Methods used for machining large cast-steel casings for 70,000-hp. hydraulic turbines installed at Niagara Falls.

Spiral. Large Spiral Turbines for Omine Hydro-electric Plant in Japan (Gross Spiralturbinen für das Kraftwerk Omine in Japan), V. Troeltsch. Zeit. des Vereines deutscher Ingenieure, vol. 68, no. 15, Apr. 12, 1924, pp. 377-378, 3 figs. Describes spiral turbines with vertical shaft built by J. M. Voith, Heidenheim, Germany.

HYDRO-ELECTRIC DEVELOPMENTS

Centralization of. The Tendency Toward Centralization of Power Development, W. L Abbott. Mun. & County Eng., vol. 66, no. 4, Apr. 1924, pp. 165-171, 2 figs. What various states are doing; consolidation of stations; rail transmission of power cheaper than wire transmission; how railway coal freight schedules are made up; etc. Paper read at annual mtg. of Ill. Soc. Engrs.

Davis Bridge Project. Davis Bridge Development of the New England Power Company. Power, vol. 59, no. 20, May 13, 1924, pp. 776-779, 8 figs. Project on Deerfield River involves earth dam 200 ft. high, storage reservoir of 50-000,000,000 cu. ft. capacity, 13,000-ft. tunnel and three 20,000-hp. units for head varying from 300 to 390 ft.

Isle Maligne, Canada. Isle Maligne Hydro-Electric Development, J. P. Chapleau. Can. Engr., vol. 46, no. 19, May 6, 1924, pp. 487-489, 5 figs. Large power development being undertaken by Quebec Development Co., on Saguenay River at Isle Maligne station; 12 turbine units will be installed having a total capacity of 540,000 hp.; details of turbine construction.

Newfoundland. Newfoundland Water Power. Times Trade & Eng. Supp., vol. 14, no. 303, Apr. 26, 1924, p. 167, 3 figs. Progress being made in large scheme for production of hydro-electric power and manufacture of paper, known as Humberarm proposition, in west of Newfoundland; details of dam, pipe line and power house, and paper mill.

HYDRO-ELECTRIC PLANTS

Load Control. Load Control in Automatic Hydro-Electric Generating Stations, R. C. Denny. Power, vol. 59, no. 19, May 6, 1924, pp. 716-717, 3 figs. Float-control method of making load changes; load control where water storage is available.

I

ICE MANUFACTURE

Cracked and Checked Ice Problems. Solving "Cracked and Checked" Ice Problems, E. Ormsby. Power House, vol. 17, no. 7, Apr. 5, 1924, pp. 28-29 and 41, 3 figs. Outline of some remedies for difficulties confronting power plant engineers as a result of strains produced in freezing. Paper read before Nat. Assn. Practical Refrig. Engrs. annual convention. See also Southern Engr., vol. 41, no. 2, Apr. 1924, pp. 50-52.

ICE PLANTS

Huntingdon, Pa. Modern Ice Making and Icing Station at Huntingdon, Pa. Ice & Refrigeration, vol. 66, no. 4, Apr. 1924, pp. 283-290, 15 figs. Describes ice-making plant and car-icing station of Bolye Ice Co. recently completed; built for supplying ice for Fruit Growers' Express and Pennsylvania R. R. Co.

Oil-Engine-Driven. Ice Plants and the Question of Oil Engine Power, C. T. Baker. Oil Engine Power, vol. 11, no. 4, Apr. 1924, pp. 212 and 217-219, 2 figs. Deals with subject of oil-engine drive for ice plants, discussing cost of installation, maintenance and repair costs, fuel and lubricating costs, method of drive, etc. Extracts from paper read before Ga. Ice Assn.

INDUSTRIAL MANAGEMENT

Average Costs, Fallacy of. A Fallacy of Management—That Average Costs Are of Any Value, B. M. Maynard and J. Heywood. Factory, vol. 32, no. 3, Mar. 1924, pp. 330-331 and 366, 1 fig. Discussion based on varied experience with industrial engineering in many plants.

Development. A Decade's Development in Management, H. P. Kendall. Taylor Soc.—Bul., vol. 9, no. 2, Apr. 1924, pp. 55-56. Trends and results of scientific management; developments in manufacturing problems; industrial relations; scientific management and selling.

Executive Function. Management as an Executive Function, J. H. Williams. Taylor Soc.—Bul., vol. 9, no. 2, Apr. 1924, pp. 66-71. Emphasizes modern biology and psychology as essential to development of science of management.

Expense Control. A Method of Expense Control That Paid, M. R. Lott. Indus. Mgt. (N. Y.), vol. 67, no. 5, May 1924, pp. 284-286, 2 figs. Keeping down cost of improvements; describes method which has proved of great benefit in controlling cost of work of expense nature, where large sums are involved.

Machine-Building Industries. Management Problems in Machine Building Industries, E. F. Du Brul. Am. Mach., vol. 60, no. 20, May 15, 1924, pp. 717-721, 2 figs. Effect of business cycle on management policies; handicaps under which builder of production equipment must work; profits of fat years must cover losses suffered in lean ones.

Principles. The Principles Underlying Good Management, H. Diemer. Indus. Mgt. (N. Y.), vol. 67, no. 5, May 1924, pp. 280-283. Investigation and standardization; comprehensive planning; preparation; inspection and records; wage incentives; control; mutual confidence and co-operation.

Production Control. A Workable Production Control Plan for the Small Plant, A. A. Dobson. Factory, vol. 32, no. 5, May 1924, pp. 652-654, 5 figs. Stock file of tickets are printed in addressing machine using metal plates; tickets required in system are stores issue, time ticket, job ticket, move ticket, and work tag.

Tool-Division System. Tool Division Organization and Management, E. C. Cooley. Machy. (N. Y.), vol. 30, no. 9, May 1924, p. 700. Deals with essential points to be considered in developing tool-division system; system successfully employed in number of shops engaged in interchangeable manufacture; making and upkeep of tools; controlling head.

INDUSTRIAL ORGANIZATION

Employers' Associations. Some Tendencies of Employers' Organizations in 1923. Int. Labour Rev., vol. 9, no. 2, Feb. 1924, pp. 208-226. Outstanding tendencies of employers' associations during 12-month period ending in autumn of 1923.

Vertical Trusts. The Vertical Trust, D. T. Farnham. Indus. Mgt. (N. Y.), vol. 67, no. 5, May 1924, pp. 257-263, 4 figs. Newer form of industrial combination and what it portends; its advantages and limitations and place in present industrial order.

INTERCHANGEABLE MANUFACTURE

Munitions. Interchangeable Manufacture and Munitions, E. Buckingham. Army Ordnance, vol. 4, no. 24, May-June, 1924, pp. 361-366, 1 fig. Traces briefly progress of a commodity through all stages of its manufacture, from its inception as a mechanical project to final testing that determines its successful completion.

INTERNAL-COMBUSTION ENGINES

Air Consumption and Power. Air Consumption and Power of Petrol Engines, H. Moss. Engineering, vol. 117, no. 3042, Apr. 18, 1924, pp. 507-509, 5 figs. Relationship of air consumption of brake horse power in internal-combustion engines; road and flight tests. (Abstract.) Paper read before Instn. Mech. Engrs.

Efficiency Standards. Efficiency Standards for Internal Combustion Engines. Engineer, vol. 137, no. 3563, Apr. 11, 1924, p. 394. Discussion by Committee on Tabulating Results of Heat Engine and Boiler Trials on standards of comparison for thermal efficiency of internal-combustion engines. See also Shipbldg. & Shipg. Rec., vol. 23, no. 15, Apr. 10, 1924, pp. 426-427.

Exhaust-Valve Temperatures. Exhaust-Valve and Cylinder-Head Temperatures in High-Speed Petrol Engines, A. H. Gibson and H. W. Baker. Instn. Mech. Engrs.—Proc., vol. 2, no. 6, 1923, pp. 1045-1092 and (discussion) 1093-1119, 31 figs. Investigation shows that, in well-designed overhead-valve engine, either of air- or water-cooled type, under normal conditions of operation, temperature of exhaust valve may be between 600 and 750 deg. cent.; best shape of valve head appears to be one having flat bottom and tulip-shaped top, but as this is impracticable owing to weight, next best is one having tulip-shaped head common in airplane-engine practice; conditions tending to give hot valve also tend to give hot cylinder head.

Flywheel Design, Chart for. Finding the Flywheel Weight Required by an Internal-Combustion Engine, P. H. Schweitzer. Power, vol. 59, no. 18, Apr. 29, 1924, p. 673, 1 fig. Presents chart for flywheel design including full instructions as to steps to be followed when using chart.

Thermal Efficiency of. Standards of Comparison in Connection with the Thermal Efficiency of Internal Combustion Engines, G. J. Wells. Gas Jl., vol. 166, no. 3179, Apr. 16, 1924, pp. 172-175, 4 figs. Traces investigation of subject from commencement of work of original committee appointed by Instn. Civil Engrs. in 1903, to which reference is made to compute ideal efficiency. Standard recommended involves use of air as ideal fluid, together with hypothesis that its specific heat was constant over range of pressures and temperatures involved. See also Gas Wld., vol. 80, no. 2073, Apr. 12, 1924, pp. 338-339.

See also Airplane Engines; Automobile Engines; Diesel Engines; Gas Engines; Motor Buses; Oil Engines.

IRON

Cold Work, Effect of. The Effect of Cold-Work upon the Density of Crystals of α-Iron, H. O'Neill. Iron & Steel Inst.—advance paper, no. 13, for mtg. May 1924, 12 pp., 4 figs. Tests on Armco iron and on single crystal; results.

Deterioration from Rolling Friction. Testing the Deterioration of Iron and Steel from Rolling Friction without Application of Lubricants (Ueber die Prüfung der Abnutzung von Eisen und Stahl bei rollender Reibung ohne Schmiermittel), H. Meyer and F. Nehl. Stahl u. Eisen, vol. 44, no. 17, Apr. 24, 1924, pp. 457-464, 25 figs. Different kinds of deterioration and their testing; wear through rolling friction and its practical importance; method of testing; process of deterioration; testing deterioration of different kinds of hard iron; change in structure through process of deterioration; influence of increased pressure and structure-changing heat treatment; zone of segregation and direction of grain.

Electrolytic. Progress in Electrolytic Iron, D. Belcher. Am. Electrochem. Soc.—advance paper, no. 10, for meeting, Apr. 24-26, 1924, pp. 157-172, 1 fig. Summary of progress made in electro-deposition of iron in last 75 years; describes two plants in commercial operation, and gives account of development work on Milford process for hydro-metallurgy of iron ores.

Wrought, Nick-Bend Test for. The Nick-Bend Test for Wrought Iron, H. S. Rawdon and S. Epstein. U S. Bur. Standards, Technologic Papers, No. 252, Feb. 29, 1924, pp. 115-155, 23 figs. Details of and results obtained from investigation which consisted of fracturing, under different conditions, of nickel bars of a number of grades of wrought iron, and study of character of fracture.

IRON ALLOYS

Preparation and Properties. Preparation and Properties of Pure Iron Alloys, J. F. T. Berliner. U. S. Bur. Standards, Scientific Papers, No. 484, Mar. 5, 1924, pp. 347-356, 4 figs. Determination of critical ranges of pure iron-carbon alloys by thermoelectric method.

IRON ORE

Minnesota. Minnesota and Ontario, C. P. McCormack. Iron & Steel of Canada, vol. 7, no. 4, Apr. 1924, pp. 66-67 and 77-78, 1 fig. Particulars of attempt being made to beneficiate low-grade magnetite of Babbitt, Minn., giving details of ore occurrences, conditions and description of plant, and application to Ontario ores where problem is similar.

IRON METALLURGY

REDUCTION FROM ORE AT LOW TEMPERATURES. The Reduction of Iron from its Ores at Low Temperatures, J. K. Smith. Foundry Trade Jl., vol. 29, no. 398, Apr. 3, 1924, pp. 280-282. Product of blast furnace, energy distribution, functioning of furnace, heat balance considerations, absence of nitrogenization, etc. See also Iron & Coal Trades Rev., vol. 108, no. 2928, Apr. 11, 1924, p. 590.

IRON, PIG

CHARACTERISTICS AND USES. Pig-Iron: Its Characteristics and Uses, H. Field. Foundry Trade Jl., vol. 29, no. 402, May 1, 1924, pp. 353-358, 1 fig. Elementary paper having the object to help foundry worker understand why they are "brands" of iron, why one brand is preferred to another, why pig-iron should be carried the length and breadth of the country, and why various castings in foundry are cast from different mixtures.

OXYGEN IN. Oxygen in Pig Iron (Nagra tankar om syre i tackjärn), J. A. Leffler. Jernkontorets Annaler, vol. 108, no. 3, 1924, pp. 149-177, 4 figs. Superiority of charcoal as a deoxidizer is claimed to be one of the main reasons for superiority of charcoal iron over coke iron. Analyses of Swedish charcoal iron as comgred to German and English coke iron show also the very low contents of sulphur and phosphor of charcoal iron as compared to the much higher contents of these elements in coke iron.

K

KILNS

DRAFTS. The Significance of Drafts in Down-Draft Coal-Fired Kilns, R. A. Sherman, R. F. Lunger and W. E. Rice. Am. Ceramic Soc.—Jl., vol. 7, no. 4, Apr. 1924, pp. 255-270, 12 figs. Applies fundamental laws of gas flow to movement of gases through down-draft kilns; data on pressure conditions in four kilns presented graphically; cause of draft, superiority of down-draft over up-draft kiln, significance of stack draft, relation of draft and excess air, features of kiln design, and comparative merits of forced, induced and natural draft. (Pub. by permission U. S. Bur. Mines.)

L

LABOUR

HOURS OF WORK. Legal Restrictions on Hours of Work in the United States. Nat. Indus. Conference Board, Research Report No. 68, 1924, 125 pp. Systematic analysis of existing legislation restricting hours of work in United States.

LATHES

ELLIPTIC-TURNING ATTACHMENT. Lathe Attachment for Elliptic Turning, I. F. Yeoman. Machy. (N. Y.), vol. 30, no. 9, May 1924, pp. 677-678, 5 figs. Describes attachment primarily employed for elliptical-turning operations on punches and dies used in making oval or elliptical frames for retaining glass windows in automobile tops.

LEAD METALLURGY

SMELTING. Lead Smelter Snapshots, E. H. Robie. Eng. & Min. Jl.—Press, vol. 117, no. 18, May 3, 1924, pp. 716-721, 20 figs. Notes on practice at plants of St. Joseph Lead Co., Herculaneum, Mo.; Federal Lead Co., Federal, near East Alton, Ill.; and St. Louis Smelting & Refining Wks., Collinsville, Ill.; in which three plants all of the Missouri concentrates, are treated.

LIGHTING

SCIENTIFIC, APPLICATION IN PRACTICE. The Application of Scientific Illumination in Practice, G. Herbert and R. A. Ives. Illuminating Engr., vol. 16, no. 10-12, Oct.-Dec. 1923, pp. 233-238 and (discussion) 238-242. Discusses importance of data, fundamentals of good lighting, relation between accidents and inadequate lighting, and shows how good illumination contributed to productive efficiency.

STREET. A Symmetric Illumination Distribution for Ornamental Street Lighting, L. A. S. Wood. Elec. World, vol. 83, no. 20, May 17, 1924, pp. 999-1003, 8 figs. Sheridan Road installation in Chicago meets high-intensity lighting requirements economically and esthetically by directing greatest density at angle of 22½ deg. from curb line.

LIGNITE

CARBONIZATION. Lignite Carbonization, W. W. Odell. U. S. Bur. Mines, Reports of Investigations, No. 2569, Feb. 1924, 6 pp. Figures showing what proportion of fuel requirements of Northwest is industrial or domestic fuel, and what proportion of lignite consumed is used for domestic purposes; notes on carbonization products; briquetting raw lignite.

Low-Temperature Carbonization, Particularly of Lignites (La carbonisation à basse température, en particulier celle des lignites), C. Berthelot. Société d'Encouragement pour l'Industrie Nationale—Bul., vol. 123, no. 1, Jan. 1924, pp. 44-66, 9 figs. Definition and realization of low-temperature carbonization, and its practical importance in metallurgical-coke industry; low-temperature carbonization of lignite.

DISTILLATION, FURNACES FOR. Historical Development of the Rolle Furnace Up to the Present Time (Die geschichltiche Entwicklung des Rolle-Ofens bis zur Neuzeit), A. Thau. Braunkohle, vol. 23, no. 2, Apr. 12, 1924, pp. 17-32, 30 figs. on supp. plates. Development of these furnaces, which serve the purpose of distilling lignite, extends over three-quarters of a century. Rolle's designs, of which a large number are illustrated and described, have not been materially improved upon by later designers.

LIQUIDS

VISCOSITIES. Viscosities of Liquids Experimentally Correlated to Pendulum Dampings, E. H. Barton and H. M. Browning. Lond., Edinburgh, & Dublin Philosophical Mag. & Jl. Sci., vol. 47, no. 279, Mar. 1924, pp. 495-500, 2 figs. Results of experiments showing relations holding between viscosity and damping.

LOCOMOTIVE BOILERS

MANUFACTURE. Building Locomotive Boilers. Eng. Production, vol. 7, no. 139, Apr. 1924, pp. 105-110, 16 figs. Procedure at works of Great Western Ry. Co. at Swindon, Eng.

PAYING WEIGHT. The Paying Weight in Locomotive Boilers, C. A. Seley. Ry. Age, vol. 76, no. 24, May 17, 1924, pp. 1216-1218, 1 fig. Firebox heating surface about twice as effective as tubes and flues per lb. of material.

LOCOMOTIVES

AXLE-REPAIR MACHINES. Machines for Repairing Journals, Cranks and Fly Cranks of Locomotive Axles (Appareils pour rectifier les fusées, tourillons et contre-manivelles des essieux de locomotives), M. Montillier. Génie Civil, vol. 84, No. 12, Mar. 12, 1924, pp. 279-280, 5 figs. Describes portable lathe for repairing axle cranks and journals which can be placed directly under axle, and machine for repairing fly cranks.

DIMENSIONS COMPARISON. The Comparison of Locomotive Dimensions, E. C. Poultney. Ry. Engr., vol. 45, no. 528, Jan. 1924, pp. 19-21 and 35. Discusses factors which it is necessary to consider when a general opinion is to be formed as to comparative capacity of any given locomotive. Locomotive power definitions.

ELECTRIC. *See Electric Locomotives.*

GARRATT ARTICULATED. Garratt Articulated Locomotives. Times Trade & Eng. Supp., vol. 14, no. 304, May 3, 1924, p. 191, 1 fig. Fundamental principle governing design is provision of engine combining great flexibility with comparatively high power, and affording possibility of large boiler dimensions; first of its kind to be used in England, recently delivered by Beyer, Peacock & Co.

INTERNAL-COMBUSTION. Mountain Trains with Internal-Combustion Locomotives (Bergbahnen mit Motorbetrieb), W. Müller. Motorwagen, vol. 27, no. 11, Apr. 20, 1924, pp. 186-190, 6 figs. Describes system recommended by author for rack railway in the Bavarian Alps, consisting of trains with internal-combustion locomotives in place of steam or electric locomotives.

LONG RUNS. Long Locomotive Runs, F. E. Russell. Pacific Ry. Club—Proc., vol. 7, no. 12, Mar. 1924, pp. 9, 11, 13, 15 and 17-27, and (discussion) 27-39. Traces briefly development of steam locomotive in past 100 years. Shows that there is ample opportunity for improvement by obtaining greater mileage out of locomotives by increasing length of locomotive runs; gives list of 34 railways that have increased locomotive runs. Modern appliances and improvements in design and material that contribute to making long locomotive runs economical.

LUBRICATION. Locomotive Valve and Cylinder Lubrication, W. J. Schlacks. Ry. & Locomotive Eng., vol. 37, no. 5, May 1924, pp. 148-150, 1 fig. Schlacks force-feed lubricator; valve and cylinder lubrication of superheater locomotives.

0-8-0 HEAVY SWITCH. New 0-8-0 Heavy Switch Engines for Wabash Ry. Ry. Rev., vol. 74, no. 19, May 10, 1924, pp. 833-838, 8 figs. Modern switch engines for use in yard and transfer service at large terminals.

REPAIRING. A Record in Completing Class III Repairs. Ry. Rev., vol. 74, no. 16, Apr. 19, 1924, pp. 713-715, 12 figs. Time record for making class III locomotive repairs was established on Kansas City Southern Ry., Mar. 17, 1924, when locomotive No. 556 was put through shops at Pittsburg, Kan., in 7 hr. and 55 min. Describes manner in which work was planned, preparations made beforehand, and schedule on which it was executed.

SWITCHING. A New Internal-Combustion Shunting Locomotive. Ry. Gaz., vol. 40, no. 16, Apr. 18, 1924, pp. 572-574, 6 figs. Particulars of the Vermont, gasoline-driven locomotive or tractor, designed to meet requirements of railway companies and industrial concerns; design based on simplicity of detail and economical operation.

TIRE PRACTICE. Locomotive Tire Practice on the Santa Fé, F. H. Colvin. Am. Mach., vol. 60, no. 19, May 8, 1924, pp. 697-698, 6 figs. Wheel gages and calipers, and how they are used; making of tires by carbon content as well as size; standard shims; shrinkage allowance.

TURBO-ELECTRIC. The Ramsay Turbo-Electric Condensing Locomotive. Ry. Engr., vol. 45, no. 528, Jan. 1924, pp. 5-10 and 24, 11 figs. partly on supp. plates. Discusses developing and transmitting power, design of condenser, driving motors, speed regulation, and gives results of tests made on Lond. Midland & Scottish Ry. subsequent to modification of certain details, showing possibilities of this class of locomotive for working main-line passenger traffic.

2-8-2 TYPE. 4-Cylinder 2-8-2 Express Locomotive. Italian State Railways. Ry. Gaz., vol. 40, no. 17, Apr. 25, 1924, pp. 606-607, 2 figs. Particulars of locomotives with large diameter coupled wheels introduced for working heavy passenger trains on heavily graded sections of Rome-Naples and Rome-Florence lines; boiler pressure 200 lb. per sq. in.; tractive effort 8,820 lb.

VALVE GEARS. The Walschaert Locomotive Valve-Gear, R. C. Bond. Instn. Mech. Engrs.—Proc., vol. 2, no. 6, 1923, pp. 1137-1141, 2 figs. Detailed consideration of Walschaert valve gear. (Abridged.)

LUBRICANTS

SPECIFICATIONS AND TESTING METHODS. United States Government Specification for Lubricants and Liquid Fuels and Methods for Testing. U. S. Bur. Mines, Technical Paper 323A, 1924, 89 pp., 21 figs. Specification officially adopted by Federal Specifications Board Feb. 3, 1922, for use of departments and independent establishments of government in purchase of materials covered by it.

ROLLING STOCK. Lubricating Materials Used by the Russian Railroads, A. V. Sapoznikow. Petroleum & Oil-Shale Industry, vol. 5, nos. 7-8, July-Aug. 1923, pp. 75-80. (In Russian.) See also article by A. K. Saytzeff, entitled Railway Car Oils and Lubricating Mixtures, Their Properties, Mechanical Tests, Valuation and Selection, pp. 81-92, 4 figs., with abstract in English, pp. 92-94.

LUBRICATION

METHODS. Methods for Applying Lubricants. Power Plant Eng., vol. 28, no. 10, May 15, 1924, pp. 560-562, 8 figs. Drop-feed method of lubrication; gravity circulation of oil; methods of purifying oil; methods of using purifiers.

M

MACHINE SHOPS

DRAFTING-ROOM MANAGEMENT. A Practical Drafting-room System, I. B. Black. Machy. (N. Y.), vol. 30, nos. 8 and 9, Apr. and May 1924, pp. 605-607 and 671-673, 9 figs. Description of methods successfully applied in management of a drafting room.

MACHINE TOOLS

ATTACHMENTS FOR. Attachments for Standard Machines, A. A. Dowd. Machy. (N. Y.), vol. 30, no. 9, May 1924, pp. 711-712, 4 figs. Important points in design; types of flexible designs.

EARLY FORMS AND PROGRESS. The Master Tools of Industry, D. S. Kimball. Am. Mach., vol. 60, nos. 19 and 20, May 1 and 15, 1924, pp. 679-683 and 723-727, 27 figs. Early attempt of man to supplement his bodily efforts; principle of transfer of skill; modern machines and transfer of thought. Henry Maudsley and his enduring contribution to lathe design; beginnings of interchangeable manufacture; semi-automatic machine; Spencer and full automatic machine.

TABLES. Work-holding Surfaces of Machine Tools. Machy. (Lond.), vol. 24, no. 605, May 1, 1924, pp. 132-137, 20 figs. Table design for different types of machines.

MACHINERY

MANUFACTURE, SIZE CONTROL IN. Workmanship—The New Direct System of Size Control, P. J. Darlington. Sibley Jl. of Eng., vol. 38, no. 4, Apr. 1924, pp. 92-96. Describes new microgage system of production measurement, or size control, in which precision made available by Bur. Standards, and represented in cylindrical standard, is directly transferred to part being produced by means of a new automatic measuring comparator called microgage.

MANGANESE STEEL

SILICO. The Hardening of Silico-Manganese Steel, E. W. Colbeck and D. Hanson. Iron & Steel Inst.—advance paper, no. 5, for mtg. May 1924, 18 pp., 26 figs. Experiments show that temperatures required for complete hardening of steels used are very much higher than corresponding hardening temperatures for straight carbon steels having same carbon content.

MARINE STEAM TURBINES

AUXILIARY MACHINERY FOR. The Application of the Steam Turbine for Auxiliary Machinery, R. W. Allen. Engineering, vol. 117, no. 3041, Apr. 11, 1924, pp. 477-479, 7 figs. Points out advantages of turbine driving for auxiliaries on ships. (Abstract.) Paper read before Instn. Nav. Architects.

HIGH PRESSURE AND SUPERHEATING. Modern Tendencies in Steam Turbine Power Plants, E. Berg. Mar. Eng., vol. 29, no. 5, May 1924, pp. 305-309, 10 figs. Advantages obtained in adoption for marine propulsion of high steam pressure, bigh superheat, steam extraction for heating feedwater and reheating. Abstract of paper read before metropolitan section of A.S.M.E.

MATERIALS HANDLING

COST-SAVING METHODS. Materials Handling Methods That Have Added to Industrial Profits, Geo. E. Hagemann. Mgt. & Administration, vol. 7, no. 5, May 1924, pp. 557-562, 1 fig. Experience data from 55 plants using larger equipment.

EQUIPMENT. Measuring the Savings of Mechanical Handling, W. T. Spivey. Mgt. & Administration, vol. 7, no. 5, May 1924, pp. 551-556, 8 figs. Factors in selection of equipment for an installation.

LABOUR-SAVING EQUIPMET. Quality Production from the Application of Automatic Handling Equipment, C. J. Alfred. Mgt. & Administration, vol. 7, no. 5, May 1924, pp. 563-566, 7 figs. Labour-saving methods of Am. Sugar Refining Co.

PLANT PAINTING DEPARTMENT. Handling Material in Painting Department, E. T. Bennington. Iron Age, vol. 113, no. 20, May 15, 1924, pp. 1413-1416, 6 figs. Overhead tramways witb special carriers take filing cabinets tbrough three dips, a drip and drying oven; automatic equipment featured.

ROUTING. Controlling the Flow of Package Products by Materials Handling Equipment, J. Mendleson. Mgt. & Administration, vol. 7, no. 5, May 1924, pp. 545-550, 8 figs. Labour-saving devices and routing methods employed by B. T. Babbitt Co. in manufacture of chlorinated lime, caustic soda, lye, etc.

MEASURING INSTRUMENTS

PRECISION. Modern Precision Measuring Instruments, W. L. Whitmarsh. Army Ordnance, vol. 4, no. 24, May-June 1924, pp. 381-384 and 400, 8 figs. Describes standard types, including micrometer caliper, vernier tools, vernier bevel protractor, fluid gage, limit gages, etc., and their functioning and use.

Precision Measuring Instruments Used in Gage Inspection, G. K. Burgess. Army Ordnance, vol. 4, no. 24, May-June 1924, pp. 375-380, 8 figs. Deals witb sucb apparatus as is applied in measurement of dimensions of gages and tools used in manufacture of macbine parts, artillery ammunition, etc.

MERCURY-VAPOUR PROCESS

EMMET. The Emmet Mercury-Vapour Process, W. L. R. Emmet. Mech. Eng., vol. 46, no. 5, May 1924, pp. 235-240 and 305, 13 figs. Early experiments; thermodynamic possibilities of process; Hartford installation; boiler problems; mercury turbines; packings and leakage; economies attainable; mercury supply.

METAL CUTTING

HYDROGEN-GAS. Cutting Metal with Hydrogen Gas, W. H. L. Portb. Am. Welding Soc.—Jl., vol. 3, no. 3, Mar. 1924, pp. 15-18. Conditions important in connection with determining use of a fuel gas for cutting of metals. Equipment used for cutting witb hydrogen as fuel gas, and details of operation.

METALS

BRINELL-TENSILE RELATIONSHIP. Experiments on the Brinell-Tensile Relationsbip, A. L. Norbury and T. Samuel. Iron & Steel Inst.—advance paper, no. 12, for mtg. May 1924, 11 pp., 4 figs. Tensile, Brinell, and scleroscope tests on materials used; plotting of results according to Meyer's formula; comparison of Brinell and tensile results.

CLEANING. Metal Cleansing with Alkaline Cleaning Solutions, E. M. Baker and R. Scbneidewind. Am. Electrochem. Soc.—advance paper, no. 15, for meeting Apr. 24-26, 1924, pp. 203-229, 11 figs. Typical analyses of cleaners used for various purposes, and factors entering into mixing of cleaners.

MELTING, FLUXES AND SLAGS IN. Fluxes and Slags in Metal Melting and Working. Foundry Trade Jl., vol. 29, nos. 402 and 403, May 1 and 8, 1924, pp. 359-363 and 388-390. Abstracts of papers read at a general discussion on tbis subject which was held Apr. 28, 1924, at Inst. Mech. Engrs., under joint auspices of Faraday Soc., Instn. Metals, Inst. British Foundrymen, and Britisb Non-Ferrous Researcb Assn., viz.; Oxidizing Fluxes in Melting of Non-Ferrous Metals, A. Portevin; Use of Fluxes in Brass Melting, R. Genders and M. A. Haughton; Note on Slags from Lead, Copper, and Otber Blast Furnaces, G. Rigg; Slags Produced in Melting Silver Alloys, J. Phelps; Sulppurizing and Desulpburizing of Metals by Basic Slags and Fluxes, B. Bogitch; Slag Inclusions in Relation to Fatigue, B. P. Haigh; Fluxing Problems in Welding Mild Steel witb Metallic Arc, H. Ogden; Physical Cbemistry of Slags and Fluxes in Non-Ferrous Metal Industries, C. H. Descb; Fluxes and Slags in Oxy-Acetylene Welding, C. C. Smith.

STRAIN DETECTION. Tbe Detection of Strain in Metals, J. D. Jevons. Metal Industry (Lond.), vol. 24, no. 10, Mar. 7, 1924, p. 225. Survey of work done by various investigators on this subject, together with comments on practical utility of the different methods suggested.

MICA

INSULATION. Mica and Micanite Insulation, A. A. C. Dickson. Elec. Rev., vol. 94, nos. 2416 and 2417, Mar. 14 and 21, 1924, pp. 408-409 and 469-470. Varieties, properties, practical tests and choice of mica, and manufacture and test of commutator micanite.

MINING

MICROSCOPIC INVESTIGATION, APPLICATION OF. Mineralography as an Aid to Mining, E. Tbomson. Can. Inst. Min. & Met.—Bul., no. 144, Apr. 1924, pp. 231-237, 12 figs. Determination of opaque mincrals by microscopic investigation; practical directions in wbich this method may be applied.

MOTOR BUSES

ENGINES. Continental Announces Special Engine for Express Bus Service. Automotive Industries, vol. 50, no. 20, May 15, 1924, pp. 1075-1076, 2 figs. 6-cylinder engine bas piston displacement of 331 cu. in. and develops maximum of over 70 hp. at 2,300 r p.m.; built for rapid, inter-city passenger work with long, non-stop runs.

MOULDING METHODS

GREEN-SAND, MOULDING. Hints on Green-Sand Moulding, C. H. Brown. Foundry Trade Jl., vol. 20, no. 399, Apr. 10, 1924, pp. 297-298 (includes discussion). Ramming of mould, venting of moulds, effects of bad gating, burning on castings, etc.

PIPE, SPECIAL SHAPES. Moulding Special Pipe Shapes, P. Dwyer. Foundry, vol. 52, no. 10, May 15, 1924, pp. 373-378, 10 figs. Equipment developed for production of large valves and special shapes which usually are ordered in single units or in limited numbers; practice of Pittsburgh Valve, Foundry & Constr. Co.

SPIRAL DRUMS. Moulding Spiral Drum From Pattern Swept in Loam, J. Taylor. Can. Foundryman, vol. 25, no. 4, Apr. 1924, pp. 12-14, 7 figs. Pattern swept on arbor in similar manner to sweeping cam core; moulded same as wooden pattern; core also swept in.

N

NAILS

MANUFACTURE. Manufacturing Nails by Automatic Machinery, H. P. Armson. Can. Machy., vol. 31, no. 17, Apr. 24, 1924, pp. 19-21, 3 figs. Practice at Graham Nail Works, Toronto, Can. Raw material first "pickled" to remove scale, then coated with lime to assist lubrication and reduce wear on dies in drawing operation.

NICKEL

ELECTROLYTIC. Mechanically Perfect Eleotrolytic Nickel, Chas. P. Madsen. Am. Electrochem. Soc.—advance paper, no. 28, for meeting, Apr. 24-26, 1924, pp. 371-378 Means are described for producing electro-nickel almost equal to pure gold in ductility; use of bydrogen peroxide in bath is claimed to be absolute cure for pits, and exerts other beneficial effects; anode is described whicb gives consistently good results in above-mentioned bath.

NICKEL ALLOYS

PERMALLOY. Permalloy, A New Magnetic Material of Very High Permeability, H. D. Arnold and G. W. Elmen. Elec. Communication, vol. 2, no. 4, Apr. 1924, pp. 226-231, 7 figs. Describes a magnetic alloy which is a composition of about 78.5 per cent nickel and 21.5 per cent iron and at magnetizing fields in neighbourhood of .04 gauss and with proper treatment has a permeability running as higb as 90,000.

O

OIL ENGINES

DOUBLE-ACTING. A Sliding Cylinder Two-cycle Double-acting Marine Oil Engine. Engineer, vol. 137, nos. 3565 and 3566, Apr. 25 and May 2, 1924, pp. 451-452, 4 figs. and 483-485, 6 figs. Design and performance of 2,000-b.hp. engine built at Nortb Brit. Diesel Engine Works, Glasgow.

HEAVY-OIL, LUBRICATION OF. The Lubrication of Heavy-Oil Engines, C. S. Darling. Mech. Wld., vol. 75, no. 1944, Apr. 4, 1924, pp. 209-210. Deals witb lubrication of pistons, cylinders, air compressors, etc., including discussion on oils.

NICKEL APPLIED TO PARTS. Nickel and Its Alloys Applied to Oil Engine Parts. Motorship, vol. 9, no. 5, May 1924, pp. 361-363, 8 figs. Cast iron is improved by addition of from 3 to 5 per cent of nickel and monel metal reduces maintenance on valves.

SOLID-INJECTION. The Solid-Injection Oil Engine, H. F. Shepherd. Mech. Eng., vol. 46, no. 5, May 1924, pp. 251-257 and (discussion) 257-258 and 278, 30 figs. Presents most pertinent facts on development of engine from former hot-surface unit and points out influence of combustion-cbamber design, spray angle and velocity, atomization, detonation, and otber problems confronting oil-engine designer.

OIL FUEL

BURNERS. Combustion Devices for Liquid Fuel, W. Trinks. Fuels & Furnaces, vol. 2, nos. 1, 2, 3 and 4, Jan., Feb., Mar. and Apr. 1924, pp. 21-24, 135-138, 255-258 and 349-352, 22 figs. Jan.: Burners of vaporization and atomization type or combination of botb. Feb.: How atomization is accomplished. Mar.: High furnace atomization; low-pressure atomization. Apr.: Means for proper mixing of atomized liquid fuel and air.

PROPERTIES. Heating and Motor Oils (Zur Kenntnis der Heiz- und Treiböle), A. Aufhäuser. Zeit. des Vereines deutscber Ingenieure, vol. 68, no. 17, Apr. 26, 1924, pp. 419-422, 1 fig. Points out that properties of oils are functions of degree of distillation, and combustion itself is also a fractionated process; method in use for determination of flasb point is of no value for Diesel-engine practice.

TRANSFORMATION FROM SOLID FUEL. Transformation of Solid into Liquid Fuel, G. L. Stadnikov. Petroleum & Oil-Shale Industry, vol. 5, nos. 11-12, Nov.-Dec. 1923, pp. 655-660. (In Russian.)

OIL PUMPS

SCREW. The Screw Oil Pump, R. H. Pearsall. Automobile Engr., vol. 14, no. 189, May 1924, pp. 145-147, 10 figs. General principle and analysis of pump action; experiments which corroborate analytical results.

OIL SHALES

HEAT TREATMENT. Heat Treatment of Oil Shale, V. Z. Caracristi. Combustion, vol. 10, no. 5, May 1924, pp. 336-340, 7 figs. Position of oil shale in relation to growing consumption of gasoline, and description of apparatus for treating oil shale.

OPEN-HEARTH FURNACES

MOLL END. New Open-Hearth Furnace End, H. Moll. Iron Age, vol. 113, no. 19, May 1, 1924, pp. 1277-1278, 1 fig. Practical results from use of new design by author in Germany; advantages of a mixing flue for gases. Translated from Stahl u. Eisen.

WASTE-HEAT RECOVERY. Recovery of Waste Heat in Open-Hearth Practice, W. Dyrssen. Iron & Steel Inst.—Advance paper, no. 6, for mtg. May 1924, 48 pp., 16 figs. Complete detailed heat balance of fuel for modern American 80-ton producer-gas open-hearth furnace; results of study of beat balance; beat balance for coke-oven gas-fired open-bearth furnace is given for comparison witb producer gas as fuel; steam output for various charges; comparison between blast-furnace and open-hearth practice; economic value of recovery of waste heat in steam in steam in open-hearth practice.

ORDNANCE

PRODUCTION PROBLEMS, U. S. WAR DEPT. Some Production Problems in the War Department's Preparedness Program, H. W. Cburcbill. Mecb. Eng., vol. 46, no. 5, May 1924, pp. 268-270 and (discussion) 270-271. Co-operation of engineering, industrial and commercial bodies with War Department; reserve-officer personnel problem; problem of securing facilities for manufacturing war material; problems typical of those confronting plant production engineers; features of type of contract now being developed; raw materials, gages, machine tools. (Abridged.)

OXY-ACETYLENE CUTTING

ADVANTAGES AND APPLICATIONS. Oxy-Acetylene Process of Cutting Metals. Macby. (Lond.), vol. 24, no. 604, Apr. 24, 1924, pp. 123-125, 3 figs. Advantages of method and modern applications.

OXY-ACETYLENE WELDING

ALUMINUM. Gas Welding Aluminum, S. W. Miller. Am. Welding Soc.—Jl., vol. 3, no. 3, Mar. 1924, pp. 44-50, 2 figs. Flux used, welding without flux, procedure in welding, character of flame, preheating, manipulation of welding rod and torch, etc.

Locomotive Fireboxes. Welding on Copper Fireboxes of Locomotives, J. F. Springer. Ry. Mech. Engr., vol. 98, no. 5, May 1924, pp. 293-294. Successful results obtained in Europe with oxy-acetylene torch and special filler rods.

Oil and Gas Industry. Theory and Practice in Use of Oxygen, L. Balliet. Oil & Gas Jl., vol. 23, no. 22, May 1, 1924, pp. 34 and 106. Results of extensive research in use of oxygen blowpipe, or acetylene torch, in oil and gas industry. Used for cutting slotted screens, welding pipe line, welding broken parts of machinery, filling in broken gear teeth, cutting off bolt heads, pipe and metal bending, etc.

P

PAINTS

Metal-Protective. Paints for Metals, H. A. Gardner. Paint Mfrs.' Assn. of U.S. Nat. Varnish Mfrs' Assn.—Circular, no. 202, Apr. 1924, pp. 302-327, 10 figs. Review of tests with suggestions regarding design and use of metal protectives.

White Lead. Manufacture of White Lead (Fabrication de la Céruse), N. Chercheffsky. Chimie & Industrie, vol. 11, no. 1, Jan. 1924, pp. 45-48. Observations on the Dutch process; average yield of white lead is about 50 per cent of gross weight of lead taken under abnormal conditions it may be as low as 27 to 28 per cent, but under favourable conditions it may attain 67 to 68 per cent.

PATTERNS

Metal Gear. Metal Gear Patterns, J. F. Hines. Machy. (N. Y.), vol. 30, no. 9, May 1924, pp. 692-693, 4 figs. Metal patterns of type shown are especially satisfactory for casting spur and bevel gears; details of construction; making patterns.

PAPER

Analysis. Rapid Analysis of Paper. Paper, vol. 33, no. 25, Apr. 10, 1924, pp. 11-12. Factors that influence character of paper in beating process; determination of degree of sizing in paper; tests for rosin in paper fibers. Translated from Moniteur de la Papeterie Française.

PAPER MANUFACTURE

Decayed Wood Utilization. The Utilization of Decayed Wood in the Chemical Processes, J. D. Rue, R. N. Miller and C. J. Humphrey. Paper Trade Jl., vol. 78, no. 20, May 15, 1924, pp. 44-48, 4 figs. Discussion of use of decayed wood in sulphite and soda processes, chiefly in former.

Names and Terms. Dictionary of Papermaking Terms. Paper, vol. 33, no. 26, Apr. 17, 1924, pp. 66-100 (18 pp.). Names and terms used in paper industry; titles and definitions of sizes and finishes of paper and paper products. Prepared by subcommittee of Committee on Simplifications of Paper Sizes appointed by Bur. Standards, in collaboration with F. A. Curtis.

PHOTOMETERS

Flicker. A New Flicker Photometer for Heterochromatic Photometry, J. Guild. Jl. Sci. Instruments, vol. 1, no. 6, May 1924, pp. 182-189, 3 figs. Specially designed to fulfill conditions requisite to accuracy and precision in use of such instruments.

PILES

Sheet, Precast. Concrete Piles Resist Action of Sea Water for Five Years, Chas. M. Spofford. Eng. News-Rec., vol. 92, no. 18, May 1, 1924, p. 765. Precast sheet piling apparently in good condition in bulkheads at Boston Army Supply Based; special care used to obtain dense concrete.

PLANERS

Equipment for. Tooling Reciprocating Machine Tools. Eng. Production, vol. 7, no. 139, Apr. 1924, pp. 94-97, 10 figs. Tools and special equipment for planers.

PLATES

Flattening Machine. Hydraulic Plate Flattening Machine. Machy. (Lond.), vol. 23, no. 600, Mar. 27, 1924, pp. 838-839, 4 figs. Type which operates on principle of gripping plate at each end and pulling it taut until irregularities and buckles disappear.

PNEUMATIC TOOLS

Waste Elimination. Cutting Out Waste in the Factory Air System, F. Johnston-Taylor. Indus. Mgt. (Lond.), vol. 11, no. 9, May 1, 1924, pp. 239-240 and 242, 4 figs. Explains how wastage and leakage may be detected in connection with pneumatic installations in factory, and how by use of compressed-air meter, economics may be effected.

POWER FACTOR

Reactive Component Measurement. Measuring the Reactive Component, J. Auchincloss. Gen. Elec. Rev., vol. 27, no. 4, Apr. 1924, pp. 263-272, 17 figs. Theory of operation of reactive volt-ampere measuring devices.

PRECIPITATION

Cottrell Process. Cottrell Electrical Precipitation Process, A. Stansfield. Fuels & Furnaces, vol. 2, nos. 3 and 4, Mar. and Apr. 1924, pp. 269-271 and 361-364, 2 figs. Review of various methods of cleaning gases with detailed account of application of Cottrell precipitator to blast-furnace gases; approximate cost and savings possible.

PULVERIZED COAL

Boiler and Metallurgical Furnaces. Powdered Coal Firing for Water-Tube Boilers and Metallurgical Furnaces, H. W. Hollands. Instn. Mech. Engrs.—Proc., vol. 2, no. 6, 1923, pp. 143-151, 6 figs. Describes unit system, which consists of one pulverizer per boiler or furnace, and points out its advantages; coal dryings; savings in use of pulverized coal. (Abridged.)

Calculations. Calculations Respecting Pulverized Fuel, E. Kilburn Scott. Power Engr., vol. 19, no. 217, Apr. 1924, pp. 148 and 157. Also Combustion, vol. 10, no. 5, May 1924, pp. 360-361. Elementary considerations regarding use of pulverized fuel, arranged as calculations.

Preparation and Utilization. Powdered Coal: Its Preparation and Utilization, R. Jackson. Engineering, vol. 117, nos. 3038 and 3039, Mar. 21 and 28, 1924, pp. 381-383 and 415-418, 22 figs. (Abstract.) Paper read before Instn. Mech. Engrs.

Tests. Experiences with Coal Dust and Combustion of Pulverized Coal (Les expériences sur les poussières de houille et la combustion du charbon pulvérisé), J. Arnoul de Grey. Chaleur & Industrie, vol. 5, no. 45, Jan. 1924, pp. 23-26, 2 figs. Calls attention to some of more important results obtained by Taffanel and Audibert from tests carried out at Liévin and Montlucon, and discusses their application to different problems of combustion of pulverized coal, dealing with problem of burners, combustion chambers, and possibility of utilizing certain combustibles in pulverized state.

Unit System. Unit System for Pulverized Coal, S. C. Martin. Power Plant Eng., vol. 28, no. 9, May 1, 1924, pp. 471-172, 1 fig. Advantages of unit system in remodeled plants; results of tests.

PUMPS, CENTRIFUGAL

Characteristic Curves. Use of Centrifugal Pump Curves. Power Plant Eng., vol. 28, no. 9, May 1, 1924, pp. 497-499, 2 figs. Usual forms of characteristic curves for centrifugal pumps based on constant speed.

Specifications. Notes on Centrifugal Pump Specifications, J. D. Morgan. Power Plant Eng., vol. 28, no. 10, May 15, 1924, pp. 555-559, 7 figs. Service requirements are principal data needed by designer; service records show dependability of centrifugal pumps.

PUNCHING MACHINES

Patents. Punching and Perforating Machines and Hand Tools for Cutting, Punching, Perforating, and Tearing Paper, Leather, Fabrics, and the Like. Abridgments of Specification, Period 1916-20, Class 31 (ii), 1924, 29 pp. (illustrated). Patents for inventions.

PYROMETERS

Disappearing-Filament. A Direct-Reading Pyrometer of the Disappearing-Filament Type, F. H. Schofield and D. C. Gall. Jl. Sci. Instruments, vol. 1, no. 7, Apr. 1924, pp. 193-198, 5 figs. Modified form of disappearing-filament pyrometer in which pyrometer lamp forms one arm of a Wheatstone bridge.

Radiation. The "Pyro" Radiation Pyrometer. Engineering, vol. 117, no. 3042, Apr. 18, 1924, pp. 493-494, 6 figs. It is easily portable, weighing only 25 oz., and is completely self-contained, requiring no batteries or other accessory apparatus.

R

RADIOTELEGRAPHY

Receivers. Atmospherics and Their Effect on Wireless Receivers, E. B. Moullin Instn. Elec. Engrs.—Jl., vol. 62, no. 328, Apr. 1924, pp. 353-366 and (discussion) 366-372, 11 figs. Mathematical analysis of effect of atmospheric upon wireless receiver; calculation of effect of each of several wave forms and comparison of results; consideration of possible advantage from use of aperiodic antenna or of slightly distuned periodic circuit; comparison of rectified current produced by atmospheric with that produced by signal.

RADIOTELEPHONY

Railway Trains. Radio Telephony on Railway Trains, E. J. Collier. Elec. Rev., vol. 94, no. 2421, Apr. 18, 1924, pp. 612-613. Experiments made by Great West. Ry. Co. on trains running between Paddington and Birmingham.

Receivers. Self Contained Three-Valve Receiver, W. F. Gildersleve. Wireless Wld., vol. 14, no. 1, Apr. 2, 1924, pp. 14-20, 10 figs. Consists of one stage of H.F. amplification, detector and one note magnifier; easy to construct and makes use of a minimum number of component instruments; easy manipulation.

Short-Period Variations in Reception. Short Period Variations in Radio Reception, G. W. Pickard. Inst. Radio Engrs.—Proc., vol. 12, no. 2, Apr. 1924, pp. 119-158, 39 figs. Continuous records of electric-field intensity at distance of from 11 to 2,600 km. from various broadcasting stations are made by amplifying and rectifying received current from open antenna, and recording galvanometer deflections produced by this current; these records show complex curve containing periodicities ranging from seconds to tens of minutes; transition from day to night conditions is shown; simultaneous records at separated receiving points are found to be dissimilar, and records of different distant stations taken at same receiving point are shown to be unlike; hypothesis for these fluctuations is advanced.

RAILLESS TRACTION

Advantages. The Case for Railless Traction. Tramway & Ry. Wld., vol. 55, no. 14, Mar. 20, 1924, pp. 132-134. Shows by means of actual and hypothetical figures, that for practically the whole field of municipal transport railless electric traction cannot only satisfy all traffic requirements, but can effect considerable saving in capital expenditure and operating costs.

RAILS

Fracture. Broken Rails. Ry. & Locomotive Eng., vol. 37, no. 5, May 1924, pp. 150-152, 4 figs. Extracts from reports on broken rails that caused derailments and loss of life, published by Bur. Safety.

RAILWAY ELECTRIFICATION

Developments. Railway Electrification in Foreign Countries, Stanley P. Smith. Instn. Elec. Engrs.—Jl., vol. 62, no. 328, Apr. 1924, pp. 317-322 and (discussion) 322-324. Deals with various countries, not including Great Britain.

RAILWAY MANAGEMENT

Material Investment. The Railways' Material Investment, L. C. Thomson. Can. Ry. Club, vol. 23, no. 3, Mar. 1924, pp. 20-29 and (discussion) 29-38. Deals with organization, facilities, inspection, distribution, rail, and reclamation.

Tonnage Volume, Forecasting. Railroad Traffic and the Business Cycle, H. B. Vanderblue. Ry. Age, vol. 76, no. 20, Apr. 19, 1924, pp. 987-990, 7 figs. Shows how individual carrier is assisted in forecasting tonnage volume; traffic of Southern Ry.

RAILWAY MOTOR CARS

Electro-mechanically vs. Mechanically Operated. Experimental Operation of Rail Cars Driven by Internal-Combustion Engines by Means of Purely Mechanical Transmission (Het proefbedrijf metb enzine-Maaetschappij), H. J. P. Brunner. Ingenieur, vol. 39, no. 17, Apr. 26, 1924, pp. 312-317, 4 figs. Comparative tests made by Limburg Railway Co. between electro-mechanically and purely mechanically operated rail cars indicate superiority of electro-mechanical system.

RAILWAY OPERATION

Stopping and Starting Trains. Estimated Cost of Stopping and Starting Trains, O. O. Carr. Ry. Rev., vol. 74, no. 18, May 3, 1924, pp. 807-808. Tables giving estimated additional cost to stop and start trains.

Train Control. An Unusual Idea in Automatic Train Control. Ry. Rev., vol. 74, no. 16, Apr. 19, 1924, pp. 723-731, 14 figs. Describes train-control system of Indiana Equipment Corp., designed and developed by C. F. Shadle, which is of the ramp of direct-contact type. Essential parts of device consist of a wayside ramp, a contact shoe having a roller contact, a neutral control relay, an electropneumatic valve, automatic air-brake valve, and a speed controller.

Automatic Cut-Off Control Tested in Service. Ry. Age, vol. 76, no. 21, Apr. 26, 1924, pp. 1033-1037, 9 figs. Describes control device and tells what its performance on two railroads has demonstrated.

Hearing on Automatic Train Control Order. Ry. Age, vol. 76, no. 23, May 10, 1924, pp. 1145-1148. Statement by W. J. Harahan outlining position of railroads and proposing three regional tests on 100 mi. of line in each region; testimony of W. S. Stone that engineers are strongly opposed to automatic control.

RAILWAY REPAIR SHOPS

Denver & Rio Grande Western. Denver & Rio Grande Western Rebuilds Shops. Ry. Age, vol. 76, no. 24, May 17, 1924, pp. 1193-1200, 11 figs. Completes extensive programme of modernization of facilities for repair of cars and locomotives; details of new facilities at Denver, Colo., and at Salt Lake City.

ORGANIZATION. B. R. & P. Has Well Organized Production Shop, (Du Bois, Pa.) Ry. Mech. Engr. vol. 98, no. 5, May 1924, pp. 295-299, 6 figs. Limited programme of repairs facilitates efficient operations; routing of locomotives and parts; department organization and machine-tool operation; shop organization.

STEEL CARS. Pennsylvania Builds Modern Steel Car Shops. Ry. Age, vol. 76, no. 22, May 3, 1924, pp. 1085-1088, 9 figs. Duplicate designs erected at Pitcairn and Enola to handle heavy repairs on Eastern and Central regions; capacity of each shop is 33 cars a day; each car-repair unit consists of rivet-cutting shed housing 8 cars at a time, repair shop with 36 tear-down and 18 set-up positions, combined storeroom, office and welfare building.

RAILWAY SHOPS

GRINDING MACHINES FOR. Machine Tools for Railway Workshops. Ry. Gaz., vol. 40, no. 15, Apr. 11, 1924, pp. 544-546, 6 figs. Describes some electrically-driven grinding machines.

RAILWAY SIGNALING

A. C. SUPPLY WITH BATTERY RESERVE. The Application of Alternating Current Supply with Battery Reserve to Signal Systems, H. G. Morgan. Am. Ry. Assn., Signal Section Proc., Mar. 1924, pp. 698-705. Results obtained with various applications.

BENEFITS OF. How Signaling Has Helped Several Roads. Ry. Age, vol. 76, no. 20, Apr. 19, 1924, pp. 971-974. Prize papers received in contest arranged by Railway Age and Railway Signaling, as follows: Congestion Relieved by Signaling on the B. & M., J. D. Bourne; Increasing Track Capacity by Signaling, Gel. S. Pflasterer; Cost Saving Accomplished by Signals on the B. & O., J. C. Hoffman.

RAILWAY TIES

CONCRETE. Concrete Ties for Light-Traffic Track in France, Adam. Eng. News-Rec., vol. 92, no. 18, May 1, 1924, p. 761, 1 fig. Reduction of maintenance forces and cost follows replacement of wood ties by concrete ties and pairs of blocks.

RAILWAY TRACK

CONCRETE ROADBED. Trials of Concrete Roadbed on Northern Pacific Ry. Eng. News-Rec., vol. 92, no. 20, May 15, 1924, p. 858. Three types of concrete slab base indicate higher maintenance cost than that for ordinary ballasted track construction.

RAIL FIXING. The "V" System of Rail Fixing. Ry. Engr., vol. 45, no. 528, Jan. 1924, pp. 11-12, 7 figs. Description of system for rail attachment in track laying which combines merits of chair and Vignoles systems without disadvantages of either.

RAILWAY YARDS

ELECTRIC POWER SIGNALING. All-Electric Power Signaling Installation and Electric Apparatus, Feltham Yard, Southern Railway, W. J. Thorrowgood. Ry. Engr., vol. 45, nos. 531 and 532, Apr. and May 1924, pp. 126-132 and 140, and 157-163, 19 figs. Speedy operation of points and automatic track-circuit protection are features of shunting yard; track-circuit tests; electrical point detection; push-button signal frames; electric clocks; telephone communication.

REFRACTORIES

ELECTRIC-BRASS-FURNACE. The Electric Brass Furnace Refractory Situation, H. W. Gillett and E. L. Mack. Am. Ceramic Soc.—Jl., vol. 7, no. 4, Apr. 1924, pp. 288-299, 5 figs. Describes the three prominent types of electric brass furnaces, and outlines conditions which they impose on refractories. Limitations which properties of refractories place on applicability of the various furnaces, and lines along which development and improvement are most likely to take place. (Pub. by permission U. S. Bur. Mines.)

REFRIGERANTS

ETHYL CHLORIDE. Thermal Properties of Ethyl Chloride. Ice & Refrigeration, vol. 66, no. 4, Apr. 1924, pp. 347-348. Summary of report of results obtained by C. F. Jenkin and D. N. Shorthose of Univ. of Oxford, Eng. General physical and chemical properties; tables of saturated and superheated vapour.

REFRIGERATION

BRINE HOLD-OVER TANKS, HEAT TRANSFER IN. Heat Transfer in Brine Hold-Over Tanks, C. H. Herter. Refrig. Eng., vol. 10, no. 10, Apr. 1924, pp. 370-371 and 375. Describes three types of hold-over tanks; makes heat-transfer calculations.

NON-CONDENSABLE GASES. Non-Condensable Gases, B. E. Hill. Refrig. Eng., vol. 10, no. 10, Apr. 1924, pp. 372-375, 1 fig. Their causes and effects upon economical and efficient operation of an ice-making or refrigerating system.

ROADS, BITUMINOUS

MAINTENANCE. Methods of Maintaining Bituminous Roads, E. A. James. Eng. & Contracting (Roads & Streets), vol. 61, no. 4, Apr. 2, 1924, pp. 751-755, 2 figs. Experiences of Toronto and York Counties, Ontario, Roads Commission. Paper read at Ontario Road Supts. annual mtg., Feb. 25, 1924.

ROADS, CONCRETE

AGGREGATES, WEIGHING OF. Weighing Aggregates for Concrete Highway Pavement, R. W. Crum. Eng. & Contracting (Roads & Streets), vol. 61, no. 4, Apr. 2, 1924, pp. 730-735, 6 figs. Experiences of Iowa Highway Commission. Paper read at Am. Concrete Inst. Convention, Feb. 26, 1924.

CURING. The Curing Period for Concrete Roads, H. F. Clemmer. Can. Engr., vol. 46, no. 17, Apr. 22, 1924, pp. 455-457, 3 figs. Possibility of cutting down curing period; use of calcium chloride. Experiments conducted by Ill. Dept. Highways. Paper read at Am. Road Bldrs. Assn. convention.

SINGLE-TRACK. Single Track Concrete Highways, A. M. Jackson. Eng. & Contracting (Roads & Streets), vol. 61, no. 4, Apr. 2, 1924, pp. 718-721. Methods of construction and experiences in Brant County, Ontario. Paper presented at Conference on Road Construction, Toronto.

ROLLING MILLS

CONTINUOUS. Continuous Rolling-Mills: Their Growth and Development, Jos. P. Bedson. Iron & Steel Inst.—advance paper, no. 3, for mtg. May 1924, 18 pp., 6 figs. partly on supp. plates. Art as it was practiced 140 years ago; history of development; modern examples of continuous system. See (abstract) in Engineering, vol. 117, no. 3045, May 9, 1924, pp. 620-622, 7 figs.; also Iron Age, vol. 113, no. 21, May 22, 1924, pp. 1493-1495.

DEFECTIVE MATERIAL, DETECTION OF. Statistical Basis for Industrial Control, K. Daeves. Iron Age, vol. 113, no. 20, May 15, 1924, pp. 1441-1443, 3 figs. A "large numbers" method applied in Germany to metallurgy of iron; theory of collective subjects in relation to control of production; detection and control of defective material in rolling mill is claimed possible if certain statistical formulas or data are made use of. Translated from Stahl u. Eisen.

SHEET MILLS. Build Sheet Mill at Golden Gate. Iron Trade Rev., vol. 74, no. 21, May 22, 1924, pp. 1373-1375, 5 figs. Subsidiary of Metal & Thermit Corp. completes new six-mill sheet plant at South San Francisco; oil fuel used in furnaces.

Sheet Mill Represents Latest Practice, E. H. Werner. Forging—Stamping—Heat Treating, vol. 10, no. 4, Apr. 1924, pp. 153-158, 10 figs. New mill of Nat. Enameling & Stamping Co. at Granite City, Ill.; mill equipment and furnaces.

S

SCREW THREADS

COMPARATORS. The Wilson Projection Comparator for Screw Threads. Engineering, vol. 117, no. 3045, May 9, 1924, pp. 606-608, 6 figs. Devised for gaging screw threads and other similar solids of revolution.

CUTTING TOOLS. Position of Thread-cutting Tool and its Effect on Thread Form. Machy. (Lond.), vol. 24, no. 602, Apr. 10, 1924, pp. 54-55, 2 figs. Position of tool for external thread cutting; distortion produced in cutting internal threads; distortion of thread grooves having angular sides.

MEASUREMENT. Measuring Threads Accurately with Micrometers. Can. Machy., vol. 31, no. 18, May 1, 1924, pp. 31-32 and 51, 6 figs. Hints on accurate use of micrometers.

SEWAGE DISPOSAL

IMHOFF TANKS. Imhoff Tanks—Reasons for Differences in Behvaior, H. P. Eddy. Am. Soc. Civ. Engrs.—Proc., vol. 50, no. 5, May 1924, pp. 616-645, and (discussion) 706-723, 14 figs. Investigation to ascertain reasons for differences in operating results obtained from Imhoff tanks, in order that requirements for satisfactory results might be better understood.

SLUDGE. Developments in Sludge Disposal, J. Haworth. Can. Engr., vol. 46, no. 18, Apr. 29, 1924, pp. 481-482. Difficulties of problem are nearer an economical solution; drying sludge on ash beds, gauze bands and with centrifuges. Paper read before Assn. Mgrs. of Sewage Disposal Wks.

SEWERS

HAMILTON, CANADA. Homeside District Sewers, Hamilton, Ont., H. S. Philips and W. M. Johnston. Can. Engr., vol. 46, no. 18, Apr. 29, 1924, pp. 468-472, 14 figs. Description of sewerage system just completed and construction methods employed; storm water run-off coefficient studies; trunk system of sewers comprises five sections; reinforced-concrete and vitrified pipe employed; details of costs for different types of construction.

SHAFTS

WHIRLING. Internal Friction Theory of Shaft Whirling, A. L. Kimball, Jr. Gen. Elec. Rev., vol. 27, no. 4, Apr. 1924, pp. 244-251, 11 figs. Shows Kimball's theory of internal friction in shafts as cause of whirling; shows that internal friction due to bending may cause a shaft to whirl when rotating at any speed about first critical speed.

SHAFT SINKING

SOFT RUNNING GROUND, THROUGH. Shaft Sinking Through Soft Running Ground by Aid of the Francois Cementation Process, G. A. Voskule. Chem., Met., & Min. Soc. of S. Africa—Jl., vol. 24, no. 8, Feb. 1924, pp. 186-189, 1 fig. How problems in course of shaft sinking on Luipaardsvlei No. 10, on far Western Rand, by Coronation Syndicate, Ltd., were met.

SPRINGS

LEAF. Suspension. Automobile Engr., vol. 44, no. 189, May 1924, pp. 135-140, 30 figs. Recent improvements in laminated springs.

STEAM ENGINES

UNIFLOW. The Uniflow or Central Exhaust Engine, E. Dickinson. Inst. Mar. Engrs.—Trans., Mar. 1924, pp. 627-642, 11 figs. Principle and important features of engine; consideration of parts.

STEAM PIPES

HIGH-PRESSURE. Piping for High Pressure and Temperature, R. A. Fiske. Power Plant Eng., vol. 28, no. 8, Apr. 15, 1924, pp. 424-427, 5 figs. Shows effect of temperature upon tensile strength of 15 to 36-point carbon steel and on wrought-iron pipe; friction losses in superheated lines; pressure drop in fittings; heat transmission through pipe walls; joints for high-pressure steam lines.

STEAM POWER PLANTS

INDUSTRIAL PLANTS. Prime Movers for Industrial Plants, J. F. Ferguson. Power, vol. 59, no. 20, May 13, 1924, pp. 766-768, 1 fig. Comparison of various types of engines and turbines for use in industrial plants, with summary on economies and relative advantages.

PHYSICAL LAWS, PRACTICAL BEARING OF. The Bases of Efficiency in Power Production, G. F. Dewynter. Power Engr., vol. 19, no. 218, May 1924, pp. 166-168. Shows practical bearing of physical laws, especially in regard to steam power.

STEAM TURBINES

CHECKING CONDITION. Maintaining Impulse-Turbine Efficiency by Checking the Condition Curve, Rob. R. Walden. Power, vol. 59, no. 21, May 20, 1924, pp. 823-825, 2 figs. Various stage pressures at normal load indicate if turbine is in efficient state of internal damage or undue wear will alter these from normal.

EXHAUST AND LIVE STEAM, COST OF. Finding the Cost of Exhaust as Compared to Live Steam, C. E. Colburn. Power, vol. 59, no. 20, May 13, 1924, pp. 759-760, 1 fig. Why exhaust steam should be cheaper than live steam; typical examples.

HIGH-PRESSURE. High-Pressure Turbines. Engineer, vol. 137, no. 3566, May 2, 1924, pp. 489-490, 5 figs. Special turbines developed by Brown, Boveri & Co.

HIGH PRESSURE, SUPERHEAT, AND VACUUM. The Effect of High Pressure, Superheat and Vacuum on the Efficiency of Large Turbines, C. Sylvester. Elec. Times, vol. 65, no. 1692, Mar. 20, 1924, pp. 327-328, 3 figs. Effects above-mentioned are illustrated by diagrams.

IMPROVEMETS. Improvements in Steam-Turbine Construction (Neuerungen im Dampfturbinenbau), R. Palm. Glückauf, vol. 60, no. 9, Mar. 1, 1924, pp. 152-156, 3 figs. Comparison of different turbine types and discussion of new possible applications; details of recent improvements in turbine and auxiliary machines, and most important improvements in condenser plants.

METROPOLITAN-VICKERS. Recent Developments in Large Turbine Practice. World Power, vol. 1, no. 4, Apr. 1924, pp. 243-248, 6 figs. Improvements in design and construction introduced by Metropolitan-Vickers Elec. Co., tending to reduce steam consumption to minimum.

WHEELS, BUCKET WEAR IN. Bucket Wear in Modern Steam Turbine Wheels, R. M. Norstrom. Nat. Engrs., vol. 28, no. 5, May 1924, pp. 214-215, 6 figs. Factors in design and construction of modern steam turbines affecting wear and efficiency of buckets. Relative advantages of pressure-stage versus velocity-stage turbines in this respect.

STEEL

ELASTIC LIMIT. High Elastic Limit of Mild Steel and Its General Applications, G. W. Barr, F. G. Martin and A. T. Wall. Engineering, vol. 117, no. 3042, Apr. 18, 1924, pp. 510-511, 4 figs. Describes new mild steel which possess very high elastic limit, and discusses some of its possibilities. Paper read before Instn. Nav. Architects. See also Engineer, vol. 137, no. 3565, Apr. 25, 1924, pp. 443-444, 4 figs.

Forging Temperature. On the Forging Temperature of Steels, Kôtarô Honda. Iron & Steel Inst.—advance paper, no. 9, for mtg. May 1924, 5 pp., 4 figs. Investigation shows that in case of carbon steels, elongation-temperature curve has generally maxima and minima, and hence in process of forging low-carbon steels it is better to take every precaution against fall of temperature to 900 deg., where elongation is at minimum; in case of carbon steels, as elongation at ordinary temperature is greater than that at 200 to 300 deg. process of slowly stretching or bending a sample at room temperature rather than at 200 to 300 deg. is safeguard against fracturing.

Grain Growth. An Occurrence of Grain Growth in Steel, A. A. Blue. Iron Age, vol. 113, no. 18, May 1, 1924, pp. 1271-1273, 8 figs. Further results of carbonizing, hardening and drawing back; comparison with double quenching and drawing; band formations.

Hardened, Fundamental Defects. Some Fundamental Defects of Hardened Steels, L. Aitchison. Am. Soc. Steel Treating—Trans., vol. 5, no. 5, May 1924, pp. 491-503, 3 figs. Deals with certain properties of fully hardened steels that can only be regarded as being of nature of defects; discusses two such defects, namely, abnormally low value of limit of proportionality (elastic limit), and instability of volume which characterizes hardened steels; gives values of limit of proportionality in different hardened steels, and shows that there is very large difference between actual stress which produces some perpanent deformation in steel, and stress which is generally called yield point.

Inter-crystalline Fracture. Inter-crystalline Fracture in Steel, R. S. Williams and V. O. Homerberg. Am. Soc. Steel Treating—Trans., vol. 5, no. 4, Apr. 1924, pp. 399-412, 30 figs. Discusses abnormal type of failure in mild steel characterized by inter-crystalline cracking and produced by action of cathodic hydrogen or caustic soda solutions; effect of hydrogen on steel under tension and action of alkaline solutions on inclusions of known chemical composition artificially introduced.

Manganese Steel. *See Manganese Steel.*

Magnetic Analysis. Exploring Within the Steel, A. G. Ingalls. Sci. Am., vol. 130, no. 5, May 1924, pp. 316-317 and 366-367, 6 figs. How magnetic analysis indicates presence of flaws in rails and beams and hoisting cables.

Metallurgical Defects, Detection of. Detecting Metallurgical Defects in Steel, F. C. Thompson. Metal Industry (Lond.), vol. 24, nos. 10 and 11, Mar. 7 and 14, 1924, pp. 229-230 and 261-262, 4 figs. Methods of examination, and causes of troubles occurring.

Perforation, Effect of. Influence of the Method of punching Holes in Steel Bars (Note sur l'influence du mode de perçage des trous dans les barres en acier), A. de Marneffe. Revue Universelle des Mines, vol. 67, no. 1, Apr. 1, 1924, pp. 42-48, 7 figs. Results of tests carried out by author on samples with holes punched according to different methods, to determine effect of perforation on resistance of metal.

Stainless. Ferrous Alloys Resistant to Corrosion, B. D. Saklatwalla. Iron Age, vol. 113, no. 17, Apr. 24, 1924, pp. 1209-1213, 6 figs. Stainless iron for engineering uses; effect of adding other metals, particularly copper; direct process; future of stainless metallurgy. Paper read before Am. section of Soc. Chem. Industry.

STEEL CASTINGS

Cleaning-Cost Records. Keeps Record of Cleaning Costs, B. K. Price. Iron Trade Rev., vol. 74, no. 18, May 1, 1924, pp. 1165-1166 and 1169, 4 figs. Steel foundry pays grinder hands according to amount of metal removed; castings weighed before being delivered to grinder and again after being ground; production and wages stimulated.

Manufacture. Liquid Steel for Light Castings, J. A. Holden. Foundry Trade Jl., vol. 29, no. 402, May 1, 1924, pp. 367-368. Shows that "Stock" plant, in addition to turning out mild steel of good quality, can be adapted for making many types of special steels. Probable cause of porosity in electric process of manufacture.

STEEL, HEAT TREATMENT OF

Problems. Heat-treatment of Steel with Special Reference to Production, J. W. Urquhart. Machy. (Lond.), vol. 23, no. 600, Mar. 27, 1924, pp. 832-835, 6 figs. Machining difficulties with mild steels; difficulties resulting from high and deep carbon casings; typical case in carburizing steels; when double quench is necessary; micrographs; French and American high-temperature initial quenching; distinction between second quenching and hardening; destructive effect of excessive temperature; structure of carbon steel gears.

STEEL WORKS

Power Organization. Power Organization in the Steel Industry, B. Bannister and F. M. van Deventer. Mech. Eng., vol. 46, no. 5, May 1924, pp. 248-250. Authors show by comparison that value of fuels used and complexity of problems incident to operation of power system of representative steel works are of greater magnitude than for representative central station; these facts warrant existence of highly qualified organization for steel company in nature of power department; description of such organization and enumeration of benefits which should result.

STOKERS

Efficiency, Computation of. Computing Guaranteed Stoker Efficiency, H. F. Gauss. Power, vol. 59, no. 21, May 20, 1924, pp. 813-815, 1 fig. Computing stoker efficiency for given fuel, with discussion of various factors entering into problem; typical examples and convenient charts to facilitate work.

Types. Stokers an Essential of Power Plant Economy. Power House, vol. 17, no. 8, Apr. 20, 1924, pp. 24-31, 8 figs. Reasons, from manufacturers of principal types in use in Canada, for reduction in fuel costs and increase in efficiency of "mechanical firemen" effect.

STREAM POLLUTION

Control. Progress Report on Agencies for the Control of Pollution by Industrial Wastes. Am. Water Wks. Assn.—Jl., vol. 11, no. 3, May 1924, pp. 628-648. State and federal authorities on stream pollution control; joint undertakings along sanitary lines, within separate states; European boards for control of stream pollution; international aspects of problem of pollution of waters; conferences on industrial wastes pollution; legislation.

STREET RAILWAYS

Cars. Rear Exit Expedites Passenger Movement. Elec. Ry. Jl., vol. 63, no. 18, May 3, 1924, pp. 693-695, 5 figs. Describes one-man double-truck lightweight cars recently placed in service in Fort Wayne by Indiana Service Corp.; rear exit and inclosed steps.

STRESSES

Internal. Internal Stresses Rendered Visible (Les tensions intérieures rendues visibles), A. Mesnager. Technique Moderne, vol. 16, no. 6, Mar. 15, 1924, pp. 161-171, 52 figs. Discusses method based on theory of polarization which permits accurate measurements of internal stresses of a solid; applications of method.

SUBSTATIONS

Automatic. Automatic Substations for Industrial Plants, C. Lichtenberg. Am. Inst. Elec. Engrs.—Jl., vol. 43, no. 5, pp. 411-415, 7 figs. Principal types of electric-power transforming equipment to which automatic switching has been applied; automatic control of synchronous condensers, motor generators, converters, hydro-electric generators and feeders is treated in such manner as to furnish industrial engineers with data upon which to base designs of automatic stations for factories, mills, mines, shops and other kinds of industrial power supply.

SUPERHEATERS

Radiant-Heat. Operation of Radiant Heat Superheaters. Power Plant Eng., vol. 28, no. 10, May 15, 1924, pp. 528-529, 1 fig. Steam temperature varies slightly with percentage of CO_2; advantages of two-stage superheating.

SURVEYING

Land. Curve Problem Met in Land Surveying, J. T. Ransom. Can. Engr., vol. 46, no. 16, Apr. 15, 1924, pp. 430-431, 2 figs. New ready simple method for computing curved or chord frontages for a lot or series of lots of equal or varying widths with parallel sides on new subdivision surveys.

Hydrographic, Sounding Tube for. New Sounding Tube Devised for Hydrographic Surveying, G. T. Rude. Eng. News-Rec., vol. 92, no. 19, May 8, 1924, pp. 806-807, 1 fig. Capillary block is added feature which gives device developed by U. S. Coast & Geodetic Survey accuracy in measuring water depth.

T

TELEPHONY

Automatic. Some Notes on the Use of the Probability Theory to Determine the Number of Switches in an Automatic Telephone Exchange, M. Merker. Post Office Elec. Engrs.' Jl., vol. 16, Pt. 4, and vol. 17, Pt. 1, Jan. and Apr. 1924, pp. 347-362 and 27-50, 4 figs. Calculations.

TESTING MACHINES

Metal Strip. Notes on the Testing of Metal Strip, L. Aitchison and L. W. Johnson. Iron & Steel Inst.—advance paper, no. 1, for mtg. May 1924, 15 pp., 13 figs. Bend-testing machine; proof stress testing; simple proof stress extensometer. See (abstract) in Iron Trade Rev., vol. 74, no. 21, May 22, 1924, pp. 1361-1364, 5 figs.

TEXTILE MACHINERY

Looms. Textile Machinery. Engineering, vol. 117, no. 3043, Apr. 24, 1924, pp. 549-550, 4 figs. Describes exhibits of Rob. Hall & Sons at Brit. Empire Exhibition, including automatic loom, belt loom for production of cotton, camel hair or hemp driving belts, loom for making horse-hair cloth, and cloth-folding and measuring machine.

TINNING

Thickening of Hot Molten Tin. Origin and Prevention of the Formation of Undesirable Thickening of Hot Molten Tin (Ensttehung und Verhütung schädlicher Verdickungen bezw. Legierungen feuerflüssiger Zinnbäder), B. Haas. Zeit. für die Gesamte Giessereipraxis, vol. 45, no. 15, Apr. 12, 1924, pp. 33-34. Molten tin combines with iron, forming an alloy that thickens tin bath, impairs process of tinning, and wastes metal. It is recommended to tin vessels containing tin bath and to pickle and preheat articles to be tinned.

TRANSFORMERS

Current, Testing of. Ratio and Phase Error Tests on Current Transformer, G. W. Stubbings. Elec. Rev., vol. 94, no. 2421, Apr. 18, 1924, pp. 604-606, 9 figs. Detailed directions for carrying out tests for errors of current transformers by a method which is suited to resources of test rooms attached to ordinary a.c. supply undertakings, consisting in direct measurement of difference between ratio and phase errors of transformer under test and those of a standard transformer of same nominal ratio.

Oils. Dehydration and Testing Transformer Oils and Transformer, W. R. Bowker. Southern Engr., vol. 41, no. 2, Apr. 1924, pp. 54-56, 4 figs. Method for treatment of oils to eliminate moisture; identification of oils; insulation resistance test for transformers.

Transverter. The Transverter. Engineering, vol. 117, no. 3044, May 2, 1924, pp. 563-566, 17 figs. partly on supp. plate. Primary function of apparatus is to convert ordinary alternating into direct current at exceedingly high voltage for purposes of transmission, and to reproduce alternating current by converse operation at point where power is to be distributed or used; name is combination of words transformer and rotary converter; principle upon which design is based and its useful field.

TRANSPORTATION

Factory. Shop Transportation Economics, S. M. Lowry. Mgt. & Administration, vol. 7, no. 5, May 1924, pp. 533-538, 6 figs. Westinghouse Elec. & Mfg. Co.'s methods and results.

Great Lakes System. The Transportation System of The Great Lakes, Geo. A. Marr. Mich. Technic, vol. 37, no. 3, Mar. 1924, pp. 5-9, 22 and 32, 5 figs. Type of vessel employed; loading and unloading facilities; freight and passenger traffic.

Railway. The Place of Railway Transportation in the American Industrial Structure. Inst. Transport—Jl., vol. 5, no. 5, Mar. 1924, pp. 230-237. Report of Research Council of Nat. Transportation Inst. setting forth place of railway transportation in economic structure of America.

TUBES

Solid-Wall, Manufacture of. Making Solid Wall Tubes of Strip Steel. Iron Age, vol. 113, no. 19, May 1, 1924, pp. 1293-1294, 2 figs. New methods of manufacturing brass, copper and steel tubing by continuous process developed by Bundy Tubing Co., Detroit; material wide enough to give double thickness of wall; tinned before rolling; walls soldered together by heat.

TURBO-ALTERNATORS

Ventilation. An Experimental Study of Ventilation of Turbo Alternators, C. J Fechheimer. Am. Inst. Elec. Engrs.—Jl., vol. 43, no. 5, May 1924, pp. 416-423, 11 figs. End bell and pressure measurements; diverging intake to end bells; volume measurement and distribution; systems of ventilation; construction of turbo models; test results.

U

UNEMPLOYMENT

Seasonal. The Problem of Seasonal Unemployment in the Building Industry, Wm. S. Parker. Int. Labour Rev., vol. 9, no. 3, Mar. 1924, pp. 361-371. Indicates economic and civic waste involved in leaving building labour idle for several months in year and considers chief causes of seasonal unemployment.

V

VARNISHES

INSULATING. Varnishes in the Electrical Industry, R. T. Fleming and A. F. Steel. Wld. Power, vol. 1, nos. 3 and 4, Mar. and Apr. 1924, pp. 149-157 and 234-240, 6 figs. Mar.: Classification of varnishes; raw materials employed in manufacture of insulating varnishes; manufacture of varnishes; processes. Apr.: Finishing and bonding varnishes; tests on insulating varnishes.

VISCOSIMETERS

MERCURIAL. A Mercurial Viscosimeter Compensated for Density, F. M. Lidstone. Chem. & Industry, vol. 43, no. 14, Apr. 4, 1924, pp. 87T-88T, 1 fig. Describes apparatus which is modified form of viscosimeter described in previous issues of same journal.

VOLTMETERS

ALTERNATING-CURRENT. A Novel Alternating-Current Voltmeter, L. T. Wilson. Am. Inst. Elec. Engrs.—Jl., vol. 43, no. 5, May 1924, pp. 446-448, 5 figs. Improved thermo-volt meter, which may be used at all frequencies up to and including 1,000,000 cycles; retains usual high sensitivity of thermo-volt-meters so that it requires very small current—for full-scale deflection about 2 milliampers.

W

WATER FILTRATION

FLOCCULATION. Study of Flocculation Phenomenon with Microscope, H. R. Baylis. Eng. News-Rec., vol. 92, no. 18, May 1, 1924, pp. 768-769, 4 figs. Excess coagulation, toughness of floc and results of rapid mixing explained largely on physical basis.

WATER HAMMER

MODERATING EFFECTS OF. Water Hammer (Il colpo d'ariete), G. B. Ugolini. Annali dei Lavori Pubblici, vol. 62, nos. 1 and 2, Jan. and Feb. 1924, pp. 7-57 and 101-130, 51 figs. partly on supp. plates. Extended study descriving methods for lessening its harmful effects in pipe lines and means for utilizing it in form of sonic waves for power transmission.

WATER POWER

STEAM AND, RELATIVE COSTS OF. Relative Cost of Water and Steam Power. Power, vol. 59, no. 21, May 20, 1924, pp. 827-828. Construction costs and fixed charges for water plant are as rule twice as great as for steam plant and overbalance smaller operating expense; steam plant has greater reserve capacity and is in position to render better and safer service.

WATER SUPPLY

DISTRIBUTION SYSTEMS. Design and Maintenance of Distribution Systems, W. E. MacDonald. Fire & Water Eng., vol. 75, no. 11, Mar. 12, 1924, pp. 491-492, 514 and 516-517, 1 fig. Fire protection must be considered in planning system; location of gate valves and fire hydrants; detection of water waste. Excerpts from paper read before Can. Soc. Am. Water Wks. Assn. See also Contract Rec. & Eng. Rev., vol. 38, nos. 14 and 15, Apr. 2 and 9, 1924, pp. 329-331 and 360-362, 1 fig.

WATER TREATMENT

VENTURI SPEED CONTROLLER. Venturi Speed Controller for Dry Chemical Feed Devices, E. S. Smith, Jr. and C. G. Richardson. Eng. News-Rec., vol. 92, no. 20, May 15, 1924, pp. 844-845, 2 figs. Installation at mechanical filter plant, Parsons, Kan., varies chemical does according to rate of flow of raw water.

WATER WORKS

QUEBEC, CAN. New Water Works System, Batiscan, Que., R. Morrissette. Can. Engr., vol. 46, no. 16, Apr. 15, 1924, pp. 425-427, 3 figs. Notes on original woodpipe line; difficulties in financing new plant; wells sunk, pumps installed and concrete reservoir constructed.

WEIRS

MOVABLE. The Development of Movable Weirs (Die Entwicklung der beweglichen Wehre), Mangold. Bautechnik, vol. 2, nos. 7, 9 and 16, Feb. 8, 29 and Apr. 11, 1924, pp. 49-51, 68-72 and 164-167, 30 figs. Deals with different types of movable weirs, namely, sluice, pin, roller, drum, and segmental weirs.

WELDING

CHEMICAL ASPECTS. Some Chemical Aspects of Welding, J. R. Booer. Inst. Mar. Engrs.—Trans., Mar. 1924, pp. 642-659, 2 figs. It is shown that crux of chemical aspect is removal and prevention of foreign inclusions in welds, which are chief cause of failures.

ELECTRIC. *See Electric Welding; Electric Welding, Arc.*

FLUXES AND SLAGS IN. Fluxes and Slags in Welding, W. Sraragen. Am. Welding Soc.—Jl., vol. 3, no. 4, Apr. 1924, pp. 36-47. Digest of opinions of experts in America on action of these fluxes in electric arc, gas and resistance welding. Paper to be presented before joint session of Faraday Soc. and Inst. Metals.

OXY-ACETYLENE. *See Oxy-Acetylene Welding.*

WELDING METAL, HIGH-CARBON. High Carbon Welding Metal, C. A. McCune. Am. Welding Soc.—Jl., vol. 3, no. 3, Mar. 1924, pp. 22-33, 16 figs. Results of experiments made in connection with high-carbon welding materials.

WELDS

FLEXIBILITY VS. RIGIDITY. Design of Welds—Flexibility Versus Rigidity. Am. Welding Soc.—Jl., vol. 3, no. 4, Apr. 1924, pp. 15-27, 3 figs. Contains five short papers giving views of experts in each of the welding fields as to whether a weld in a structure should be designed more rigid or flexible than parts which it joins: Carbon Arc Welding, J. C. Lincoln; Gas Welding, S. W. Miller; Metal Arc Welding, C. J. Holslag; Resistance Welding, H. A. Woofter; and Thermit Welding, J. H. Deppeler.

WOOD

SOFT, MICROSCOPIC STRUCTURE. Microscopic Structure of Softwood. Eng. News-Rec., vol. 92, no. 20, May 15, 1924, p. 861, 1 fig. Presents drawing of cel structure of minute block of softwood.

WOOD PRESERVATION

PAINT AS PRESERVATIVE. Does Paint Preserve Wood? H. D. Tiemann. Sci. Am., vol. 130, no. 5, May 1924, pp. 314-315, 6 figs. Points out that paint is not proof against gradual absorption of moisture and will not prevent swelling or shrinkage, but it retards rate of absorption or loss of moisture through surface, thus giving time for partial equalization of moisture and reduetion of moisture gradient within piece.

WOOD-WORKING PLANTS

LUMBER CONSERVATION. Ford Upsets Precedents in Interest of Lumber Conservation. Automotive Industries, vol. 50, no. 16, Apr. 17, 1924, pp. 866-867, 4 figs. System employed at saw mills and woodworking plants of Ford Motor Co.; body parts are cut from unedged green slabs and are kiln-dried afterward; crooked logs, swell at butt and even branches 4 in. or more in diam., formerly discarded, are now utilized effectively.

WORKMEN'S COMPENSATION

LENGTH OF SERVICE. Compensating Employees for Length of Service. Soc. Indus. Engrs.—Bul., vol. 6, no. 3, Mar. 1924, pp. 6-8. Experience of a number of firms in dealing with the question of what is best method of compensating employees for length of service, especially when they are on piece rates and are engaged in work at which their speed and consequent earning power decreases with age.

SOCIAL INSURANCE AND. Workmen's Compensation and Social Insurance. Monthly Labor Rev., vol. 18, no. 4, Apr. 1924, pp. 152-184. Steadying worker's income—establishing unemployment insurance plans; recent workmen's compensation reports; old-age and invalidity pensions of French miners; English unemployment insurance and profit-sharing plan; recommendations of Brit. Imperial Economic Conference respecting workmen's compensation.

(*For August*)

A

ABUTMENTS

MOVEMENTS, ELASTICITY. The Movements of Abutments in Statically Indeterminate Supporting Structures (Widerlagerbewegungen bei statisch unbestimmten Tragwerken), A. Troche. Beton u. Eisen, vol. 23, no. 8, Apr. 20, 1924, pp. 97-99, 5 figs. Describes simple and readily comprehended formulation of equations of elasticity in abutment movements.

AIR COMPRESSORS

PORTABLE. Portable Compressors, F. A. McLean. Can. Min. Jl., vol. 45, no. 21, May 23, 1924, pp. 503-506, 5 figs. Notes on their use in mining and contracting.

AIRCRAFT

ACCESSORIES. British Aeronautical Accessories. Flight, vol. 16, no. 22, May 29, 1924, pp. 340-346, 20 figs. Brief descriptions of accessories put out by the various firms.

BRITISH INDUSTRY. The British Aircraft Industry. Flight, vol. 16, no. 22, May 29, 1924, pp. 302-304. Brief outline of past history and present activities of the various British aviation firms and aero engine firms, with a short reference to personalities responsible for conduct of firms.

AIRCRAFT CONSTRUCTION MATERIALS

DOPES AND FABRIC. Dopes and Fabric, J. E. Ramsbottom. Roy. Aeronautical Soc.—Jl., vol. 28, no. 161, May 1924, pp. 273-305 and (discussion) 305-314, 16 figs. Deals with dopes and fabric as far as they relate to problem of production of structural covering for aircraft which will maintain its tautness under varying conditions of humidity and also retain its strength after prolonged weathering.

AIRPLANE ENGINES

BRITISH TYPES. British Aero Engines. Flight, vol. 16, no. 22, May 29, 1924, pp. 331-339, 24 figs. Gives particulars such as power, weight, consumption, etc., of all modern British aero engines. Brief particulars of two small engines which have been proved suitable for light airplanes, and of one engine which is as yet experimental.

FUEL PUMP. The Bellows (Sylphon) Fuel Pump for Liberty, "12" and Wright "H" Engines, H. C. Osborne. Air Service Information Circular, vol. 5, no. 458, Mar. 15, 1924, 6 pp., 6 figs. Description of pump; overhaul; installation; precautions.

AIRPLANES

AILERON DISPLACEMENT, EFFECT OF. On the Distribution of Lift Along the Span of an Airfoil with Displaced Ailerons, M. M. Munk. Nat. Advisory Committee for Aeronautics—Tech. Notes, no. 195, June 1924, 8 pp., 4 figs. Effect of aileron displacement on distribution of lift along span is computed for elliptic wing of aspect ratio 6 for three conditions.

AILERON EFFICIENCY. Aileron Effectiveness, A. L. Morse. Air Service Information Circular, vol. 5, no. 454, Mar. 15, 1924, 8 pp., 19 figs. Wind-tunnel tests of U. S. A.-35 (half-span) airfoil to determine aerodynamic efficiency of ailerons, hinge lines of which were skewed at various angles with transverse or y-axis.

BEAMS, FORM FACTORS. Form Factors of Beams Subjected to Transverse Loading Only, J. A. Newlin and G. W. Trayer. Nat. Advisory Committee for Aeronautics—Report, no. 181, 1924, 19 pp., 8 figs. Tests to determine factors to apply to usual beam formula in order that properties of wood based on tests of rectangular sections might be used as basis of design for beams of any section, and to develop formulas for determining such factors.

CIVIL. British Civil Aircraft. Flight, vol. 16, no. 22, May 29, 1924, pp. 327-331, 3 figs. partly on pp. 324-325. Illustrates and describes commercial, racing, and school machines.

CORPS OBSERVATION. Notes on the Design of a Corps Observation Plane, H. F. Marshall. Aviation, vol. 16, no. 21, May 26, 1924, pp. 561-563, 2 figs. Exhaust silences is said to be desirable; cockpit arrangement; provision for overload; cruising range; landing speed; reporting on observation.

ECONOMY TESTS. Economy Test of the DH-4, W. F. Gerhardt and Rob. Anderson. Air Service Information Circular, vol. 5, no. 461, Apr. 1, 1924, 4 pp., 3 figs. Following development of satisfactory flowmeter installation for airplanes, application was made to determine economical operating conditions of DH-4; attempt to check results of previous economy tests, to ascertain effect of altitude adjustment, and to confirm theory of economical operation previously developed.

GLIDERS. Gliders: Their History and Uses, W. H. Sayers. Roy. Aeronautical Soc.—Jl., vol. 28, no. 161, May 1924, pp. 315-322. Review of development and discussion of possibilities.

WIND-TUNNEL TESTS. Wind Tunnel Test of the Original TA-4 with the Following Airfoils: USA-27C Large, USA-27C Small, Gottingen 387 and Gottingen 255, A. L. Morse. Air Service Information Circular, vol. 5, no. 455, Mar. 15, 1924, 27 pp., 31 figs. Test to determine aerodynamic characteristics.
Wind Tunnel Test of CO-2A Model Airplane, C. E. Archer. Air Service Information Circular, vol. 5, no. 453, Mar. 15, 1924, 17 pp., 12 figs. Results of test to obtain full data on lift, drag, *L/D*, and moment curve about center of gravity for angles from below zero lift to above maximum lift (with and without tail plane and with and without elevator).

ALLOY STEELS

DEVELOPMENT. Alloy Steel Development Rapid, Rob. Hadfield. Iron Trade Rev., vol. 74, no. 25, June 19, 1924, pp. 1627-1628, 1 fig. Traces steps in progress in making of alloy steels; advance from 1882 to present time hastened by increase in volume of research work. (Abstract.) Paper read before Brit. Empire Min. & Met. Congress.

ALLOYS

ALUMINUM. *See Aluminum Alloys;*
NICKEL. *See Nickel Alloys.*

ALUMINUM

CASTINGS. The Production of Aluminum Castings (Die Herstellung von Aluminiumguss), von Zeerleder. Metall u. Erz., vol. 21, no. 5, 1st Mar. issue, 1924, pp. 99-101. Describes recommendable working methods in aluminum foundries; melting arrangements; treatment of metal and production of molds.
MELTING, USE OF FLUXES IN. The Use of Fluxes in the Melting of Aluminium and its Alloys, W. Rosenhain and S. L. Archbutt. Foundry Trade Jl., vol. 29, no. 405, May 22, 1924, pp. 427-428. Paper read at symposium arranged by Faraday Soc., Inst. Metals, Inst. British Foundrymen and Non-Ferrous Research Assn.
PROPERTIES. Investigations of the Properties of Aluminum (Recherches faites au Laboratoire central d'Electricité sur les propriétés de l'aluminium), M Jouaust. Société Française des Electriciens—Bul., vol. 3, no. 30, Dec. 1923, pp. 663-669. Results of investigations carried out at Central Laboratory of Electricity on samples of French, American and English aluminum.

ALUMINUM ALLOYS

ALUMINUM-COPPER. The Heat Treatment of Light Alloys of Aluminum with Copper Base (Le traitement thermique des alliages légers d'aluminium à base de cuivre), A. Portevin and F. Le Chatelier. Revue de Métallurgie, vol. 21, no. 4, Apr. 1924, pp. 233-246, 14 figs. Gives characteristics of alloys containing magnesium and those containing no magnesium, and describes new process of heat-treating alloys without magnesium; influence of hardening temperature; mechanical properties of alloys, etc.; summary of advantages of alloy without magnesium. Bibliography.
METALLOGRAPHY. Metallography of Sand Cast Aluminum Alloys, A. J. Lyon and S. Daniels. Air Service Information Circular, vol. 5, no. 449, Mar. 1, 1924, 19 pp., 54 figs. Defines technique employed in metallography of aluminum and its alloys by Material Section, Engng. Div., Air Service; illustrates and describes common constituents and characteristic micro-structure of cast-aluminum alloys used by Air Service.
PRODUCTION. History of Light Aluminum Alloys and Actual Status of Their Production (Historique des alliages légers d'aluminium et état actuel de leur fabrication), L. Guillet. Génie Civil, vol. 84, nos. 13, 14 and 15, Mar. 29, Apr. 5 and 12, 1924, pp. 298-303, 319-321 and 356-359, 9 figs. Traces history of development and describes latest improvements.

AMMONIA

BY-PRODUCT. By-Product and Synthetic Ammonia, Gas Engr., vol. 40, nos. 574 and 575, Feb. and Mar. 1924, pp. 24-25 and 48- 9. Account and criticism of modern methods of by-product ammonia production. Discusses potential ammonia in coal, ammonia per ton carbonized, excessive addition of lime, heat-interchange devices, and ammonium bicarbonate and chloride and their possibilities as commercial fertilizers.
SYNTHETIC. Catalyst Bombs for Synthetic Ammonia Production, E. K. Scott. Chem Age (Lond.), vol. 10, no. 256, May 10, 1924, pp. 482-483, 3 figs. Describes Haber-Bosch, Claude, and Casale catalyst bombs; catalyst material.

AMMONIA CONDESNERS

SUPERHEAT. Superheat at the Condenser, J. E. Starr. Ice and Refrigeration, vol. 66, no. 5, May 1924, pp. 461-462. Discussion of determination of amount of superheat in ammonia at condenser; effect of power requirements; a possible way of utilizing superheat by absorption system; means of reducing superheat.

APPRENTICES, TRAINING OF

CO-OPERATIVE PLAN. Making the Skilled Mechanic of Tomorrow, F. A. Pope. Indus. Mgt. (N. Y.), vol. 67, no. 6, June 1924, pp. 363-367, 5 figs. Co-operative plan for apprentice training in metal trades, developed by Nat. Metal Trades Assn.
FRANCE. The Training of Apprentices (L'Apprentissage). Société des Ingénieurs Civils—Mémoires et Compte Rendu des Travaux, vol. 76, nos. 10-12, Oct.-Dec. 1923, pp. 1172-1281. Account of what has been accomplished in 13th Ward of Paris, by Ch. Quillard; laws and organization of Syndicate of Mechanics, Boiler Makers and Foundrymen with regard to training of apprentices and vocational instruction, J. Quantin; training of apprentices from pedagogical viewpoint, M. Loffet; training of shop apprentices in its relation to rational organization of work, J. Androuin; rapid development of apprenticeship, M. Lacoin; the crisis in apprenticeship and its remedy, and technical instruction, J. Hiernaux; training of apprentices at steel works of Schneider, Jaquet & Cie, Strasbourg, and Cockerill Works, Belgium, E. Kern; theoretical vocational training and education during period of apprenticeship, M. Bostsarron; apprenticeship in the electrotechnical industry, Geo. Westercamp; school for training of apprentices at works of Dion-Bouton, M. Winder.
RAILWAYS. Training Apprentices, H. L. Shipman. Car Foremen's Assn.—Proc., vol. 18, no. 7, Apr. 1924, 15 pp. between pp. 12 and 52 (including discussion). Basic elements that must be given consideration before an apprenticeship system is undertaken by a railroad. Suggestions regarding establishment of system and training of apprentices.

ARMATURES

RECONNECTING D. C. Reconnecting Direct-Current Armature—Fractional-Pitch Windings, A. C. Roe. Power, vol. 59, no. 25, June 17, 1924, pp. 983-984, 6 figs. Effects of reducing pitch of armature coils and how chording coils may make it possible to use coils that have been made too short for full pitch.

AUTOMOBILE ENGINES

CONSTANT-COMPRESSION. Economy of Fuel Attained by Means of Constant Compression Engine. Automotive Industries, vol. 50, no. 24, June 12, 1924, p. 1278, 1 fig. Gas mixture and air are drawn in successively so that they will remain on different levels of combustion chamber, and so that stratification replaces turbulence of charge in Burtnett 4-cycle engine.

EIGHT-IN-LINE. Falls Eight-in-Line Has Crank-case and Cylinders Cast Integral. Automotive Industries, vol. 50, no. 22, May 29, 1924, pp. 1182-1183, 2 figs. Valve in head-type engine has five-bearing crankshaft lubricated by pressure, integral inlet manifold, and two additional cylinders have same bore and stroke as six of same make.

AUTOMOBILE INDUSTRY

S. A. E. STANDARDS REPORT. Standards Committee Division Reports. Soc. Automotive Engrs.—Jl., vol. 14, no. 6, June 1924, pp. 625-640, 15 figs. Gives following Division Reports: Parts and fittings; agricultural power equipment; ball and roller bearings; lighting; non-ferrous metals; screw threads; springs.

AUTOMOBILE MANUFACTURING PLANTS

MACHINE TOOLS FOR. Large Fixtures and Tools for Building Twin City Tractors, H. Campbell. Am. Mach., vol. 60, no. 25, June 19, 1924, pp. 907-910, 13 figs. Details of operations on large automotive units at plant of Minneapolis Steel & Machy. Co., Minneapolis.

AUTOMOBILES

BRITISH EMPIRE EXHIBITION. Cars at the British Empire Exhibition. Autocar, vol. 52, no. 1489, May 2, 1924, pp. 785-792, 46 figs. Summarized specifications of models on view; 80 cars, ranging from 749-cc. to 7413-cc. cylinder capacity, represent 47 different manufacturers.
CHASSIS LUBRICATION. Chassis Lubrication. Soc. Automotive Engrs.—Jl., vol. 14, no. 6, June 1924, Contains following papers; Notes on Chassis Lubrication and Maintenance, A. F. Masury, pp. 641-646, 14 figs.; Magazine Oiling System of Chassis Lubrication, C. T. Myers, pp. 646-648, 5 figs.
CONSTRUCTION, CAST IRON IN. Cast-Iron in Motor Car Construction, F. H. Hurren. Foundry Trade Jl., vol. 29, no. 405, May 22, 1924, pp. 423-426. Considers technical and metallurgical aspects of production of automobile parts, and extent to which science can assist.
STEERING-GEAR ANALYSIS. Steering-Gear Analyses, F. F. Chandler. Soc. Automotive Engrs.—Jl., vol. 14, no. 6 June 1924 pp. 585-590 and 648, 8 figs. Describes set of automatic recording instruments being developed by author assisted by H. A. Huebotter, that will record not only physical effort needed to steer automobile, but simultaneously, forces and shocks imposed upon entire steering system, so that such records will constitute basis for steering-system design; study of helix characteristics; possibilities of producing variable-ratio helix that gives great mechanical advantage in extreme positions.
TWO-WHEELED. A Revolutionary Proposal, P. Schilovsky. Autocar, vol. 5 , no. 1490, May 9, 1924, pp. 833-835, 3 figs. Advantages and possibilities of gyroscopic two-wheeled car, and its main principles of design and operation. Details of an experimental model.

AVIATION

AERIAL TRANSPORTATION. Air Transport and Its Uses, G. H. Thomas. Inst. Transport—Jl., vol. 5, no. 5, Apr. 1924, pp 245-256 and (discussion) 256-261, 3 figs. Shows that this form of transport is of vital interest to British trade and commerce.

B

BATTERIES

PRIMARY. An Efficient Primary Cell. Engineer, vol. 137, no. 3,571, June 6, 1924, pp. 636-637, 6 figs. New cell, which is invention of Belgian engineer, L. Darimont, is of two-fluid type.

BEARINGS

LUBRICATION. Some Types and Applications of Babbitt, Ball and Roller Hanger Bearings, F. E. Gooding. Indus. Engr., vol. 82, no. 5, May 1924, pp. 229-231 and 257, 9 figs. Methods of lubricating bearing surfaces and reducing friction losses.
OIL ENGINES. White Metal Bearings for Oil Engines, F. J. Taylor. Gas and Oil Power, vol. 19, no. 225, June 5, 1924, pp. 155-156, 2 figs. Causes and prevention of engine-shaft failure.
USE AND MAINTENANCE. Possible Improvements in Bearing Service, G. A. Van Brunt. Indus. Engr., vol. 82, no. 6, June 1924, pp. 264-270 and 304, 11 figs. Manufacturers of sleeve, ball and roller bearings give their viewpoint on things to be considered in connection with use and maintenance of bearings.

BEARINGS, BALL

MACHINE TOOLS, APPLICATION TO. Application of Ball Bearings to Machine Tools. Machy. (N. Y.), vol. 30, no. 10, June 1924, pp. 776-781, 9 figs.; also Machy. (Lond.), vol. 24, no. 609, May 29, 1924, pp. 257-262, 9 figs. Method of applying ball bearings to lathes, grinding machines, drilling-machine spindles, and transmission shafts.

BEARINGS, ROLLER

TAPERED. Production and Application of Tapered Roller Bearings. Machy. (Lond.), vol. 24, nos. 604, 605 and 606, Apr. 24, May 1 and 8, 1924, pp. 108-111, 129-131 and 161-165, 21 figs. Timken bearing and its production by Brit. Timken Ltd., Birmingham, Eng.

BELTING

INSTALLATION AND CARE. Installation and Care of Belting, C. O. Streeter. Paper, vol. 34, no. 3, May 8, 1924, pp. 90-91, 11 figs. Points in the purchasing of leather belting; approved types of belt drives; aligning and care of belts to avoid injury.

BLAST-FURNACE GAS

CLEANING. The Cleaning of Blast Furnace Gas. G. M. Hohl. Iron Age, vol. 113, no. 22, May 29, 1924, pp. 1563-1564. Savings from clean gas; preliminary cleaning; heat saved by dry cleaned gas; flue dust as washer sludge. (Abstract.) Paper read before Am. Iron and Steel Inst.
COMPOSITION. Composition of Blast-Furnace Gas (Sur la composition des gaz de hauts-fourneaux), J. Seigle. Académie des Sciences—Comptes Rendus, vol. 178, no. 17, Apr. 22, 1924, pp. 1426-1429, 2 figs. With aid of graphic presentation author discusses possible proportions of carbon dioxide and monoxide in gas at mouth of blast furnace, Gruner's ideal point, extreme values of volume of oxygen reduced per kg. of carbon, possible compositions of gas produced when dry air containing 20 per cent of oxygen, or air enriched in oxygen, or pure oxygen is used for blast, etc.

BLAST FURNACES

DESIGN, PROGRESS IN. Progress in Blast Furnaces (Considérations sur les progrès réalisés dans les hauts-fourneaux), R. Jordan. Revue de Métallurgie, vol. 21, nos. 3 and 4, Mar. and Apr. 1924, pp. 127-142 and 223-232, 20 figs. Critical examination of problems and solutions relating to progress in blast-furnace design during last 20 years. Mar.; Charging apparatus. Apr.: Determination of cross section; details of construction.
FUEL REGULATION. Uniform Coking Coal is Needed, W. Mathesius. Iron Trade Rev., vol. 74, no. 22, May 29, 1924, pp. 1422-1424, 3 figs. Regulation of blast-furnace fuel in accordance with principles of iron-ore trade; author urges analysis as basis of accounting for furnace fuel. (Abstract.) Paper presented before Am. Iron and Steel Inst.

BOILER EXPLOSIONS

LOCOMOTIVE BOILERS. Low Water Causes Fatal Crown Sheet Explosion. Boiler Maker, vol. 24, no. 5, May 1924, pp. 136-138, 3 figs. Report of Bur. of Locomotive Inspection investigation of A. T. & S. F. Locomotive 1455 disaster which occurred on Feb. 13, 1924.

BOILER FURNACES

AIR PREHEATERS. The Preheating of Combustion Air (Le préchauffage de l'air de la combustion), Roszak. Société des Ingénieurs Civils—Mémoires et Compte Rendu des Travaux, vol. 76, nos. 10-12, Oct.-Dec. 1923, pp. 1145-1170, 8 figs. Study of question as to whether preheating of air of combustion offers same advantage when applied to evaporators as to metallurgical furnaces; derivation of calorific equation and analytical relation between preheating of air and increase of combustion temperature; advantages and disadvantages of process.

GROUND FIREBRICK FOR REPAIR. Ground Firebrick for Furnace Repair, Jos. Harrington. Power, vol. 59, no. 25, June 17, 1924, pp. 976-978, 10 figs. Results from experience with special bond made principally from old firebrick for laying up new walls and of mortar for facing or patching; thick joints of this bond show saving of 35 per cent over thin cement joint construction.

OIL-FIRED. Efficiency in Oil Burning Installations, F. A. Rothwell. Power Plant Eng., vol. 28, nos. 10 and 12, May 15 and June 15, 1924, pp. 526-528 and 639-641, 3 figs. May 15: Furnace design and location of burners. June 15: Selection of burners; method of supplying fuel to burners; necessary auxiliary equipment; operation of fuel-oil-burning furnace.

OPERATION. The Economical Operation of Boiler Furnaces, R. June. Power House, vol. 17, no. 9, May 5, 1924, pp. 21-22, 5 figs. Stresses fact that development of flat suspended arch has been an important factor in reducing maintenance costs.

BOILER PLANTS

IRON AND STEEL INDUSTRY. The Generation and Utilization of Steam in the Iron and Steel Industry, J. A. Hunter. Mech. Eng., vol. 46, no. 6, June 1924, pp. 325-328 and 342, 3 figs. Equipment employed in iron and steel industry for generating and using steam; quantities and cost of fuel, and cost of converting heat in fuel to steam; present-day tendencies toward design and size of equipment, and refinements in control; describes two of latest installations; probable savings which could be made if all of steam required in industry were made and consumed in most efficient apparatus now in use.

BOILER ROOMS

EFFICIENCY IN. Boiler-Room Practice, J. Bruce, Elec. Rev., vol. 94, nos. 2424 and 2425, May 9 and 16, 1924, pp. 736-738 and 809-811, 3 figs. Furnace efficiency, excess air, and critical point of combustion.

BOILERMAKING

LOCOMOTIVE. Building the Longest Locomotive Boilers in the World. Boiler Maker, vol. 24, no. 5, May 1924, pp. 127-133, 13 figs. Details of construction of boilers recently built by Am. Locomotive Co. for an order of 25 simple 2-8-8-2 Mallet locomotives for Chesapeake & Ohio R. R.; overall length of boiler 56 ft. 11 1-8 in.; 205 lb. steam pressure.

BOILERS

BENSON HIGH-PRESSURE. *See Steam Generators, Benson High-Pressure.*

COMBUSTION CONTROL. Combustion Control for Boilers, R. J. S. Piggott. Combustion, vol. 10, no. 6, June 1924, pp. 432-436. General discussion of subject; what combustion control should do, what it usually does, what it can do. Paper read before A.S.M.E.

COMBUSTION PROBLEMS CALCULATION. The Relation of Ash Pit Loss to Flue Gas Analysis, R. Brown. Combustion, vol. 10, no. 6, June 1924, pp. 436-438, 2 figs. Two charts which furnish short-cuts in boiler calculations.

LOCOMOTIVE. *See Locomotive Boilers.*

PRIMING OF. Priming of Boilers, A. A. Pollitt-Gas Engr., vol. 40, no. 576, Apr. 1924, pp. 74-76, 1 fig. Discusses problem of priming and necessity for maintaining low concentrations in feedwater.

SCALE REMOVAL. Boiler Tubes and Boiler Scale. Eng. and Boiler House Rev., vol. 37, no. 10, May 1924, pp. 370 and 372-373, 3 figs. Some of the most modern methods of scale removal.

BOMBING

AERIAL. Aerial Bombing, A. H. Hobley and H. B. Inglis. Mech. Eng., vol. 46, no. 6, June 1924, pp. 309-316, 8 figs. Early practice and conditions; bombing moving targets; theory of bomb trajectory; principles of various sights; ground-speed determination; sources of error and methods of overcoming them.

BREATHING APPARATUS

SELF-RESCUER. The Carbon Monoxide Self-Rescuer, A. C. Fieldner, S. H. Katz and D. A. Reynolds. U. S. Bur. Mines, Reports of Investigations, No. 2591, Apr. 1924, 10 pp., 5 figs. on supp. plates. Describes construction and details of M.S.A. self-rescuer, a pocket-size respirator which protects wearer from air contaminated with poisonous carbon monoxide gas, and discusses its performance under test conditions.

BRIDGES, CONCRETE

ARCH. Reinforced Concrete Bridge of 432 Ft. Span. P. Calfas. Concrete and Constructional Eng., vol. 19, no. 5, May 1924, pp. 281-288, 5 figs. Describes new bridge which replaces old road bridge connecting St. Pierre-du-Vauvray with Andé across Seine, consisting of two arches imbedded in abutments and having a clear span of 432 ft. 6 in.; rise above level of spandrel is 82 ft.

Six-Span Concrete Arch Highway Bridge at Danville, H. H. Edwards. Eng. News-Rec , vol. 92, no. 21, May 22, 1924, pp. 896-898, 5 figs. Bridge is 1037-ft. reinforced-concrete structure, consisting of 6 arches and 7 short approach spans; details of foundation and arch centering.

BRIDGES, HIGHWAY

TORONTO, CAN. Construction of Gerrard Street Bridge, J. S. Burgoyne and G. Alison. Can. Engr., vol. 46, no. 23, June 3, 1924, pp. 573-575, 6 figs. Further details describing construction of new highway bridge over River Don at Toronto; erection of steel grillages for steel spans; falsework for arches; laying concrete deck and sidewalk slabs.

BUSES

TROLLEY. The Trolley-Bus Line between Modane and Lanslebourg (France) (La ligne d'electrobus de Modane à Lanslebourg), A. Chardin. Industrie des Tramways, vol. 18, no. 206, Feb. 1924, pp. 41-46, 4 figs. Brief description of installations, including two substations, trolley lines, passenger buses and trucks; results of tests and economic advantages of system.

BUSHINGS

CAST-IRON. Close Work on a Cast Iron Bushing, D. T. Hamilton. Am. Mach., vol. 60, no. 25, June 19, 1924, pp. 915-917, 5 figs. Accurate guide bushing for gear-shaper spindle; tolerance of 0.0002 in. in bore; insuccessful methods; grinding operations.

C

CABLES, ELECTRIC

CHARGE AND DISCHARGE. Cable Charge and Discharge, Chas. P. Steinmetz. Am. Inst. Elec. Engrs.—Jl , vol. 43, no. 6, June 1924, pp. 525-530. It is shown that phenomenon of "soaking in of charges" or "electrification of cable" is true electric-circuit transient, has nothing to do with hysteresis effects, but is result of inductance and capacity, that is, is in no essential different from usual rapid starting or stopping transient of ordinary circuit, except that it is many thousands of times slower; conclusions are derived, some of which may be pertinent with regard to mechanism of breakdown of insulation.

HIGH-TENSION. High-Voltage Cables. Elec. World, vol. 83, no. 21, May 24, 1924, pp. 1087-1091, 2 figs. Paper-cable insulation, cable splices and splicing methods and cable operation. Report presented before Nat. Elec. Light Assn.

CAISSONS

SINKING. Slim Pneumatic Caissons Penetrate Stone-Filled Crib, C .S. Rindsfoos. Eng. News-Rec., vol. 92, no. 22, May 29, 1924, p. 936, 1 fig. In building foundations for new grain elevator for state of New York, 57 caissons were sunk 45 ft. through riprap, in 70 days, some as close together as 12 in.

CALCULATING MACHINES

COST ACCOUNTING. The Mechanical Compilation of Costs. Eng. Production, vol. 7, no. 140, May 1924, pp. 139-141, 5 figs. Describes machines in connection with Powers system, and their performance; system where one clerical entry is required to produce a master from which all subsequent work may be done by mechanical means.

CANALS

PANAMA. Salt Water Climbs the Locks of the Panama Canal, R. Z. Kirkpatrick. Eng. News-Rec., vol. 92, no. 22, May 29, 1924, pp. 935-936, 1 fig. Up-lockage brings seawater into Miraflores Lake; tests of salinity; conditions controlling increase.

CARBON MONOXIDE

POISONING. Tests of a Commercial Solution Used to Reduce the Hazard of Co Poisoning in Garages. A. C. Fieldner and W. P. Yant. U. S. Bur. Mines, Reports of Investigations, No. 2594, Apr. 1924, 4 pp. Results of analysis made of a compound sold under a trade name for which claims are reported to have been made regarding its efficacy in reducing CO poisoning in automobile garages, to determine its power to absorb, oxidize, or destroy CO10, 810 8.

CAR WHEELS

MANUFACTURE. The Manufacture of Railway Tires. Engineer, vol. 137, no. 3570, May 30, 1924, pp. 602-603. Account of work done in Sheffield, England, 50 years ago.

CARS, FREIGHT

FOUNDATION BRAKE GEAR. Freight Car Foundation Brake Design, W. G. Stenason. Ry. Rev., vol. 74, no. 21, May 24, 1924, pp. 923-924, 5 figs. Describes form of foundation brake gear, with slack compensating attachment, that has given very satisfactory service. (Abstract.) Paper presented before Air Brake Assn.

REBUILDING CONTEST. Box Cars Rebuilt in Record Time, D. & H. Co. Ry. Rev., vol. 74, no. 21, May 24, 1924, pp. 913-921, 12 figs. At freight-car rebuilding contest conducted at Oneonta. N. Y., entire superstructure of 60,000-lb. capacity, steel underframe, double-sheathed box car was rebuilt in record time of 52 man-hours.

CARS, PASSENGER

ORIENTAL LIMITED. New Equipment for Oriental Limited Trains. Ry. Age, vol. 76, no. 26, May 31, 1924, pp. 1303-1305, 8 figs. Great Northern cars of improved design to be placed in service between Chicago, Seattle and Portland; equipment of each train will consist of dynamo baggage car, smoking car, first-class Pullman tourist car, dining car, pullman sleepers and observation car.

STEEL. The Passenger Car Up-to-Date, C. E. Barba. New Eng. Railroad Club, Apr. 8, 1924, pp. 70-81 and (discussion) 81-103. Discussion of construction of steel passenger cars. Ideals to be considered in up-to-date equipment. Tentative specification for painting.

CASE-HARDENING

PREVENTION BY COPPER PLATING. Prevention of Case-Hardening by Copper Plating, J. C. McCullough and O M. Reiff. Indus. and Eng. Chem., vol. 16, no. 6, June 1924, pp. 611-613, 4 figs. Selective case-hardening by carbon-pack method may be secured by protecting desired parts with copper plating; method can always be relied upon when copper plating is perfect.

CAST IRON

CHEMICAL COMPOSITION, INFLUENCE OF. Influence of Chemical Composition on Cast Iron. Metal Industry (Lond.), vol. 24, nos. 14, 15, 16, 17, 18 and 19, Apr. 4, 11, 18, 25, May 2 and 9, 1924, pp. 331-333, 355-356, 379-380, 403-405, 431-432 and 455-457, 3 figs. Influence of silicon, sulphur, phosphorus, and manganese; carbon forms and changes under the various conditions of chemical composition and temperature influences.

COOLING EFFECTS IN. Some Cooling Effects in Cast Iron and Their Correction, R. T. Rolfe. Metal Industry (Lond.), vol. 24, nos. 21, 22 and 23, May 23, 30 and June 6, 1924, pp. 501-502, 525-526 and 551-552, 2 figs. General causes giving rise to internal stresses in castings and methods of relieving them. Particulars of a series of tests carried out into annealing temperatures. Typical cases in which annealing is resorted to.

GRAPHITIC SOFTENING. The Graphitic Softening of Cast Iron, J. W. Shipley and I. R. McHaffie. Indus. and Eng. Chem., vol. 16, no. 6, June 1924, pp. 573-575, 6 figs. Graphitic softening is produced by retention within residual structure of cementite-phosphide cutectic and graphite of some of products of corrosion; wrought iron, steel, and some cast irons corrode out of face and hole, owing to absence of supporting non-corrodible framework.

PEARLITIC. Pearlitic Cast Iron, K. Emmel. Mech. Eng., vol. 46, no. 6, June 1924, pp. 352-353. Methods of production; photomicrographs and structure of piston rings cast in pearlitic metal. Translated and abstracted from Stahl u. Eisen, vol. 44, no. 13, Mar. 27, 1924.

Pearlitic Cast Iron. Metal Industry (Lond.), vol. 24, no. 20, May 16, 1924, pp. 477-478. Comments on recent work, including process of Diefenthaler and Sipp, iron-carbon conditions, mechanism of change on slow-cooling, etc.

CEMENT

ALUMINA. Aluminous Cement in Practice, T. J. Gueritte. Surveyor & Mun. & County Engr., vol. 65, no. 1685, May 2, 1924, pp. 425-426. Deals with practical applications, including practical precautions, effect of temperature, shrinkage, and action of chemicals.

RAPID-HARDENING SLAG. A New Cement (Un nouveau ciment). Revue des Matériaux de Construction et de Travaux Publics, no. 172, Jan. 1924, pp. 1-4 3 figs. Describes new rapid-hardening slag cement and compares its resistance with that of other slag cements commonly employed, showing economy of former.

STORAGE, EFFECT OF. Effect of Storage of Cement Up to Five Years. Eng. News-Rec., vol. 92, no. 22, May 29, 1924, pp. 931. Results of tests of storage in large and small lots, for different times and varying conditions of protection. (Abstract.) Revised Bulletin no. 6, issued by Structural Matls. Research Laboratory.

CEMENT MILLS

PULVERIZED COAL, USE OF. Use of Pulverized Fuel in the Cement Industry, L. N. Duryea. Nat. Engr., vol. 28, no. 6, June 1924, pp. 277-279, 5 figs. Experiences in Portland cement industry point to new economies in boiler house management. Pumping coal through pipes; accident precautions necessary in plants operated with powdered fuel; power requirements in cement industry and latest methods in utilizing waste heat.

CENTRAL STATIONS

ABANDONED, IDLE-EQUIPMENT UTILIZATION. Utilization of Abandoned Steam Power Plants, H. A. Woodworth. Nat. Engr., vol. 28, no. 6, June 1924, pp. 262-264, 3 figs. Constructive suggestion for making use of idle equipment at present located in the many abandoned power plants throughout the country.

PRIVATE PLANT, VS. Central-Station Power Versus the Private Plant, H. C. Thuerk. Elec. World, vol. 83, no. 22, May 31, 1924, pp. 1140-1141. Disadvantages of isolated plant which are sometimes overlooked in comparing relative merits of two sources of power.

SERVICE IMPROVEMENT. Improving Central Station Service by the Application of Current-limiting Reactors to Distribution Feeders, D. K. Blake. Gen. Elec. Rev., vol. 27, no. 6, June 1924, pp. 361-368, 17 figs. Decided advantages that are obtainable by installation of current-limiting reactors in distribution feeders.

UNIT COSTS. Power Plant Unit Costs and Their Engineering Significance, L. Helander. Elec. Jl., vol. 21, no. 6, June 1924, pp. 285-290, 4 figs. Presents unit costs intended to be a guide to engineer undertaking a preliminary survey of desirability of expanding capacity of an existing power station, of building a new station, or of entering into an agreement with an existing power plant for purchase of power, and particularly to assist engineers who are not continuously engaged in power-plant erection but find it, necessary to make occasional surveys of power-generating costs.

CHARTS

PRODUCTION REPORTS. Charts for Report Purposes, H. N. Stronck. Mgt. and Administration, vol. 7, no. 6, June 1924, pp. 705-709, 6 figs. Treatment of large production charts; reproductions of charts; photostat reproduction of special material; lettering of charts; chart showing percentage fluctuations; arrangement of charts in report.

CITY PLANNING

HIGHWAYS AND TRAFFIC. Highways and Traffic, F. S. Besson. Soc. Automotive Engrs.—Jl., vol. 14, no. 6, June 1924 ,pp. 594-601, 18 figs. Dividing streets into three classes, rapid transit and local streets and traffic highways, author defines these terms and, using original plan of City of Washington and present street conditions there as basis of illustration, comments thereon and shows how important adequate city planning is in its bearing on traffic problem and what great foresight it requires.

STREET PLANNING. Street Planning for Relief of Congestion at Bridges, Chas. W. Leavitt. Eng. News-Rec., vol. 92, no. 23, June 5, 1924, pp. 974-975. Widening of approaches; variable-speed traffic zones; separation of rapid-transit lines recommended. (Abstract). Paper read before Nat. Conference on City Planning.

CLUTCHES

RING. Expanding and Contracting Ring Clutches, A. Clegg. Machy. (N. Y.), vol. 30, no. 10, June 1924, pp. 793-796, 6 figs. Expanding ring clutch with unusual adjustment; design operated by toggle levers; Johnson expanding ring clutch; contracting ring clutch.

COAL

CARBONIZATION. Practical Coal Carbonization, F. W. Sperr, Jr. Mech. Eng., vol. 46, no. 6, June 1924, pp. 329-333, 4 figs. Discusses high-temperature and low-temperature carbonization with special reference to American conditions.

Thermal Reactions of Coal During Carbonization, J. D. Davis and P. B. Place. Indus. & Eng. Chem., vol. 16, no. 6, June 1924, pp. 589-592, 4 figs. Discusses thermal behavior of coals during carbonization and compares methods applicable to determination of reaction heats; heat-rate method originally used by Hollings and Cobb for investigating reaction heats of English coals has been applied with slight modification to seven typical American coals and sample of pine sawdust, and attempt made to compare results with those found by direct determination in constant-volume calorimeter; results indicate that for high temperatures prevailing in coke-oven operations reaction heats are endothermic.

LOW-GRADE AND WASTE. The Utilization of Low-Grade and Waste Coals in Power Production, W. S. Coates. Chem. & Industry, vol. 43, no. 21, May 23, 1924, pp. 157T-163T, 5 figs. Notes on furnace design; combustion of carbon in coke; boiler; pulverized fuel.

COAL GAS

CORROSION DUE TO. The Corrosion Caused by Products of Combustion of Coal Gas, U. R. Evans. Chem. & Industry, vol. 43, no. 20, May 16, 1924, pp. 506-507. Investigations as to whether practice of employing coal gas in place of direct combustion of solid fuel tends to increase or reduce damage, with special reference to indoor corrosion.

COAL HANDLING

CONVEYORS AND HAULING ARRANGEMENTS. Modern Developments in Coal Conveyors and Haulage Arrangements for Dealing With the Coal From the Working Face to the Pit Bottom, G. L. Leston. S. Wales Inst. Engrs.—Proc., vol. 40, no. 2, May 8, 1924, pp. 175-205, 10 figs.

PIERS. Modern Practice of Handling Coal in Bulk at Coal Piers, J. W. Speer. Elec. Jl., vol. 21, no. 6, June 1924, pp. 260-265, 11 figs. Turning-type dumper installation, direct-loading stationary lifting-type dumper, direct-loading stationary revolving-type dumper, mechanical coal trimmers, etc.

COAL MINES

SPONTANEOUS COMBUSTION IN. Spontaneous Combustion in Coal Mines, J. I. Graham. Colliery Engr., vol. 1, no. 1, Mar. 1924, pp. 27-31, 3 figs. Survey of underlying causes of this trouble, with indications of practical preventative methods.

VENTILATING DOORS, LEAKAGE OF. Tests on the Leakage of Mine Ventilating Doors, J. W. Paul, G. E. McElroy and H. P. Greenwald. U. S. Bur. Mines, No. 2602, May 1924, 3 pp. Particulars of tests made to determine leakage of two air locks which had been placed in experimental mine as part of equipment for tests on friction factors.

COAL STORAGE

PRECAUTIONARY MEASURES. What to Avoid When Storing Soft Coal, A. J. Hoskin. Coal Age, vol. 25, no. 23, June 5, 1924, pp. 840-842, 2 figs. Conclusions from results of investigation carried out at University of Illinois.

COAL WASHING

SAND FLOTATION. Application of Sand-flotation Process to the Preparation of Bituminous Coal, T. M. Chance. Am. Inst. Min. & Met. Engrs.—Trans., no. 1352-C, June 1924, 10 pp., 4 figs. Types of plant installed; operating results; maintenance; bituminous coal washing; bituminous washery estimates.

COKE

BLAST-FURNACE. Production of High-grade Blast-furnace Coke, H. M. Chance. Am. Inst. Min. & Met. Engrs.—Trans., no. 1351-C, June 1924, 8 pp., 2 figs. Outline of differential separation which makes available vast stores of low-ash coal locked up in coal beds from which it has been impossible to ship anything better than fair grades of steam coal; can be made by any liquid or solution having specific gravity greater than that of coal which is to be floated and less than that of coal that is to be separated by sinking in liquid.

COKE MANUFACTURE

BY-PRODUCT. Making Coke to Combat Canada's Fuel Problem, H. P. Armson. Can. Machy., vol. 31, no. 23, June 5, 1924, pp. 27-30, and 47-48, 4 figs. Description of processes by which Hamilton By-Products Coke Ovens Co. produce foundry and domestic coke, tar, ammonium sulphate, city gas, blue water gas and naphthalene.

CONCRETE

CEMENT CONTENT. Determining the Cement Content of Concrete, H. F. Kriege. Eng. News-Rec., vol. 92, no. 21, May 22, 1924, pp. 892-893. Chemical method of analyzing concrete based on silica content; check results given.

SEA-WATER ACTION. The Action of Sea Water on Concrete. Concrete & Constructional Eng., vol. 19, no. 4, Apr. 1924, pp. 249-256. Discusses the subject under following headings: Impermeability and density; proportioning and mix; quantity of water; forms, spading and temping; curing; proper location and percentage of steel; avoidance of seepage or drainage action; effect of alternate action of air and water during setting; exterior protection of concrete; cement.

CONCRETE CONSTRUCTION, REINFORCED

DIMENSIONING OF CROSS SECTIONS. The Dimensioning of Reinforced-Concrete Cross Section (Beitrag zur Bemssung von Eisenbetonquerschnitten), R. Saliger. Basichgenibau, vol. 5, no. 7, Apr. 15, 1924, pp. 162-166, 2 figs. Method of calculation and its advantages.

CONDENSERS, STEAM

BAROMETRIC, TESTING. Testing Steam Turbine and Barometric Condenser, F. S. Youtsey. Power, vol. 59, no. 25, June 17, 1924, pp. 979-980, 2 figs. Method employed in testing condenser serving mixed-pressure steam turbo-generator.

PUMPS, COOLING-WATER. Economical Operation of Condenser Pumps, Chas. E. Colborn. Power Plant Eng., vol. 28, no. 12, June 15, 1924, pp. 643-645, 4 figs. Study of conditions governing use of one or two circulating pumps with changes in cooling-water temperatures.

CONDUITS

PENSTOCK MANIFOLDS. Penstock Manifolds Designed to Simplify Stresses, H. L. Doolittle and C. W. Larner. Eng. News-Rec., vol. 92, no. 24, June 12, 1924, pp. 1006-1008, 7 figs. Describes unusual penstock manifolds of radically different types installed at two of new power plants, one at Big Creek, no. 3 plant of S. Cal. Edison Co., and other in Vermont at Davis Bridge plant of N. E. Power Co.; both designed to eliminate as many indeterminate stresses as possible.

CONVEYORS

FORGINGS AND SCRAP HANDLING. Conveyors to Handle Forgings and Scrap. Iron Age, vol. 113, no. 24, June 12, 1924, pp. 1711-1712, 3 figs. Application of conveyor equipment for handling flashings and small automobile forgings from cold trimming presses at forge plant of Chevrolet Motor Co., Detroit.

COPPER METALLURGY

ORE TREATMENT. The New Copper Queen Concentrator, E. Wittenau. Eng. & Min. Jl.—Press, vol. 117, no. 21, May 24, 1924, pp. 836-841, 10 figs. Results obtained during first year in treatment of a low-grade sulphide ore in Copper Queen concentrator of Phelps Dodge Corp. at Warren, Ariz., and description of equipment. Three units doing work originally planned for four, making 92 per cent recovery on 2 per cent ore; no ball mills used.

CORROSION

ELECTROLYTIC. Electrolytic Corrosion in a Water-Gas Holder, F. H. Rhodes and E. B. Johnson. Indus. & Eng. Chem., vol. 16, no. 6, June 1924, p. 575. Describes special case of electrolytic corrosion and gives results of investigation.

STUDY OF. A Paradox in Corrosion, U. R. Evans. Chem. & Met. Eng., vol. 30, no. 24, June 16, 1924, pp. 949-953, 3 figs. Mechanism by which currents are produced explains why corrosion depending on oxygen is sometimes greatest where oxygen is excluded.

COST ACCOUNTING

CAPITAL CONTROL. Capital Requirements and Control, J. H. Bliss. Mgt. & Administration, vol. 7, no. 6, June 1924, pp. 653-658. Protection of working capital.

DEPRECIATION SCHEDULES. New Forms of Depreciation Schedules, G. W. Greenwood. Mgt. & Administration, vol. 7, no. 6, June 1924, pp. 689-692, 3 figs. Outlines method called sinking-fund method, which is believed to be new and to have advantages in many cases; comparison with straight-line method.

COTTON MILLS

MECHANICAL ENGINEERING AND MANAGEMENT. The Relation of Mechanical Engineering to Management in the Textile Industry, E. H. McKitterick. Mech. Eng., vol. 46, no. 6, June 1924, pp. 343-344 and 359. Reduction of cost of manufacture by means of improvements in power, lighting, and heating systems, and in handling of goods between processes.

CRANES

QUAY. The Design of Quay Cranes, F. M. Du Plat Taylor. Engineer, vol. 137, no. 3570, May 30, 1924, p. 598, 2 figs. Suggests arrangement and design of cranes to meet requirements of modern large sea-going vessels.

SELF-PROPELLING. A French Automobile Crane. Engineer, vol. 137, no. 3570, May 30, 1924, pp. 604-605, 2 figs. Type of self-propelled crane extensively used in France for railway siding and port work, as well as for town and city transport and cleaning services.

CULVERTS

CORRUGATED. Roads Use Corrugated Culverts Under Fills. Ry. Age, vol. 76, no. 27, June 7, 1924, pp. 1359-1363, 5 figs. Study of many installations in service up to 16 years indicates satisfactory service.

CORRUGATED IRON. Is the Corrugated Iron Culvert Adapted to Railroad Use? W. S. Lacher. Ry. Eng. & Maintenance, vol. 20, no. 6, June 1924, pp. 224-230, 12 figs. Study of problem based on behavior of 10,000 installations in service up to 16 years.

D

DAMS

FAILURES. Experts Charge Gleno Dam Failure to Masonry Base. Eng. News-Rec., vol. 92, no. 24, June 12, 1924, p. 1018. Advance abstract of official report on cause of disaster; base defective in both design and construction.

GRAVITY. Arching Not Effective in Slightly Arched Gravity Dams, B. F. Jakobsen. Eng. News-Rec., vol. 92, no. 24, June 12, 1924, pp. 1020-1022, 2 figs. Relatively small curvature may be harmfull because of reduced stability; arch action cannot be counted on under such conditions; construction costs increased by arching.

DIES

FORGING. Taking the Guesswork Out of Dies, C. C. Rhead. Forging—Stamping—Heat Treating, vol. 10, no. 3, May 1924, pp. 188-193, 3 figs. Records covering die performance essential to efficient production; discusses system for recording performance of dies used in production of pressed-metal parts.

PROGRESSIVE. Progressive Dies for Piercing, Bending, and Blanking, W. Richards. Machy. (Lond.), vol. 24, no. 606, May 8, 1924, pp. 174-175, 5 figs. Comments on progressive die for production of bracket, described in same journal (vol. 23, p. 543), and shows that simpler tool and simpler method of producing piece, in one operation, are both available.

DIESEL ENGINES

DOUBLE-ACTING. Double-Acting Marine Diesel Engines. Engineering, vol. 117, no. 3048, May 30, 1924, pp. 707-708, 7 figs. on supp. plates. Details of 1000-i.hp. experimental 4-cycle North-Eastern-Werkspoor engine. See also Engineer, vol. 137, nos. 3570 and 3571, May 30 and June 6, 1924, pp. 604 and 626-627, 5 figs. partly on p. 630.

MANUFACTURE. One of America's Prominent Diesel Plants. Motorship, vol. 9, no. 6, June 1924, pp. 434-436 and 441, 6 figs. Describes Cleveland, Ohio, plant of Winton Engine Works. Quantity production, handling and routing highly developed.

DREDGES

HYDRAULIC. High-Lift Hydraulic Dredge Has Toothed Cutter Head, V. J. Milkowski. Eng. News-Rec., vol. 92, no. 24, June 12, 1924, pp. 1016-1017, 4 figs. Designed for deep digging and long discharge in Welland River canalization of Chippawa power canal.

DRILLING MACHINES

ANGULAR SETTINGS FOR. Angular Settings for Drilling and Boring. Mech. Wld., vol. 75, nos. 1943, 1945 and 1948, Mar. 28, Apr. 11 and May 2, 1924, pp. 190-192, 222 and 270-271, 16 figs. Describes various methods of angular setting.

RADIAL. A New Portable Universal Radial Drilling Machine. Eng. Production, vol. 7, no. 140, May 1924, pp. 144-145, 4 figs. Describes drilling and tapping machine of Wm. Asquith, Ltd., Halifax.

DYNAMOMETERS

DIRECT-READING POWER INDICATOR. A Direct-Reading Power Indicator (Indicateur de puissance à lecture directe), H. Guillou. Société d'Encouragement pour l'Industrie Nationale—Bul., vol. 135, no. 10, Dec. 1923, pp. 1163-1170, 7 figs. Apparatus developed by author which, in contrast to simple dynamometer, registers actual power transmission at any moment; can be applied in all cases where power is transmitted by means of rotating shaft.

E

EARTHQUAKES

CAUSES. Inside the Earth, and Out, Oliver Lodge. Sci. Am., vol. 130, no. 6, June 1924, pp. 374-375, 3 figs. Conditions in rock crust that lead to earthquakes.

ECONOMIZERS

OPERATION. The Efficient Operation of the Economizer. Eng. & Boiler House Rev., vol. 37, no. 11, June 1924, pp. 425-427, 3 figs. Discusses methods whereby maximum efficiency may be obtained, both as regards reduction in coal bill and satisfactory operation of installation, especially from point of view of length of service.

EDUCATION, ENGINEERING

CALCULUS, VALUE OF. Value of Calculus to the Engineer, R. Fleming. Can. Engr., vol. 46, no. 23, June 3, 1924, pp. 587-588. Divergent views as to value of calculus. Personality of instructor of more importance than text book; better to learn calculus at college than after.

ELECTRICAL EQUIPMENT

ZINC PLANT. Electric Equipment, Consolidated Mining and Smelting Company's Zinc Plant, Trail, B.C., Canada, R. N. Lockyer. Am. Inst. Elec. Engrs.—Jl., vol. 43, no. 6, June 1924, pp. 531-544, 25 figs. Power supply; electrical equipment in distributing station; generator rooms; motor-generator sets; ventilation; switchboards; load characteristics; air compressors; industrial motors; water supply.

ELECTRICAL MACHINERY

SPEED DETERMINATION. Photographic Method of Determining Machine Speeds, R. F. Mundorff. Machy. (N. Y.), vol. 30, no. 10, June 1924, p. 782, 1 fig. Method of determining retardation of machine speeds which eliminates personal equation and possibility of error that exists when successive speed readings are taken in usual way. See also Machy. (Lond.), vol. 24, no. 609, May 29, 1924, p. 271, 1 fig.

ELECTRIC DISTRIBUTION

VOLTAGE INCREASE. Increases in Distribution Voltage, H. P. Seelve. Elec. Light & Power, vol. 2, no. 5, May 1924, pp. 131-133, 5 figs. Discusses some of the factors which bear upon problem of, what adoption of a higher distribution voltage, what that voltage shall be.

ELECTRIC DISTRIBUTION SYSTEMS

UNDERGROUND A. C. NETWORK. Underground Alternating-Current Network Distribution for Central Station Systems, A. H. Kehoe. Am. Inst. Elec. Engrs.—Jl., vol. 43, no. 6, June 1924, pp. 545-554, 27 figs. Experimental arrangements for underground a.c. system; experience with combined light and power network on one set of mains; effect of voltage variation on incandescent-lamp illumination; tests on cables which indicate that for underground distribution conditions, low-voltage cables will eliminate arcing faults which high-voltage cable will not do; description of experimental system.

ELECTRIC DRIVE

SHIPYARDS. Electrical Power Transmission for Shipyards, T. Schwarz. Eng. Progress, vol. 5, no. 5, May 1924, pp. 85-88, 7 figs. Show how all kinds of power transmission, especially hydraulic transmission, have been substituted by electrical drives, which has recently even mastered largest machines for handling plates.

ELECTRIC FURNACES

BRASS. Present Tendencies in Electric Brass-Furnace Practice, H. W. Gillett and E. L. Mack. U. S. Bur. Mines, Reports of Investigations, No. 2597, Apr. 1924, 10 pp. Also Brass Wld., vol. 20, no. 5, May 1924, pp. 163-166. Trend of developments in practice in last two years. Bibliography.

HEATING IN VACUUM. Apparatus for Heating Electrically in a Vacuum to a High Temperature (Sur un dispositif permettant de chauffer électriquement dans le vide à haute température), P. Lebeau and M. Picon. Académie des Sciences —Comptes Rendus, vol. 178, no. 14, Mar. 31, 1924, pp. 1151-1153. Apparatus consists essentially of tube of carbon, molybdenum, or tungsten, which forms resistance and which is placed in flask of Pyrex glass or quartz; authors describe use and calibration of optical pyrometer of double-scale, disappearing-filament type which was used in connection with apparatus.

PIG-IRON. New Norwegian Electric Pig Iron Furnace, F. Hodson and M. Sem. Iron Age, vol. 113, no. 22, May 29, 1924, p. 1585, 1 fig. Open-top furnace successfully operating with charcoal or coke; new ore-reduction process.

PRINCIPLES AND DESIGN. Electric Furnaces (Les Fours électriques). Electricien, vol. 55, nos. 1347 and 1348, May 1 and 15, 1924, pp. 193-197 and 221-225, 15 figs. General considerations; electro-thermal problem; resistance furnaces; arc and induction furnaces.

ELECTRICITY SUPPLY

INTERCONNECTION AND FARM SERVICE. Interconnection and Service to the Farm, Gifford Pinchot. Elec. World, vol. 83, no. 21, May 24, 1924, pp. 1095-1096. Points out that hope of rural electric service lies in regulated private industry with pooling of power for large-area use; state lines should interpose no obstacle to extension of interconnection for good of all. Address before Nat. Elec. Light Assn.

ELECTRIC LOCOMOTIVES

NORFOLK & WEST. RY. New Electric Locomotives of the N. & W. Ry., T. C. Wurts. Ry. Rev., vol. 74, no. 23, June 7, 1924, pp. 1018-1022, 9 figs. Equipment just put in service illustrates advances of 30 years' experience in electric motive power.

SWITCHING. Electric Switchers for Paulista Railway, W. D. Bearce. Elec. Traction, vol. 20, no. 5, May 1924, pp. 214-215, 2 figs. Steeple cab-type electric switching locomotives used on railway in Brazil; running gear consists of two swivel trucks each equipped with two GE-255—1500/3000 volt motors.

2-8-2. The Pennsylvania 2-8-2 Type Electric Locomotive, W. H. Eunson. Ry. & Locomotive Eng., vol. 37, no. 6, June 1924, pp. 173-175, 3 figs. Details of L-5 locomotives for passenger and freight service.

ELECTRIC METERS

KV.A. METERS. A Universal Meter for Electric Power, B. H. Smith. Sibley Jl. of Eng., vol. 38, no. 5, May 1924, pp. 120-123, 14 figs. Describes new kv.a. meter especially well adapted for billing data on large power circuits. Gives direct reading of indicated power factor, total kw. hours, total kv.a. hours, and kw. and kv.a. demand for any pre-determined time interval, also power factor for any time interval, particularly at time of maximum demand, can be readily obtained.

SERVICE FUSES VS. CIRCUIT BREAKERS. Service Fuses Versus Circuit Breakers, G. E. Palmer. Elec. World, vol. 83, no. 24, June 14, 1924, pp. 1225-1227, 3 figs. Universal service entrance and meter requirements met by properly designed combination fuse and switch boxes; disadvantage of circuit breakers.

ELECTRIC MOTORS

AMPERE-TURNS FOR SATURATED TEETH. Ampere-Turns for Saturated Teeth, V. Karapetoff. Elec. World, vol. 83, no. 24, June 14, 1924, p. 1231, 1 fig. Approximate method of computation which will be found sufficiently accurate for purposes of design.

GROUNDS, LOCATING. Locating Grounds on Motor Circuits, A. Haist. Power Plant Eng., vol. 28, no. 12, June 15, 1924, pp. 655-656, 1 fig. In writer's experience one of best methods for locating grounds on any of various motors on 3-phase system is by means of radial switch having contact point for each phase and voltmeter.

ELECTRIC MOTORS, A.C.

OPERATION AND MAINTENANCE. Alternating-Current Motors, Operation and Maintenance. South. Engr., vol. 41, no. 4, June 1924, pp. 42-49, 15 figs. Application of various types of a.c. motors and some of their characteristics.

ELECTRIC RAILWAYS

TRACTION EXHIBIT, ERIE, PA. Electric Traction Exhibit Held at Erie, Pa. Ry. Age, vol. 67, no. 25, May 24, 1924, pp. 1267-1269, 5 figs. Demonstration includes 3000-volt d.c. multiple-unit train for suburban service; current-collection tests; otheograph for recording action on rails of each separate wheel of locomotive or motor car; locomotive tests.

ELECTRIC TRANSMISSION LINES

CALCULATION. A Vector Treatment of Long Transmission Lines, S. Holmes. Instn. Elec. Engrs.—Jl., vol. 62, no. 329, May 1924, pp. 471-476, 2 figs. Equations of transmission line; calculation for 250-mi., 110,000-volt transmission line; calculation for constant-voltage transmission, and of circle diagram. Bibliography.

DESIGN AND ECONOMICS. Overhead Electric Power Transmission, W. T. Taylor. Elec. Rev., vol. 94, nos. 2422 and 2423, Apr. 25 and May 2, 1924, pp. 646, 647 and 721-722. Elements of design and economics.

MAXIMUM OUTPUT, DETERMINATION. Maximum Output of Transmission Systems, R. D. Evans and R. C. Bergvall. Elec. World, vol. 83, no. 23, June 7, 1924, pp. 1171-1173, 5 figs. Simple graphical method for determining maximum output of any given system; determination of maximum permissible load is difficult problem, but estimates may be made.

ELECTRIC WELDING

OIL TANKS. Electric Welding of Large Storage Tanks, H. C. Price. Am. Inst. Min. & Met. Engrs.—Trans., no. 1345-P, June 1924, 11 pp., 12 figs. Describes construction of welded roofs and bottoms and gives their advantages over riveted construction; data and conclusions obtained from observations made during welding of tanks by Welding Eng. Co., Texas City, Tex., and Tonkawa and Burbank, Okla.

ELECTRIC WELDING, ARC

RAIL JOINTS. Improvements in Arc-Welded Rail Joints, R. B. Fehr. Elec. Ry. Jl., vol. 63, no. 20, May 17, 1924, pp. 783-785. Recent developments in method of welding joint plates by means of carbon arc process, and tests on several types of joints.

ELEVATORS

GEARLESS TRACTION MOTOR AND BRAKE. Mechanical Features of the Gearless Traction Elevator Motor and Brake, J. J. Matson. Gen. Elec. Rev., vol. 27, no. 6, June 1924, pp. 390-394, 7 figs. Shows how manufacturer's engineers have made a thorough study of each part and have developed a most capable elevator hoist.

ENGINEERING

MECHANICAL, IN MILITARY SERVICE. The Progress of Mechanical Engineering in the Military Service, G. LeQ. Martel. Instn. Mech. Engrs.—Proc., no. 2, Jan. 1924, pp. 101-138, 9 figs. Brief historical survey of work of mechanical engineer in army up to outbreak of Great War; how work of mechanical engineer was organized and carried out during war and progress made since war; account of work in connection with repair of munitions of war of every kind in field.

EXCAVATORS

DRAGLINE. An Economic Study of Dragline Excavator Operation, C. W. Ullom. Eng. News-Rec., vol. 92, nos. 22 and 23, May 29 and June 5, 1924, pp. 932-934 and 976-979. Performance, operating practices, and costs determined by 13 million yards of excavation for Miami Valley flood-protection works. May 29: Output and cost records. June 5: Operating methods and costs.

F

FIRE EXTINGUISHERS

FOAM. Testing of Foam for Use on Fires, C. K. Swift. Indus. & Eng. Chem., vol. 16, no. 6, June 1924, pp. 580-582, 1 fig. Describes desirable characteristics of foams and foam solutions; analytical methods applicable to solutions, and methods for comparing fire resistance and other physical characteristics of foams.

FLOORS

FLAT-SLAB. Modern Examples of Girderless Flat-Slab Floors (Neuere Ausführungen trägerloser Pilzdecken), H. Marcus. Bauingenieur, vol. 5, no. 7, Apr. 15, 1924, pp. 171-177, 15 figs. Report on progress made in application and design of such floors.

FLOTATION

SELECTIVE. Selective Flotation as Applied to Canadian Ores, C. S. Parsons. Min. Jl., vol. 145, nos. 4628 and 4629, May 3 and 10, 1924, pp. 355-356 and 380-381. Reviews in a general way results of investigations conducted in Ore Dressing & Metallurgical Laboratories of Dept. Mines at Ottawa that have particular reference to selective flotation as applied to Canadian ores; oils used, addition reagents, control of flotation pulp, examples of problems; examples of selective flotation.

FLUE-GAS ANALYSIS

CO_2 METERS. Electrical Carbonic Oxide and Hydrogen Meters, E. Zopf. Eng. Progress, vol. 5, no. 5, May 1924, pp. 91-92, 6 figs. Electric apparatus for testing flue gases for their content of combustible components (especially carbonic oxide and hydrogen).

CO_2 RECORDERS. The "Positif" CO_2 Recorder (Analyseur de CO_2 "positif".) Chaleur & Industrie, vol. 5, no. 48, Apr. 1924, pp. 195-197, 5 figs. Describes new and simple apparatus manufactured by Société Anynome des Appareils de Manutention & Fours Stein, Paris.

FORESTRY

FIRE-STATISTICS COLLECTION. Some Suggestions for Proposed Changes in the Methods of Collecting Forest Fire Statistics, P. W. Stickel. Jl. of Forestry, vol. 22, no. 3, Mar. 1924, pp. 266-274. Discusses importance of forest-fire statistics in relation to question of forest-fire insurance, and suggests some changes in method of collecting such statistics. Bibliography.

FOREST COLONIZATION. Forest Colonization in Sweden, I. H. Baldwin. Jl. of Forestry, vol. 22, no. 3, Mar. 1924, pp. 241-257. Character of forest; climate. Primary object of colonization has been development of a settled population of forest workers. Relation between population and intensity of forestry; previous efforts at colonization in state forests; present grants for colonization; general extent and results of colonization. References.

RESEARCH Use of Statistical Methods in Forest Research, J. Kittredge, Jr. Jl. of Forestry, vol. 22, no. 3, Mar. 1924, pp. 306-314. Author outlines what seems to him to be most promising statistical methods for use in forest research and gives examples of kinds of problems in which their application might prove useful. References.

FORGING

SAFETY CODE FOR. Safety Code for Forging. Nat. Safety News, vol. 9, no. 6, June 1924, pp. 55-61, 23 figs. Tentative draft formulated under general auspices of Am. Eng. Standards Committee, to provide reasonable safety for life, limb and health. Applies to all power forging hammers and incidental operations in connection therewith, including hot saws.

FORGINGS

TESTING LARGE. How English Test Big Forgings. Iron Trade Rev., vol. 74, no. 24, June 12, 1924, pp. 1557-1558, 4 figs. Stresses encountered by turbine rotors and other large forgings have led British steel-makers to examine core by means of special optical instrument; defects usually develop along axis.

FUELS

SLUDGE. Sewage Sludge as a Source of Heat. Contract Rec. & Eng. Rev., vol. 38, no. 20, May 14, 1924, pp. 478-479. Experiments carried out in England by burning sludge direct in a furnace and by utilizing gas made by carbonizing it; special furnace is solution.

See also Coal; Coke; Lignite; Pulverized Coal.

FURNACES, INDUSTRIAL

GAS-FIRED. Gas-Furnace Installations, Hems. Gas Jl., vol. 166, no. 3182, May 7, 1924, pp. 400-403, 1 fig. Describes some of the different types of furnaces and industrial apparatus which manufactures of a city demand, including oven and muffle furnaces, furnaces for melting, tube manufacture, sugar boiling, cyanide hardening, etc. Paper read before Midland Jr. Gas Assn.

RECUPERATORS FOR. Recuperation—Design Requirements, E. R. Posnack. Combustion, vol. 10, no. 6, June 1924, pp. 439-440. Features of design which should be incorporated to eliminate objections usually raised to use of recuperators.

G

GAGES

ORDNANCE-DEPT. PROBLEMS. Gage Problems of the Ordnance Department, C. C. Williams. Am. Mach., vol. 60, no. 22, May 29, 1924, pp. 791-793, 1 fig. Safeguarding gages on hand; studying allowances and tolerances; multiplicity of gages needed.

SINE BAR FOR PLANER WORK. The Sine Bar as a Universal Planning Gage, R. H. Rausch. Mech. Eng., vol. 46, no. 6, June 1924, pp. 345-348, 15 figs. Details of accurate system of gaging for use where large pieces are machined at comparatively long intervals; use of sine bar as templet for setting planer head and toils; formulas.

GALVANIZING

FLUXING. A Study of Fluxing in Galvanizing, H. Bablik. Metal Industry (Lond.), vol. 24, no. 23, June 6, 1924, pp. 541-543. Author describes tests carried out to determine mechanism of sal-ammoniac as a fluxing agent, from which he draws conclusions to guide in efficient control of a galvanizing bath.

GAS ENGINES

STARTING AND STARTERS. Gas Engine Starting and Starters, E. Pagett. Southern Engr., vol. 41, no. 3, May 1924, pp. 58-60, 7 figs. Explanation of various kinds of gas-engine starters and some of the difficulties, encountered in starting an engine.

GAS MANUFACTURE

RETORTS. Refractory Materials and the Design of Retort Settings, V. E. Harston. Gas Wld., vol. 80, no. 2078, May 17, 1924, pp. 444-449 (includes discussion), 1 fig. Behavior of different clays, requirements of a retort setting, design of settings, section of retort, constructional details of a retort bench, producers and generators, segmented retorts, etc. Paper read before East Counties Gas Mgrs.' Assn. See also Gas Jl., vol. 166, no. 3184, May 21, 1924, pp. 530-535, 5 figs.

GAS PRODUCERS

PORTABLE. A Portable Power Generator Using Gas Made From Local Fuel, S. D. Ware. Min. Mag., vol. 30, no. 5, May 1924, pp. 275-277, 3 figs. Describes new type of power generator specially useful in mining and transport abroad, having three features, viz., portability, low fuel costs, and low capital cost.

PRACTICE. Gas Producer Practice, W. Dyrrsen. Blast Furnace & Steel Plant, vol. 12, no. 6, June 1924, pp. 271-273. Savings possible by use of waste gases in place of steam for cooling fire zone; modern types of gas producers. (Abstract.) Paper presented before Am. Iron & Steel Inst.

Notes on Gas-Producer Practice, J. D. Troup. Iron & Coal Trades Rev., vol. 108, nos. 2929 and 2930, Apr. 18 and 25, 1924, pp. 631-632 and 678-679, 4 figs. British and American practice.

GAS TURBINES

PROBLEMS OF. The Gas Turbine, H. Campbell. Inst. Mar. Engrs.—Trans., vol. 35, Apr. 1924, pp. 681-694 and (discussion) 694-701, 5 figs. Review of what is known about gas turbines up to date. Difficulties which have been experienced in dealing with gas turbines both theoretically and practically. Points out that a new material has to be found to stand high temperatures.

WASTE-HEAT RECOVERY. Gas Turbines for Waste Heat-Recovery. Colliery Engr., vol. 1, no. 2, Apr. 1924, pp. 96-98, 4 figs. Notes on German developments with their possible applications to conditions in Great Britain.

GEAR CUTTING

INSTRUMENT. Cutting Instrument Gears. Machy. (Lond.), vol. 24, nos. 604 and 609, Apr. 24 and May 29, 1924, pp. 103-107 and 273-274, 17 figs. Apr. 24: Production of small gears by means of hand-operated and automatic machines of formed-cutter and hobbing types. May 29: Application of hobbing process and production of small pinions in rod form.

RACKS. Rack Cutting. Machy. (Lond.), vol. 24, no. 608, May 22, 1924, pp. 235-237, 5 figs. General practice in cutting racks on machines designed for this work.

GRADING

AGGREGATES. Grading Aggregates by Fineness Modulus Method, C. D. Willett. Eng. News-Rec., vol. 92, no. 24, June 12, 1924, pp. 1010-1011, 3 figs. Abrams theory supplemented by charts for three sizes of aggregates; scientific method of proportioning made easy.

GRINDING

METHODS. Grinding Shop Practice Described, F. B. Jacobs. Abrasive Industry, vol. 5, no. 5, May 1924, pp. 111-115, 11 figs. Methods followed at shops of L. Lawrence Co., Detroit, Mich. Worn cylinders reground and new pistons fitted; large crankshafts refinished by regrinding; broken units welded.

H

HARDNESS

TESTING. The Hardness of Metals and Hardness Testing. Mech. Eng., vol. 46, no. 6, June 1924, pp. 360-362. Observations on nature of hardness, together with descriptions of various methods used in testing. Report prepared at request of Special Research Committee on Cutting and Forming of Metals.

Work-Hardening of Various Metals, E. G. Herbert. Iron Age, vol. 113, no. 25, June 19, 1924, pp. 1792-1793, 3 figs. Measuring extent of progressive change with Herbert pendulum hardness tester.

HEALTH

PHYSIOLOGICAL REACTIONS TO AIR COOLING. Cooling Effect on Human Beings Produced by Various Air Velocities, F. C. Houghten and C. P. Yagloglou. Am. Soc. Heat. & Vent. Engrs.—Jl., vol. 30, no. 2, Feb. 1924, pp. 169-184, 13 figs. Study of relation of temperature, humidity and air motion to human comfort, giving details of tests and results obtained.

PHYSIOLOGICAL REACTIONS TO HIGH TEMPERATURES. Air Motion—High Temperatures and Various Humidities—Reactions on Human Beings, W. J. McConnell and C. P. Yagloglou. Am. Soc. Heat. & Vent. Engrs.—Jl., vol. 30, no. 3, Mar. 1924, pp. 199-224, 19 figs. Results of experiments on physiological reactions to high temperatures and humidities, presented with the view of illustrating influence moving air exerts over still air.

HEAT TRANSMISSION

BUILDINGS. Measuring Heat Transmission in Building Structures and a Heat Transmission Meter, P. Nicholls. Am. Soc. Heat. & Vent. Engrs.—Jl., vol. 30, no. 1, Jan. 1924, pp. 35-70, 30 figs. Deals with measurement of heat flow through walls, more particularly of existing structures. Outlines principles employed and describes in detail work done at A. S. H. V. E. research laboratory in an attempt to develop a heat transmission meter which will indicate instantaneous flows. Difficulties involved in such measurements and variable factors in building materials that will influence heat-transmission constants. Short review of present state of knowledge, future requirements, and indications of probable trend of investigational work.

THERMAL-CONDUCTIVITY VALUES. New Tests on the Thermal Conductivity of Liquids, Insulating Materials and Metals (Nouveaux essais sur la conductibilité calorifique des liquides, matières isolantes et métaux), M. Jakob. Chaleur & Industrie, vol. 5, no. 46, Feb. 1924, pp. 62-65, 3 figs. Shows how to utilize to advantage relations between thermal properties of bodies and their employment in industry.

HEAT TREATMENT

ELECTRICAL PROCESS. Annealing, Hardening, and Tempering by the Electrical Process. Machy. (Lond.), vol. 24, no. 609, May 29, 1924, pp. 263-265, 5 figs. Heat treatment of ferrous and non-ferrous wire and strip.

606

HEATING, ELECTRIC

Advantages and Uses. The Place of Electricity in the General Heating Field, L. P. Hynes. Am. Soc. Heat. & Vent. Engrs.—Jl., vol. 30, no. 1, Jan. 1924, pp. 17-24, 1 fig. Peculiar advantages of electric heat, and practical data for readily determining when and how to use it in solving some of the especially perplexing problems which confront heating engineer.

HEATING, HOT-AIR

Pipe Sizes. Principles of Design in Furnace Heating. Sheet Metal Worker, vol. 15, no. 10, June 6, 1924, pp. 373-376 and 404. Simplified method of determining leader sizes based on standard code for regulating installation of warm-air furnaces in residences.

HEATING, STEAM

Central. Central Station Heating Requirements, H. A. Woodworth. Power Plant Eng., vol. 28, no. 12, June 15, 1924, pp. 658-662, 7 figs. Conservation of fuel due to double use of steam, that is, for electric generation and commercial heating purposes; modern heating system at Grand Rapids, Mich.; modern underground construction.

The Economical Utilization of Heat from Central Station Plants, N. W. Calvert and J. E. Seiter. Am. Soc. Heat. & Vent. Engrs.—Jl., vol. 30, no. 1, Jan. 1924, pp. 1-16, 15 figs. Shutting off of steam at night and during day; thermostatic control; vacuum systems; building details for efficient heating; data on heat consumption; etc.

HOISTS

Mine. Novel Features of Electric Mine Hoists Recently Installed in Northern Ontario, H. V. Haight. Elec. News, vol. 33, no. 9, May 1, 1924, pp. 52-55, 5 figs. Details of two hoists recently built for use in Porcupine mining districts double-drum type; controlled by compressed air; 250-hp. motor used in each case; liquid rheostat found most suitable.

HYDRAULIC MACHINERY

Glycerine, Use in. The Use of Glycerine in Hydraulic Machinery, F. Mercier. Mech. Eng., vol. 46, no. 6, June 1924, p. 353. Results of investigation. (Abstract.) Translated from Revue Industrielle, vol. 54, no. 29, Apr. 1924.

HYDRAULIC TURBINES

Characteristic Curves. The Characteristic Equations of Reaction and Impulse Water Turbines, H. W. Coultes. World Power, vol. 1, no. 5, May 1924, pp. 292-296, 5 figs. Shows how quantities are related and how equations can be obtained for characteristic curves of turbines.

Draft Tubes for. Draft Tubes for Hydraulic Turbines, J. M. Dymond. Univ. of Toronto Eng. Soc.—Trans. & Year Book, Apr. 1924, pp. 63-81, 10 figs. Functions of draft tubes; past types of draft tubes, and present outstanding types; present-day tendencies; special devices. List of references.

Factory. The Control of Power Production, Chas. L. Hubbard. Factory, vol. 32, no. 6, June 1924, pp. 822-825 and 908, 20 figs. Hydraulic turbines as factory power source.

Governors. Study of Speed Regulators of Hydraulic Turbines with Regard to Their Influence on Efficiency of Installations, (Etude des régulateurs de vitesse des turbines hydrauliques au point de vue de leur influence sur le rendement global des installations), Cayère. Houille Blanche, vol. 23, no. 85-86, Jan.-Feb. 1924, pp. 10-18, 21 figs. Examination of three distinct elements of problem: Role of governors in maximum distribution of load among the different stations; in maximum utilization of hydraulic energy in plants having no reserve; and in maximum utilization of energy of plants having hydraulic reserve supply.

Hydro-electric Equipment. Recent Developments in Hydro-electric Equipment, Wm. M. White. Am. Inst. Elec. Engrs.—Jl., vol. 43, no. 6, June 1924, pp. 519-524, 10 figs. Facts relating to recent developments in hydro-electric machinery, such as that installed at power house at Mitchell Dam, Alabama.

HYDRO ELECTRIC DEVELOPMENTS

Carolinas. The Catawba River Development. Elec. World, vol. 83, no. 24, June 14, 1924, pp. 1234-1236, 1 fig. How hydro-electric power is utilized in Carolina to supply large group of textile industries; operating conditions.

Interdependence of Irrigation and. The Interdependence of Irrigation and Hydro-electric Power, J. D. Galloway. Jl. of Elec., vol. 52, no. 10, May 15, 1924, pp. 351-354, 2 figs. Exposition of relation of these two factors in Western development and of use of water for both purposes.

LaGabelle, Can. Power Developments on St. Maurice River, L. H. Burpee. Can. Engr., vol. 46, no. 22, May 27, 1924, pp. 553-556 and 570, 6 figs. Existing hydro-electric plants on St. Maurice river produce 450,000 hp.; new development at LaGabelle will increase this by 150,000 hp. Some power house construction details. Paper read at Toronto branch, Eng. Inst. Canada.

HYDRO-ELECTRIC PLANTS

Automatic Operation. Present Practice in the Automatic Operation of Hydro-electric Generating Stations, R. J. Wensley. Am. Inst. Elec. Engrs.—Jl., vol. 43, no. 6, June 1924, pp. 508-513, 3 figs. Various methods of starting and controlling together with their limitations; sequence of operations in modern automatic switching equipment.

Scheme of Arrangement. The Arrangement of Hydro-electric Plant sof High and Medium Head (Quelques notes sur l'organisation des hautes et moyennes chutes d'eau), E. Maurein. Arts & Métiers, vol. 77, no. 43, Apr. 1924, pp. 126-135, 20 figs. Study of scheme of arrangement whereby weir pond is eliminated and head race is replaced by supply tunnel driven in mountain.

I

ICE PLANTS

Distilled-Water. Ice Plant Installs Uniflow Engines. Power, vol. 59, no. 25, June 17, 1924, pp. 981-982, 4 figs. Plant at Memphis, Tenn., economizer by purchasing governmental excess machinery; how water is treated; ice-storage facilities.

Oil Engines in. Oil Engines as a Prime Mover in the Ice Plant, C. T. Baker. Ice & Refrigeration, vol. 66, no. 5, May 1924, pp. 467-469. Discusses various features of primary interest to business man, including dependability, maintenance costs, different methods of drive, kind of fuel, etc. See also Refrig. Wld., vol. 59, no. 5, Apr. 1924, pp. 13-15.

IGNITION

Automobile Engines. Vacuum Tubes Applied to Engine Ignition. Automotive Industries, vol. 50, no. 24, June 12, 1924, pp. 1287-1289, 4 figs. Automotive application of thermionic valve, patented by Robert Bosch, makes it possible to place ignition system anywhere on car and eliminate mechanical interrupter.

INDUSTRIAL MANAGEMENT

Production Control. Results of Scientific Management from the Viewpoint of Corporate Control, M. M. Baker. Mgt. & Administration, vol. 7, no. 6, June 1924, pp. 645-646. Discusses general effect of scientific management upon entire organization of manufacturing institution.

Records. The Works Records Department, W. J. Hiscox. Indus. Management (Lond.), vol. 11, nos. 1, 3, 6 and 10, Jan. 10, Feb. 7, Mar. 20 and May 15, 1924, pp. 6-7, 67-69, 151-152 and 265-266, 9 figs. Describes its function, dealing with delays, what records should show, stock records and costing, and employment records.

Suggestion System. A Suggestion System That Works, K. H. Condit. Am. Mach., vol. 60, no. 25, June 19, 1924, pp. 923-925, 4 figs. Description of system used by the Gilbreths; purpose is to secure from men on job suggestions for improvement in manufacturing methods; useful by-products of system.

INDUSTRIAL ORGANIZATION

Basic Principles. The Basic Principles of Organization, T. H. Jackson. Military Engr., vol. 16, no. 86, Mar.-Apr. 1924, pp. 95-99. Discusses decentralization, selection of group leaders, policy of command, creation of new groups, appointment of group leaders, specialist command, organizing around leaders, support of group leaders, and excessive overhead.

INSULATING MATERIALS, ELECTRIC

Electrical Machinery, for. Insulation of Electrical Apparatus, A. P. M. Fleming. Electrician, vol. 92, no. 2402, May 30, 1924, pp. 656-657, 1 fig. Trend of its development; some striking changes; influence of ventilation.

INSULATORS

Suspension. A New 110,000-Volt Suspension Insulator. Elec. World, vol. 83, no. 24, June 14, 1924, pp. 1229-1230, 3 figs. Single-unit suspension insulator of radical design proposed for high-tension service; details of development and of unit and comments of engineers at A.I.E.E. meeting.

INSULATORS, ELECTRIC

1,000,000-Volt Testing Rooms for. The First European Testing Room for Alternating Current of 1 Million Volts Pressure. Eng. Progress, vol. 5, no. 5, May 1924, pp. 93-95, 8 figs. Reasons for building testing room, which is intended to ascertain quality of suspension, pin-type and leading-in insulators, etc.; building and mechanical equipment; transformer plant; erected at porcelain works in Freiberg (Saxony) of Hermsdorf-Schomburg Insulator Co.

INTERNAL-COMBUSTION ENGINES

Naphthalene. Naphthalene Engines (Les moteurs à naphtaline), C. Anguenot. Société Industrielle de Mulhouse—Bul., vol. 90, no. 1, Jan. 1924, pp. 57-71, 6 figs. Describes types of engine for burning naphthalene, constructed by Société anonyme des moteurs économiques à naphthaline (A. A. M. E. N.), which are said to be particularly well adapted to light industry and farming.

Two-Cycle Double-Acting. A New Two-Cycle Double-Acting Engine (Un nouveau moteur à deux temps et à double effet), R. Mathieu. Outillage, vol. 344, no. 3, Mar. 1924, pp. 17-18, 2 figs. Details of Leroy light explosion-type engine.

See also Automobile Engines; Diesel Engines; Gas Engines; Oil Engines.

IRON

Corrosion. The Relation of Hydrogen Ion Concentration to the Corrosion of Iron, J. W. Shipley and I. R. McHaffie. Can. Chem. & Metallurgy, vol. 8, no. 5, May 1924, pp. 121-124, 6 figs. Corrosion of iron in contact with graphite; corrosion of iron in absence of oxygen; corrosion of gray cast iron in soil water of pH 7 4 and saturated with oxygen; hydrogen-ion concentration obtained when iron is in contact with water; rate of corrosion of iron in absence of oxygen in solutions of various hydrogen-ion concentrations.

Direct Production from Ore. The Direct Production of Iron, E. Fornander. Chem. & Met. Eng., vol. 30, nos. 22 and 23, June 2 and 9, 1924, pp. 864-868 and 907-910, 10 figs. Critical review of more important methods used to produce wrought iron from ore.

IRON MINING

Methods. Straight Line Production, F. J. Crolius. Blast Furnace & Steel Plant, vol. 12, nos. 5 and 6, May and June 1924, pp. 226-232 and 264-267 and 305, 11 figs. Practice at Woodward Iron in Birmingham, Ala., district; chemical composition of ores; mining system; production and consumption of iron ore; typical installations; Crockard furnace top; pig bed machines.

IRON ORE

Canadian, Beneficiation Tests. Beneficiation Tests, W. B. Timm. Can. Min. Jl., vol. 45, no. 20, May 16, 1924, pp. 481-483. Results of experimentsl tests on beneficiation of Canadian iron ores.

IRON CASTINGS

Cupola Mixtures for. Simplifying Cupola Mixtures, Geo. A. Drysdale. Foundry, vol. 52, no. 11, June 1, 1924, pp. 433-434. Claims that chemical composition of pig irons used should closely parallel that for castings required; uniform amounts used in cupola mixture produce more even product.

Monobloc Cylinder. Making a Monobloc Cylinder Casting. Eng. Production, vol. 7, no. 141, June 1924, pp. 176-180, 25 figs. Describes equipment designed for intensive manufacture of small monobloc cylinder castings of 63-mm. bore by 69-mm. stroke. Methods adopted to secure quality in quantity production.

IRRIGATION

Canals. Construction of Concrete Lined Irrigation Canals, W. E. Code. Eng. & Contracting (Water Works), vol. 61, no. 6, June 11, 1924, pp. 1314-1316, 1 fig. Methods and costs on two jobs in Arizona. From recent bulletin of Agricultural Experiment Station of Univ. of Ariz.

L

LATHES

High-Speed. Modern High-Speed Lathes. Eng. Progress, vol. 5, no. 5, May 1924, pp. 81-84, 9 figs. Design of headstock, feed gear, etc. of high-speed lathe manufactured by Heidenreich & Harbeck, Hamburg; comparison of economy with ordinary lathes.

Interchangeable Construction. Building Lathes Interchangeably, Chas. O. Herb. Machy. (N. Y.), vol. 30, no. 10, June 1924, pp. 758-761, 8 figs. Manufacturing methods used by Chard Lathe Co., New Castle, Ind., to facilitate assembly of machines and supply of replacement parts.

LIGHTING

Automobile Factory. The White Motor Company Improves Illumination, H. Hylkema and H. T. Spaulding. Elec. World, vol. 83, no. 23, June 7, 1924, pp. 1177-1181, 6 figs. How engineering investigation recommended 4957 outlets, raising average intensity to 12 foot-candles; new type of reflector partly lights ceiling; more than 1800 units installed.

Factories. The Relation of Illumination to Production, W. E. Bush. Eng. Production, vol. 7, no. 140, May 1924, pp. 124-129 (includes discussion), 14 figs. Foot-candle meter; shadows; illumination and vision; effect of light on output.

INDUSTRIAL, UNIT COSTS OF. Unit Costs of Industrial Lighting, D. H. Tuck. Illuminating Eng. Soc.—Trans., vol. 19, no. 5, May 1924, pp. 411-419 and (discussion) 419-423, 1 fig. Unit costs of installation and operation of various actual systems of lighting in industrial plants. Value of unit costs is in comparing economy of installation and operating costs of various types of lighting and in arriving at a quick estimate of cost of any industrial lighting installation when area to be illuminated, foot-candle intensity to be obtained and type of equipment to be used are known.

RAILWAY YARDS. Railroad Yard Lighting, W. C. Gilman. Ry. Elec. Engr., vol. 15, no. 6, June 1924, pp. 185-189, 6 figs. Discusses various methods of using floodlighting projectors, with advantages of each.

SCHOOL BUILDINGS. Code of Lighting School Buildings. Illuminating Eng. Soc.—Trans., vol. 19, no. 5, May 1924, pp. 375-410, 21 figs. partly on supp. plates. Revision of Illuminating Eng. Soc.'s code issued in 1918.

STREET. Some Notes on Street Lighting, P. S. Millar. Am. Inst. Elec. Engrs.—Jl., vol. 43, no. 6, June 1924, pp. 495-503, 9 figs. Test data upon certain sizes and types of incandescent lamps for street lighting; present status of street lighting; presentation of selected list of modern lamp posts and lighting equipments; data to show character of installations recommended by experts for lighting of various classes of streets.

LIGNITE

SOURCE OF HEAT. Lignite Fuel Source of Heat for Industries, W. Roth. Gas Age-Rec., vol. 53, no. 22, May 31, 1924, pp. 763-764. Recent development, in Germany, described by editor of Chemiker Zeitung, including gas from liguite, by-products from lignite, and lignite for central stations.

LIMESTONE

LIME PRODUCTION FROM SMALL STONE. The Production of Lime From Small Stone, W. M. Myers. U. S. Bur. Mines, Reports of Investigations, No. 2596, Apr. 1924, 9 pp. Conversion of small stone into lime is most desirable means of disposal. Difficulty of burning lime in shaft kiln; calcination of small stone impeded by CO gas; possible alterations in shaft kiln construction; use of rotary kiln, its advantages and disadvantages.

LIQUIDS

HEAT TRANSFER. Heat Transfer vs. Agitation, D. E. Pierce and P. B. Terry. Chem. & Met. Eng., vol. 30, no. 22, June 2, 1924, pp. 872-873, 3 figs. Discusses use of agitation as means of increase of heating or cooling in places where it is difficult to provide more transfer surface.

LOCOMOTIVE BOILERS

FLUE HOLES AND PATCHES. Flue Holes and Patches, T. P. Tulin. Boiler Maker, vol. 24, no. 5, May 1924, pp. 134-135, 6 figs. Methods of installing flue "blinders" with welding process and flue-sheet patches.

LOCOMOTIVES

BRITISH EMPIRE EXHIBITION. Locomotive Development, J. H. Brittain. Engineer, vol. 137, no. 3568, May 16, 1924, 528-531, 9 figs. partly on supp. plate. Description and comparison of Lond. & North-Eastern Ry. (Great Northern) 3-cylinder locomotive, Flying Scotsman, Great Western 4-cylinder locomotive, Caerphilly Castle, both of which are exhibited at Brit. Empire Exhibition, and Vincent Raven's 3-cylinder Pacific, which is not exhibited.

DAILY PROGRAM AND PERFORMANCE. Daily Program and Performance of a Locomotive, R. S. Parsons. Ry. Rev., vol. 74, no. 20, May 17, 1924, pp. 884-886. Discussion from transportation viewpoint of locomotive performance in fast freight, slow freight and switching service. (Abstract.) Paper read before central Ry. Club.

DRAFTING CONDITIONS, CONTROL OF. Exhaust Nozzle and Front End Adjustment, D. L. Derrom. Ry. Mech. Engr., vol. 98, no. 6, June 1924, pp. 362-365, 2 figs. Outlines effective means of controlling changes in drafting conditions.

MECHANICAL DRAFT. Report on Front-Ends, Grates and Ashpans, E. C. Schmidt. Ry. Rev., vol. 74, no. 23, June 7, 1924, pp. 999-1004, 6 figs. Devices for creating mechanical draft in locomotives and description of draft arrangements of oil-burning locomotive. (Abstract.) Report of committee to Int. Ry. Fuel Assn.

LUBRICATING OILS

SPECIFIC HEATS. Specific Heats of Lubricating Oils, E. H. Leslie and J. C. Geniesse. Indus. & Eng. Chem., vol. 16, no. 6, June 1924, pp. 582-583, 1 fig. Measurement of specific heats of six typical lubricating oils over range of temperature from 37.78 to 143.33 deg. cent.

LUBRICATION

ECONOMICS. Economics of Lubrication—Suggestions for a Research Program, W. F. Parish. Nat. Petroleum News, vol. 16, no. 19, May 7, 1924, pp. 59-60 and 63. Deals with lubrication of steam railroads, electric roads, and farming, marine, automotive and industrial machinery.

M

MACHINE SHOPS

ECONOMICAL MACHINING METHODS. Analysis of a Machine-Shop Problem on a Quantity and Final-Economy Basis, A. L. De Leeuw. Mech. Eng., vol. 46, no. 6, June 1924, pp. 335-338 and 362, 1 fig. Discusses nature of analysis which should be followed in determining most economical method of machining work, either in large or small quantities; deals only with items relating to actual machining processes; particular attention is called to difference between saving of labour cost and ultimate economy; as example some of operations on automobile connecting rod are taken. (Abridged.)

SINGLE PIECES, MACHINING OF. Economical Machining of Single Pieces, A. A. Dowd. Iron Age, vol. 113, no. 14, Apr. 3, 1924, pp. 989-991, 4 figs. Cause of loss in setting up machine tools for repair or replacement jobs: handling of work by planning department advantageous.

MACHINE TOOLS

BRITISH EMPIRE EXHIBITION. The British Empire Exhibition. Machy. (Lond.), vol. 24, no. 608, May 22, 1924, pp. 241-250, 17 figs. Machine tools and mechanical equipment.

MAGNETIC CONTROL. Electric Drive and Magnetic Control for Machine Tools, A. L. Harvey. Elec. Jl., vol. 21, no. 6, June 1924, pp. 265-269, 9 figs. Advantages of use of electric drive with magnetic control; reversing drive; suggestions in connection with operation.

SLOTTING MACHINES. Tooling Reciprocating Machine Tools. Eng. Production, vol. 7, no. 141, June 1924, pp. 166-169, 6 figs. Various methods of extending utility and scope of slotting machines.

MAPPING

TOPOGRAPHIC. A Review of Topographic Mapping, G. S. Smith. Military Engr., vol. 16, no. 86, Mar.-Apr. 1924, pp. 108-115, 7 figs. partly on supp. plate. Review of development of topographic mapping, and experience of government organizations.

MATERIALS

CARE AND CONTROL. The Care and Control of Raw Materials. Factory, vol. 32, no. 6, June 1924, pp. 831-834, 872, 874 and 876, 4 figs. Plan adopted by Bausch & Lomb Optical Co. involves use of one central store and branch or divisional stores.

MATERIALS HANDLING

MECHANICAL EQUIPMENT. Speeding Industrial Progress, M. W. Potts. Indus. Mgt. (N. Y.), vol. 67, no. 6, June 1924, pp. 348-355, 12 figs. How mechanical handling is revolutionizing all industry.

METALLURGICAL WORKS, RUHR. Materials Handling in the Metallurgical Industry of the Ruhr (Les engins de manutention dans l'industrie de la Ruhr), R. de Boysson. Vie Technique & Industrielle, vol. 5, no. 54, Mar. 1924, pp. 365-371, 12 figs. Describes gantries and cranes employed in storage houses and yards, blast-furnace, rolling-mill equipment, and foundry equipment, inter-plant transportation, and private railways connecting mines and plants.

MEASUREMENTS

SHOP. Shop Measurements, E. Buckingham. Univ. of Toronto Eng. Soc.—Trans. & Year Book, Apr. 1924, pp. 26-34. English standards of length; metric standards of length; purposes of shop measurement.

METALLURGICAL WORKS

LABOR-SAVING EQUIPMENT. Labor Saving Machinery Adopted, G. H. Charls. Iron Trade Rev., vol. 74, no. 24, June 12, 1924, pp. 1563-1564. Devices used in various departments of coke plants, blast furnaces, steel works and rolling-mills to augment production and reduce costs.

METALS

MOLTEN, TEMPERATURE DETERMINATION OF. The Temperature Determination of Molten Metals, R. L. Binney and N. I. Terbille. Metal Industry (N. Y.), vol. 22, no. 5, May 1924, pp. 189-190. A combination of base metal and rare metal couples which proved trustworthy in brass foundry.

SULPHURIZING AND DESULPHURIZING OF. Sulphurizing and Desulphurizing of Metals by Basic Slags and Fluxes, B. Bogitch. Metal Industry (Lond.), vol. 24, no. 21, May 23, 1924, pp. 498-499. Describes methods and results of experiments. Translated from French, and contributed at symposium arranged by Faraday Soc., Inst. Metals, Inst. British Foundrymen, and Non-Ferrous Research Assn.

THERMAL EMISSIVE POWER. The Relation Between the Total Thermal Emissive Power of a Metal and Its Electrical Resistivity, C. Davisson and J. R. Weeks, Jr. Optical Soc. of Am.—Jl., vol. 8, no. 5, May 1924, pp. 581-605, 6 figs. Theoretical considerations. Details of experiments, and results obtained. Bibliography.

MINES

COMMUNICATION IN. Radio as a Method for Underground Communication in Mines, J. J. Jakosky. U. S. Bur. Mines, Reports of Investigations, No. 2599, Apr. 1924, 4 pp. Discussion of some of the factors involved in applying radio in mines.

EQUIPMENT, MAINTENANCE OF. How to Keep Mining Equipment in Satisfactory Operating Condition at All Times, J. F. MacWilliams. Coal Age, vol. 25, no. 23, June 5, 1924, pp. 843-844, 1 fig. Electrical apparatus should be supplied with rated voltage; repair of worn parts by welding and machining; pumps and fans must not be required to deliver more than their normal capacity. Paper delivered before Min. Inst.

MECHANICAL LOADING. Mechanical Loading—Advantages and Disadvantages. Min. Congress Jl., vol. 10, no. 6, June 1924, pp. 267-271, 3 figs. Rapid development of machine loading; application of various types of loaders; room and pillar mining; mine cars; conveyor haulage; combined cutting and loading machines; etc. Discussion at Am. Min. Congress mtg.

MOLDING METHODS

PROPELLER IN LOAM. Molding a Propeller in Loam, L. V. Johnston. Foundry, vol. 52, no. 11, June 1, 1924, pp. 446-448, 1 fig. Methods and rigging employed for purpose; necessity for skill and observance of care and accuracy.

MOLDING MACHINES

SQUEEZER. The Squeezer Molding Machine, R. E. Search. Metal Industry (N. Y.), vol. 22, no. 5, May 1924, pp. 191-194, 7 figs. Principles of this type of machine. Various makes and their applications.

MORTARS

ALKALI, EFFECT OF. Effect of Alkali on Strength of Mortar, Chas. E. Proudley. Pub. Roads, vol. 5, no. 3, May 1924, pp. 25-26, 2 figs. Tests of mortar briquets made in laboratory of U. S. Bur. of Pub. Roads to determine to what extent presence of alkali in mixing water is harmful.

MOTOR BUSES

TRANSPORTATION WITH. Motorbus Transportation, A. E. Hutt. Soc. Automotive Engrs.—Jl., vol. 14, no. 6, June 1924, pp. 591-593. Outlines underlying principles of motor-bus transportation and makes suggestions concerning certain features conducive to successful operation.

MOTOR-GENERATORS

ARC-WELDING. The Selection of a Single-Operator Arc-Welding Motor-Generator Set, M. S. Hancock. Elec. Jl., vol. 21, no. 6, June 1924, pp. 269-272, 2 figs. Points that should be considered by purchaser in selection.

MOTOR-TRUCK TRANSPORTATION

COST CALCULATION. Cost of Motor-Truck Transportation in Public Works (Coût des transports par camions automobiles dans les travaux publics), A. Mettler. Société des Ingénieurs civils—Mémoires et Compte Rendu des Travaux, vol. 76, nos. 10-12, Oct.-Dec. 1923, pp. 1138-1144, 2 figs. Develops formula and chart for calculating cost of transportation of cubic meter of material for a given distance.

MOTOR TRUCKS

ELECTRIC. Why American Railway Express Uses 1,800 Electric Trucks, Rob. E. M. Cowie. Elec. World, vol. 83, no. 21, May 24, 1924, pp. 1084-1085. Definite reasons for adoption of electric transportation; fifteen specific advantages of electric truck as compared with gasoline and other types of vehicles are enumerated. (Abstract.) Address delivered before Nat. Elec. Light Assn.

LOADING AND UNLOADING. Loading and Unloading Bulk Materials to and from Motor Vehicles. Indus. Mgt. (Lond.), vol. 11, nos. 8, 9 and 10, Apr. 17, May 1 and 15, 1924, pp. 215-217, 246-249 and 277-279, 12 figs. Described different methods.

SPECIFICATIONS. Gas Truck and Tractor Specifications. Power Wagon, vol. 32, no. 234, May 1924, pp. 40-47. Table giving specifications for different makes.

N

NICKEL ALLOYS

Permalloy. The Reluctivity of the Recently Discovered Magnetic Metal Permalloy, A. E. Kennelly. Franklin Inst.—Jl., vol. 197, no. 5, May 1924, pp. 623-627, 2 figs. Gives data on observations of permalloy.

O

OFFICE MANAGEMENT

Standard Paper Forms. Standard Forms for Office and Shop Use. Mgt. & Administration, vol. 7, no. 6, June 1924, pp. 695-698, 1 fig. Notes on selection of paper and sizes of forms.

OIL ENGINES

Production Methods. Production Methods on Large Oil Engines, L. S. Love. Iorn Age, vol. 113, no. 25, June 19, 1924, pp. 1777-1782, 14 figs. Savings effected in use of some special machines; ingenious fixtures on standard machines help to reduce costs.

OIL WELLS

Drilling. The Critical Line of Drilling in Oil-field Development, S. H. Breckunier. Eng. & Min. Jl.—Press, vol. 117, no. 21, May 24, 1924, pp. 850-851, 2 figs. Discussion of evil of overdrilling, with reference to Petrolia-Oil Springs district in Ontario.

OPEN-HEARTH FURNACES

Extensions, Inland Steel Co. Increases Steel-making Capacity, E. C. Boehringer. Iron Trade Rev., vol. 74, no. 24, June 12, 1924, pp. 1566-1567, 3 figs. Extension at open-hearth department of Inland Steel Co. plant at Indiana Harbor, Ind.; augments output 18 per cent; charging doors and reversing valves electrically operated; describes new units.

Heat Losses in. Heat Losses in Open Hearth Furnaces, W. Dyrssen. Fuels & Furnaces, vol. 2, no. 6, June 1924, pp. 565-569, 3 figs. Heat balance showing how 40 per cent of heat in fuel may be obtained in total steam in a furnace without gas checkers passing part of waste gases from melting chamber direct to boiler.

ORE TREATMENT

Chloride Blast Roasting and Leaching. Laboratory Tests for Chloride Blast Roasting and Leaching, T. P. Holt. Eng. & Min. Jl.—Press, vol. 117, no. 23, June 7, 1924, pp. 922-925, 5 figs. Describes practice as how followed, method of analysis used, and gives metallurgical notes bearing on adaptability of ores in general to this treatment.

OXY-ACETYLENE WELDING

Cast Iron, Bronze Welding of. A New Field for the Oxy-Acetylene Process. Acetylene Jl., vol. 25, no. 11, May 1924, pp. 533-536, 9 figs. Bronze welding of cast iron pipe. Bronze welding overcomes practically all of the difficulties of preheating in the field and enables construction of cast-iron lines upon an economic basis.

OXYGEN

Electrolytic Generation. Catalytic Electrolytic Generation of Oxygen, C. G. Fink. Indus. & Eng. Chem., vol. 16, no. 6, June 1924, pp. 566-567. Deals primarily with anodes that form protective film electrolytically.

P

PAPER

Analysis. Rapid Analysis of Paper, J. Crolard. Paper, vol. 34, no. 3, May 8, 1924, pp. 87-89. Necessary conditions in analysis of sizing substances and description of methods employed. From Moniteur de la Papeterie Française.

Coated, Analysis of. Analysis of Coated Papers. Paper, vol. 34, no. 2, May 1, 1924, pp. 48-51. Methods available to paper chemists for ready determination and estimation of binding materials and surface coatings used in manufacture of coated paper.

PAPER MACHINERY

Newsprint Machines. Anti-Friction Bearings on High-Speed Newsprint Machines, G. H. Spencer. Paper Trade Jl., vol. 78, no. 22, May 29, 1924, pp. 46-49, 11 figs. Fundamentals of plain and of anti-friction bearings, and advantages of anti-friction bearings. Paper read at Am. Pulp & Paper Mill Supts.' Assn. convention. See also Wood Pulp News, vol. 48, no. 23, June 7, 1924, pp. 16, 18 and 38, 8 figs.

Suction Rolls on News Machines, W. H. Theroux. Paper Mill, vol. 48, no. 21, May 24, 1924, pp. 44, 46 and 48. Treatment of subject from paper-maker's standpoint.

The Modern News Print Machine, A. N. Russell. Paper Mill, vol. 48, no. 22, May 31, 1924, pp. 26, 28 and 30. Discusses recent improvements, including Fourdriniers, improvements in press sections and in dryer section, etc.; advantages to be derived from driving paper machines by sectional electric drive.

PAPER MANUFACTURE

Beaters. Shartle Continuous Beater. Paper, vol. 34, no. 2, May 1, 1924, pp. 38-39, 8 figs. Describes new invention providing a battery of beaters for continuous operation in combination with raw stock breaker for manufacture of paperboard.

Drying. Drying Paper, F. C. Stamm and E. P. Gleason. Paper Trade Jl., vol. 78, no. 21, May 22, 1924, pp. 54-56, 5 figs. Discusses briefly drying methods in use to-day and brings out factors affecting drying. Outlines simple method of detecting some of the faults most commonly found. Paper read at Am. Pulp & Paper Mills Supts.' Assn. annual convention.

Pulp, Decay of. Decay of Wood and Groundwood Pulp, M. W. Bray. Paper Trade Jl., vol. 78, no. 23, June 5, 1924, pp. 58-60, 3 figs. Relation of loss in weight to chemical properties.

Pulp Manufacture. Soda Pulp Production, H. J. Payne. Chem. & Met. Eng., vol. 30, no. 21, May 26, 1924, pp. 817-822, 11 figs. Survey of methods and equipment, with emphasis on recent developments.

Pulp Sources. Sources of Pulp in North America, G. J. Druckerman. Paper Trade Jl., vol. 78, nos. 23 and 24, June 5 and 12, 1924, pp. 44, 46, 48, 50 and 82; and 36, 38 and 64, 2 figs. Compilation of statistics relating to North American resources in wood and woody substitutes for manufacture of paper.

PAPER MILLS

Electric Drive. Application of Electric Drive to Finishing Room Machinery, O. C. Cordes and W. W. Spratt. Paper Mill, vol. 48, no. 21, May 24, 1924, pp. 50 and 52. Covers, in a general way, machinery used in finishing room, touching on the various methods of electric drive and discussing their relative merits.

Rubber Bearings, Application of. The Adaption of "Cutless" Rubber Bearings to Pulp and Paper Mill Use, C. F. Sherwood. Paper Mill, vol. 48, no. 21, May 24, 1924, pp. 34, 36 and 48. It is impossible to imbed sand or grit in smooth resilient surface of live Olivete rubber, which is used in making rubber Construction of "cutless" rubber bearings, and its use in pulp and paper mills.

Sulphite Mills, Steam Economy in. Heat Problems in a Sulphite Mill, A. H. Lundberg. Paper Trade Jl., vol. 78, no. 22, May 29, 1924, pp. 41-45. Actual steam consumption for cooking, bleaching and drying of sulphite pulp and possibilities of savings. Paper read at Am. Pulp & Paper Mill Supts.' Assn. convention. See also Paper Mill, vol. 48, no. 21, May 24, 1924, pp. 14-16, 62 and 64.

PATENTS

Applications. The Preparation and Prosecution of Patent Applications, J. R. Langley. Elec. Jl., vol. 21, no. 6, June 1924, pp. 290-295.

PIPE, CONCRETE

Manufacture. The Manufacture of Pipe for Spavinaw Water Project. Eng. News-Rec., vol. 92, no. 21, May 22, 1924, pp. 899-902, 8 figs. 53 mi. of reinforced-concrete pipe made in field factory in 13½ months; operation rate at 97-per cent capacity was 1.3 mi. per week.

PISTONS

Accurate, Securing. Maxwell Method of Securing Accurate Pistons, F. H. Colvin. Am. Mach., vol. 60, no. 24, June 12, 1924, pp. 873-874, 4 figs. Novel chuck by which piston is squared with piston-pin hole before final turning; gages used in measuring checking and grading.

PLATES

Steel. The Calculation of the Weight of Steel Plates, E. V. Telfer. Shipbldg. & Shipg. Rec., vol. 23, no. 20, May 15, 1924, pp. 573-574, 1 fig. Considers the various steps entering into calculation of weight of steel plates, and simplification adopted by use of progressively improved methods. Gives nomogram.

PNEUMATIC TOOLS

Repair and Upkeep. Repair and Upkeep of Pneumatic Tools, R. W. Wilson. Instn. Mech. Engrs.—Proc., no. 2, Jan. 1924, pp. 151-163 and (discussion) 163-207, 19 figs. Consideration of what is necessary to maintain in efficient operation and in economical service pneumatic tools commonly used in engineering workshops and shipbuilding yards; these are roughly classified as reciprocating tools or pneumatic hammers, and rotating tools or pneumatic drills.

POLES

Sizes, Determination of. Determination of Pole Sizes, J. H. Mathews. Elec. World, vol. 83, no. 23, June 7, 1924, pp. 1173-1176, 1 fig. Table permitting quick calculating of pole size for almost any type of line and facilitating calculation of type of line that can be carried on selected poles; based on Nat. Elec. Safety Code.

POLES, WOODEN

Calculation. Calculation of Wooden Poles from Mechanical Viewpoint (Calcul des poteaux en bois au point de vue mécanique), P. Burdin. Revue Générale de l'Electricité, vol. 15, no. 18, May 3, 1924, pp. 799-805. Results of calculation, made with aid of logarithmic tables, are given in tabular form and relate to poles of from 9 to 20 m. in height and from 20 to 35 cm. in diam.

POLES, STEEL

Erection. 228 Transmission Towers Built and Erected in 75 Working Days, H. A. Scribner. Elec. News, vol. 33, no. 11, June 1, 1924, pp. 61-62, 4 figs. Methods employed in erection of towers for 132,000-volt double circuit 27-mile tower line erected by Pub. Service Co. of Northern Illinois.

POWER GENERATION

Steam. Modern Steam Power Generation, R. W. Angus. Univ. of Toronto Eng. Soc.—Trans. & Year Book, Apr. 1924, pp. 35-41, 3 figs. Brief discussion of some of the developments in economical generation of power by steam made during past 10 years, including bleeding of steam from turbines, mercury turbines, etc.

PULVERIZED COAL

Combustion. The Combustion of Pulverized Coal, E. Audibert. Colliery Guardian, vol. 127, no. 3306, May 9, 1924, pp. 1188-1189, 3 figs. Results obtained up to the present in a study, made by Comité Central des Houillères de France, of combustion of pulverized ocal, with object of ascertaining precautions to be observed in its application to boiler firing. Primary object of experiments were measurement of duration of combustion, and determination of essential conditions for use of a given coal in form of powder. From Revue de l'Industrie Minérale.

Developments and Advantages. Pulverized Fuel and Efficient Steam Generation, D. Brownlie. Instn. Elec. Engrs.—Jl., vol. 62, no. 329, May 1924 pp. 385-418 and (discussion) 418-469 1 fig. Detailed consideration of latest developments in use of pulverized coal for steam generation, and comparison of its advantages and disadvantages as compared with mechanical stoking under most modern conditions; full account of Lakeside station at Milwaukee with exact working costs, and description of River Rouge plant at Dearborn, Detroit, as representatives of modern pulverized-fuel practice; comparison with Dalmarnock power station, Glasgow, characteristic of best British mechanical-stoker practice; in author's opinion advantages of pulverized fuel are so great that they constitute almost revolution in boiler practice.

Physical Properties. A Study of the Physical Properties of Powdered Coal of Varying Degrees of Fineness; and of the Distribution of Ash and Volatile Matter among the Fractions of Different Size, Chas. Roszak. Fuel, vol. 3, no. 5, May 1924, pp. 161-165, 7 figs. Paper read at Congrès de Chauffage Industriel in Paris, 1923. See reference to original article in Eng. Index 1923, p. 526.

Use, Development in. Development in Use of Pulverized Coal, C. F. Herington. Elec. Light & Power, vol. 2, no. 5, May 1924, pp. 121-125 and 166, 6 figs. Review of development of its use in industrial furnaces, boilers, locomotives, etc.; comparison between pulverized coal and other fuels; future possibilities.

PUMPING STATIONS

Diesel-Engine Operation. Operating Experiences of a Diesel Engine Pumping Station, W. De Witt Vosbury. Fire & Water Eng., vol. 75, no. 23, June 4, 1924, pp. 1215, 1219 and 1224, 4 figs. Statistics showing experiments in use of Diesel engine in Gloucester, N. J., station, a typical small water-works pumping station.

Irrigation. An Electrically Operated Irrigation Plant, C. W. Geiger. Nat. Engr., vol. 28, no. 6, June 1924, pp. 259-261, 3 figs. Description of irrigation pumping plant of River Farms company in California; capacity 504,000,000 gal. per day; screw pumps designed to operate very efficiently at low heads and driven by synchronous motors constitute present equipment.

Irrigation Pumping Machinery (Gezira Scheme), Sudan, R. W. Allen. Engineering, vol. 117, nos. 3046 and 3047, May 16 and 23, 1924, pp. 654-656 and 685-687, 11 figs. Object of scheme is to provide, for purpose of growing cotton, irrigation of northern portion of Gezira plain; construction details of Wad-el-Nau pumping station; drainage arrangements; suction wells ann pipes; discharge pipes; labour employed on erection; trials of machinery. See also Engineer, vol. 137, no. 3568, May 16, 1924, pp. 549-550, 5 figs.

ROAD CONSTRUCTION

Cost Estimating. Notes on Estimating in Road Construction Work. Surveyor & Mun. & County Engr., vol. 65, no. 1687, May 16, 1924, pp. 465-467. Outlines a few examples illustrating how estimating prices are ascertained and numerous items which have to be considered in deducing such prices.

ROADS, BITUMINOUS

Tar-Macadam Plant. Tar Macadam Plant with Scroll Drier and Cube Mixer. Engineering, vol. 117, no. 3048, May 30, 1924, pp. 700-702, 12 figs. Details of plant installed at Port Clarence Works of Wake & Co., where is work is being carried out on large slag heap from which their aggregate is procured.

ROADS, CONCRETE

Impact Tests. Impact Tests on Concrete Pavement Slabs, L. W. Teller. Pub. Roads, vol. 5, no. 2, Apr. 1924, pp. 1-14, 22 figs. Details of tests made by U. S. Bur. Pub. Roads to determine resistance of various designs to impact of motor vehicles, and results obtained.

Tests. Wear of Concrete Pavements Tested, F. H. Jackson. Pub. Roads, vol. 5, no. 3, May 1924, pp. 1-19, 14 figs. Report of accelerated tests by U. S. Bur. of Pub. Roads show (1) no wear from rubber-tired wheels; (2) no strength-wear relation. (See also (abstract.) in Eng. News-Rec., vol. 92, no. 23, June 5, 1924, pp. 984-985, 1 fig.

White Joint Filler. White Joint Filler for Concrete Roads, L. G. Carmick. Pub. Roads, vol. 5, no. 3, May 1924, pp. 21-22, 4 figs. Two-years' trial shows value of new material.

ROADS, EARTH

Oiling of. Oil Test Roads Furnish Valuable Information in Illinois, H. F. Clemmer and F. L. Sperry. Highway Engr. & Contractor, vol. 10, no. 5, May 1924, pp. 37-40, 6 figs. Details regarding tests made by Illinois State Division of Highways in spring of 1923 on Cambridge test road, 3 miles in length and divided into 15 separate sections, and on Rosemond road, divided into 16 sections. Physical and chemical characteristics of oils used on experimental roads; results with oil applied in varying quantities and number of treatments; preparation and shaping of road for oiling; drainage; application of oil; etc.

ROLLING MILLS

Atlantic Steel Co., Atlanta, Ga. A Southern Rolling Mill, M. P. Lawton. Blast Furnace and Steel Plant, vol. 12, no. 6, June 1924, pp. 291-294 and 305 9 figs. Equipment and methods of Atlantic Steel Co.'s plant, Atlanta, for manufacture of hoop and cotton ties.

Sheet Mills. Sheet Steel Plant on Pacific Coast. Iron Age, vol. 113, no. 23, June 5, 1924, pp. 1650-1652, 5 figs. Six-mill installation put in operation by Pac. Sheet Corp. at South San Francisco, Cal.; blue annealed, black and galvanized sheets to suit local market.

ROLLS

Grinding. How Chilled Iron Rolls are Ground. Abrasive Industry, vol. 5, no. 5, May 1924, pp. 119-122, 5 figs. Special machines are provided for finishing steel-mill rolls. Value of grinding over turning.

S

SCREW MACHINES

Magazine Attachments. Design of Magazine Attachments, A. A. Dowd. Machy. (N.Y.), vol. 30, no. 10, June 1924, pp. 771-773, 4 figs. Problems of design; details of bar-stock magazine.

SEPARATION

Ash and Fuel. Recovering Unburned Fuel and Other Matter from Ash, C. H. S. Tupholme. Gas Age-Rec., vol. 53, no. 20, May 17, 1924. pp. 679-682, 7 figs. Description of British apparatus employed for this purpose with results of operation; a type of washer, known as the Columbus, which is actuated by difference in specific gravity between coke and clinker.

SEWAGE DISPOSAL

Activated Sludge. Four Activated-Sludge Plants in California, C. E. Grunsky, Jr. Eng. News-Rec., vol. 92, no. 22, May 29, 1924, pp. 937-939, 1 fig. Various systems of air distribution used include perforated pipes and Trent aerator on Barker-mill principle.

SHAFT SINKING

Freezing Process. Freezing Process Enables Lessees to Sink Shafts in Deep Marsh Land of North Belgium, M. Biquet. Coal Age, vol. 25, no. 23, June 5, 1924, pp. 831-834, 3 figs. Describes sinking of two shafts by refrigeration nearly a mile deep; 46 beds aggregating over 100 ft. of coal made almost unapprochable by hogs thousands of feed deep; shafts sunk with protecting ice wall.

SHEET METAL

Standardization. Standardization of Sheet Metal L. D. Mercer. Sheet Metal Worker, vol. 15, no. 9, May 23, 1924, pp. 327-328 and 350. Facts about waste in this industry, with recommendations on its elimination and on expansion of business.

SOLIDS

Density, Determination of. The Density of Liquid and Solid Substances (Sur la densité des corps liquides et solides), A. Damiens. Société Chimique de France—Bul., vol. 35-36, no. 4, Apr. 1924, pp. 455-463, 5 figs. Describes simple and accurate method of determination developed by author; apparatus employed.

SOUND

Quantitative Testing. The Quantitative Testing of Sound, C. E. Noel-Storr. Testing, vol. 1, no. 3, Mar. 1924, pp. 227-246, 9 figs. Reviews gradual development of sound testing instruments as applied to engineering. Some of the methods which have been devised and which have proven efficient in practical use.

STEAM ENGINES

Admission and Exhaust in. The Zeuner Valve Diagram, H. Smith. Pacific Mar. Rev., vol. 21, no. 5, May 1924, pp. 269-270, 1 fig. Practical use and solution of Zeuner diagram, a method by which a study of the various conditions governing admission and exhaust of steam can be made, in order to obtain a more thorough knowledge of events which take place inside cylinder. Relation to valve positions and indicator diagram.

Rolling Mills. British Rolling Mill Engine Design, Johnstone-Taylor. Iron Age, vol. 113, no. 24, June 12, 1924, pp. 1717-1719, 5 figs. Large and massive engines of marine type with special features; both horizontal and vertical 3-cylinder designs.

STEAM GENERATORS

Benson High-Pressure. The Scientific Principles of the Benson High Pressure Steam Generator, D. Brownlie. Eng. and Boiler House Rev., vol. 37, no. 10, May 1924, pp. 358-360, 2 figs.

STEAM PIPES

High-Pressure. Progress in High Pressure Piping Details. Power Plant Eng., vol. 28, no. 12, June 15, 1924, pp. 656-657. Recent tests show effects of expansion stresses in pipe; progress being made in flangebolt materials and design. (Abstract.) Report of Prime Movers Committee of N.E.L.A.

STEAM POWER

Economy. The Steady Progress in Steam Power Economy, Jas. T. Beard, 2nd. Indus. Mgt. (N. Y.), vol. 67, no. 6, June 1924, pp. 329-335, 8 figs. Review of progress from Newcomen engine to mercury boiler.

STEAM POWER PLANTS

Bonus Systems for. Practical Bonus Systems for Power Plants, G. Burgess. Nat. Engr., vol. 28, no. 6, June, 1924, pp. 255-258, 4 figs. Outline of bonus system methods for average power plant. Value of a bonus system in increasing interest of operators and efficiency of plant.

British and American Practice. Power Station Practice and Progress, W. H. Patchell. Power Plant Eng., vol. 28, no. 11, June 1, 1924, pp. 611-612. Comparison of British and American practice. (Abstract.) Address before (Brit.) Inst. Mech. Engrs.

Oil Refinery. Vacuum Oil Co. Plant at Paulsboro, N. J. Power Plant Eng., vol. 28, no. 12, June 15, 1924, pp. 31-636, 9 figs. All electric power used in refining processes is generated at plant by turbo-generators at potential of 2,300 volts; all turbines operate non-condensing against back pressure of about 20 lb.; details of boiler room and furnace design.

Wood-Refuse Burning. New Plant of American Seating Co. Burns Wood Refuse. Power, vol. 59, no. 23, June 3, 1924, pp. 892-897, 8 figs. Model 1,500-kw. industrial plant employing condensing turbo-generators with bleeder connections to balance exhaust-steam demands; high-pressure steam supplied to manufacturing departments.

STEAM TURBINES

Assembling Runners. Assembling 15,000-Horse-power. Impulse-Turbine Runners, Ralph Brown, Power, vol. 59, no. 22, May 27, 1924, pp. 867-868, 3 figs. Methods employed in assembling rotor spiders for 22,222-kva. generator.

Developments. Developments in Steam-Turbine Field, E. H. Brown. Power, vol. 59, no. 25, June 17, 1924, pp. 989-992, 2 figs. Steam turbine from its inception in 1884, with particular reference to recent developments in American and European practice, such as general application of stage heating, use of high pressures with resuperheating, and improvements designed to give high efficiency at moderate peripheral velocities for rotating parts. Paper presented at Wis. Utilities Assn.

Mixed-Pressure. Mixed-Pressure Turbine versus a New Steam Plant, F. S. Yontsey. Power, vol. 59, no. 24, June 10, 1924, pp. 934-936, 3 figs. To supply power to new mine 4½ mi. distance, mixed-pressure turbine in home plant was selected over steam plant at new mine or additional high-pressure capacity in original plant; salient features are condenser and cooling-water installations.

STEEL

Alloy. *See Alloy Steels.*

Identification by Grindstone Sparks. Differentiation of Steels by Examination of the Grindstone Sparks in Air and in Oxygen (Différenciation des aciers par l'examen des étincelles de meulage dans l'air et dans l'oxygène), E. Pitois. Académie des Sciences—Comptes Rendus, vol. 178, no. 11, Mar. 10, 1924, pp. 942-944. By placing sheet of glass in path of sparks and examining incrustations so obtained, it is found that, in air, most of particles obtained by grinding from ordinary steels undergo fusion; these incrustations are not wholly pearlitic, but exhibit wide regions of ferrite resulting from decarburization, latter becoming complete in atmosphere of oxygen; photographic representations of sparks were obtained; this method of examination is of special value for valve steels.

Magnetic. A study of the Old and the New Magnet Steels, E. Gumlich. Testing, vol. 1, no. 3, Mar. 1924, pp. 194-222, 10 figs. Deductions, based mostly on investigations undertaken in Magnetic Laboratory of Physico-Technical Govt. Inst. (Phys. Techn. Reichsanstalt) at Charlottenburg, reviewing what a permanent magnet is able and is required to accomplish, and which of the older and newer kinds of steel are meeting the respective requirements.

STEEL CASTINGS

Design. Designing Steel Castings, E. R. Young. Machy. (N. Y.), vol. 30, nos. 9 and 10, May and June 1924, pp. 701-703 and 790-792, 8 figs. Problems encountered in production. May: Pattern design; effect of dry sand and green sand molds on shrinkage; cores; rip design; size and shape of castings; chemical composition; finish allowances. June: Engineering or structural design; castings of intricate design; fatigue strength of castings.

Manufacture. The Manufacture of American Steel Castings, W. H. Woodhall. Foundry Trade Jl. vol. 29, no. 404, pp. 399-401. Molding methods, acid or basic melting, physical properties and tests, dirty versus clean steel, sampling, cleaning and inspection, annealing furnaces, annealing period, etc.

STEEL, HEAT TREATMENT OF

Carburizing. Practical Views on Carburizing, J. Sorenson. Fuels and Furnaces, vol. 2, no. 6, June 1924, pp. 583-584 and 587-588, 2 figs. Outlines the various thermal treatments in carburizing and results to be secured with each.

Production Methods. Heat-treatment of Steel with Special Reference to Production, J. W. Urquhart, Machy. (Lond.), vol. 24, no. 608, May 22, 1924, pp. 230-233. Locomotive and car-axle treatments; mild treatment; production of unequal stresses; importance of reduction forging and steel selection for this work; quenching media; dynamic endurance and tensile strength; quenching of coreless pieces.

STEEL MANUFACTURE

Ordnance Steel. Making Steel for Ordnance Use, J. B. Rhodes. Iron Trade Rev., vol. 74, no. 22, May 29, 1924, pp. 1429-1430 and 1433. Points out that reduction of iron oxide to minimum is essential; sulphur and phosphorus should be eliminated; steel quality affected by slag; shop-practice instructions are suggested. (Abstract.) Paper presented before Am. Iron and Steel Inst.

Processes. The Manufacture of Iron and Steel and Tubular Products, R. J. Kaylor. St. Louis Ry. Club—Proc., vol. 28, no. 12, Apr. 11, 1924, pp. 258-273. Describes some of the major processes connected with manufacture of steel of various kinds.

STEEL WORKS

Developments. A Gigantic Automaton, A. R. R. Jones. Iron & Steel of Canada, vol. 7, nos. 4 and 6, Apr. and June 1924, pp. 61-65 and 99-103, 12 figs. Part that mechanism is playing in steel industry, and amelioration that has taken place in working conditions.

STOKERS

Efficiency, Calculation of. Computing Guaranteed Stoker Efficiency, H. F. Gauss. Power, vol. 59, no. 22, May 27, 1924, pp. 858-860, 3 figs. Deals with unaccountable losses, moisture in coal, available hydrogen content and combustible matter in ash.

Water-Tube and Cylindrical Boilers. Mechanical Stokers and Boiler Furnaces. Eng. and Boiler House Rev., vol. 37, no. 11, June 1924, 18 pp. between pp. 397-422, 19 figs. Notes on present-day practice describing some leading types in use for water-tube and cylindrical boilers.

STREET RAILWAYS

Car Lubrication. Lubricating Practice for Electric Cars. Elec. Ry. Jl., vol. 63, no. 20, May 17 1924, pp. 763-766, 4 figs. Analysis of quantity of lubricant used, period of oiling, and methods of applying lubricants as found from a study covering 57 electric railway properties.

Track Structure. Observations on the Track Structure, H. P. Hevenor. Elec. Ry. Jl., vol. 63, no. 19, May 10, 1924, pp. 737-740, 6 figs. Relative advantages of various types of flexible and rigid construction; opinion expressed as to type to be built to meet various conditions; causes of disintegration and beneficial possibilities of standardization.

Trolley Wires, Steel. Overcoming Current-Collection Troubles on Steel Wire, H. M. Robinson. Elec. Ry. Jl., vol. 63, no. 20, May 17, 1924, pp. 767-769, 3 figs. Investigations made at Forth Worth, Tex., where much of the overhead construction is of this material, demonstrated superiority of trolley shoes under those conditions. Describes methods of lubricating trolley wire.

STRESSES

Shearing, on Flat Elastic Strips. On the Stability under Shearing Forces of a Flat Elastic Strip, R. V. Southwell and S. W. Skan. Royal Soc.—Proc. vol. 105, no. A 733, May 1, 1924, pp. 582-607, 6 figs. Investigation relating to a flat elastic strip, of uniform breadth, thickness and material, upon which a uniform shear is imposed by tangential applied at its edges and in its plane.

SUBSTATIONS

Alternating-Current. The Cleveland Heights Substation of the Cleveland Electric Illuminating Company, H. L. Wallau. Am. Inst. Elec. Engrs.—Jl., vol. 43, no. 6, June 1924, pp. 555-556, 6 figs. A.c. station having ultimate capacity of 12,000 kw.

Combined Railway and Power. Railway and Power Substations Combined for Economical Operation. Elec. Ry. Jl., vol. 63, no. 19, May 10, 1924, pp. 729-731, 4 figs. Cicero (Ill.) substation of Chicago Rapid Transit Co. and Pub. Service Co. of Northern Illinois presents example of coordinated efforts to reduce maintenance and operating costs. Details of installations.

SUPERPOWER

Interconnection and. Superpower and Inter-connection, Herbert Hoover. Elec. World, vol. 83, no. 21, May 24, 1924, pp. 1078-1080. Points out that economical expansion is possible in these twin developments and shows necessity of keeping initiative free from deadening influence both of bureaucracy and of socialistic experiment. (Abstract.) Address before Nat. Elec. Light Assn.

SURVEYING

Geodetic. A Simple Form for the Azimuth Equation, L. B. Stewart. Can. Engr., vol. 46, no. 18, Apr. 29, 1924, pp. 475-477, 1 fig. By "azimuth equation" is meant equation used in reducing an observation of Polaris to determine azimuth of a direction, observation being taken at any time. Operation of finding pole star in daylight; taking observation; formulas for reducing, suitable for most precise geodetic observations, or those taken with engineer's transit.

Instruments for. New Instruments and Apparatus for Surveys. Eng. and Contracting (Water Works), vol. 61, no. 5, May 14, 1924, pp. 1085-1089, 6 figs. Recent developments of U. S. Coast and Geodetic Survey.

Stereotopography. Stereotopography and Its Recent Progress. (La stéréotopographie et ses récents progrès), J. Boyer. Nature (Paris), no. 2614, May 10, 1924, pp. 299-304, 7 figs. Discusses development of stereophotogrammetry by Pulfrich, stereocomparator and Orel stereoautograph; advantages of stereoautogrammetry.

T

TELEPHONY

Long-Distance. Long-Distance Transmission, K. W. Wagner and J. F. Dommerque. Telephone Engr., vol. 28, nos. 5 and 6, May and June 1924, pp. 26-28 and 21-23, 7 figs. Discussion of transmission-theory and practice as applied in modern long distance telephone plant. Some technical and economic features of application of repeaters to long distance lines. Cross-talk and balancing of cable pairs.

Transmission-Efficiency Unit. The Transmission Unit and Telephone Transmission Reference Systems, W. H. Martin. Am. Inst. Elec. Engrs.—Jl., vol. 43, no. 6, June 1924, pp. 504-507, 1 fig. Considers method of determining and expressing transmission efficiencies of telephone circuits and apparatus, and of desirable qualifications for unit in which to express these efficiencies; "transmission unit" described has been selected as being much more suitable for this purpose under present conditions than "mile of standard cable" which has been generally used in past.

Trunking. Improved Manual Trunking, J. P. Boylan. Telephone Engr., vol. 28, no. 6, June 1924, pp. 17-20. Development of straightforward trunking methods and equipm ent; elimination of call wire and addition of other features make faster and more accurate service possible.

TERMINALS, LOCOMOTIVE

Turntables. Types of Turntable Developed for Heavier Locomotives. Eng. News-Rec., vol. 92, no. 23, June 5, 1924, pp. 964-967, 6 figs. Continuous and 2-span tables replace cantilever type; larger and heavier locomotives introduce problems not present with light power; lower maintenance cost and quicker operation.

TERMINALS, RAILWAY

Ferry Terminal. New Ferry Terminal Includes Advanced Designs, F. Jasperson. Ry. Age, vol. 76, no. 25, May 24, 1924, pp. 1249-1252, 8 figs. Reading Co. completes installation at Camden, N. J., to handle heavy seashore traffic. See also Ry. Rev., vol. 74, no. 20, May 17, 1924, pp. 871-876, 11 figs.

Smoke-Removal System. Fans to Avoid Smoke Nuisance in Chicago Union Station. Eng. News-Rec.; vol. 92, no. 22, May 29, 1924, pp. 929-931, 3 figs, Low-level viaducts crossing trainshed have smoke chambers in floor with exhaust fans discharging into open air.

TIMBER

Softwood, United States. Our Softwood Timber, W. B. Greeley. Military Engr., vol. 16, no. 86, Mar.-Apr. 1924, pp. 89-94, 9 figs. Extent of softwood forests in the United States; consumption of softwood timber; paper-making woods; exports and imports of softwoods.

TOOLS

Cutting Trials. Tool-Steel and Cutting Trials. D. Smith and I. Hey. Mech. Wld., vol. 75, nos. 1947 and 1948, Apr. 25 and May 2, 1924, pp. 255-258 and 272-274, 9 figs. Investigation of behavior of tools when taking extremely find cuts over a wide range of speeds and quality and treatment of tool steel most suitable for use under such conditions. Report of Lathe Tool Research Committee.

TRAFFIC

Control. Traffic Control by Wireless, R. Twelvetrees. Motor Transport (Lond.), vol. 38, no. 1006, June 9, 1924, pp. 714-716, 6 figs. How London Metropolitan Police Force engineers controlled flow of vehicles to and from Epsom on Derby Day. Explains general scheme and gives details of vehicles used as wireless tenders.

TRANSFORMERS

22,000-Kva. 22,000-kva. Transformers for Niagara Falls Development, F. F. Brand. Am. Inst. Elec. Engrs.—Jl., vol. 43, no. 6, June 1924, pp. 514-518, 4 figs. Spacing arrangements; insulation; cooling arrangements.

TRANSPORTATION

St. Lawrence and Hudson Bay Projects. The St. Lawrence River and Hudson Bay Projects. Eng. Jl., vol. 7, no. 6, June 1924. Discussion on Canada's water-transportation problems, including following contributions: Economic Examination of the Hudson Bay Projects, W. Nelson Smith, pp. 269-278. 1 fig.; The Hudson Bay Railway and Port Nelson, L. C. Nesham, pp. 278-282; The Hudson Bay Railway, J. L. Busfield, pp. 282-289, 4 figs.; The St. Lawrence River Waterway—Discussion, pp. 289-290.

TURBO-GENERATORS

12,000-Kw. 12,000-Kw. Steam Turbo-Generator at the British Empire Exhibition. Engineering, vol. 117, no. 3049, June 6, 1924, pp. 721-723, 22 figs. partly on supp. plate. Type of machine built for Colenso power station of African Railways and Harbors Administration, by C. A. Parsons & Co., Newcastle.

V

VAPORS

Pressures. Graphical Vapor Pressure and Specific Gravity Tables, H. G. Deming. Indus. and Eng. Chem., vol. 16, no. 6, June 1924, pp. 614-615, 3 figs. Tables present information commonly given in 40 or 50 pages of print in very much condensed form, and offer advantage of instant visual interpolation between values given in ordinary tables.

VENTILATION

Air-Duct Calculations. Cold Air Ventilating Ducts, H. J. Macintire. Southern Engr., vol. 41, no. 3, May 1924, pp. 47-49, 3 figs. Determining friction heat due to flow of air in ducts, and methods of designing air-duct systems.

W

WASTE HEAT

Utilization. The Utilization of Exhaust Steam (A propos de l'utilisation de la vapeur d'échappement), F. D'Espine. Chaleur et Industrie, vol. 5, no. 46, Feb. 1924, pp. 53-61, 8 figs. Calls attention to fuel economy which can be effected by rational utilization of waste heat, and gives numerical values showing profits which can be realized by installations for this purpose; examples of waste-heat installations.

WATER

Viscosity in Passage through Sand. Tests on the Viscosity of Water in Very Narrow Passage Sections (Versuche über die Viskosität des Wassers in sehr engen Durchgangsquer-schnitten), K. v. Terzaghi. Zeit. für angewandte Mathematik u. Mechanik, vol. 4, no. 2, Apr. 1924, pp. 107-113, 2 figs. Equations are given for expressing relation between pore volume and coefficient of permeability of granular materials for sand, equation agrees well with observed results, whereas with clays, differences are evident, which leads to conclusions on increase of viscosity of water in very narrow capillary tubes.

WATER METERS

Attachment for Fixed Liquid Quantities. Meter Attachment for Delivering Fixed Quantities of Liquids. Engineering, vol. 117, no. 3049, June 6, 1924, p. 749, 2 figs. Fitting exhibited at British Empire Exhibition enables water meter automatically to supply given quantity of liquid and then to cut off flow.

WATER SUPPLY

Waste Detection. Underground Water Waste Detection in New York City, F. B. Nelson. Eng. and Contracting (Water Works), vol. 61, no. 6, June 11, 1924, pp. 1289-1296. Organization, equipment, methods and results obtained. Paper presented before Mun. Engrs. of City of N. Y.

WATER WORKS

Statistics. Water Works Statistics. Pub. Wks., vol. 55, no. 5, May 1924, pp. 161-174. Tabulated from questionnaires filled out by nearly 700 water works officials. Mains laid in 1923; pressures in mains, both regular and for fire service; and pumping plants, with recent changes made in type of plant.

WELDING

Chemical Aspects. Some Chemical Aspects of Welding, J. R. Booer. Welding Engr., vol. 9, nos. 4 and 5, Apr. and May 1924, pp. 29, 44 and 46; and 29 and 32-33. Notes on physical phenomena; principles of oxidation and reduction. Paper read before Instn. Welding Engrs. See also Acetylene Jl., vol. 25. nos. 10 and 11, Apr. and May 1924, pp. 487-488 and 492-494, and 537-539.

Electric. *See Electric Welding; Electric Welding, Arc.*

Oxy-Acetylene. *See Oxy-Acetylene Welding.*

WIND TUNNELS

Resistance of Spheres. The Resistance of Spheres in Wind Tunnels and in Air, D. L. Bacon and E. G. Reid. Nat. Advisory Committee for Aeronautics—Report, no. 185, 1924, 21 pp., 18 figs. Satisfactory confirmation of Reynolds law has been accomplished, effect of means of support determined, range of experiment greatly extended by work in new variable-density tunnel, and effects of turbulence investigated by work in tunnels and by towing and dropping tests in free air.

X

X-RAYS

Precision Research Apparatus. An Improved Apparatus for Precision Researches with X-Rays, S. K. Allison and C. L. Clark. Optical Soc. of Am.—Jl., vol. 8, no. 5, May 1924, pp. 681-691, 3 figs. X-ray apparatus which has been in use in laboratory of Wm. Duane at Jefferson Physical Laboratory of Harvard Univ. has been improved so that results may be obtained more accurately and rapidly than before. Describes improved apparatus and mentions some of the technical difficulties which have arisen and been solved, in hope that other workers in the field of x-rays may be benefited.

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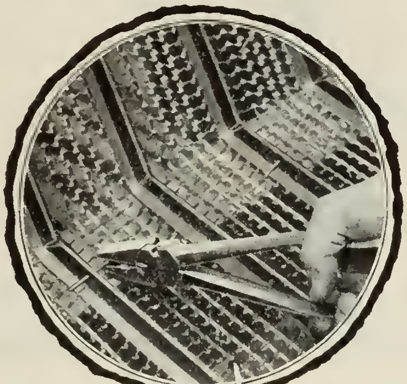

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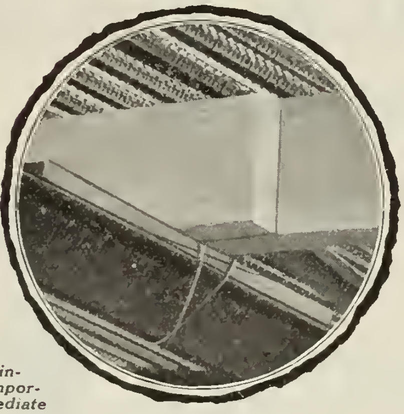
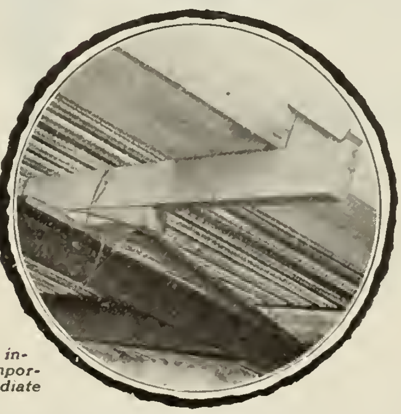


Method of installing temporary intermediate supports.



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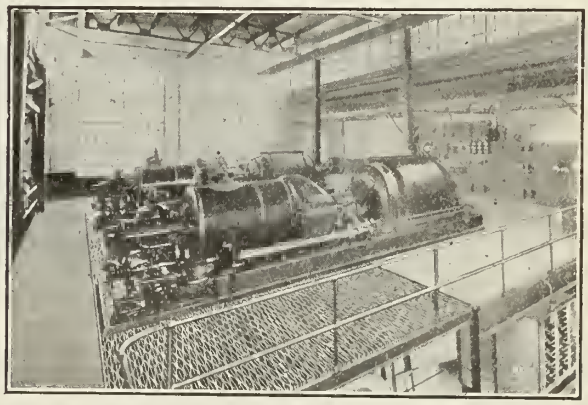

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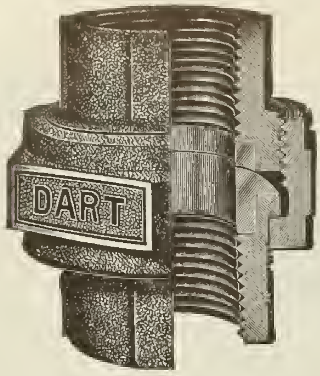

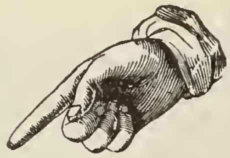

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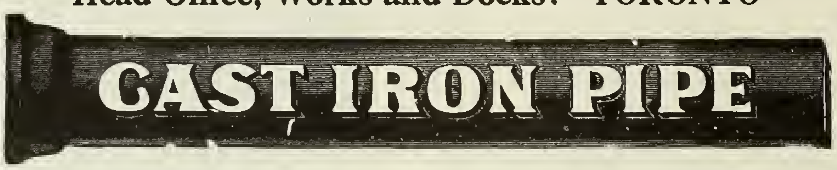

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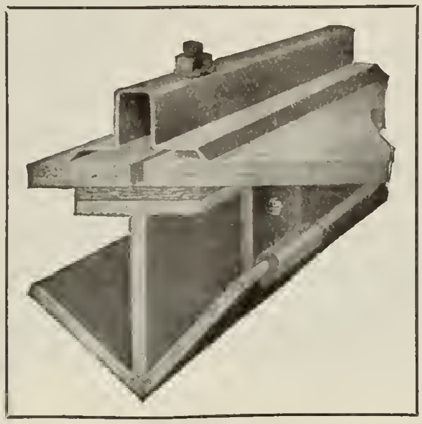

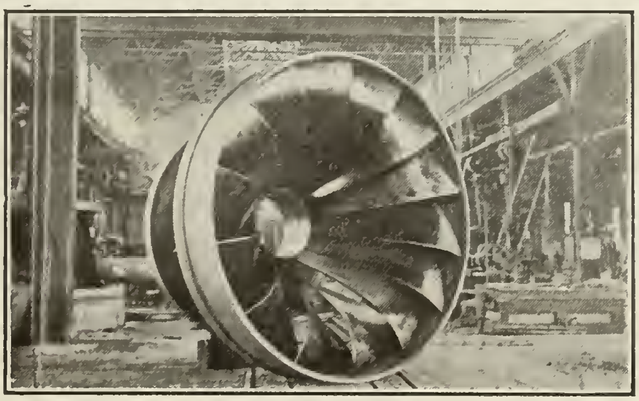

Purchaser's Classified Directory

A Selected List of Equipment, Apparatus and Supplies

For Alphabetical List of Advertisers see page 56

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B

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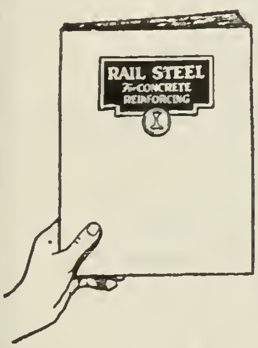

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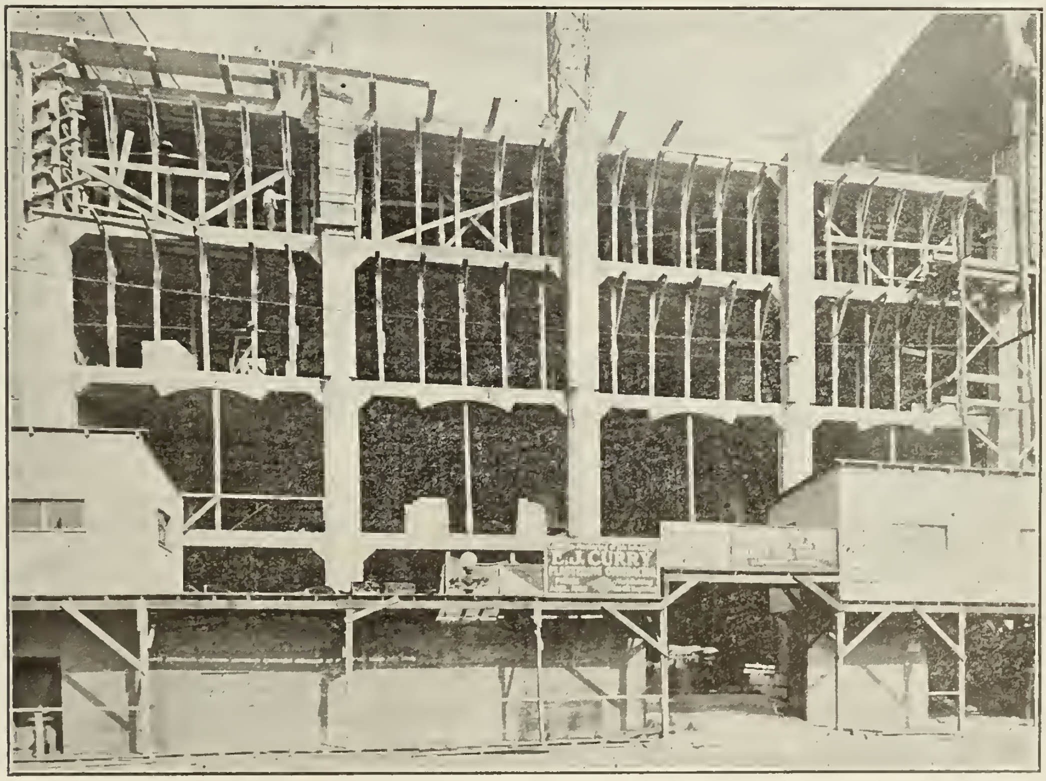

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To the Members of The Institute

In order to make the Year Book and List of Members of the greatest possible value to the membership, it is earnestly requested that you kindly fill in the return slip.

In many cases we have not on our records the official positions of our members and it is hoped that all members will return the slip, filled in, at the earliest possible date.

FRASER S. KEITH, Secretary.

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DEPARTMENT OF ROADS

Tenders

BEAUHARNOIS—SAINT-JEAN

Highways

Tenders made on forms supplied by the Department of Roads and placed under envelopes bearing the word: "Tender" shall be received at the office of the Minister of Roads, in the city of Quebec, Government Building, until one o'clock in the afternoon (daylight saving time), on Friday the twenty-second (22nd) of August, 1924, for the gravelling of Beauharnois—St-Jean highway in the municipalities of parishes of St. Jean, length 10,882 feet; Ste. Marguerite of Blairfindie, length 30,102 feet and of St. Cyprien of Napierville, length 10,835 feet.

The Government of the Province of Quebec does not bind itself to accept any of the tenders.

J. L. BOULANGER,
Quebec, July 31st, 1924. *Deputy Minister.*

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THE

ENGINEERING JOURNAL

THE JOURNAL OF THE ENGINEERING INSTITUTE OF CANADA

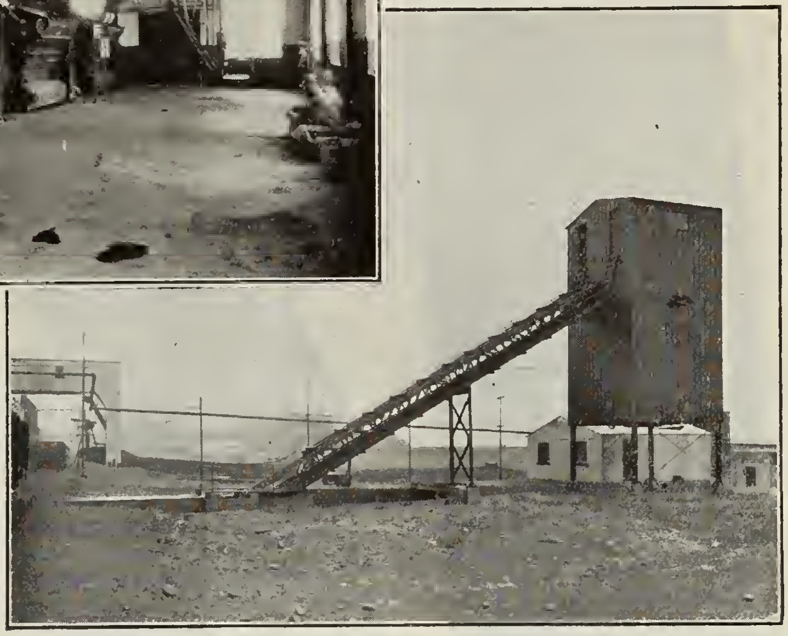
"TO FACILITATE THE ACQUIREMENT AND INTERCHANGE OF PROFESSIONAL KNOWLEDGE AMONG ITS MEMBERS, TO PROMOTE THEIR PROFESSIONAL INTERESTS, TO ENCOURAGE ORIGINAL RESEARCH, TO DEVELOP AND MAINTAIN HIGH STANDARDS IN THE ENGINEERING PROFESSION AND TO ENHANCE THE USEFULNESS OF THE PROFESSION TO THE PUBLIC"

SEPTEMBER 1924

PUBLISHED MONTHLY BY THE ENGINEERING INSTITUTE OF CANADA

AT 176 MANSFIELD STREET, MONTREAL

Vol. VII No. 9

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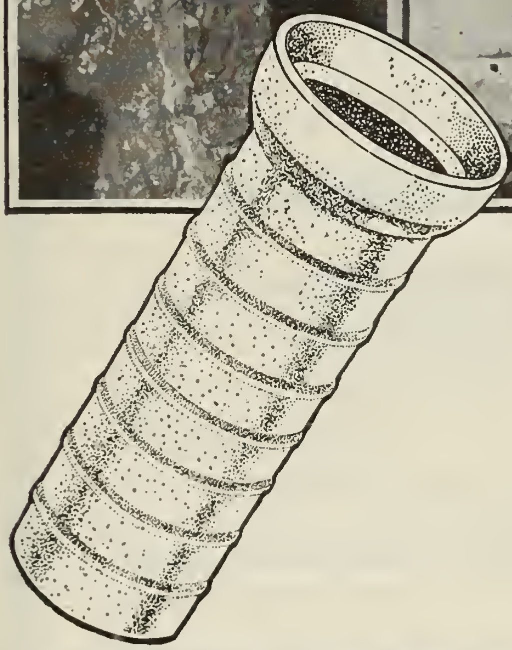

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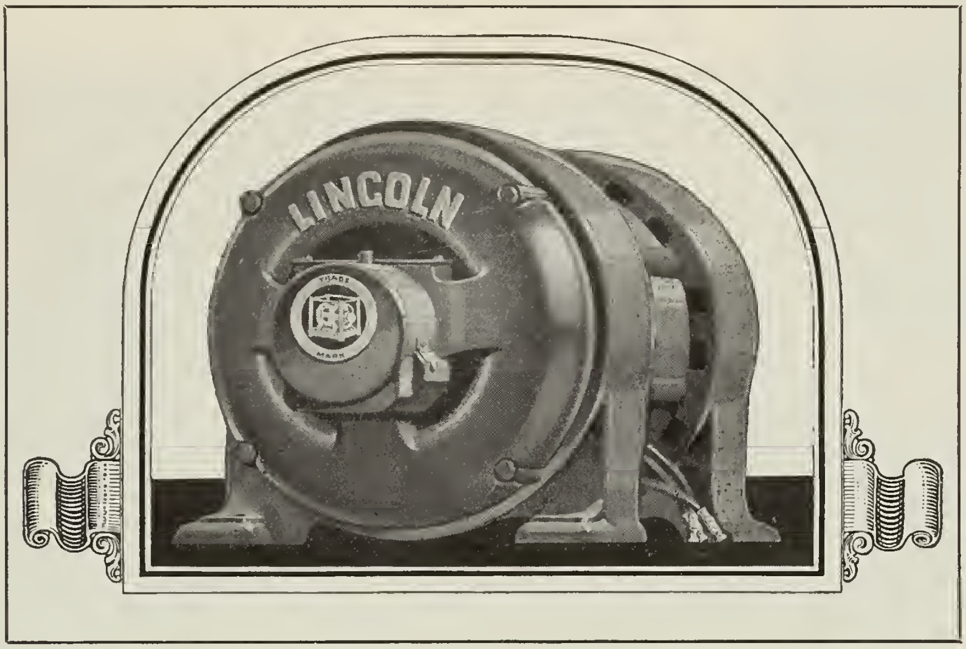

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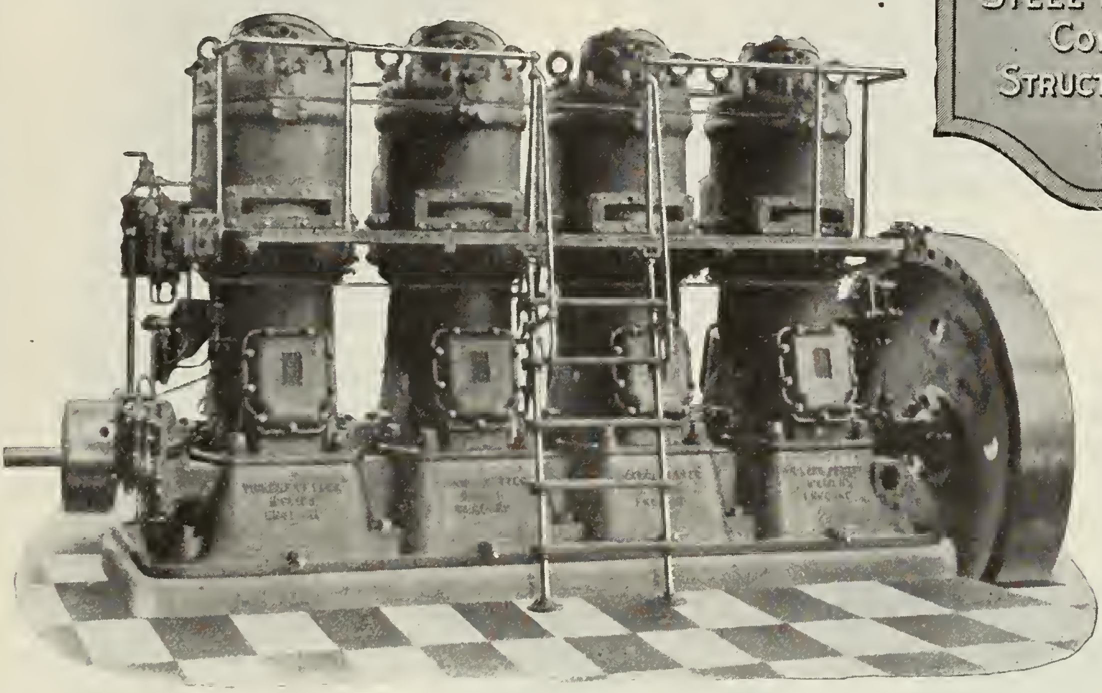

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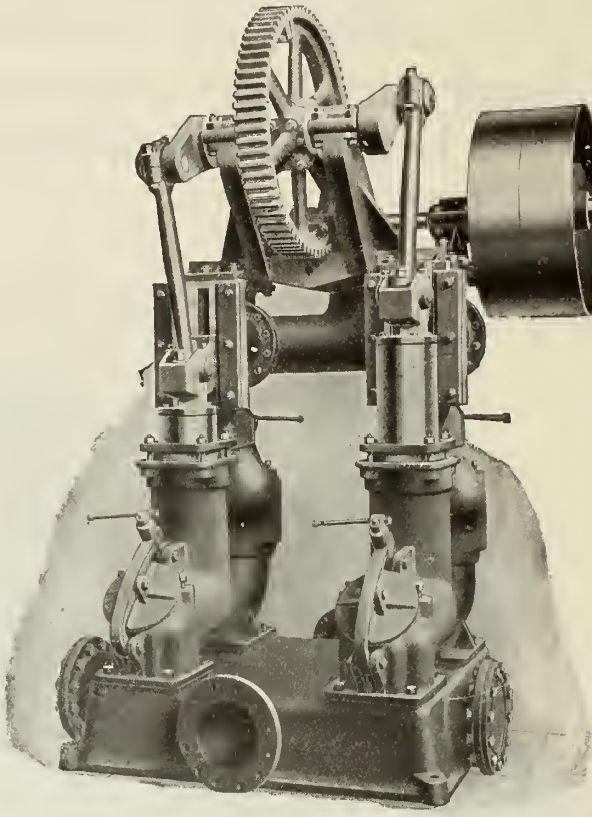

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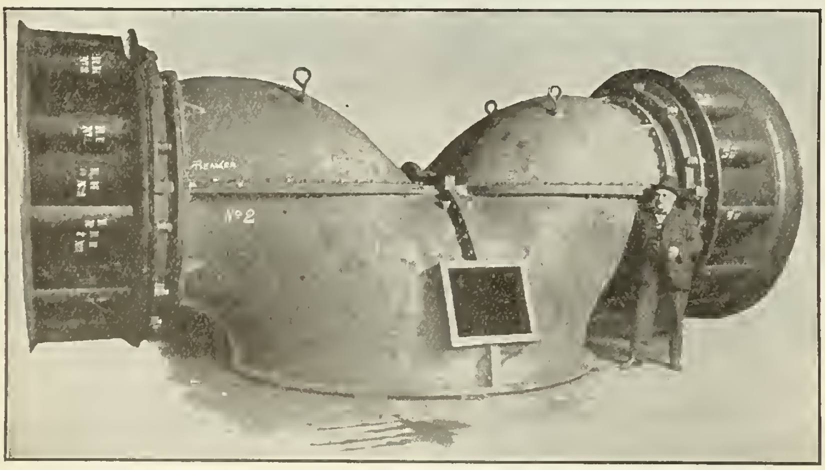

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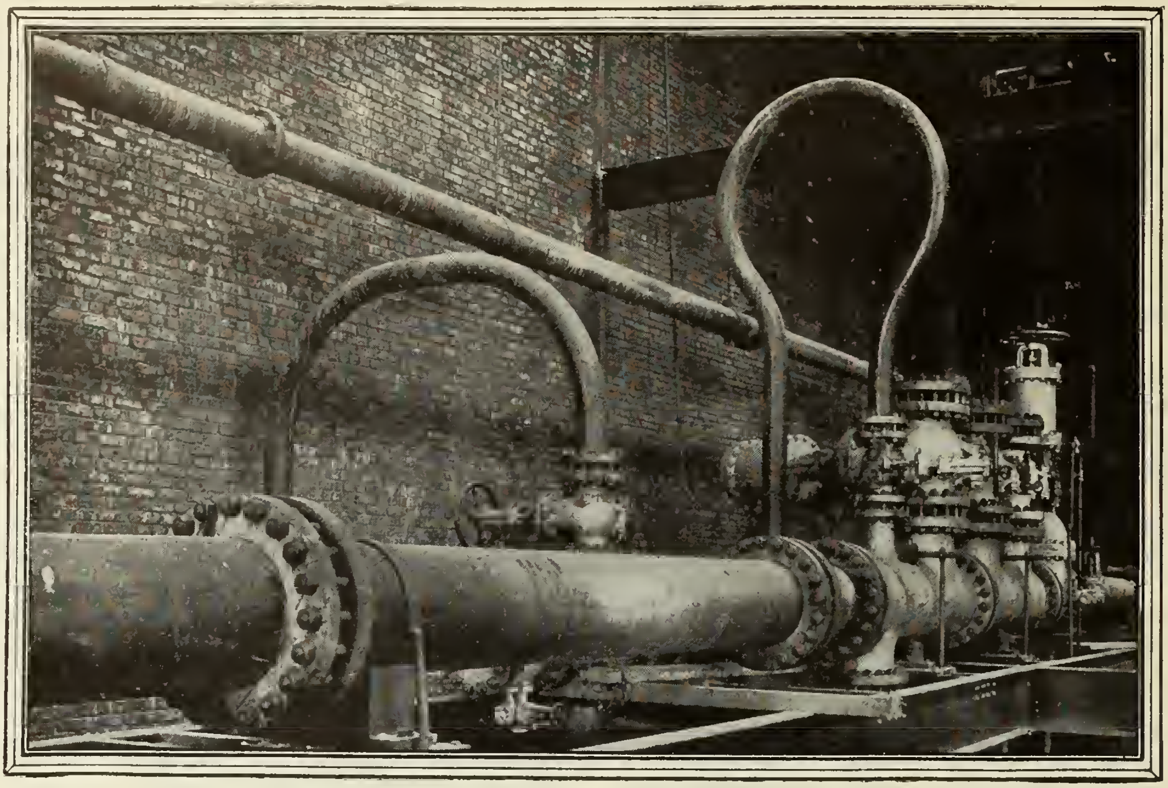

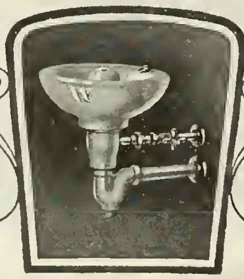

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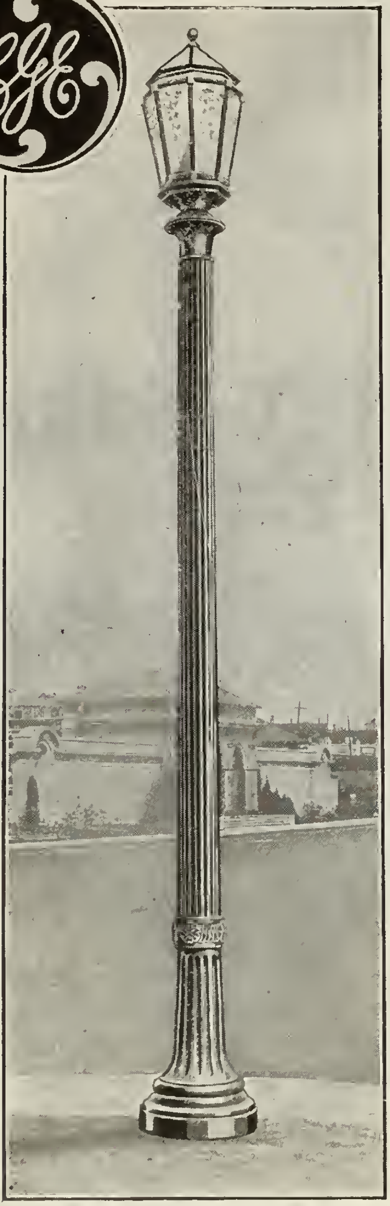
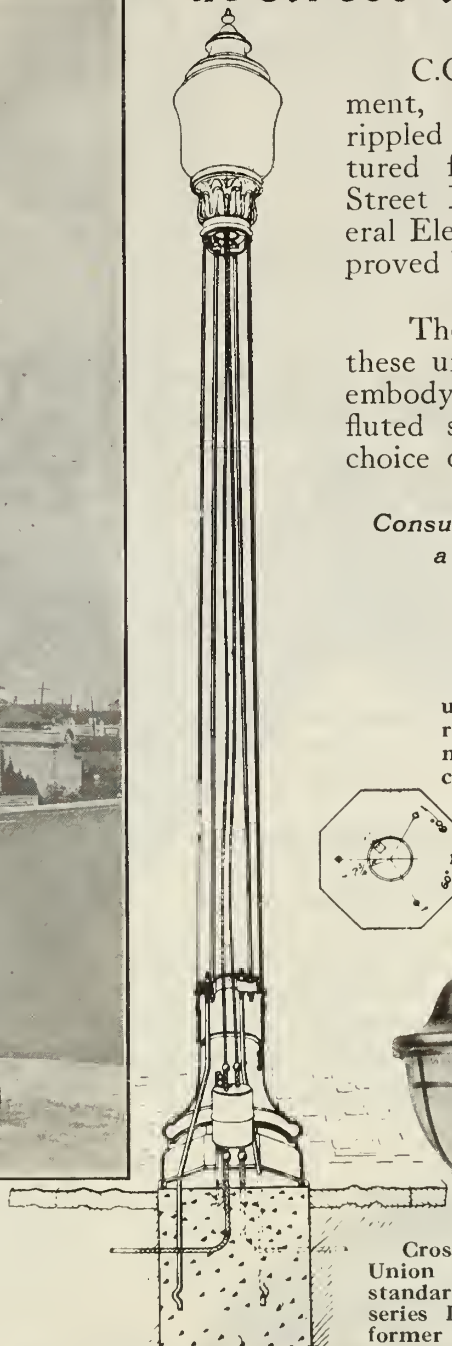
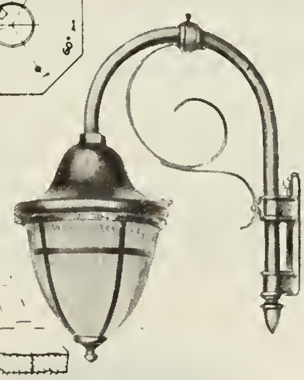


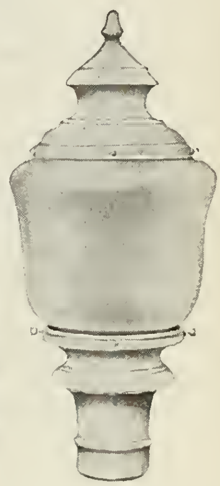
Sunnyside lantern mounted on Union metal steel standard.



Cross-section of Union metal steel standard, showing a series I. L. transformer mounted in base.



Form 25 Novalux unit, with alabaster rippled globe, mounted on bishop's crook bracket.



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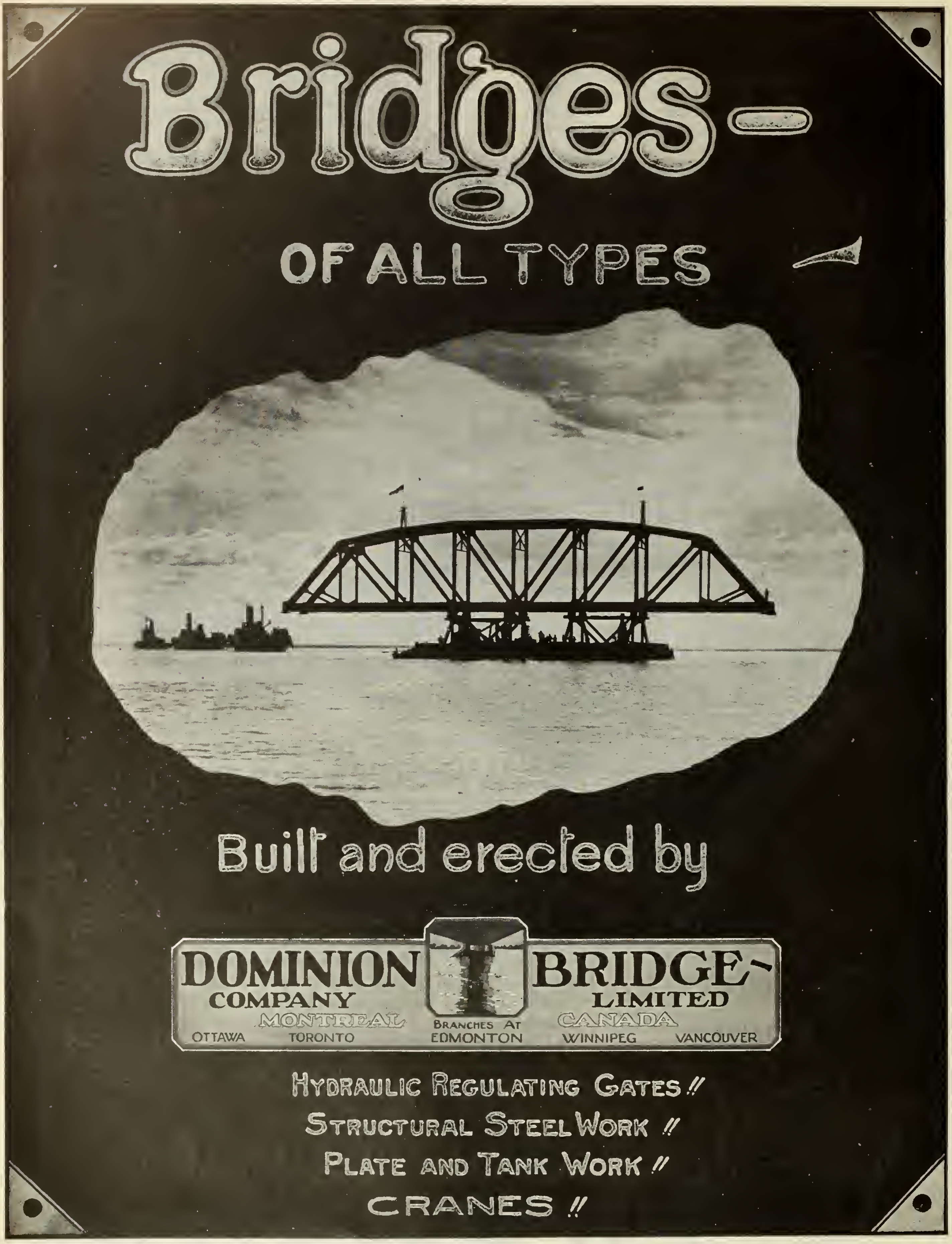
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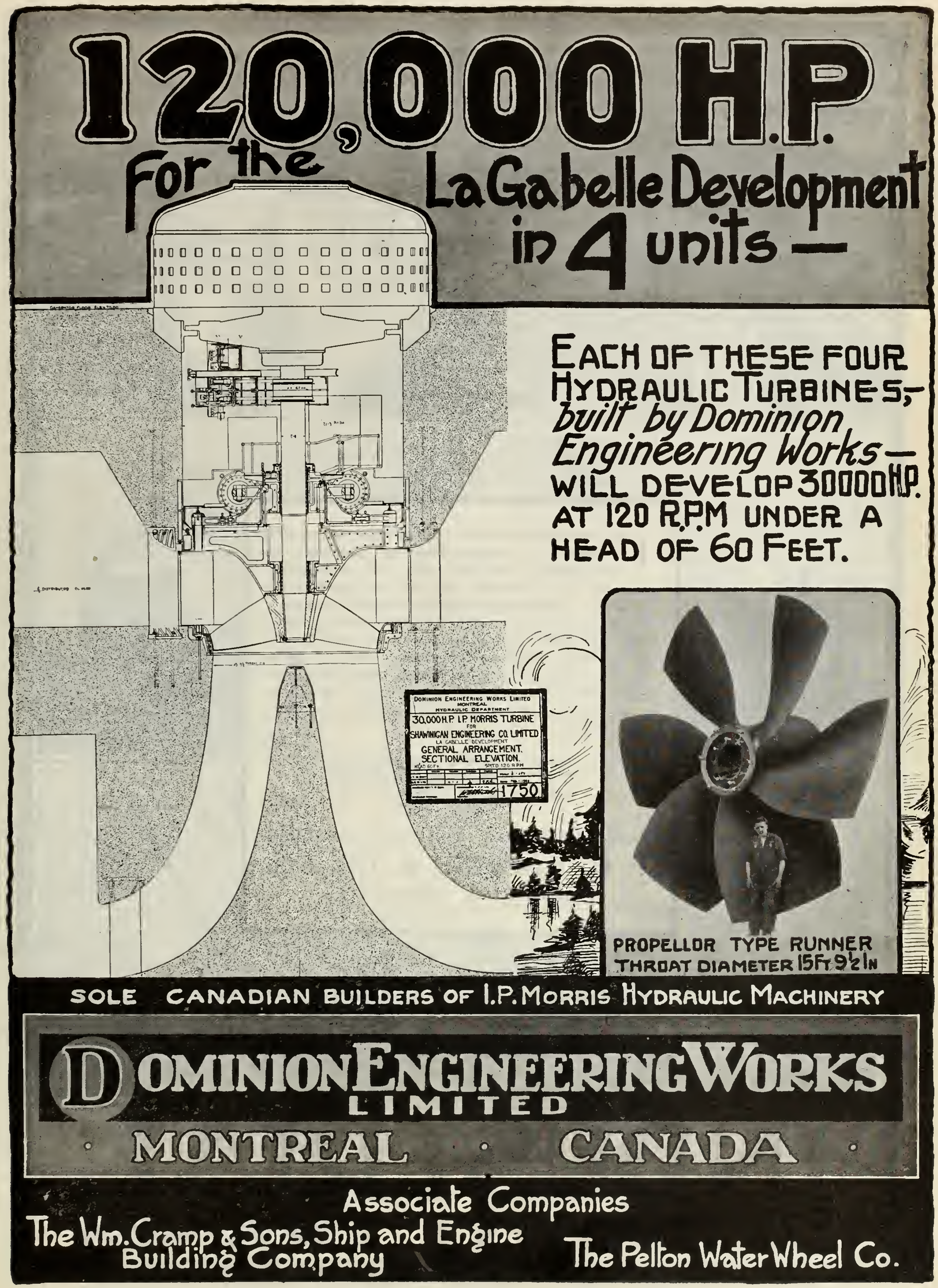
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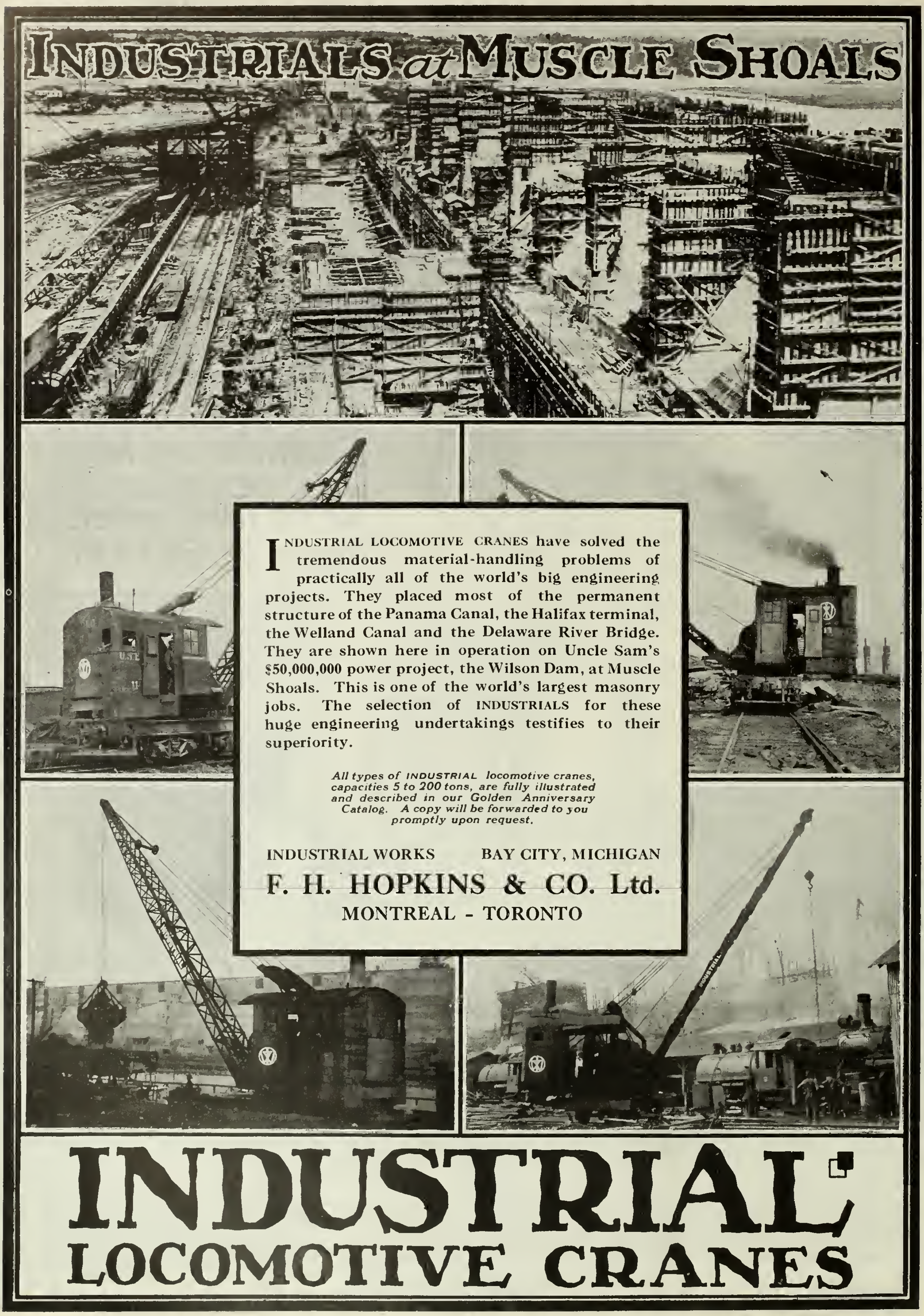
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Inductive Co-ordination as a Practical Problem

A Review of the Subject of Inductive Interference.

J. L. Clarke, A.M.E.I.C.,

Electrical Engineer, The Bell Telephone Company of Canada.

Paper read before the Montreal Branch, The Engineering Institute of Canada, November 15th, 1923.

As the subject of inductive interference involves a number of considerations which are more or less interrelated, and in order to avoid unnecessary repetitions, it was thought desirable to divide this paper into several parts: Part I, general considerations. Part II, co-ordinated transposition schemes. Part III, elimination of harmonics. Part IV, residual voltage. Part V, abnormal conditions. Part VI, effects produced by extraneous currents.

Part 1.—General Considerations

The commencement of the present century coincided with the inception of a period of great expansion in the production of electrical energy from water power. This development was nowhere more notable than in the Dominion of Canada, being particularly marked in the provinces of Ontario and Quebec.

The facility with which power in the electrical form may be transported to considerable distances from its source, and the comparatively high cost of power produced by the combustion of fuel in localities more or less distant from the source of coal supply, constituted a powerful incentive to the construction of transmission lines whereby electrical energy produced at points where hydro-electric generation of power was relatively cheap could be transported to other points where the cost of producing power by other means was more expensive. With the multiplication of these power transmission lines it was inevitable that a number of these organizations engaged in the distribution of electric power should begin to make use of the public highways.

It soon became apparent that the telephone and telegraph circuits occupying the same highways were being affected detrimentally by the transfer of energy from the power circuits, and that the continual extension of these power lines was creating a serious problem for the communication companies.

Early Investigation of Problem of Inductive Interference

In other parts of the world similar conditions were arising, and in 1915 conditions had become so acute in California that it lead to the appointment of a committee on inductive interference by the California Railroad Board. This committee made an extensive investigation of the whole question and the report made by the committee to the California Railroad Commission forms the most important contribution to the bibliography on inductive interference.

The initiative in investigating these matters was necessarily taken by the communication companies, since the telephone and telegraph circuits do not interfere with the operation of power circuits occupying parallel locations, although the power circuits affect the operation of the communication circuits. This state of affairs has engendered certain difficulties in dealing with the entire problem and the matter was further complicated by the fact that the phenomena of inductive interference involve electro-physical relations which are in general quite dissimilar to those obtaining in the ordinary course of electric power engineering.

Investigation of the subject soon showed that a solution of the problem could not be obtained without the active co-operation of the power supply organizations, and furthermore that conditions existing in both the communication and power supply systems not only within the section in which the two systems were in proximity but also at points remote from the parallel, had very appreciable effect on the magnitude of the interference produced in the communication circuits, and in some cases these latter constituted the dominating factor.

Interference in a telephone circuit arises from the presence of harmonics or high frequency ripples on the voltage and current waves in the power circuit. These high frequency components of voltage and current acting through the mutual impedance between the power circuit and the telephone circuits, generate extraneous currents in the telephone circuits which manifest themselves in the form of noise in the terminating set on the telephone lines. This mutual impedance becomes of appreciable magnitude when the communication and power circuits occupy approximately parallel locations for more than a short distance.

Interference in telegraph circuits is due to the fundamental voltages and currents in the power circuits.

Equations Describing these Phenomena

The general equations mathematically describing these phenomena are similar in form to those involved in the case of a transformer having a plurality of windings; they consist of a series of homogeneous linear differential equations of the following form:

$$\left.\begin{aligned} V_1 &= A_{11}X_1 + A_{12}X_2 + A_{13}X_3 + \ldots\ldots A_{1n}X_n \\ V_2 &= A_{12}X_1 + A_{22}X_2 + A_{23}X_3 + \ldots\ldots A_{2n}X_n \\ V_3 &= A_{13}X_1 + A_{23}X_2 + A_{33}X_3 + \ldots\ldots A_{3n}X_n \\ V_n &= A_{1n}X_1 + A_{2n}X_2 + A_{3n}X_3 + \ldots\ldots A_{nn}X_n \end{aligned}\right\} \ldots\ldots (1)$$

Where V_1, V_2, V_3 ..... V_n are the impressed potentials and X_1, X_2, X_3 ..... X_n are the displacements from equilibrium in the co-ordinates 1, 2, 3 .... n, and A_{11}, A_{12}, A_{13} .... A_{nn} are the coefficients describing the constants of the network.

The general coefficient A_{mn} is defined by the following equation:

$$A_{mn} = L_{mn}\frac{d^2}{dt^2} + R_{mn}\frac{d}{dt} + \frac{1}{C_{mn}} \ldots\ldots\ldots\ldots (2)$$

The displacements X_1, X_2, X_3 ..... X_n are the instantaneous charges existing in the co-ordinates 1, 2, 3 .... n.

These equations describe both the forced and free oscillations of the system.

Where the forced oscillations only are to be considered and the impressed potentials can be expressed in the form of a Fourier series we can replace the differential operator d/dt by jw, and the equations may be solved independently for each component of the Fourier series.

This permits a simplified form of equation (1):

$$\left.\begin{aligned} V_1 &= I_1Z_{11} + I_2Z_{12} + I_3Z_{13} + \ldots\ldots\ldots I_nZ_{1n} \\ V_2 &= I_1Z_{12} + I_2Z_{22} + I_3Z_{23} + \ldots\ldots\ldots I_nZ_{2n} \\ V_3 &= I_1Z_{13} + I_2Z_{23} + I_3Z_{33} + \ldots\ldots\ldots I_nZ_{3n} \\ V_n &= I_1Z_{1n} + I_2Z_{2n} + I_3Z_{3n} + \ldots\ldots\ldots I_nZ_{nn} \end{aligned}\right\} \ldots\ldots (3)$$

Where I_1, I_2, I_3 .... I_n are the currents in the co-ordinates 1, 2, 3 .... n and the general coefficient Z_{mn} is given by the equation:

$$Z_{mn} = jw\,L_{mn} + R_{mn} + \frac{1}{jw\,C_{mn}} \ldots\ldots\ldots\ldots\ldots\ldots (4)$$

The magnitude of these coefficients vary with the frequency of the impressed voltage and with the different conditions of terminating impedances; it is necessary to use superscripts to designate the different values of the coefficients for each condition. For instance $(Z_{11})^a_n$ would be the impedance of co-ordinate (1) under conditions designated by the letter "a" at the frequency "n" when co-ordinates (2), (3) etc., are all open at the sending end, $(Z_{12})^a_n$ would be the negative vector ratio of the open circuit voltage at the sending end of co-ordinate (2) to the input current at the sending end of co-ordinate (1) under the conditions described by the superscripts "a", "n", and when co-ordinates (3), (4) etc., are open at the sending end.

For substituting in equation (3) the impedance coefficients must all be of the same designation and frequency. The solution of these equations gives the relations between the currents and applied potentials for the specific conditions for which the coefficients were obtained.

If the power circuit is a three-phase line, then V_1, V_2 and V_3 are the absolute potentials of the three conductors, and V_4, V_5, V_6 .... V_n are all zero.

Furthermore the induced currents in the communication circuits are so small that they do not react appreciably in the power line, hence we can make the coefficients of all the terms in the first three rows, except those in the first three columns equal to zero.

Now the quantities Z_{45}, Z_{46}, etc., represent the mutual impedance coefficients between the several communication conductors, and in the case in which the parallels between the power and communication circuits is short compared with the total length of the communication circuits, the effects of these mutual impedances can be neglected, hence we can make Z_{45}, Z_{46} etc., equal to zero.

Equation (3) now becomes:—

$$\left.\begin{aligned} V_1 &= I_1Z_{11} + I_2Z_{12} + I_3Z_{13} \\ V_2 &= I_1Z_{12} + I_2Z_{22} + I_3Z_{23} \\ V_3 &= I_1Z_{13} + I_2Z_{23} + I_3Z_{33} \\ O &= I_1Z_{14} + I_2Z_{24} + I_3Z_{34} + I_4Z_{44} \\ O &= I_1Z_{15} + I_2Z_{25} + I_3Z_{35} \ldots + I_5Z_{55} \\ O &= I_1Z_{1n} + I_2Z_{2n} + I_3Z_{3n} \ldots + I_nZ_{nn} \end{aligned}\right\} \ldots\ldots\ldots (5)$$

Hence we can solve for I_1, I_2, I_3 independently and substitute in each succeeding equation and obtain I_4, I_5 etc. since:—

$$I_4 = \frac{I_1Z_{14} + I_2Z_{24} + I_3Z_{34}}{Z_{44}} \ldots\ldots\ldots\ldots\ldots\ldots (6)$$

In this equation the numerator on the right hand side represents the induced potential in co-ordinate (4) which in this case becomes the circuit formed by one of the communication conductors and the ground. The potential absorbed in co-ordinate (4) will be equal to I_4Z_{44}.

We may designate this quantity as (V_4), using the bracket to indicate that relative to the entire system comprising the power and communication conductors, it is not an impressed potential, but relative to the communication conductors considered as a system by itself, we may consider it as an impressed potential.

In the case of a ground return circuit such as a telegraph circuit, this voltage represents the quantity that we wish to discover, but in this case of the telephone circuit the ground is not used as a return conductor and we require to know the difference between the potentials induced in the two conductors forming the telephone circuit. This is obviously $(V_4) - (V_5)$, or if a curve is plotted showing the variation in magnitude and phase of (V_x) with respect to the distance x from the power circuits, then (V_4), (V_5), (V_6) become space functions and $(V_4) - (V_5)$ may be expressed as follows:

$$(V_4) - (V_5) = \frac{dV}{dx}\triangle x \ldots\ldots\ldots\ldots\ldots\ldots (7)$$

where $\frac{dV}{dx}$ represents the rate of change of (V) with respect to x and $\triangle x$ is the distance between the conductors 4 and 5.

In order to reduce the magnitude of this quantity, the relative positions of conductors 4 and 5 may be interchanged for certain distances, and this has the effect of equalizing the absolute potentials of conductors 4 and 5. It does not, however, reduce the mean potential to ground of the conductors and the existance of this potential to ground causes a current to flow through the admittance of each conductor to ground, and if these admittances are not equal the currents will not be equal and this will cause differences of potential between conductors 4 and 5 which cause currents to flow in the terminating apparatus of the telephone circuit.

Similar effects are produced by differences in the series impedances of each conductor. In practice it is not found possible to obtain circuits perfectly balanced to ground.

The degree of balance attainable depends on the type and constitution of the circuit; a circuit composed of aerial wire conductors, and terminated directly by telephone subsets, may be maintained at a very high degree of balance, but where the circuit passes through cables and intermediate exchanges containing much associated apparatus, it is not practicable to obtain a very high degree of balance to ground. Thus, in order to reduce the inductive effects in the latter type of circuit, it becomes necessary to adopt some means of reducing the mean induced potential to ground in the telephone conductors. This of course holds for a telegraph circuit since there is no practicable method of transposing a grounded return circuit.

A method of effecting a reduction in these induced potentials consists in interchanging the relative locations of the power line conductors. This is equivalent to associating each line current with a different impedance coefficient for each particular arrangement of conductors.

Now in order to show the effect of this operation by means of an equation which is not too complicated, two assumptions can be made. First, that the currents I_1, I_2 and I_3 each remain the same in magnitude and phase throughout the portion of the exposure considered; second, the coefficients Z_{11}, Z_{12}, etc., remain constant throughout this section and that implies uniformity of separation between the power and communication lines and equality of length of each of the three sections into which we have divided the part of the parallel considered.

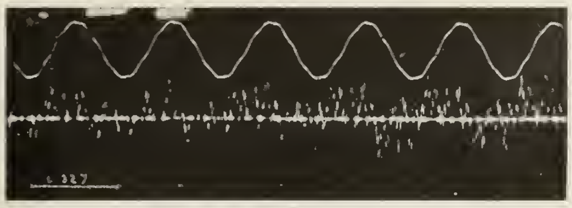

Figure No. 1.—R.M.S. voltage of induced potencial (lower curve) 2.6 volts.

These assumptions are justified if the portion of the power line considered is short compared with the total length of the power line and also short compared with the wave length at the frequency considered, and that physical conditions of the parallel are such that the second assumption can be made. Where no limitations are imposed, the general expressions describing the electrical conditions in parallel, in which there are transpositions in the power line, are very complicated.

In equation (6) we can write $(V_4)_1$, $(V_4)_2$, $(V_4)_3$ for the potentials induced in the communication circuit by the sections of the power line having the conductors arranged in the three configurations obtained by a partial rotation of pin positions.

$$(V_4)_1 = I_1Z_{14} + I_2Z_{24} + I_3Z_{34}$$
$$(V_4)_2 = I_2Z_{14} + I_3Z_{24} + I_1Z_{34} \quad \ldots\ldots (8)$$
$$(V_4)_3 = I_3Z_{14} + I_1Z_{24} + I_2Z_{34}$$

Hence $(V_4)_1 + (V_4)_2 + (V_4)_3 = (I_1 + I_2 + I_3)\ (Z_{14} + Z_{24} + Z_{34}) \ldots\ldots (9)$

Now if $I_1 + I_2 + I_3 = 0$, then the sum of the induced potentials will be equal to zero.*

If $(I_1 + I_2 + I_3) \neq 0$ but equals a quantity I_R then there will be voltage induced given by:

$$V_R = I_R \quad (Z_{14} + Z_{24} + Z_{34}) \ldots\ldots (10)$$

This is known as induction from residual components. Hence we see that induction from residual components cannot be mitigated by transpositions in the power line.*

In order to reduce the effects of residual components it is necessary to investigate the particular conditions in the power system which give rise to these effects with a view to discovering some feasible means of reducing the magnitude of these components. The means for effecting these results will be discussed in Part IV.

In making calculations of inductive effects, it is often found to be convenient to consider the induced voltages to be separated into two components:—First the induced voltage due to the electrostatic fields produced by the power circuit; second, the induced voltage due to the electromagnetic fields produced by the power circuits. If the potential of the ground is assumed to be zero, then the electrostatic component will appear as a potential between the affected conductor and the ground and the electromagnetic component will appear as a potential generated in the conductor and tending to produce a current longitudinally in the conductor. It should be kept in view however that these two effects are merely two manifestations of the same phenomenon.

It may be of interest to note that the coupling between the power circuit and communication circuit increases rapidly with increasing frequency in the fields produced by the power circuit, hence the wave shape

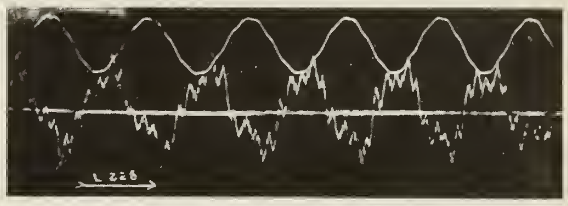

Figure No. 2.—R.M.S. voltage of induced potential (lower curve) 16.6 volts.

of the induced potential in a communication circuit indicates a very marked accentuation of the higher harmonics as compared with the relative magnitudes existing in the power circuit. An example of this is shown in figure No. 1, which shows an oscillogram of an induced voltage in a telephone circuit and also the wave shape of the voltage in the power circuit, which was causing the disturbance. Figure No. 2 shows an oscillogram of the induced voltage in a long circuit due to the cumulative effect of several parallels.

Part II.—Co-ordinated Transposition Schemes

It has been found that the placing of certain transpositions in the power and telephone circuits constitutes the most generally useful method of overcoming inductive effects in the communication circuits.

A co-ordinated transposition scheme may be defined as, a specification covering location of transpositions in the power and telephone circuits so designed that the sum of the induced potentials in any one of telephone conductors is equal to zero and that the difference of potential between any two or more telephone conductors forming a telephone circuit is equal to zero. This desired condition can only be approximately attained by means of a co-ordinated transposition scheme. In the practical case such a scheme consists of a layout of transpositions designed for the power circuit and another designed for the communica-

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* It might be noted that equations (1) and (3) will be rigidly accurate in all cases, equations (5) and (6) will only be exact in the case of one disturbed conductor at a distance from the disturbing conductors which is large compared with the spacing between the disturbing conductors, and equations (8) and (9) only hold good when all the foregoing assumptions are justified.

* This refers to transpositions within the parallel.

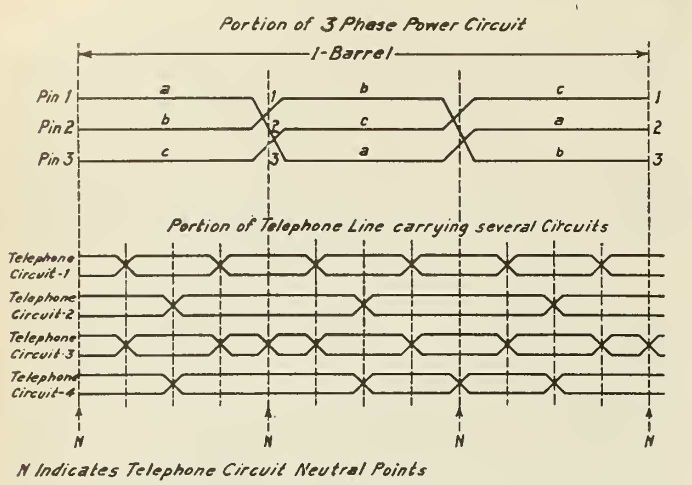

Figure No. 3.—Section of a co-ordinated transposition scheme.

tion system; these two layouts being related to each other by the coincidence of certain definite points in each scheme. These points are known as neutral points.

It was shown in Part I that by changing the relative locations of the power conductors for certain distances, it was possible to cause the induced potentials in the adjacent conductors to be much reduced in magnitude. In a three-phase line there are six possible arrangements of the three conductors, calling the conductors *a*, *b*, *c* and the pin positions 1, 2, 3, the six arrangements can be listed as follows:—

a b c 1 2 3	*b c a* 1 2 3	*c a b* 1 2 3
c b a 1 2 3	*b a c* 1 2 3	*a c b* 1 2 3

It will be seen from this schedule that the arrangements in the first row may be gotten from the one on the left by successively advancing the positions of the conductors *a*, *b*, *c*, at each change between specific arrangements, a third change would bring the conductors back to their original positions. The same condition of affairs holds for the second row. The change of conductor locations occurring between specific arrangements corresponds to a transposition and a combination of three arrangements, such as is shown either in the first or in the second row, is known as a "barrel". If the absolute values of the voltages impressed on each phase were equal and they differed in phase by 120° from one another, then the electrostatic fields (at a given distance from the power circuit), produced by each part of the barrel would be equal in magnitude and differ in phase by 120°. Except in the case of symmetrical configuration power circuits, no simple relation exists between the magnitudes and phase angles of the fields produced by the arrangements in the first and second rows, hence a combination of these two series of arrangements in one transposition scheme is seldom used unless required by some special circumstances. If a transposition, which has the effect of changing conductors *b*, *c*, *a* to the arrangement *c*, *a*, *b* and continuing in the same rotation would change *c*, *a*, *b* to *a*, *b*, *c*, be denoted by the letter *X*; then a series of barrels in the power circuit could be shown as:—

| — *X* — *X* — *X* | — *X* — *X* — *X* | — *X* —
| 1 barrel | 1 barrel |

where the dashes represent nominal thirds of barrels.

This method of transposing is known as continuous barrelling and while it is very effective in balancing out the induced voltages of fundamental frequency, it is not as effective for the higher harmonic components which are the source of the interference in a telephone circuit. This is because the electromagnetic disturbance in the power line is not propagated with infinite velocity, but travels approximately at the speed of light, thus causing a difference in phase between two points in the power line considered at any instant of time; this difference in phase is insignificant at the fundamental frequency but at higher frequencies it has the effect of causing the three induced vector potentials in the telephone circuit to be: (approximately)

$$V,\ V\ \underline{/120^\circ + \theta}\ ,\ V\ \underline{/240^\circ + 2\theta}$$

instead of:

$$V,\ V\ \underline{/120^\circ}\ ,\ V\ \underline{/240^\circ}$$

so that the sum of these potentials is no longer zero.

A considerable improvement in the degree of balance obtained for the higher frequency components may be obtained by omitting the transpositions at the points between successive barrels, this series of barrels could be shown as,

| — *X* — *X* — | — *X* — *X* — | — *X* — *X* — | —
| 1 barrel | 1 barrel | 1 barrel |

This is known as halting barrelling.

In some cases a further improvement may be made by reversing the direction of rotation of alternate pairs of transpositions, this gives a series of barrels which could be shown as,

| — *X* — *X* — | — *Y* — *Y* — | — *X* — *X* — | — *Y* — *Y* — | —
| 1 barrel | 1 barrel | 1 barrel | 1 barrel |

Where *Y* represents a transposition in which the conductors are rotated in the direction opposite to that occurring in a transposition designated "*X*". This is known as halting-reverse barrelling. It should be noted that in the actual case, it is necessary to take into account not only phase charges in the power line but also in the communication circuit; since the induced disturbances are propagated along the communication circuit with a velocity determined by the electrical characteristics of the circuit. These effects may cause the neutralization of induced effects to be much more complete at one end of the communication circuit than at the other end.

In the case of a parallel between a power circuit and a telephone circuit in which transpositions are to be placed in both circuits, it can be shown that the minimum voltage between the two sides of the telephone circuit is obtained when the telephone circuit neutral points coincide with the transposition points and inter-barrel points in the power circuit. That is the telephone circuit is divided into short sections terminated by the neutral points and each short section is so transposed as to balance up as far as possible the effects produced in each conductor. . Now this balance in each section is obtained by approximately equalizing the induced voltages in each section, both conductors in the transposed section are still energized by comparatively large voltages, but the approximately equalized voltages in the adjacent sections in which the induced voltages are successively displaced by 120°, will operate to neutralize these voltages in each other. A section of a co-ordinated transposition scheme is shown in figure No. 3.

This method is in general quite effective in reducing the inductive effect in the paralleled circuits, arising from balanced components of current and voltage in the power circuit, but it is also necessary to arrange the transpositions in the telephone circuits on the affected pole line in such a manner that the inductive effects occurring between every possible combination of telephone circuits, of which there may be as many as 60 (including phantoms) on the pole line, may be maintained at a very small amount. This transfer of energy from one telephone circuit to another is known as crosstalk and it has been found that if the power transferred to any circuit from another telephone circuit exceeds one millionth of the power flowing in the disturbing circuit, the crosstalk becomes appreciable. The necessity of maintaining a very high degree of balance between the various telephone circuits on the communication pole line imposes severe limitations on the methods available for co-ordinating the telephone and power circuit transposition schemes.

The reasons which prevent the obtaining of perfect results, by this method, may be summarized as follows:

First, — The possibility of the existence of residual components of voltage and current in the power circuit.

Second, — The departure from ideal conditions in the actual parallel, such as non-uniform separation between the power and telephone pole lines, non-uniform height of conductors above the ground, branching circuits, and loads, changes of configuration in the portion of the power line included within the exposure. In this connection reference may be again made to the equations given in Part I; in these formulæ the coefficients are functions of the length of the exposure as well as separation and frequency, consequently in exposures of non-uniform separation the equations become much more complicated and although positions for power transpositions may be determined such that the total induced voltage is a minimum it is quite possible that this minimum may be an appreciable fraction of the voltage induced under similar conditions without any transpositions in the power circuit. One reason for this condition is that the space potential at points adjacent to a three-phase power circuit varies not only in magnitude, but also in phase with changes in distance from the power circuit. Figure No. 4 shows graphically the conditions existing in the vicinity of a three-phase triangular configuration circuit. This applies to the effects of balanced components of voltage and current, the fields produced by residual components do not vary in phase with change of location relative to the power circuit. These phase change effects are particularly marked in the case of power circuits whose configuration is vertical or approximately vertical, hence it is particularly desirable in this case to endeavour to maintain separations as uniform as practicable.

Third, — The equations given in Part I describe the conditions occurring at a specific point in the parallel, at any other point a similar set of equations will hold and in order to obtain the total inductive effect in the communication circuits, it is necessary to integrate these incremental quantities over the entire length of the parallel. This procedure is not required in the case of short parallels, but in the case of long parallels it is necessary to take into account the fact that the impressed potentials change in phase with distance along the line. In the case of the fundamental frequency this phase change is quite small, but in the case of the higher harmonics which are the cause of the disturbances in the telephone circuits this phase change with distance becomes quite appreciable. This is the reason why transpositions in the power circuit if placed too far apart become ineffective in reducing the magnitudes of the higher harmonic components of the induced potentials. It should be further noted that this neutralization of induced potentials actually occurs in the communication circuit consequently it is necessary to take into account, not only the phase change effects in the power circuit, but also those occurring in the communication circuits. In addition to this, there is appreciable attenuation of the induced disturbance as it passes along the conductors of the communication circuit and this also operates in such a manner as to reduce the degree of neutralization of induced effects in the affected circuits.

Fourth, — In the case of a pole line carrying a number of telephone circuits, which is exposed to induction from a power circuit, the scheme of telephone circuit transpositions must be designed to serve two purposes, first to prevent crosstalk between any two circuits on the pole line and second to maintain a balanced condition to effects of external fields. It is sometimes difficult to design a system of transpositions which will fulfill both functions with the degree of perfection desired.

Fifth, — In computing coefficients of capacity it is not possible to take into account the effects of trees, buildings and irregularities in the surface of the ground, which all affect the electrostatic fields produced and hence the precision of balance obtainable by means of co-ordinated transposition schemes is limited by the accuracy of the fundamental data available.

In spite of all these limitations the co-ordinated transposition scheme constitutes the most generally useful means of mitigating the effects of interference in signal circuits which are exposed to induction from power circuits.

Part III.—Elimination of Harmonics

The problem of preventing interference in telephone circuits could be attacked from a different angle altogether. The design of a co-ordinated transposition scheme may be likened to the operation of balancing a Wheatstone bridge, or more generally it is similar to making modifications in

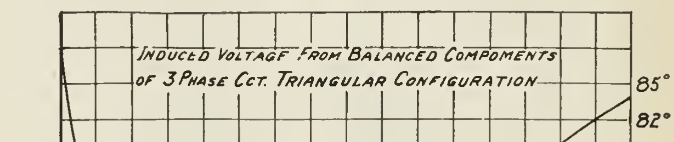

Figure No. 4.—Graphical representation of conditions in vicinity of three-phase triangular configuration circuit.

an electrical network with a view to causing the transfer admittance between certain pairs of meshes equal to zero, that is equivalent to stating that if A_{xy} is the transfer admittance between meshes x and y, then if $A_{xy} = 0$, a source of electromotive force may be inserted in mesh x, without causing any change in the current in mesh y. Now the interference in a telephone circuit is due entirely to currents whose frequency is much higher than the frequencies used in transmitting power and if these higher harmonic components could be prevented from going out in the power transmission line, the problem would be satisfactorily solved. The comparative interfering effect of unit voltage in the power circuit at different frequencies is shown in figure No. 5. Inspection of this graph shows why the telephone engineer is in this case not interested in the magnitude of voltage and current of fundamental frequency, but wants to know what is the voltage and current at various higher frequencies; in general this information is not available and for this reason the American Telephone and Telegraph Company has developed an instrument that measures the relative interfering effect of a certain wave form, it measures the amplitude in each frequency and weights each component according to its relative interfering effect and automatically integrates the whole effect, giving what is known as a telephone interference factor.* This factor is of considerable value in computing inductive effects. For instance, if a power circuit which parallels a telephone circuit is fed from source A, whose potential has a telephone interference

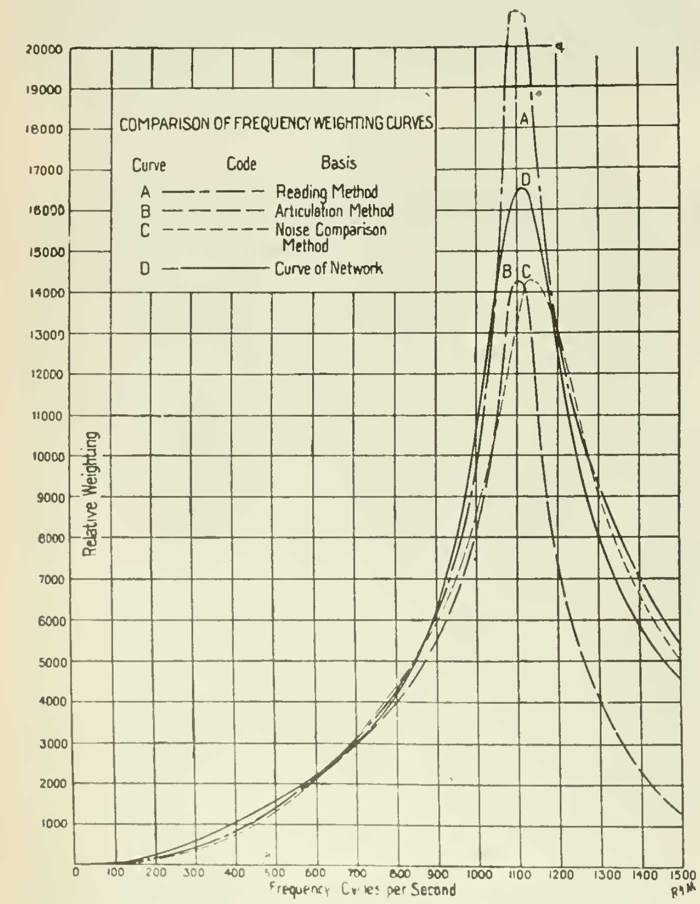

Figure No. 5.—Comperative interfering effect of unit voltage in power circuit at different frequencies.

* A.I.E.E. Trans. 1919 Vol. XXXVIII, article entitled "Review of Work of Sub-Committee on Wave Shape Standard of the Standards Committee".

factor a then if the same power circuit is fed from another source B having a telephone interference factor b the amount of interference in the second case will be equal to b/a times the amount of interference experienced in the first case.*

Higher harmonic voltages are produced by generators which might be expected from consideration of the mechanical structure of such a machine. The potential generated consists of a sum of a number of small potentials produced by a finite number of separate components.** If, however, each one of these components is itself a sine wave of fundamental frequency, their sum will be a sine wave of fundamental frequency. In the case of salient pole machines, these components are in general far from being sine waves of fundamental frequency. In order to attain this condition, it would be necessary to design the generator field in such a manner that the variation in the field flux relative to the circumferential distance of the pole pitch is sinusoidal, that is the double pole pitch is considered to be equivalent to 2π radians and the points corresponding to $\pi/2$ and $3\pi/2$ radians come at the centres of the poles. This condition is difficult to obtain with salient pole machines, but in the case of the slot-wound field it is not difficult to obtain. This type of harmonic is known as a pole harmonic. Stator windings are generally not uniformly distributed on the surface of a core of magnetic material, but are located in slots, these slots disturb the uniformity of the field flux and produce harmonics in the generated voltage. These slot harmonics will appear in pairs and the frequencies will be:

$$f_1 = f_0\,(2n + 1) \quad \ldots\ldots (11)$$
$$f_2 = f_0\,(2n - 1)$$

where f_0 is the fundamental frequency and n is the number of slots per pole. Since the slot harmonic voltage is not itself a pure sine wave, there will also be present superharmonics which will appear as pairs of harmonics differing in frequency by twice the fundamental frequency. There are several methods of substantially preventing the generation of slot harmonics; by making the number of slots per pole fractional, by using tunnel or nearly closed slots, by making the field slots slightly out of parallel with the axis of the machine, (in this case the angle of divergence would be such that $\tan.^{-1}(\phi) = P/W$, where P is the slot pitch and W is the pole width), by dividing the stator longitudinally into two or more sections and staggering the slots in each section, this last method has been used with very satisfactory results by one of the larger manufacturing companies. Slot harmonics are in general much more pronounced than pole harmonics. The relative interfering effects of the voltage wave forms produced by generators measured by the telephone interference factor meter vary widely; modern large machines will usually have a factor between 10 and 30, in some cases this factor is much larger and factors as high as 600 have been noted. The large generator at the Queenston plant of the Hydro-Electric Power Commission of Ontario produces a very good wave shape, the measured telephone interference factors ranging from 3.8 to 4.4. Higher harmonic components are created in transformers and this action is due to the non-linear relation between the flux and the magnetizing force producing it. Since the induced potential in a transformer winding is proportional to the rate of change of the flux,

* This is not strictly true in all cases, since there may be apparatus in the system whose impedance characteristics are non-linear, such as motors whose back E. M. F. contains higher harmonic components and transformers which take from the line a current whose wave shape is badly distorted.

** This excludes the case of the unipolar generator.

every harmonic component existing in the flux must also appear in the windings interlinking this flux; and therefore to obtain a pure sine wave of generated potential in the secondary winding, the flux must be a pure sine function of the time. To obtain this condition there are two requirements, first the impressed potential must be sinusoidal and second the transformer connections must be such as to allow all the components of the magnetizing current to flow freely. In a star-star connected bank of three-phase transformers the third harmonic and its superharmonics in the magnetizing current have no path in which to flow and consequently, the generated voltage wave-form is badly distorted. Various means have been devised to find a path for these components, such as providing the transformers with a tertiary delta winding, using an auxiliary bank of transformers having a secondary winding delta connected, and making the connections as shown in figure No. 6. If the generator is close to the transformers and is star-wound a connection may be made between the generator neutral and the transformer neutral; either of these methods will allow the necessary components of the magnetizing current to flow, but the results are not as satisfactory as those obtained by the use of the star-delta or delta-star connected transformers.

The degree of saturation of the cores has a marked bearing on the magnitude of the harmonics produced, in some cases, the magnitudes of certain harmonic components have been shown to increase as the fifth power of the flux density, when operating considerably above the "knee" of the B-H curve.

Part IV.—Residual Voltages

When a bank of transformers is connected in star on the line side and the neutral is grounded, the third harmonic component of the generated voltage in each phase is producing a potential between the ground and the other end of the transformer winding connected to the line conductor. Now the third harmonic components on each phase are 120° apart and this corresponds to 360° for the third harmonic, hence all these third harmonic components are in phase and this causes the voltages of all three line conductors to oscillate as a unit with respect to the ground at triple frequency.

This voltage is known as a residual voltage. The fields produced by a residual voltage in the power circuit often produce very severe interference in parallel telephone circuits, this is because the charges in and hence the fields produced by each conductor are in phase and add up arithmetically, whereas the charges produced by the normal or so-called balanced voltages are approximately 120° out of phase with each other and hence the field produced at some point external to the power circuit is the vector sum of three separate components which are roughly 120° out of phase with one another. A similar consideration applies in the case of induction from residual currents. In a transformer bank, star-connected on the

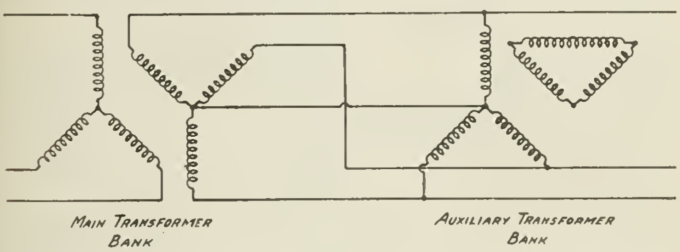

Figure No. 6.—Tertiary delta winding for transformers with auxiliary bank of transformers having secondary winding delta connected.

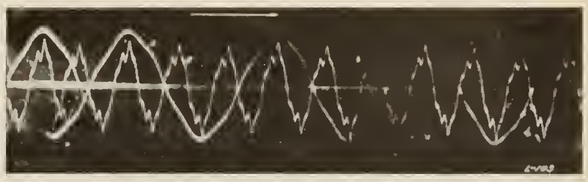

Figure No. 7.—Oscillogram of residual charging current of three-phase circuit operating with grounded neutral.
A—phase voltage.
B—current in neutral (no load).
Oscillogram taken by Hydro-Electric Power Commission of Ontario. Reproduced by permission.

line side, with the neutral grounded, the third harmonic component of the star voltage will cause a charging current to flow between the three line wires and the ground. Figure No. 7 shows an oscillogram of the residual charging current of a three-phase circuit operating with a grounded neutral.

In this connection it may be observed that the e.m.f. produced in the secondary winding of a transformer is proportional to the rate of change of the flux, thus if there were in the flux R per cent of a higher harmonic of n times the fundamental frequency, the percentage of nth harmonic voltage produced in the secondary would be Rn. Now the charging current of the line is proportional to the rate of change of the impressed voltage, hence the percentage of the nth harmonic in the charging current will be Rn^2, similarly the induced voltage in a parallel communication circuit will be proportional to the rate of charge of the charging current in the power line (considering this effect independently) and hence the percentage of the nth harmonic voltage in the communication circuit will be Rn^3. Further, experiment has shown that the interfering effect of unit current in a telephone circuit is approximately proportional to the square of the frequency, hence the comparative interfering effects in the telephone line vary as the fifth power of the frequency of harmonics in the flux, when the interference is due to charging currents. If these currents are residual, i.e., returning through the ground their inductive effects in neighbouring conductors may be ten or twenty times as great as the effects of similar currents which are confined to the conductors. The reason for this effect has been explained above.

These remarks will serve to show that when a power system whose transmission lines parallel telephone circuits is to be operated with a grounded neutral it is desirable to give careful consideration to the wave form of the star voltage which will be applied to the power circuits. Where the generating system is connected star-delta-star the delta connection provides a closed path for the circulation of the third harmonic current and its superharmonics, and this greatly improves the wave form of the star voltage. On lower voltage systems, the generator is often directly connected to the line and may be star-wound with the generator neutral grounded; in this case there is nothing to modify the star-voltage wave form applied to the line and in some cases very severe interference has been experienced in telephone circuits exposed to portions of power systems of this type. At the present time the manufacturers of electrical machinery can produce generators suitable for this kind of service having a very good star voltage wave shape.

Residual voltages in a three-phase power line may be produced by single-phase taps, the magnitude of the residual voltage being dependent on the length of the tap or more precisely on the ratio of the length of the tap to the length of the three-phase line, this residual voltage will appear both in the three-phase line and in the single-phase tap, but if the tap is short compared with the main line, this voltage will not appear in the main line, but it always appears in a single-phase tap however short; this, of course, refers to conductive connection, if the single-phase load is taken off through a transformer, no residual voltage will be produced in either circuit.

Abnormal Conditions

When any sudden change in circuit or load conditions occurs in a power system, it is always productive of a disturbance in the electrical and magnetic fields surrounding the transmission line conductors. These sudden changes may be due to the variety of causes, the operation of overload cut-outs, the use of separate single pole switches for disconnecting three-phase lines, the occurrence of various troubles such as breaks, shorts and grounds, some of these causes produce a transient which dies away in a very short period of time and others produce an abnormal circuit condition which may persist for some time. An arcing ground due to a defective insulator may cause a sustained high frequency oscillation in the power system which has often produced very serious disturbances in parallel telephone circuits in some cases fires have been started in a telephone exchange, due to this cause. The charging of electrolytic arresters through horn gaps gives rise to similar disturbances and in cases in which a power line parallels a telephone circuit, it is desirable that these arresters be charged through resistances and not through horn gaps, and if possible, at times when the telephone circuits are not likely to be in use, for instance between 2 a.m. and 4 a.m.

The operation of circuit breakers and other switching devices on three-phase circuits may give rise to severe disturbances, if conditions are such as to permit prolonged arcing at the contacts, particularly if there is some dissimilarity between the apparatus associated with each of the phases which causes one of the arcs to extinguish before the other two.

There is no general method of solution for cases of interference from transient disturbances, each case must be made the subject of a special study. Where the disturbance is due to one particular type of transient, some specific remedy may be indicated, for instance in the case of interference arising from arcing grounds on a three-phase system having a grounded neutral, the magnitude of the effects produced may be reduced by placing a resistance between the neutral and the ground, thus limiting the maximum current to ground in the periods during which abnormal conditions exist. The extent to which this current may be limited depends on the sensitivity of the relays which are to be operated by this abnormal current in the ground connection to the neutral.

Part VI.—Effects Produced by Extraneous Currents in Communication Circuits

The principal effect of extraneous currents in a telephone circuit is the production of noise in the receiver. Small amounts of noise are productive of a certain amount of annoyance to the persons using the telephone circuit; larger amounts of noise impair the intelligibility of the conversation and if very much noise is present conversation becomes impossible. The amount of extraneous current which produces a certain deterioration in intelligibility depends on the frequency of the disturbing current. It has been found by experiment that the following magnitudes of foreign current in a 70-ohm receiver have about the same effect in impairing the intelligibility of conversations:

Frequency	*Current in microamperes*
100	200
200	110
500	32
1,000	10
1,100	8
1,400	55

These amounts of foreign current are sufficient to cause very appreciable annoyance to the telephone user and also a certain deterioration in the intelligibility of the conversation. Five times this amount of foreign current renders conversation very difficult. Where extraneous currents of several frequencies are present simultaneously the total impairing effect on the intelligibility is approximately proportional to the square root of the sum of the squares of the several components, each component of current being weighted according to its comparative effect on intelligibility.

It has been remarked that the human apparatus of audition and the telephone receiver acting in conjunction with one another make a wonderfully sensitive detector of small alternating currents; a current of 0.02 microamperes at 800 cycles in an efficient 70-ohm receiver is audible. It may be interesting to note that the excursion of the diaphragm is then about 10^{-8} c.m. or about the same order of magnitude as the diameter of an atom.

It is largely owing to the remarkable sensitivity of this combination, the telephone receiver and the ear, that it has been possible to provide telephone service at a cost so low as to be available to everyone. With this great advantage comes the minor disadvantage that it makes the telephone circuit very susceptible to extremely small amounts of energy derived from extraneous sources. Putting this into figures, it will be noted that 10^{-7} watts of foreign power absorbed in the receiver will cause an appreciable impairment in its efficiency as a translator of intelligence.

Now a power transmission line may be delivering 10^6 or even 10^8 watts, so that if $1/10^{15}$ of this power is transferred to a telephone circuit, its effect is quite appreciable. In the case of telegraph circuits the lower frequencies only have any appreciable disturbing effect. A single line Morse circuit will be rendered very difficult to operate by 15-20 milliamperes of 60 cycle foreign current, and 5-10 milliamperes of 25 cycle foreign current will have a similar effect. Printer telegraph systems are much more sensitive and 2 or 3 milliamperes of foreign current flowing in the circuit will cause the reception and printing of incorrect letters or symbols.

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Aeroplane Surveying

Progress in the Preparation of Contoured Maps from Air Photographs

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Although the problem of preparing maps from photographs taken from the air has been the subject of investigation for over fifty years, the present wide-spread interest in this subject only began to be evident after the beginning of the recent war. The extraordinary development in aeroplane design and the technique of air photography which was accomplished very early in the war resulted in the production of air photographs of very high technical perfection. A very cursory examination of these photographs reveals the vast amount of detailed information which can be obtained by means of them and as the photographs appear to have the same general characteristics as drawn maps and in many cases where very close approximations to maps, the conclusion was jumped at that the preparation of accurate maps from these photographs was a simple matter. But a detailed examination of the nature of the problem of preparing contoured maps by means of these photographs reveals at once the extreme complexity of the matter.

Two Classes of Photographs

Photographs taken from the air may be broadly classed in two groups: vertical and oblique views. A vertical photograph has the advantage of being an approximation to a map without contours. The relative positions of all objects shown in the same photograph are approximately true and approximately to scale. But as soon as one attempts to make accurate measurements on such a photograph the errors in scale and exact position become apparent and it is seen that although the photograph is approximately a plan of the country, it lacks precision. The approximate accuracy of these vertical views is utilized in so-called mosaics, in which vertical views covering an area are fitted together and form a reasonably good plan of the country covered. These mosaics show an extraordinary wealth of detail but their inaccuracies are always present to an appreciable degree. Tracings made from these mosaics cannot be regarded as maps in the scientific sense of the word.

The other class of aeroplane photographs, the oblique views, give one a much more realistic impression of the country and indicate in a more or less satisfactory way the nature of the undulations of the ground, but due to the variations in scale in the foreground and distance they are almost useless for an accurate estimation of relative distance and directions. It is the so-called distortion, due to the tilt of the camera, which is evidenced in the form of varying scale.

Types of Distortion

This brings us to a much discussed feature of our problem: that of distortion. The different types of distortion encountered in aeroplane photographs may be classed under several headings: First, there is the lens distortion, due to the fact that no lenses are perfect, and in general this distortion takes such a form that a perfect square when photographed will appear to have either convex or concave sides; these two effects being known respectively as barrel and cushion distortion. In a high grade lens this effect is small and will not be discussed in detail in this paper. Other distortions of negligible magnitude are those due to refraction of the atmosphere and curvature of the earth. But when these effects are disregarded, we are left with two types of distortion of considerable magnitude which are of prime importance in the problem of aeroplane mapping.

The first of these is the distortion which is the characteristic feature of the oblique photograph. This distortion would appear by taking an oblique photograph of a rectangular grid on the ground, in which case the photograph of the grid would in general show two perspective vanishing points. This type of distortion will be referred to as the distortion of perspective and it has to be eliminated in some way before the photographs can be employed directly for mapping. The photograph must be put through a process of horizontalizing or rectifying by means of which it is changed into the photograph which would have been taken if the axis of the camera had been exactly vertical and the plate exactly horizontal at the instant of exposure. A photograph taken under these conditions or rectified so as to conform to them is entirely free from the distortion of perspective.

The last type of distortion to be discussed constitutes the most important and useful feature of photographs from the air. This distortion will be referred to as the radial distortion. The nature of this effect may be understood if one imagines a photograph of a high tower taken from the air in an oblique manner. The top of the tower will occupy the same position on the photograph as an object on the ground lying beyond the tower in a direction radial from the plumb line through the camera position. This effect will at once be seen to depend, amongst other things, on the height of the tower, and it is, in fact, the means of determining heights and contours by means of aeroplane surveying.

This effect is present to a very slight degree in vertical small angle photographs, which are therefore not of great value for accurate contour surveying. On the other hand, radial distortion is present in pronounced form in oblique photographs. But the difficulty in horizontalizing oblique views is much greater than in the case of nearly vertical views. Vertical wide angle photographs combine advantages of both types and for this reason I have devoted a great deal of time to the production of a camera adapted to secure vertical views of this kind, and at the present time I think I am justified in saying that the main difficulties of this problem have been solved.

A detailed examination of the difficulties encountered in the mapping problem will show that they are nearly all either eliminated or simplified by the use of this type of photograph, which appears to be quite free from any characteristic disadvantages. For instance, it may be shown that if a given areas, say ten square miles, is to be covered by a single photograph, the most advantageous position for the camera is over the center of the ground photographed with the camera axis vertical, and from as low a height as will just prevent the serious obstruction of the view of distant objects by higher objects lying nearer to the camera position.

Production of Contoured Maps

We now come to a consideration of the main problem, which is the production of the contoured map from the photographs. To understand this problem we will have to realize at the outset that the geometrical principles on which any scientific method is to be based are in essence identical with those of the method of topographical surveying from the ground; methods which have been understood for thousands of years.

In work from the ground it is necessary for the observer in the field to locate his position by direct or indirect reference to known control points whose positions have been determined. To locate objects in the field the surveyor must determine the bearing or direction of the object as viewed from two located points. The intersection of these bearings determines the position of the object and angles of elevation or depression determine the heights. The fundamental problem of the field surveyor is the determination of the position from which his angles are read. Similarly, the determination of the aeroplane position is the fundamental problem of the aeroplane surveyor.

Although the problems confronting the two types of surveyor are the same as regards their general object, the solution of this resection problem as it is called, is child's play for the ground surveyor as compared with the difficulty which confronts the aeroplane surveyor. The reason for this is that the ground surveyor has a fixed platform to work from and his instruments are fitted with levels which enable all his angles to be read under ideally simple conditions as regards subsequent reduction by the computer. Once the instruments are levelled it makes very slight difference whether the observations are taken photographically or by sighting in a telescope. In the aeroplane, however, the conditions are entirely different.

Attempts have been made to devise instruments which will indicate a true vertical when used on aircraft in flight, and for the purpose of preparing mosaics, instruments of this type have already been produced which are reasonably satisfactory in their performance. But for the purpose of contour surveying, the determination of the vertical must be effected with scientific precision if the contours of the map are to be exact.

The requirements for the determination of the height of the aeroplane also calls for a precision considerably in excess of anything so far attained by the use of altimeters. It appears, therefore, that at the present time it will not be possible to determine the aeroplane position corresponding to a photograph directly by means of instruments carried in the machine. We are in effect thrown back on the same geometrical principles for our position determination as those employed by the ground surveyor. The resection problem on the ground, in two dimensions, becomes in effect the resection problem in space, and its difficulties are multiplied enormously when it becomes a three dimensional problem.

The Problem of Determining Position

Let us now consider the problem in detail. Just as the ground surveyor requires observation on three control points to determine his position, so the aeroplane surveyor requires that three known objects shall appear on each photograph. The angular separation of three control points as viewed from the aeroplane enables the position of the point of sight to be determined, but not without ambiguity. Time prevents a detailed discussion of this ambiguity, but it may be stated that if certain simple precautions are observed this ambiguity disappears and the position is definitely determined by means of the angular separations of the three points photographed on the plate. These angular separations are determined by means of the photograph if the relative position of the lens and plate is known, so that without further discussion we may say that by direct or indirect methods these angles are known from an examination of the plate.

Let us, then, imagine that the plate, after development, is set up in the same relation to the lens and that the images of the three control points are projected as rays passing out from the lens into space and forming the edges of a tetrahedron or pyramid. If, now, we imagine that we are able to construct out of, say a piece of cardboard, a triangle corresponding exactly to the triangle formed in nature by the three control points appearing on the photograph taken in their own plane, (which is not necessarily horizontal, same height), we can imagine that we are able to move this cardboard triangle around in the path of the three rays until we find a position in which the rays exactly coincide with the corresponding corners of the triangle. If this operation is carried out we have reconstructed the geometry of the aeroplane position and the three control points in nature, and the subsequent calculation of the aeroplane position based on this reconstruction of the pyramid is a perfectly straightforward problem of computation or mechanical solution and the horizontalization of the photograph is a simple matter.

But the solution of the pyramid reconstruction is beset with difficulties on every hand. The problem has been solved by direct mathematical methods but the labour involved is enormous and on this account it does not appear at present that this is the practical solution of which we are in search. An idea of the complexity of direct mathematical methods may be gathered from the fact that if simultaneous equations for the aeroplane position are set up, based on the angular separations of the control points, these equations have sixty-four roots, one of which is the position of which we are in search. This direct mathematical method is the work of two German scientists, Hugershoff and Cranz.

There is a second method also due to a German, which consists in a mechanical reconstruction of the pyramid. In this method an adjustable metal tripod is used which is fitted with telescopic legs and angular adjustments and scales at the apex. These angles are adjusted to correspond with the angular separations of the control points as determined by means of the photographs, and a three dimensional reproduction of the three control points is set up by means of adjustable pillars resting on a horizontal surface. The tripod is then moved around until its three feet simultaneously rest on the corresponding three points of the reconstructed triangle, the telescopic legs enabling this adjustment to be carried out without alteration of the apex angles of the tripod. When this adjustment has been effected, a plumb line suspended from the tripod apex indicates the projection of the aeroplane position on the horizontal surface and the height of the apex above this surface corresponds with the height of the aeroplane. This method, due to Dr. Max Gasser, is much more rapid than the method of Hugershoff and Cranz, but it appears to be open to the serious objection that the tripod cannot be constructed of sufficient rigidity and accuracy to compete in its performance with the accuracy of the field theodolite or the mathematical accuracy of the Hugershoff and Cranz method.

The third and last method which I shall describe, is one on which I have been working for a number of years. It consists in essence of mounting the developed photographic plate and projection lens in a camera so that the relation between the plate and lens is similar to that which existed at the time the photograph was exposed and projecting the images of the control points so as to secure coincidence with three points plotted on a screen so as to correspond to scale with the control triangle in nature considered in its own plane. When this adjustment is effected the relative position of projection lens and the three points on the screen corresponds with the pyramid in nature resting on the three control positions with the aeroplane position as apex. This seems at first the obvious and straightforward method of solution, but in practice it is beset with many serious difficulties.

If vertical views of the ordinary sort are employed it is found that the fixing of the aeroplane position cannot be attained with the required accuracy as considerable changes in adjustment do not appreciably affect the coincidence of projective images and plotted points. If oblique views are employed it is necessary, in order to secure sharp focus in the plane of the screen, to decenter the projection lens by swinging it on its center. This introduces errors and mechanical difficulties of a serious nature which very much reduce the accuracy and usefulness of the method.

It thus appears that if this projection method is to be employed, the aeroplane surveyor is on the horns of a dilemma, since the vertical and oblique views each have characteristic disadvantages. The employment of wide angle approximately vertical views eliminates these disadvantages and enables the aeroplane position to be determined with a very high degree of accuracy

The projection apparatus, is based on certain geometrical principles which enables the coincidence of the projected triangle to be effected with great speed and accuracy and the three scales incorporated in the instrument enable the polar co-ordinates of the aeroplane position to be read off directly with the precision of a theodolite. The arrangement of the instrument is also such that a single angular adjustment made after the above coincidence has been effected enables the operator to secure an accurately horizontalized projection of the photograph of which all the constants are determined by scale readings of the apparatus. It appears that this method represents the shortest means to obtain the horizontalized positive to be used for the mapping itself.

In both the other methods referred to, the production of the rectified positive after the aeroplane position has been determined is a much longer and more tedious matter. However, this step in the different processes will not be gone into in detail and we will assume at once that we may obtain these rectified projections by any of the three methods described and go on to a consideration of the method of employing these rectified projections in the production of contoured maps.

Preparing Contoured Maps from Rectified Projections

In order to secure contoured maps from the rectified projections it is necessary to employ these projections in pairs and by a method corresponding to the method of cross bearings and elevations employed in ground surveying to determine the position and height of unknown objects. This involves projecting the horizontalized views on the mapping surface in a certain definite relation to each other corresponding to the relative positions of the projections on a horizontal plane in nature of the objects as viewed from the two aeroplane positions.

When this relative position of the projections has been secured the position and height of unknown objects may be determined by means of the method of cross bearings and radial displacements of the images. Although this method may be employed directly it is an enormous advantage to arrange the projections so that they may be viewed by a direct stereoscopic method or an anaglyphic method, (two color stereoscopic method), or an equivalent of one of these methods.

By a process of this type the draftsman may be made to see the terrain standing out in bold relief and to draw contour lines directly by running his pen through all objects which appear to be in the same plane as the mapping surface. Different contours may be drawn by shifting the mapping surface backwards and forwards from the lenses which are projecting the images on the mapping surface, these lenses being placed to correspond with the aeroplane positions of the two photographs. These stereoscopic methods are capable of a great variety of modifications.

Types of Cameras

A word may now be said about the cameras with which I have been experimenting. In order to secure a satisfactorily exposed wide angle view, it is necessary to employ a slow lens and a much longer duration of exposure than with the fast lenses heretofore used in aeroplane photography in which the exposures are usually about 1/200 of a second. If a wide angle lens is to be employed it is practically necessary to take a time exposure from the moving aircraft. The point of sight of the exposure is changing during the exposure, as evidenced by a drift of the photographic image across the plate, and the camera, with the ordinary type of mounting, is vibrating to such an extent that a time exposure is out of the question.

Two types of camera have been experimented with in which the vibration is eliminated by a suitable stabilizing device in which the drift of the photographic image across the plate is compensated for by an adjustable slow motion. With the first type of camera an exposure of one-third second was employed with resulting good definition over an area of about seven and half square miles in vertical photograph, taken from a height of ten thousand feet. In the second type of camera, which is still being experimented with, an exposure of one second was employed. This camera is designed to take in a very much wider angle of view than the first type. The photographs taken with the first type of camera are being employed for the production of a contoured map of an area of about twelve square miles lying about ten miles to the northwest of Ottawa, Ontario, this area being selected as exhibiting unusual difficulties from the point of view of aeroplane survey, a large part of the ground being extremely hilly and covered with uniform woods. The flying and field work was done with the very kind co-operation of the Canadian Air Board and Survey Department. The constructional and mapping work are being done at the Palmer Physical Laboratory of Princeton University.

Limitations of Aeroplane Surveying

With regard to the ultimate limitations of aeroplane surveying it may safely be said that the time will never come in which all the work will be done from the air. The three methods of aeroplane surveying which have been outlined each look forward to the possibility of enabling aerial traverses to be run between control points many miles apart, so that ultimately we may hope that the necessary ground control will be reduced to geodetic points twenty or thirty miles apart, fixed with the highest accuracy.

The precision of these aerial traverses will depend very largely on the number of over-lapping photographs required to bridge the gap between adjacent geodetic controls. If vertical views of extreme wide angle can be obtained, this problem of working directly on the geodetic control will have been practically solved. It is very largely on this account that I attach so much importance to the wide angle vertical view. But even supposing that these extreme angle photographs are obtainable, we are still left with much work to do on the ground. Names of rivers, towns, etc.; conditions of roads, courses of roads covered by overhanging forests; nature of important land marks and structures, will all have to be ascertained by direct examination on the ground.

The method will probably be for trained men to travel around in small cars with enlarged photographs of aeroplane views covering the terrain on which they are working. Details and information about the terrain will be sketched in and noted on these enlarged photographs to be forwarded to the drafting room where the maps are being drawn. But the work of field surveying as we now understand it with the plane-table and small theodolite, will be practically eliminated for the purposes of mapping. The field surveyor will be employed more and more in the accurate surveying of properties. On the other hand, I can see the work of establishing geodetic controls for the aeroplane surveying being pushed to the limit in the way of speed in order to keep up with the speed of the pursuing aeroplane.

Before closing this paper something may be said about the general situation with regard to aeroplane surveying. A rapid and accurate method of producing contoured maps from aeroplane photographs is urgently required in practically all the civilized countries of the world. In the United States, for instance, there are still about two million square miles which have not been covered by contour maps. At the present rate of progress it will require more than forty years to complete this work. Demands are received in Washington almost every day for maps of almost any kind, of regions in which industrial development is proceeding rapidly. The situation in other countries is very similar. It is this situation which makes all those conversant with the facts so interested in this problem, which is one of utmost importance to the progress of rapidly developing countries.

I have tried in this paper to give you some idea of the problem from a scientific viewpoint and have tried to treat it in as broad a way as possible. We may say that the problem of aeroplane surveying has been solved. The development of methods to a state of very high efficiency may be looked forward to with absolute certainty and in view of the vast interests involved it will undoubtedly be carried out with great rapidity and energy. It is certain that within a quarter of a century this country will be completely mapped and that the contouring of these maps will be far more accurate and reliable than that produced by present means, since stereoscopic methods enable direct observation to be made on each point of a contour line and not merely at considerable intervals, as is done by present methods.

Consideration in the Design and Construction of Highways

Relation of the Design of Highways and Limitations Imposed on Motors Using Them

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From the time of building the Great Appian Way, (300 B.C.), to the present date, highway construction has undergone many changes. Appius Claudius decreed that the Via Appia should be built in accordance with the best engineering practice then prevailing, and, as a result, the Appian Way to-day is a credit to the old Roman road builders. For 65 miles this road runs in a straight line to the town of Terracina. At this point it passes under the cliff of Monte Sant Angelo. The Romans had to make a side cut at this point by chiselling the face of the cliff. The outstanding features of this highway are the alignment, the excellent workmanship shown in the cut, the curvature around the cliff, the "easy" grades, the wide road bed, the neatly trimmed shoulders, the retaining walls, and, most important, the foundation, which has carried all manner of traffic. To-day we can learn much from these early Romans.

Subsequent to the construction of the Appian Way, there was a period in the history of road construction which might well be called the "Dark Ages of Road Building", but to-day we are enjoying a period of highway renaissance.

The problem, briefly, as far as the subject of this paper is concerned, has two phases, — *engineering* and *financial.* In this address I will not go into wearying detail. The ensuing discussion, I hope, will bring up further points.

Engineering and Financial Considerations

As to the engineering phase, briefly, the first principle involved is to design and build the road to carry the greatest loads to which it may be subjected, having regard to future traffic development and climatic conditions.

As to the financial phase, the load must be limited to conform to the design of road which can be built in accordance with the funds available. Public bodies always demand the greatest mileage of improved roads at a minimum of cost. This is the "parting of the ways" where engineers must choose a course of either pleasing a fickle public by sacrificing quality for quantity or run the risk of public censure by adhering strictly to good engineering practice at a consequent greater cost. Limitation of loading has its "limit" and the needs of growing industries must not be crippled by too stringent regulations.

Limiting Loads on Highways

In considering the question of limiting loads, we must be governed by the fact that many of our improved road surfaces built, say, ten years ago, were not designed to carry the loads to which they are now daily subjected. For instance, what will be the financial condition of a municipality which builds a first class road surface of say, concrete 8 inches thick or 2-inch asphaltic concrete on a 6-inch concrete base, and permits *unrestricted loads* to be carried over this surface, knowing that these loads must traverse another section of roadway built by the same municipality ten years previous having, say, a 4- or 5-inch concrete base with 1½-inch asphaltic concrete top; the latter financed on the assumption of a pavement having a life of twenty years, bonds having been floated for this purpose? Unless a limit of load and speed is enforced, the latter road surface will be totally destroyed long before the bonds mature; or, if traffic is limited, full use of the more expensive pavement will not be secured.

There is no "ideal" pavement section, in my opinion. Such "ideal" sections have been built, at great cost, and have failed. It is universally conceded that limitation of loads and speeds must be enforced, and this in relation to the locality and the period of the year. Therefore, the "ideal" pavement section may carry the load during a period from April to September but fail when the frost is coming out of the ground.

Automotive engineers argue that permanent highways must be built in order to suit the latest truck design. Arguments are used to show that railroads have undertaken reconstruction of their roadbeds on a large scale, placed heavier steel, built bridges to carry heavier loads, etc. The comparison is hardly fair in that the majority of railroads are financed by private companies, pay dividends, — or attempt to do so, — whereas our highways are financed by the public, are, in a sense, non-revenue producing in that the revenue cannot be shown.

Trunk Roads parallel Railways in British Columbia

If you will examine the map of British Columbia you will note that practically all of our trunk roads, projected and built, are parallel to railways: The Island highway, on Vancouver Island, the Dewdney trunk road, Vancouver to Agassiz, the Provincial highway, Vancouver to Hope and Lytton, Spences Bridge to Kamloops, Kamloops to the north and practically all trunk roads radiating from Kamloops, Ashcroft to Prince George, and Prince George to Hazelton and Prince Rupert. All these main trunk highways are so placed that the finances of the railroads will be seriously affected by competition of transporting companies using the highways built by public funds. These highways cannot be classed as "feeders" to the railways and in this province there are very few roads that might be called "feeders". Is the public then to be regarded as a competitor of railways?

By the above you are not to infer that limitations should be placed on trucks to eliminate competition with railways. Limitations must be placed not only to prevent our road surfaces from being entirely destroyed, but in order that they may be preserved for the use of the greatest number. It is then a question of finance as to what are the loads for which the roads will be designed and built. Is it possible to reasonably foresee what the traffic will be five or ten years hence?

Referring to the load limitations on highways, a large owner of trucks testified at a conference that "the public will have to pay for 1½ ton that is not hauled if this limitation is enforced". On the other hand, the public would require to pay a higher price if the roadbed is destroyed by excessive loads.

Importance of Foundations

As we are in the transient stage in the history of motor traffic on highways, it is my opinion that we should direct our engineering knowledge and skill to the preparation of the sub-foundation. You all know how the Romans built strong foundations, with extra heavy stone slabs laid in mortar. Those foundations are to be seen to-day intact. We are inclined to pay too much attention to the wearing surface, which, after all, has very little to do with the strength of the road. So that in considering the economics of design of surfaces for motor traffic, you must primarily consider the foundation.

Engineers are often faced with the problem as to what thickness of surface should be used when preparing plans for reconstruction of highways. Bituminous "carpet surfaces" cannot and should not be used where the foundation is not uniformly stable. Portland cement concrete attempts to take the middle course to distribute the load and bridge the weak spots in the sub-foundation, this being used as an argument in favour of this type of pavement over all other types.

It is undisputed that the *foundation* carries the load and the condition of the latter solely determines what type of surface should be used, having regard, of course, to loads, grades, etc. And in referring to foundations it must always be understood that drainage is of primary importance. The character of the foundation will solve the above problem. I do not intend to go into the merits of the various types of road surfaces at the present time. This is a subject too controversial and is not altogether essential in this paper. Job said, "Oh, that mine adversary had written a book". The inference is obvious.

In the design of highways, with regard to motor traffic limitations, as stated above, weight of load carried is important. Equally so are width and length of loads, speed, type and *condition* of tires.

What width road surface should be designed and built? Referring to paved roads, it is interesting to note the development from widths of 14 feet to 16 feet, and increasing to 20 feet. The widths of lanes of traffic vary: 8 feet is not "comfortable"; 9 feet is a fair average; if funds permit, 10 feet is most desirable. Two lanes of traffic should be provided for. Even as an expedient single track highways are not desirable. In British Columbia, legislation provides for the regulation of extraordinary traffic. The Lieutenant-Governor-in-Council may specify the gross load which may be hauled over any highway.

Appended hereto is a table showing the number of motor trucks registered in the province of B.C. covering the periods 1922 and 1923. It is interesting to note the decrease in the number of large units.

Statistics of Registration of Motor Trucks for years 1922 and 1923, for the Province of British Columbia

Capacity tons	No. of trucks 1922.		No. of trucks 1923.		Percentage Increases and Decreases.
½	1,808		2,316		
1	2,582	4,710	2,796	5,518	17.2 increase
1½	320		406		
2	530		529		
2½	78	694	89	712	2.6 "
3	86		94		
3½	122		116		
4	19	191	16	187	2.1 decrease
5	50		55		
6	3	6	2	3	50.0 "
over 7	3		1		
Total number of trucks	5,601		6,420		

Total number of *automobiles* registered in 1923................ 33,052
Total number of *motor trucks* registered in 1923................ 6,420

Total number of motor vehicles registered in 1923............ 39,472

Grand River Conservation and Power Development

The possibility of Power Development and its Beneficial Effect in preventing Destructive Floods

W. H. Breithaup, M.E.I.C.

Paper read before the Hamilton Branch, The Engineering Institute of Canada, May 15th, 1924.

In what may best be called its physical geography, the peninsula of southwestern Ontario is unique. The surrounding great lakes, the greatest continuous bodies of fresh water in the world, constitute the main feature of this distinction. The land area is in shape a rounded irregular cone, with flattened apex near its northern extremity, Georgian bay. Across the peninsula, from the Niagara river to the Bruce peninsula between Georgian bay and lake Huron, extends the Niagara escarpment, an abrupt break in the surface of the ground with a rise of 300 to 400 feet from below to above. The rim of water is almost level, the drop from lake Huron to lake Erie being only 9 feet, from Georgian bay to the outlet of lake Erie, from where there is fall, over the escarpment, to the level of lake Ontario.

The contour map, figure No. 1, showing also the Grand River drainage basin, is constructed on the well known White's Dictionary of Altitudes, compiled from railway elevations throughout Canada. This map gives an accurate general idea of the topography of the peninsula. The area within the 1,400-foot contour constitutes a tableland, the headwater area, comprising about 1,100 square miles, the greater part of which was originally swamp. On or near this plateau rise all the comparatively larger rivers of the peninsula: the Nottawasanga, Beaver, Sydenham, Maitland, Thames (north branch), and Grand rivers. Below the 1,400-foot contour the surface falls away sharply toward the north, less so toward the west and more gradually toward the southwest and south, the fall in every direction being at first steep and further on less so, becoming flat toward the rim, where smaller streams flow directly to the lake. Toward the north the fall from the highest contour, 1,700-foot, is over 1,100 feet in less than 23 miles.

The original surface condition, up to 100 years and less ago, was in greater part one of dense forestation. Especially in the central part there was one of the finest forests in North America; magnificent pine, 150 to 200 feet in height and 4 to 5 feet and over in diameter, and under them hardwoods, mostly maple and beech. On the headwater area there was much swamp, 700 square miles or more. A policy of intelligent government conservation fifty years ago would have retained all of these swamps as public domain; a continuing supply of cedar, tamarack and other poles and timber, a bird and game sanctuary and a perennial source of stream flow benefitting the entire peninsula. Instead of that, drainage was aided by government funds. The territory is now a flat plain largely of grazing lands with few if any farms of much value and this great natural resource is destroyed.

Grand River Drainage Basin

The Grand River drainage basin occupies the central part of the peninsula, lies on the higher ground directly within the upper edge of the escarpment, is approximately 2,600 square miles in area and comprises practically the whole of the counties of Waterloo, Wellington and Brant and parts of Grey, Dufferin, Perth, Halton, Oxford, Wentworth, Norfolk and Haldimand. The river rises about twenty-three miles from Georgian bay and has a length along its windings of over one hundred and sixty miles. The drainage basin is wide at the source and for some distance down, becoming narrower south of Waterloo county and quite narrow approaching the lake. It may be divided into two parts, the Upper river, extending to the outlet of the Conestoga tributary, and the Lower river from there on. The main tributaries in their order from the source are the Conestoga river from the west, rising on the headwater plateau, the Speed from the east and the Nith from the west. On the headwater plateau, mainly in the townships of East and West Luther, about 400 square miles of the Grand River drainage basin was swamp. This has since 1870, and largely between 1875 and 1895, practically all been drained.

Precipitation

Precipitation data for the immediate Grand River basin are scant. There exist however fairly good records for southwestern Ontario, and extending back for a considerable period. The Canadian Meteorological Service was organized in 1870, but there was observation to a considerable extent for some time before; in Toronto from 1840. Snowfall on the headwater plateau is heavy, ordinarily from 120 to 130 inches. One record 1879, is 153.8 inches. The average annual precipitation has varied from about 30 to over 40 inches of water. There is no evidence that with deforestation in the peninsula, precipitation has decreased. It has varied in cycles, but the general average of rainfall and snowfall remains about the same as at the beginning of observation. Runoff has however greatly changed with deforestation. Where the forest cover prevented quick passage of rainfall to the streams, retarded snow melting and facilitated accumulation of ground water, and the great swamps served as natural storage basins, the bare, compact surface now quickly delivers the water to the streams.

The gulf of Mexico is the great midcontinent source of rainfall and this influence extends to southwestern Ontario. How the large body of water intervening serves as a barrier against extreme precipitation is well shown in the records of March 1913, when occurred the disastrous floods along the Miami river and its tributaries in Ohio.

Precipitations from beginning of the storm to the dates given, were, at various points of observation in Ohio, as follows:—

Wooster	March	26th	9 in.
Upper Sandusky	"	26th	8.44 in.
Bangerville	"	27th	9.5 in.
Bellefontaine	"	27th	11.16 in.
Marion	"	27th	10.6 in.

North of lake Erie daily records are not available. The month's records are:—

	Location	*Rain*	*Snow*	*Total for month*	*Maximum 24 hrs.*
Port Stanley	Lake Erie	4.77	12.1	6.	1.77
Port Burwell	"	3.23	14.5	4.68	—
Port Dover	"	4.59	17.8	6.57	—
London	22 miles inland	2.83	23.5	5.18	1.34
Woodstock	30 "	2.99	10.8	4.07	0.42
Brantford	25 "	3.09	10.8	4.17	—
Guelph	52 "	0.65	11.	1.75	—

For the Grand River basin an average of 35 inches of water may be assumed as the annual precipitation; a little more in the upper river part, due to the large snowfall, and a little less in the lower. This compares with the precipitation in the total drainage area of lakes Erie and Ontario which has been taken at 34 inches.

Flood Records

The greatest floods in the year are invariably in the spring, when the snow melts, and invariably originate on the Upper river. However, heavy snow accumulations do not always cause extreme floods. Groundwater may be low, from lack of fall rains, and a good deal of snow-melting may be absorbed in the ground. Or the snow may pass very gradually, as in 1924. Minor floods occur any time during the summer after continued heavy rains, when the river may rise 6 feet in as many hours. Extreme high water never continues more than three or four hours, and generally less; and flood condition not longer than for a few days. The maximum flood in the history of the river, as far as I have been able to ascertain, was on April 7th, and 8th, 1912. In 1913 there was again an extreme flood, only slightly under that of 1912; but for the past eleven years including this year there has been no spring rise of more than moderate height; an unusually long period of exemption from destructive high water as the history of the river goes.

Discharges at various points on the river, during the 1912 flood, were approximately as follows:—

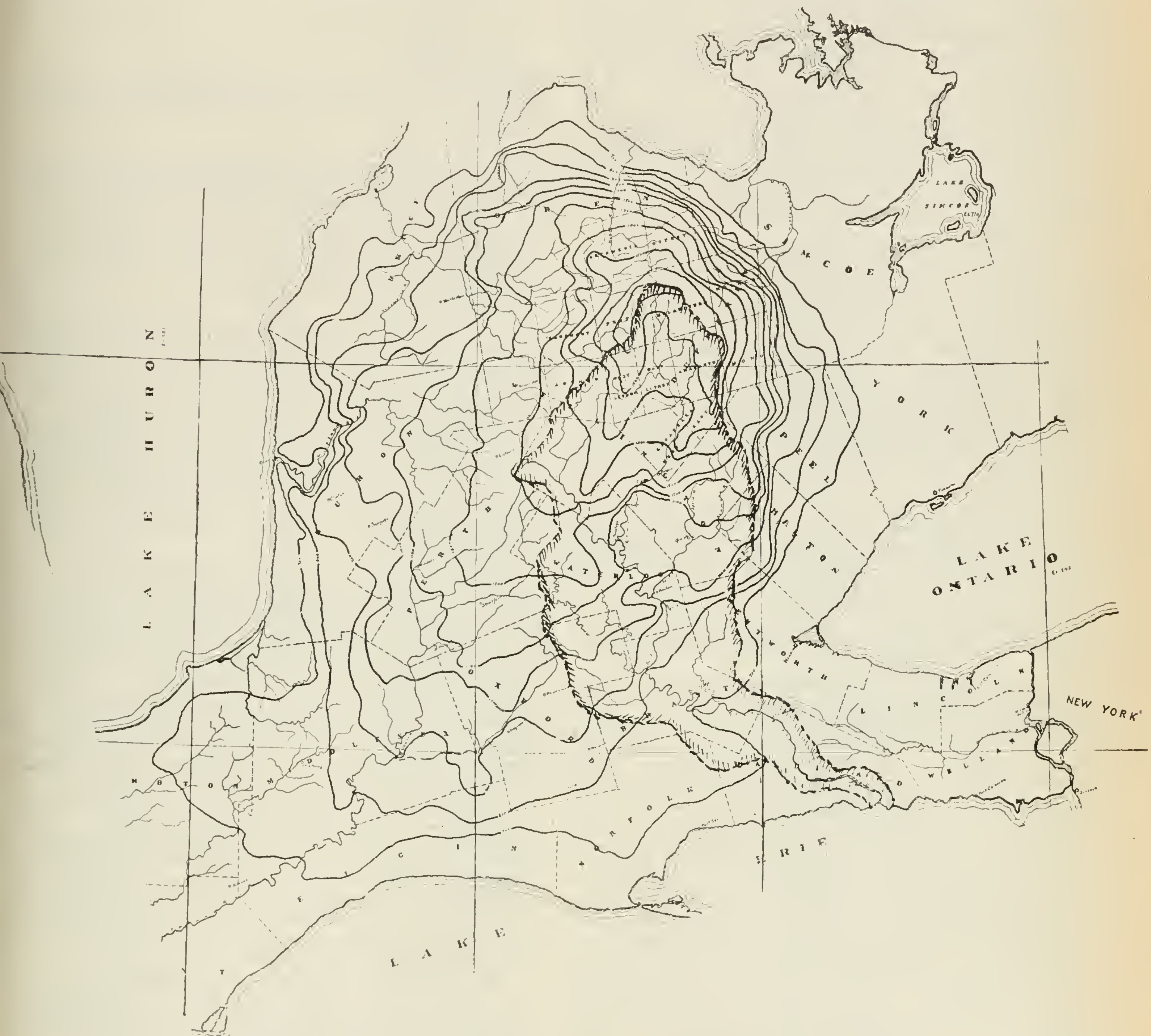

Figure No. 1.—Map showing sources of rivers in Ontario peninsula, with approximate 100-foot contours.

Elora	11 a.m.	Apr. 7	13,000 c.f.s.	
St. Jacobs (On Conestoga tributary)			12,300	"
Bridgeport	3 p.m.	Apr. 7	24,000	"
Galt	9 p.m.	" 7	31,000	"
Brantford	2 a.m.	" 8	51,000	"

Bridgeport shows the combined flow of Elora and St. Jacobs. Above Galt there is the Speed river outlet and above Brantford, at Paris, that of the Nith. A reduction of say 12,000 c.f.s., for a few hours only would have eliminated the destructive crest of the flood; a basin large enough to hold such discharge would therefore be effective in protection against extreme floods.

Storage Possibilities on Grand River

Let us look into the possibilities of storage on the Grand river. The Hydro-Electric Power Commission of Ontario, mainly in 1912 and 1913, made a topographical survey extending up the main river to beyond Elora and to some extent up its tributaries. In the township of Pilkington, just below Elora, the contours show a basin (previously known and called attention to), of about 5 square miles in area, and of capacity of two and three-quarter to three billion cubic feet depending on the dam at its outlet, the possibilities of which have not yet been at fully established. This dam will have a crest length of about 2,400 feet and a height above the river bed of from 60 to 70 feet.

This basin is by far the largest on the river, and in itself determines the economic practicability of conservation, giving not only ample capacity for flood control, but, above that, for very considerable sustained flow throughout the year in addition. Further storage is however available, and very desirable, and that on the Conestoga tributary. By its means a discharge at times approaching that of the main upper river, (compare St. Jacobs and Elora in the 1912 flood), can to a large extent be saved from waste. The practicable Conestoga storage will be only about one-half that of the Pilkington basin. It would bring the total to four and one-half billion cubic feet or over.

A flow of 15,000 c.f.s., for 24 hours would give 1,296,000,000 cubic feet, less than half the capacity of the Pilkington basin alone. Flood control would therefore be readily practicable. Sustained flow is however a very valuable consideration. A total of four billion cubic feet would supply a flow of 500 c.f.s., for 92½ days which is considerably longer than any period of drouth in the basin and there would therefore be replenishment from time to time.

The drainage area above the Pilkington basin would be approximately 440 square miles, and that above the Conestoga basin 180 square miles. There are no direct data on runoff, the proportion of precipitation delivered to the streams, in the Grand River drainage basin. Runoff depends on permeability and declivity of the drainage area. Evaporation, plant growth and ground water take up a large part of precipitation, although ground water will reappear in stream flow further down the valley. In general in the drainage area of the Great Lakes, including their surfaces which form a considerable part, runoff appears fairly established to be somewhat less than one-half of the precipitation. It appears reasonable to assume for the upper river parts of the Grand River drainage area, a runoff of twelve inches, about one-third of the precipitation. This would give for the Pilkington storage a total of over twelve and one-quarter billion cubic feet, and on the Conestoga a little over five billion; together over 17 billion, more than required for a flow of 500 c.f.s., throughout the year.

Above Bridgeport, about midway in Waterloo county, the summer low water flow is 40 c.f.s., while ordinary spring flood flow is 16,000 to 18,000 c.f.s., and has been as high as 24,000 c.f.s., as noted in the 1912 flood; i.e. low water is one-quarter of one per cent, or less, of ordinary spring floods, and one-sixth of one per cent of extreme floods, a condition approaching that of arid countries.

Power Possibilities with Storage Development

We come now to the consideration of power development by reason of conservation of flow. Below the proposed storage there are six power developments on the Grand river, utilizing heads as follows:—

Galt	8½	feet.
Paris	14	"
Brantford, upper dam	16	"
lower dam	33	"
Caledonia	7	"
Dunnville	6½	"

With sustained flow of 400 c.f.s., or more, other developments on the river would become practicable as there are good falls at a number of places, notably one just above Kitchener.

A much greater possibility of power development is by diverting the flow directly to the lake Ontario level. While the drainage area all along lies fairly closely within the edge of the high ground above the escarpment, the river channel does not come near this edge until three miles below Galt, where there is a lateral opening eastward with not more than about 40 feet of rise to the summit of the watershed between the river and lake Ontario.

By means of a dam, water can be taken from the river at this point at elevation 855 feet above sea level. This would give practically 600 feet of fall to the level of lake Ontario. There is no detail survey of the country between the proposed diversion point and Dundas, but the topographical map of the Department of Militia and Defence, with contour intervals of 25 feet, demonstrates the practicability of the project. The first two miles after leaving the river would be the most difficult and might have to be partly in tunnel. Such tunnel would be of about 12-foot bore, and not an undertaking presenting much difficulty.

A flow of 450 c.f.s., would give approximately 26,000 horse power. Development could well be in stages at various points with a first drop of 55 feet to the 800-foot contour, which could be followed, mostly by surface canal and partly by a flume resting on supports, across the provincial highway to the head of Spencer creek, from where on there would be no great difficulty. This route appears more easily practicable than one leading further south to the top of the escarpment nearer Hamilton. A moderate dam further down on Spencer creek could give a good regulating basin. The final drop would be from a forebay and could probably be 300 feet or more.

A diversion of water from the river at Galt may be disputed by municipalities further down stream. As to this there is to be said that if the diversion is no more than of the surplus water, now destructively wasted, to be gained by storage, and the present low water flow is maintained, or even somewhat increased, there can be no just complaint. On the contrary all municipalities will greatly gain by prevention of destructive floods, and must reasonably contribute to the cost of conservation.

The summer flow at Galt, augmented by the Speed river, which has a comparatively better minimum flow than the main river, and other smaller streams below the proposed storage, is approximately 150 c.f.s. An increase of 500 c.f.s. would proportionately benefit the developed water power in Galt.

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Annual Meeting Montreal

The combined annual general meeting and annual professional meeting of *The Institute* will be held in Montreal, commencing Tuesday, January twenty-seventh, nineteen twenty-five.

A committee of the Council is co-operating with the Montreal Branch in arranging definite plans for the professional meeting, it being anticipated that the coming annual meeting will be of particular interest to the engineering profession in the Dominion.

British Association for the Advancement of Science

What is considered the most successful meeting of the British Association yet held was convened in Toronto on August sixth, and concluded on August thirteenth. The sections, to which a large number of valuable papers were presented, included mathematics and physics, chemistry, geology, zoology, geography, economic science and statistics, engineering, anthropology, physiology, psychology, botany, educational science and agriculture. The sessions were held in the various halls of the University of Toronto. In the engineering section a number of papers were presented by members of *The Institute*, all of which were well received.

A Hundred Years of Electrical Engineering

A Hundred Years of Electrical Engineering was the subject of a paper presented by Professor G. W. O. Howe, D.Sc., in which Professor Howe reviewed the entire range of electrical science since its inception. A remarkable prediction made in this paper was that long distance transmission of electrical power may yet take place by direct current of high voltage instead of by alternating current.

Lord Kelvin, said Prof. Howe, who championed the uni-directional system as opposed to the alternating current method, notwithstanding the successful operation of the early alternating installations at Niagara Falls and elsewhere, was the original sponsor of this idea. The constant current principle has again been brought to the fore by the demonstration of a commercial scale at the British Empire Exhibition, of machinery for efficiently producing direct currents of sufficiently high voltage to permit their application to long land lines without undue waste, Dr. Howe reported.

Formerly the only practical means of producing high pressure direct current was by linking in series a large number of dynamos. This required very careful insulation. The new device, known as a transverter, which has been developed during the last three years, obviates this difficulty, but it works on a different principle. The high voltage is secured by the use of step-up transformers as usual, and the ebb-and-flow current from these is converted into a steady supply by the use of a rotating commutator, which switches over the reverse half of the current of each pulsation.

"The machines convert a 3-phase alternating current supply into an almost steady current", Prof. Howe said. The Wembley plant turns out direct current of 100,000 volts, which is about the limit at present in use in transmission lines. The transverter has the double advantage of being reversible in operation, and thus the high voltage direct current can be changed back to alternating at the receiving end for the purpose of putting it through transformers and reducing it to a safe working pressure.

The re-introduction of the older principle on lines already in operation would require little alteration, it is pointed out, as three-phase generating stations and three-phase distributing depots would function as usual but would be connected by direct current lines. The three-phase current, which the transverters require, is used on practically all large installations, owing to its simplification of the electric motor problem, and the fact that lighter transmission lines are possible.

The advantages in favor of the continuous current lines are the facility with which generators can be thrown in or taken out, and the elimination of capacity and inductance effects in the circuits. The fact that the alternating wires must be insulated for a voltage 1.4 times as great as the effective voltage, is a further point in favor of the new proposal, as the "d. c." lines never carry more than the effective voltage. This aspect of the situation was one which appealed strongly to Lord Kelvin during his long but losing fight for the direct currents.

During the course of his address, Prof. Howe traced the development of modern electrical machinery from the time of the discovery of the principle of the electromotor by Faraday in 1821, regarded as the birth of electrical engineering, down to the present day. Showing how the efficiency of the machines for converting mechanical power into electrical energy, and vice versa, has been gradually raised, he pointed out that with the perfection of materials and the increased demand for electricity for all purposes during the last few years, the individual units employed at the generating stations have increased enormously in size. "In 1913, the largest high speed steam turbine alternators had an output of 7,500 kilowatts", he said. "Single generators of this type of 30,000 kilowatt capacity are now in use. Slower speed machines of 60,000 kilowatt capacity have appeared in the past ten years, also". Among the improvements in engineering practice which have contributed to this sudden expansion are the provision of better cooling arrangements for the big coils, and in conjunction with this, changes in their construction so that higher saturation with magnetic waves is possible and heavier electric currents can be carried by the conducting wires for the same waste of energy.

Pointing out that while the first hydraulic turbine dynamos installed at Niagara Falls were rated at only 5,000 horse-power, in comparison with the 70,000 horse-power alternators recently put in operation, Dr. Howe warned against a tendency to the construction of units on too large a scale, suggesting that a limit may have been reached to the size which it is feasible to construct and operate.

"The difference in efficiency between a 10,000 kilowatt and a 60,000 kilowatt alternator is of no practical importance", he declared.

"It is not sufficient to counterbalance the decreased factor of safety due to concentrating the whole power supply in several units, instead of distributing it between a dozen or more generators." While recognizing that the building of mammoth dynamos reduces the capital cost per horsepower, the engineer said: "There are many cases in which too much consideration has been given to this factor, and too little to the importance of a guaranteed continuity of supply."

Successful electric heaters for intermittent use was the possibility entertained by the scientist in his appraisal of the merits of electric heat. Citing the relative cost, convenience and efficiency of coal and electric heating in Glasgow, where anthracite coal costs $22 a ton and electricity is sold for cooking and heating at 2 cents per kilowatt hour, the speaker showed that some radical improvement must be made before current can be used economically as the standard means of heating. The amounts of heat available from the expenditure of a similar amount of money on coal, and on electricity, are in the proportion of 7½ to 1 with the Glasgow prices, which corresponds to the efficiency with which the power station converts the coal into electrical energy. Use of water power instead of coal, at the generating station would not affect the situation, it is pointed out, until there is a big cut in the present cost of water power.

"In view of the high efficiency and convenience of slow combustion stoves, it is evident that electric heating cannot be expected to compete with them for continuous operation", Dr. Howe admitted.

"But for intermittent heating, the comparison is much more favorable to the electric principle", he said, in suggesting that developments may be expected in this field.

That the time is ripe for a continent wide agreement for the purpose of standardizing the equipment of electrified railroads, is borne out by Prof. Howe's reference to the debate among electrical engineers as to the best method of distributing power to electric locomotives. "Five hundred volt direct current supply has been standardized for street tramways", he said. But the relative merit of direct and alternating currents for electric railways has been a burning topic for over twenty years.

"The question is one of increasing interest to engineers. It is comparable to the dispute over guage widths in the early days of the steam railways, because it involves the problem of through running.

"Through running will be facilitated or handicapped in the future, depending upon whether provision is made for it as railways are eletricfied."

Two systems find general favor, Dr. Howe explained. The exponents of the direct current system would cut down the line loss by stepping up the voltage to 1,500 or 2,000 volts, while the advocates of the alternating current system have perfected their motors so that they compare favorable with those used on direct current, and on their side is the advantage of cheap distribution and transmission. A third principle, found successful in Italy, which has not been widely endorsed, is the use of 3-phase alternating currents. This simplifies the design of the motors, but requires a three wire trolley service.

Experts are divided as to the relative merits of the systems, but the need is for the uniform adoption of either of them, the speaker indicated.

In his review of the development of communication by means of electricity, Prof. Howe showed how progress in radio transmission has had a reflex effect on the wired 'phone'.

The three-electrode vacuum tube, used in all radiotelephony work for both transmission and reception, has been applied to the long distance telephone. The tubes are used as amplifiers and repeaters at various points along the line, with the result that the attenuated currents are strengthened and sent along their journey with a new lease of life. This procedure has facilitated telephone communication between New York and San Francisco, for example, but it has been of even greater service owing to the fact that the use of the amplifiers permits greater losses on the wires with the result that lighter and consequently cheaper lines can be utilized.

Commenting on recent rapid progress in radio transmission, the scientist stated: "The accomplishment of long distance communication bristled with difficulties, largely due to unsuspected atmospheric effects which are still little understood.

"Such progress has been made, however, and is continually being made, that one dare not now adopt an incredulous attitude to the wildest dreams or forecasts of what is to be accomplished by 'wireless'.

"The commonplace facts of to-day would have appeared beyond the bounds of possibility ten or twenty years ago."

In concluding his address, Dr. Howe showed how practically the entire practice of modern electrical engineering, has been developed within a century, and that progress has been proceeding at a rapid rate in the last score or so years.

"In preparing this address, I have been greatly impressed by the enormous advances made, especially during the last thirty or forty years, in the mastery of man over the resources of nature, and in the use of these resources to the amelioration of the conditions of life", he declared.

"In no branch of electrical engineering is there any suggestion of having reached finality. On the contrary, rapid development is taking place in every direction, and we can look forward with confidence to an ever-increasing application of electricity to the utilization and distribution of the natural sources of energy for the benefit of mankina."

Five Million Horse Power Available

R. S. Lea, M.E.I.C., consulting engineer of Montreal, stated in an address before the Association on August eighth, on the Deep Waterway from the Great Lakes to the sea, that four-fifths of the potential power resources of the St. Lawrence were within Canada, within transmission distance of its largest industrial centres, mining areas, and its two largest cities, forming one of the country's most valuable assets.

Schemes for the development of this power, with or without added provision for water transportation, must take into account characteristic of the river as regards the volume and variation of flow under summer and winter conditions, and the action of ice in different forms, Mr. Lea pointed out. "Ice is generally the governing factor in determining the best method of developing power in the different reaches of the river", he said.

Describing present conditions along the St. Lawrence: "From the lake Ontario level at Prescott to the ocean port of Montreal, a distance of 120 miles, the St. Lawrence river descends in a series of rapids alternating with navigable reaches, through a total height of 225 feet.

"In the upper half of the stretch, which forms the boundary between Canada and the United States, two-fifths of this fall occurs, and along it each country has equal rights in the use of the water. Below this, the river is wholly within Canadian territory.

"Fourteen-foot navigation by means of a system of canals and locks around the rapids has been available for many years. Power has also been developed to the extent of 350,000 horse power, partly in connection with the canals, but mainly in a few plants, two of large size and recent installation, deriving their power by diverting for themselves a portion of the flow of the river."

Projects for the development of the waterway must choose between the primary purpose of power development on a scale necessitating the utilization of the whole flow of the river, with provision for present and future navigation requirements, and the object of securing deep-draft navigation sufficient for ocean-going vessels, with the incidental creation of opportunities for power development.

The second scheme is part of a more extensive undertaking, to enable ocean shipping to reach the head of the Great Lakes system", said Mr. Lea. "From either point of view, the projects are of exceptional magnitude and importance, the minimum ultimate depth proposed for the locks and navigation channels being 30 feet, and the total power when fully developed amounts to from 4 to 5 million horse power, with individual plants having capacities of from 600,000 to 1,500,000 horse power."

Water Power Development in Canada

The Water Power Development in Canada was the subject of a paper by J. B. Challies, M.E.I.C., before the Conference on August eighth, in which he stated the modern water power industry began in 1895 and has shown a steady and remarkable growth.

Which promises to be even more rapid in the future than in the past. During the last ten years", "while the population increased twenty-two per cent, the developed water increased nearly one hundred per cent and its use in industry two hundred and forty-five per cent. The total water power throughout the Dominion is estimated at over eighteen million horse power, of which about three and a quarter million is now developed and three-quarter million is under construction.

The capital invested in water power development, transmission and distribution has grown from one hundred and twenty-one million dollars in 1910 to six hundred and eighty-eight million in 1923, and the opportunities for further investment in such enterprises are numerous and attractive. Natural resources are abundant, labor conditions are stable, agriculture and manufactures are increasing their yield, and new markets are being developed". The pulp and paper, mining and other industries of the Central Provinces, Mr. Challies pointed out, are dependent on water power development. He also assured the meeting that the conditions under which the Canadian Government permitted the development of its water power resources afforded reasonable protection to capital, combined with such extent of control as was considered necessary in the public interest.

Public Health as an Engineering Science

On August thirteenth, F. A. Dallyn, M.E.I.C., presented a paper on Public Health as an Engineering Science.

In his paper Mr. Dallyn, pointed out that in such branches as sanitation, the supervision of public water supplies, milk supplies, sewerage and sewage disposal, stream protection, garbage collection and disposal, and municipal sanitation generally, including such projects as fly and mosquito control, rodent extermination, etc., the engineering element is very great. The work in those branches could with advantage be left to the direction of engineers and biologists, releasing the medical personnel for their distinctive field-hygiene and nutrition.

Transportation in Canada

A paper by Sir Henry Thornton, president of the Canadian National Railways, was presented, in which he gave a complete sketch of the Development of Railway Transportation in Canada.

Sir Henry Thornton first dealt with the part which railway transportation plays in modern social and economic life. The great difficulties in communication between different parts of the country before railways were built, contrasted with the conveniences of to-day.

The history of Canadian Railway Development was then dealt with in detail. Sir Henry divided this history into four main chronological periods, — prior to Confederation, the Confederation period, the balance of the nineteenth century, and finally, the 20th century. The fact that great obstacles had to be overcome, said Sir Henry, in the laying of trans-Canada railways is a credit to Canada when we consider that there was a relatively small population to carry the burden of expense. The laying of railways was, however, the foundation of national industry, and there is no doubt that railway development would lead to great and greater prosperity, he said. Slides were shown, comparing the Canadian transportation system with that of Great Britain. The lumber industry, the pulp and paper industry, the handling of grain, and other interests were also illustrated on the screen.

OBITUARIES

Death of Am. Soc. C. E. Secretary

The sympathy of the members of *The Institute* goes out at this time to their fellow members of the American Society of Civil Engineers in the loss they have sustained in the tragic death of John H. Dunlap, their secretary. Mr. Dunlap was seriously injured in a train wreck near Buda, Ill., on June 30th, and died at the Presbyterian Hospital, Chicago, on July 29th. The body was accompanied by Charles F. Loweth, past president of the Society, to Franklin, Vt., where the funeral was held.

Taking advantage of the fact that transfer was made at Montreal, the President and members of the Council of *The Institute* were present at Windsor Station to pay their respects, a floral wreath being sent in the name of the President and Council of *The Institute.*

Mr. Dunlap accepted the secretaryship of the American Society of Civil Engineers only two years ago, succeeding Doctor Charles Warren Hunt as permanent secretary of the Society. Previous to this position he was professor of hydraulics and sanitary engineering at the State University of Iowa, Iowa City. The late Mr. Dunlap was a capable executive and his genial disposition has made him many friends in the profession, who regret the untimely ending to so promising a career.

John Alfred Symes, A.M.E.I.C.

Following an illness of some months, John Alfred Symes, A.M.E.I.C., died at his late residence, in Ottawa, on June 4th, 1924. Since returning from overseas in 1919 where he served with the Allied Armies from the time of his enlistment in 1915 until invalided to England in August 1918, he had not regained his health, and while able to attend his work in the Department of the Interior at Ottawa until a few months prior to his death, he never recovered from the effects of his war disability, which ultimately resulted in his death.

The late Mr. Symes was born and educated in Ottawa and, after matriculating from Ashbury College, spent one year at Queen's University. In 1904 he was with the Canadian Pacific Railway Company on survey work near Winnipeg and the following year was attached to the field staff on the company's irrigation work at Calgary. He was later assistant engineer for the company in charge of preliminary location and construction parties on the irrigation work and from 1910 to 1915 was office engineer, first at Brooks, Alta., and later at Calgary, Alta., until he enlisted for overseas service. He was elected an Associate Member of *The Engineering Institute of Canada* on April 9th, 1910.

Thomas Thomson Dunlop, A.M.E.I.C.

News of the untimely death of Thomas Thomson Dunlop, A.M.E.I.C., has been received with sincere regret by his many friends both in the profession and in private life. The late Mr. Dunlop, who for the last seven years has been on the engineering staff of the Public Works Department of the government of British Columbia, was drowned on May 15th, 1924, while inspecting the piers on the highway bridge over the Bukley river near Smithers, B.C.

Mr. Dunlop was an Associate Member of *The Engineering Institute of Canada*, having been admitted to the Canadian Society of Civil Engineers, as such, on December 12th, 1907. He was born at Glasgow, Scotland, on August 28th, 1877, and was educated at Royston Grammar School, Royston, England. His first work in this country in 1900, was on surveys for the Canadian Pacific Railway Company, and in his subsequent railway work, which extended over a number of years, he was continuously with the C.P.R., with the exception of one year with the Chicago and Northwestern Railway.

John St. Vincent Caddy, M.E.I.C.

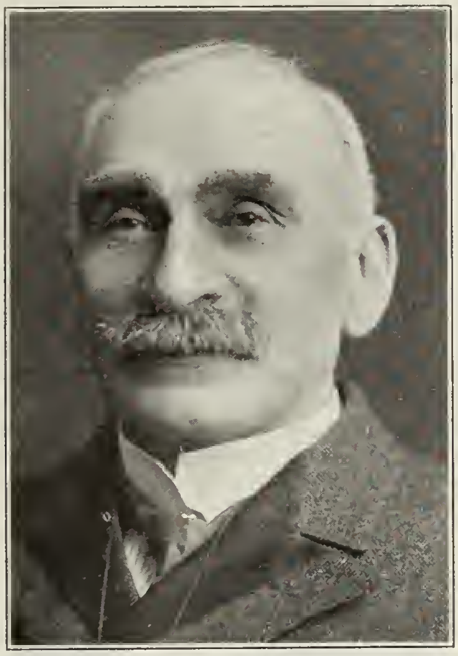
Regret is expressed at the death of John St. Vincent Caddy, M.E.I.C., of Ottawa, which occurred at his late residence 327 Laurier Avenue, East, on May 30th, 1924. The late Mr. Caddy was in his eighty-eighth year at the time of his death and had been a member of *The Institute* for thirty-five years, having been elected a Member of the Canadian Society of Civil Engineers on January 3rd, 1889.

Born at Fort Charlotte, St. Vincent W.I.Is., Mr. Caddy commenced his engineering work with a construction party on the Great Western Railway in 1851, later being appointed assistant draughtsman and then second assistant engineer with the company. In 1858 he was second assistant engineer on the St. Mary's and Sarnia extension of the Grand Trunk Railway, and from 1860 to 1863 he served his apprenticeship with a land surveyor, receiving his certificate as a Dominion and Ontario Land Surveyor in 1866. During the year 1864 he was with the Detroit and Milwaukee Railway as assistant engineer and draughtsman on maintenance work. He was later located at Windsor and Detroit on maintenance and construction of docks and landing aprons, having sole charge of this work in 1868. In 1870 he was resident engineer and the following year, division engineer on the Air Line of the Great Western Railway. For the next four years he was engaged in surveying and locating several short lines in Canada and the State of Ohio. For seven years from 1879 he was with the Canadian Pacific Railway, first as district engineer on construction, then as inspecting engineer and later as resident engineer on construction.

From 1889 to 1892, the late Mr. Caddy was engineer in charge for the Department of Railways and Canals, on the location and construction of the Annapolis and Digby Railway in Nova Scotia. Subsequently, in 1908 he was appointed assistant engineer of the Rideau Canal Branch of that department of the federal government.

Nathan Hanson Greene, A.M.E.I.C.

In the death of Nathan Hanson Greene, A.M.E.I.C., at his home in Montreal on March 24th, 1924, *The Institute* has lost one of its early members and one who for fifty years has been actively identified with the practice of land surveying in the province of Quebec. The late Mr. Greene was born on December 22nd, 1847, in the township of Bolton, in the county of Brome. He studied at St. Francis College, Richmond, Que., and in 1869 he undertook his first work as assistant engineer with the South Eastern Missisquoi and Clyde Rivers and Canada Central Railway. For twelve months prior to the fall of 1872 he was resident engineer in charge of construction work.



NATHAN HANSON GREENE, A.M.E.I.C.

On April 14th, 1873, he was admitted to practise land surveying in the province of Quebec and for eleven years he was chiefly engaged in railway work, being at different periods with the Quebec, Ottawa and Occidental, the Intercolonial, and the Laurentian railways.

In 1882-1883 he was engaged in the preparation of special railway reports for the government, on arbitration work, and on exploration and location work for the department of railways of the Federal government in connection with the Intercolonial Railway.

In later years Mr. Greene has been in private practice giving special attention to municipal water systems as consulting engineer, in the Eastern Townships and elsewhere.

On December 9th, 1897, he was admitted to *The Institute*, (then the Canadian Society of Civil Engineers) as an Associate Member.

PERSONALS

A. L. Farnsworth, S.E.I.C., is at present with Messrs. Price Brothers and Company, Limited, at Kenogami, Que.

G. A. McClintock, S.E.I.C., is located at present at Thetford Mines, Quebec, with the Bell Asbestos Mines.

W. B. Hutcheson, A.M.E.I.C., of the Water Power and Reclamation Branch, Dept. of Interior, Calgary, has been transferred to the same department at Ottawa.

C. F. Draper, M.E.I.C., of the engineering staff of the Canadian Pacific Railway at Montreal has been placed in charge of grade separation work in Toronto, Ont.

N. W. Wade, Jr.E.I.C., formerly with the Department of Telephones, Regina, is at present with Siemens Brothers, London, Eng.

E. K. Macnutt, S.E.I.C., who graduated in civil engineering this year from McGill University has accepted a position with the E. B. Eddy Company at Hull, Que.

Kenneth M. Ramsey, S.E.I.C., who has for two years been construction superintendent of the Citadel Brick Company, Limited, of Quebec, has been made assistant manager of the organization.

H. W. Mahon, A.M.E.I.C., has resigned his position as assistant engineer, Dominion Water Power Branch, Halifax, N.S., and joined the staff of the Nova Scotia Power Commission, Halifax, N.S., as assistant engineer.

E. D. MacDonald, S.E.I.C., is at present employed in the draughting room of the B. F. Sturtevant Company, Hyde Park, Boston, U.S.A. His address is 39 Davison St., Hyde Park., Boston.

J. D. Chisholm, S.E.I.C., who graduated from McGill University in electrical engineering in 1923,is now electrical engineer with the Newfoundland Power and Paper Company, Limited, Cornerbrook, Newfoundland.

Donald G. Robertson, S.E.I.C., is located at Hemming's Falls, Drummondville, Que., with the Southern Canada Power Company. Mr. Robertson is a graduate of this year from Queen's University.

C. H. Frid, S.E.I.C., until recently with the Truscon Steel Company, Youngstown, N.Y., as concrete designer, has resigned to accept a position as engineer for the Frid Construction Company, Incorporated, of Buffalo, N.Y.

Hugh A. McKay, S.E.I.C., of Toronto, Ontario, is at the present time located in New Liskeard, Ont., with the Sutcliffe Company, Limited, as assistant engineer. Mr. McKay received his B.A.Sc., degree from the University of Toronto in 1923.

William F. Stewart, S.E.I.C., of Montreal, Que., is with the Canadian Westinghouse Company, Limited, and is at present located at La Gabelle, Que., at the site of the new hydro-electric power development of the St. Maurice Power Company.

William Watson, S.E.I.C., of Montreal, Que., has been appointed to the staff of the Sir W. G. Armstrong, Whitworth and Company, Limited, being located at Deer Lake, Newfoundland. Mr. Watson received his B.Sc. degree in electrical engineering this Spring from McGill University.

Peter Emslie, A.M.E.I.C., formerly with J. M. Robertson, M.E.I.C., Montreal, and later with A. F. Byers and Company, Limited, has been in Scotland since November 1922. He was recently appointed manager for the Dundee branch of Currie and Company, Limited, large dealers in building supplies.

F. W. Clark, A.M.E.I.C., has been placed in charge of power surveys on the Ottawa river for the Hydro-Electric Power Commission of Ontario. Mr. Clark has been on the engineering staff of the commission for the past thirteen years and was for sometime assistant chief field engineer on the Queenston-Chippawa development.

Noel M. Barclay, A.M.E.I.C., has been appointed assistant engineer with the Technical Service Department of the city of Montreal. Until recently Mr. Barclay has been on the draughting staff of the Bureau of Economics of the Canadian National Railway, prior to which he was on the Arbitration staff and later on the Valuation staff of the Valuation Department of the Grand Trunk Railway.

J. H. Forbes, A.M.E.I.C., formerly division engineer at Smith's Falls, Ont., for the Canadian Pacific Railway, has been transferred to Montreal, Que. Mr. Forbes received his B.Sc. degree from McGill University in 1908 and with the exception of the period of his war services he has been associated with the Canadian Pacific Railway in various capacities ever since.

T. C. Thompson, Jr.E.I.C., has resigned his position as assistant mechanical engineer of the Crosby Steam Gauge and Valve Company of Boston, Mass., to join the staff of the transmission engineering department of the Bell Telephone Company of Canada in Montreal. Mr. Thompson graduated from McGill University with the class of '20 and was for a time demonstrator at McGill.

U. R. Moore, A.M.E.I.C., who until recently has been connected with the engineering department of the Hydro-Electric Power Commission of Ontario at Niagara Falls, Ont., has joined the staff of the Pennsylvania Water and Power Company at Holtwood, Penna., as assistant superintendent in charge of field engineering on the construction of a large steam power plant. The initial development will consist of two 10,000-k.w. units, and will cost approximately $3,000,000., and the ultimate development will contain two, 20,000-k.w., and two, 30,000-k.w., units in addition to the two units at present being installed.

A. C. D. Blanchard, M.E.I.C., who for the past seven years has been connected with the Hydro-Electric Power Commission of Ontario as chief field engineer in charge of surveys, field engineering and inspection on the Queenston-Chippawa power development has resigned to accept an appointment with the New Brunswick Power Commission as hydraulic engineer. Since 1911 when he resigned from the position of assistant engineer with the city of Toronto, Mr. Blanchard was for two years city engineer for the city of Lethbridge, Alta., and for the next four years he was connected with the Greater Winnipeg Water District as locating engineer, assistant chief engineer and division engineer in charge of thirteen miles of the heaviest section of the aqueduct construction and the diversion works at the intake, from which position he resigned to accept his appointment with the Hydro-Electric Power Commission of Ontario.

Rex P. Johnson, A.M.E.I.C., has recently joined the staff of the Pure Gold Manufacturing Company, Limited, and Todhunter, Mitchell and Company, Toronto, as production manager in charge of production costs and factory management, and will be assistant to the general manager. Mr. Johnson graduated in civil engineering from the University of Toronto with the class of '14, and was employed for the next two and a half years as designing draughtsman on the Welland Ship Canal at St. Catharines, Ont. In 1916 he joined the staff of the Hydro-Electric Power Commission of Ontario on the Queenston-Chippawa development. During the last three years that he was with the commission he held the position of office engineer in charge of plant layout, design of temporary structures, construction schedules, etc. After resigning from the commission Mr. Johnson joined the staff of the Forest Products Engineering Company of Chicago and for the next two years he was engaged on factory production, cost finding and business research. While with the Hydro-Electric Power Commission, Mr. Johnson was secretary-treasurer of the Niagara Peninsula Branch of *The Institute* for over two years just prior to his leaving the commission.

Major H. W. L. Doane, M.E.I.C., has been appointed assistant city engineer of Halifax, Nova Scotia, to fill the vacancy left when H. W. Johnstone was elevated to the position of city engineer after the resignation of Colonel F. W. W. Doane, M.E.I.C. Major Doane graduated from Nova Scotia Technical College with the degree of Bachelor of Science in civil engineering in 1913. From 1912 to 1915 he was engaged in sewer design and construction at Springhill, N.S., Chester, N.S., Halifax, N.S., Lunenburg, N.S., and Hazel Hill, N.S.; in water works design and construction at Kentville, N.S., Hazel Hill, N. S., and Trenton, N.S., including the construction of a 1,000,000 gallon reservoir and attendant pipe lines. He assisted in the making of survey and the preparation of plans for and the engineering construction of the electric light system Truro, N.S., and investigated and reported on a proposed hydro-electric development for Parrsboro, N.S. From 1915 to 1919 he was on active service overseas in Palestine and France during which he rose from Lieutenant to Major. After his return to Halifax in 1919 he joined the city engineer's staff. Since then his work has been highly successful. Acting under the direction of Mr. Johnstone he reorganized the waterworks department and of late has had charge of both the waterworks and street and sidewalk departments, including the city's paving plant. Major Doane is one of the most widely known and most active engineers connected with the Halifax Branch of *The Institute* where he has been a member of the executive for several years.

EMILE LACROIX, A.M.E.I.C.
Recently appointed Acting City Engineer and Manager of Outremont, Que.

Outremont's Former General Manager Honoured

Major J. A. Duchastel de Montrouge, M.E.I.C., whose recent appointment as general manager of the Quebec Forest Industries Association was announced in the August issue of *The Journal*, was presented with a "grand-father's" clock by the citizens of Outremont on August eighth, on the occasion of his retirement as general manager and engineer of that city. The presentation was made by Ex-Mayor Alfred Joyce and Mayor Joseph Beaubien of Outremont and took place in the city hall in the presence of a large gathering of representative citizens, the aldermen of Outremont and the mayors and other representatives of adjacent municipalities. Tributes to Major Duchastel's untiring devotion to duty during his eighteen years of service to Outremont, and to his ability as an administrator were the theme of the presentation speeches.

In the evening, Major Duchastel was tendered a banquet by the citizens of Outremont, at Laval-sur-le-lac, at which there were also representatives of the neighbouring cities. At the banquet many tributes were paid to Major Duchastel, not only as an official who has accomplished much within the strict realm of civic endeavour, but also as one who has done much for the general welfare and advancement of the province, and consequently of Canada, and in this connection his work for better roads, and for the automobile traffic generally was referred to. In paying honour to the guest of the evening, Mayor P. W. McLagan, of Westmount, said: "I know of no man who has been a public servant who deserves more of honour which can be given him by his fellow citizens than does Mr. Duchastel".

In its editorial column of August 2nd, *The Gazette* of Montreal makes the following reference to Major Duchastel's appointment, "The Quebec Forest Industries Association, Limited, has made no mistake in its selection of Major J. A. Duchastel de Montrouge for the important and difficult duties connected with its general managership, for as an official of the city of Outremont and a citizen of Greater Montreal, Major Duchastel has amply proven his qualifications for the larger fields of usefulness to which he has gone. His administration of the two civic departments under his charge, his professional equipment, his wide experience of men and affairs, and his faculty of grasping the essentials of technical subjects and of keeping abreast of scientific advancement as it affects practical matters, all combine to mark him as eminently fitted to initiate and carry on the important new activities now being entrusted to his keeping."

Members are earnestly requested to make special note of the dates of the Annual General and General Professional Meeting, January 27th, 28th, and 29th, at Montreal, and to plan to be present as the meeting will be interesting and entertaining.

Brantford Holds Interesting Celebration

On Monday, August 11th, the city of Brantford, Ont., gave itself over to a day of festivity, commencing with the commemoration of the fiftieth anniversary of the invention of the telephone by the late Alexander Graham Bell, which was followed by the celebration of the opening of the New Lorne bridge. The date fixed for the celebration was the nearest anniversary date that could be selected to that time when, in 1874, the human voice in articulate conversation was first transmitted through space by telephonic mechanism at the Bell Homestead in Brantford.

The following record of dates supplied by the inventor of the telephone and recently published by the Brantford Expositor are of interest as substantiating Brantford's claim of the title of "The Telephone City":—

The Invention of the telephone at Tutela Heights	Brantford	1874	Summer
First telephone constructed and speech sounds heard	Boston	1875	June
First draft of the telephone patent specification prepared	Brantford	1875	Sept.
Complete sentences first clearly understood by telephone	Boston	1876	Mar. 10th
The telephone exhibition at the Centennial exhibition	Philadelphia	1876	June 25th
First attempts to transmit speech over telegraph lines	Boston	1876	July 7th, 9th and 12th
First successful attempt to transmit speech over a telegraph line	Brantford	1876	Aug. 10th
First public demonstration of ability to speak over a telegraph line	Brantford	1876	Aug.
First transmission of a number of voices simultaneously over a telegraph line	Brantford	1876	Aug.
First conversation by telephone over a telegraph line (reciprocal communication)	Boston	1876	Oct. 9th
First long-distance conversation over a telegraph line (143 miles)	Boston	1876	Dec. 3rd
First newspaper dispatch sent by telephone	Salem	1877	Feb. 12th
First telephone line opened	Boston	1877	April 4th

The new Lorne Bridge, Brantford, Ont.

The second part of the celebration centred around the official opening of the New Lorne bridge. This bridge, which was officially opened by the Lieutenant-Governor of Ontario, replaces the old steel structure forming the only crossing over the Grand river connecting the rapidly growing western district of the city. The former bridge was opened on September 16th, 1879, on which occasion the city was honoured with a visit from the Marquis of Lorne and H. R. H. The Princess Louise but for some years has rapidly approached a condition unsafe for the heavy present day traffic necessitating the building of the new structure. The design and plans for the present bridge were prepared by city engineer, Major Frank P. Adams, A.M.E.I.C., under whose direction the structure was built by the Port Arthur Construction Company and in the work of the supervision of construction Major Adams was assisted by Edward T. McLaren, assistant city engineer, and C. Ralph Hagey, as resident engineer.

The new bridge has an over all length of 424 feet, the three spans totalling 400 feet, the centre span 140 feet and the side spans 130 feet each. The over all width is 64 feet providing a roadway width of 40 feet and the rise of the centre arch is 19 feet, while that of the side arches is 17.4 feet. Other interesting data regarding the bridge is as follows:—Width of arches 58 feet; thickness of arches at crown 34 inches; thickness of arches at haunches 51 inches; thickness of floor slab 10 inches; thickness of spandrel walls 14 inches; cement used 16,500 barrels; concrete poured 12,811 cubic yards; contract let March 24th, 1923; last cement poured December 24th, 1923; officially opened August 11th, 1924; cost $335,000.

The First World Power Conference

Session on Economic Aspect of Power Resources—Legal and Government Policy

Discussion by E. A. Cleveland, M.E.I.C.

In speaking on the legal and government policy aspects of power development, Mr. Cleveland said that he was not able to agree fully with the policies suggested in the paper of Professor Vanderleys, but he felt that all could subscribe to the general doctrine outlined in the opening paragraphs of the paper by the Rt. Hon. Sir Philip Lloyd-Graenel that governments should encourage and foster the development of power: that encouragement might of course take any suitable form in the wide range from moral support to that of the loan of government credit or the outright ownership and operation of power producing plants.

There were many factors in the practice of construction, equipment and operation that might be standardized, some of which he instanced, but it was hardly to be expected that the contentious subject of state versus private ownership and operation should by discussion be brought much nearer to a deadlevel of uniformity. The subject was a local one, for each state, province or federal authority having complete jurisdiction to deal with.

In respect to hydro-electric power production, he briefly reviewed the situation in each of the provinces of Canada, showing how different the policies of the several governments were in the matter.

He was of opinion that the great contribution to be made by the World Power Conference toward a consideration of this aspect of the problem was in the collection of the views expressed in the several papers and in the discussion and the statements as to the position already taken by the countries or their autonomous subdivisions, so that when published they would form an epitome of present experience and views available to those whose duties might require of them advice or assistance in the framing of government policies in such matters.

He was impressed by such clear statements of a country's laws and regulations respecting water power as that contained in Mr. Larrsen's paper in respect of Norway and by such illuminating discussion on the subject of ownership and operation as that by Dr. Hadley.

The Conference had at least brought together much informative data on the subject even though it could not formulate government policy.

Notes on the World Power Conference and Subsequent visit to Norway and Sweden

G. Gordon Gale, M.E.I.C.

The World Power Conference was inaugurated at the Palace of Industry, Wembly, on Monday the 29th of June, with an address of welcome by H.R.H. the Prince of Wales.

Morning and afternoon sessions followed every day, and several evening meetings were arranged during the two weeks ending on the 11th of July. The meetings were attended by from three to four hundred representatives from forty-one countries.

Four hundred and fifteen papers were presented, giving a complete review of the power resources, their development, and utilization in the different countries. During the time available, it was impossible to do more than summarize the more important features of the different subjects. Some interesting discussions took place, but as most of the papers were not received until after the conference opened, the speakers usually limited their remarks to brief outlines of the contents of their own papers.

The purpose of the first World Power Conference was to consider how the industrial and scientific sources of power may be adjusted nationally and internationally. The frank manner in which the different problems were presented, the complete exchange of thought and information, and the many acquaintenceships which were formed, have, I believe, gone a long way towards the accomplishment of this desirable object.

Favourable comment was made upon the contribution offered by the Canadian delegates, and it is quite evident that this country has secured a place in the foremost rank of hydro-electric developments.

In many countries, the natural resources, and industrial demands have combined to form problems which are widely different.

Great Britain and France contemplate the consolidation of existing steam plants, the development of available water powers, and the construction of supersteam power stations.

Norway and Sweden with a quantity of surplus power, developed, and undeveloped, are negotiating with adjoining countries to provide a market for their surplus electric energy.

Italy, Denmark and Holland are anxious to import electrical power, to provide for their industrial and domestic demands in excess of their own power supply.

Spain, with water powers and minerals, needs financial assistance to aid in the development of its natural resources.

In the United States hydro-electric development has progressed rapidly, particularly in California, while the north eastern section, New England, is looking to Canada to supply the ever increasing demand for hydro-electric power.

In Canada the demand for electric power has been increasing steadily, and hydro-electric developments are under construction from coast to coast.

A number of the papers were not of special personal interest, and it was possible to make use of these intervals to visit the following plants in different sections of England.

Stonebridge, — Steam station, 20,000 h.p. Overhead and terminal electrification, car sheds, and electrical repair shops of the London Midland and Scotish Railway.

Vickers, — Manufacturing plant at Barrow-in-Furness. Inspection of large water wheel under construction for the Ottawa River Power Company's plant at Bryson, and deisel oil engines for marine service.

Cambridge University, — Demonstration of experiments with radio-active elements, the liberation of electrons, etc., under the direction of Sir Ernest Rutherford.

The English Electric Company, — Inspection of electrical equipment, and rotary convertors for railway service.

Armstrong—Whitworth Company, Elswick, Newcastle,—Inspection of deisel oil engines and water wheels for the Humberarm Newfoundland hydro-electric development.

C. A. Parsons & Company, Beaton, Newcastle, — Inspection of large steam turbines under construction for Chicago Edison Company.

Wembley, — Inspection of many extensive exhibits of oil, steam and equipment in the Palace of Engineering.

Immediately following the World Power Conference, a party of thirty-two engineers, representing eleven countries, joined the Scandinavian tour, and the following itinerary was carried out with much enthusiasm, and without any mishap.

Thursday, July 17th.

Excursion on Florien Railway. Left Bergen 4.00 p.m. by rail. Arrived Frengereid 5.36 p.m. and proceeded to Tysse by motor cars. Visited Samnanger 23,000 h.p. hydro-electric plant. Proceeded by motor car to Norheimsund. Arrived 11.30 p.m.

Friday, July 18th.

Left Norheimsund 8.00 a.m. by steamer, called at Aalvick, visited Bjolvo power station, 36,000 h.p. 850 meters head. Left Aalvick and visited Valurfoosen on the Veig river. Possible capacity 175,000 e.h.p. Inspected power station at Tyssedal. 140,000 h.p. development. Arrived Odda midnight.

Saturday, July 19th.

Left Odda by motor and passed over mountains, snow, etc., to Haukelii for lunch, and continued to Dalen.

Members of Canadian Delegation to World Power Conference on Scandinavian tour.

Left to right; E. A. Cleveland, M.E.I.C.; G. Gordon Gale, M.E.I.C.; K. H. Smith, M.E.I.C. and Eugene Vinet, A.M.E.I.C.

Sunday, July 20th.
Left Dalen by steamer to Kvileseid, (Apalsta) proceeded by motor to Notodden. Inspected the Tinfess power plants, six in number of various capacities, heads and designs. By rail to Tinnoset and lake steamer to Mael, rail to Rjukan. Inspected Rjukan No. 2 power plant 190,000 h.p. supplying power to electrio-chemical plant.

Monday, July 21st.
Inspected Rjukan falls and plant No. 1, 180,000 h.p. capacity, supplying power to electric furnaces. Rail to Hael, steamer to Tinnoset. Rail to Notodden and thence to Christiania.

Tuesday, July 22nd.
Visited two substations in Christiania. Inspected patent low capacity electric cooking stove. Inspected trolley system. Wages of employees about 1½ kroner (23 cents) per hour for an 8-hour day and 48-hour week.

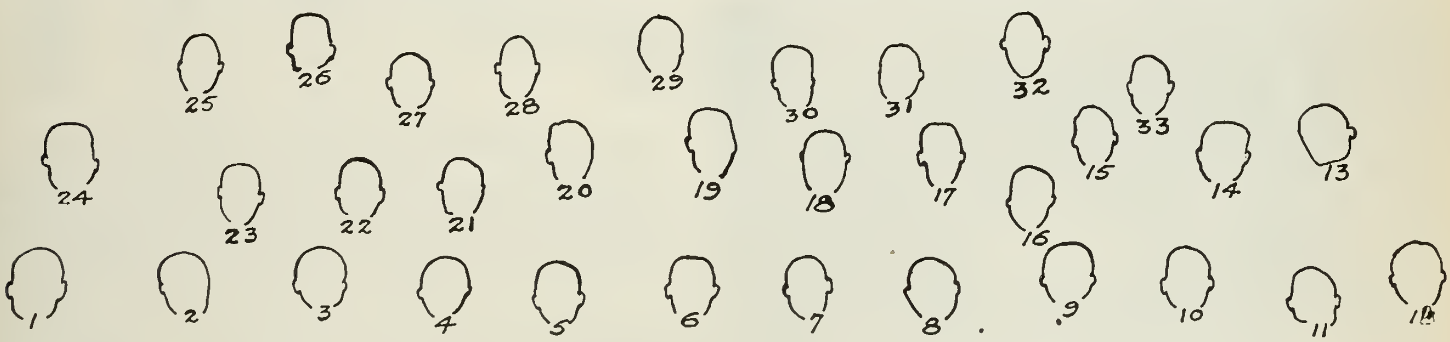
Wednesday, July 23rd.
Proceeded to Askim by motor. Visited plants at Vamma 75,000 h.p. and Mokfos-Solbergfos 150,000 h.p. under construction. Motored to Mysen. Presented cup to Secretary Sandberg, of the Norwegian National Committee. Proceeded by rail to Kornsjo on the frontier.

Thursday, July 24th.
By rail to Lilla Edet. Inspection of 35,000 h.p. hydro-electric plant under construction, 18-foot head. Largest water wheels in the world. Boat up Dal river. Inspection of Trollhattan locks. Visit to Nydgvist and Holm's locomotive and turbine works. Exciter water wheels, also 500 steam locomotives under construction for Russia. Inspected Trollhatian canal, power station 164,000 h.p., and transformer station. Sleepers to Ludvika.

Friday, July 25th.
Visited Swedish General Electric transformer works at Ludvika.

Personnel of the International Executive Committee, World Power Conference—taken at London, August 1924.

This committee was continued, to meet within a year, at the call of the organizing director, to consider ways and means of continuing the World Power Conference and arrange for a conference during the year of 1927.



1. Russell Sinclair (Australia)
2. D. Pedro M. Gonzalez Quijano (Spain)
3. Calvert Townley (U.S.A.)
4. Prof. C. Matschoss (Germany)
5. Dr. H. J. van der Bijl (Union of South Africa)
6. D. N. Dunlop (Organizing Director)
7. B. Longbottom (Great Britain)
8. H. J. Pierce (U.S.A.)
9. M. Genissieu (France)
10. J. B. Challies (Canada)
11. Ing. Barbagellata (Italy)
12. Ing. Luigi Emanueli (Italy)
13. W. Elsdon-Dew (Union of South Africa)
14. F. Zur Nedden (Germany)
15. J. Wolf (Czechoslovakia)
16. D. A. de Artigas (Spain)
17. J. W. Meares (India)
18. Prof. Gorew (Russia)
19. Prof. Glouchkoff (Russia)
20. M. H. F. Zangger (Switzerland)
21. Prof. T. Yamamoto (Japan)
22. M. le Baron Guillaume (Belgium)
23. M. Alexandre Simonis (Belgium)
24. W. van Dalsen (Union of South Africa)
25. M. W. Burt (Secretary to the Organizing Director)
26. E. Velander (Sweden)
27. C. A. Weekes (Great Britain)
28. Mr. Borreson (Denmark)
29. J. G. Bellaar-Spruijt (Holland)
30. Dr. F. Kneidl (Czechoslovakia)
31. F. H. Krebs (Denmark)
32. J. Emjellem (Norway)
33. K. Inouye (Japan)

By Deisel electric engine, 250 h.p. to Vasteras. Two standard sleeping cars and baggage cars, speed 35 m.p.h. Visited Swedish General Electric Company's main works. Generators for Lilla Edet plant under construction. Visited state steam station. Steam turbine generating set running as synchronous condenser. Boiler plant closed down. Generating steam by electricity.

Saturday, July 26th.
Rail to Uppsala. Inspected city buildings, viking mounds, transformer station, farming, plowing, etc., by electricity, tertiary sub-stations and portable motor sub-stations. Rail to Orrskog. Storage battery car 250 amp. 250 volts, to Untra. Inspected city of Stockholm hydro-power station 40,000 kv.a. at Untra. Motored to Alvkarleo.

Sunday, July 27th.
Inspection of 70,000 kv.a. power station at Alvkarleby. Rail to Stockholm. 1,800 h.p. steam turbine locomotive. Presentation to E. Verlander, secretary of the Swedish National Committee.

Monday, July 28th.
Rail to Kristinoheim. Inspection of wheels for Lilla Edet plant and Russian hydro-electric development, also visted laboratory and demonstration tests on water wheels. Motor to Cerlebo.

Tuesday, July 29th.
Rail to Hamburg.

Wednesday, July 30th.
Rail to Paris.

Thursday and Friday, July 31st, Aug. 1st.
Paris.

Saturday, Aug. 2nd.
Rail to Cherbourg.

EMPLOYMENT BUREAU

Situations Wanted

Civil Engineer

University graduate, A.M.E.I.C., nine years experience in highway and building construction, wants position with a firm of contractors or manufacturers. Apply box No. 149-W.

Civil Engineer

B.A.Sc., M.E.I.C., D.L.S., B.C.L.S. Experience covers several years railway exploratory, preliminary and location surveys in Canada, United States and Mexico. Railway construction, hydro power development, investigations ana surveys. Topographical, sub-division surveys and plans, town planning, etc. Mining surveys and exploration. Several years private practice in British Columbia. Capable of handling men successfully under frontier conditions. Best of references. Will go anywhere, and expect to be paid according to results. Apply box No. 151-W.

Situation Vacant

Junior Topographical Engineer

A Junior Topographical Engineer for the Topographical Survey Division, Department of National Defence, Ottawa, at an initial salary of $1,680 per annum, which will be increased upon recommendation for efficient service at the rate of $120 per annum until a maximum of $2,160 is reached. This salary will be supplemented by whatever bonus is provided by law.

Application forms properly filled in must be filed in the office of the Civil Service Commission *not later than September 18, 1924.*

Trade Publication

A publication, which merits special mention and which is more in the nature of a text book than a trade publication, has been issued by The Kidwell Boiler Company and is being distributed by The Combustion Engineering Corporation, Limited, of Toronto. The book is entitled "Kidwell" and while dealing principally with the Kidwell two-flow ring-circuit water tube boiler yet it contains a vast amount of very valuable and interesting information explanatory of the principles of boiler design and operation. The book is cloth bound and its 268 pages are profusely illustrated with diagrams, photographs and coloured plates. This volume should prove of great interest to all those in any way connected with combustion engineering.

Exchange Privileges for Transactions

As a number of enquiries have recently been received regarding privileges extended to members of *The Engineering Institute of Canada* whereby publications of other engineering societies may be secured, the attention of the membership is directed to the arrangements which have been made with the American Institute of Electrical Engineers, American Institute of Mining and Metallurgy, American Society of Civil Engineers, and The American Society of Mechanical Engineers, whereby *our members may receive the transactions of these societies at the same price as that paid by their own members.* The following table can be used as a reference of the various prices, *the first column indicating the amount paid by the members of* The Engineering Institute *for the various publications.*

	Rate to Members	Rate to Non-Members
American Institute of Electrical Engineers		
Journal, single copies	$0.50	$ 1.00
" per year	5.50	10.50
Transactions, per year, paper	5.00	10.00
" " cloth	5.75	11.40
Year Book	1.00	2.00
Pamphlets	.25	.50
American Institute of Mining and Metallurgy		
Journal, single copies	0.50	1.00
" per year	5.00	10.00
Transactions, per year, paper	4.00	8.00
(Other publications 50 per cent reduction on catalogue price to E.I.C. members.)		
American Society of Civil Engineers		
Proceedings, single copies	0.50	1.00
" per year	4.00	8.00*
Transactions, "	6.00	12.00†
(Other publications 50 per cent reduction on catalogue price to E.I.C. members.)		
American Society of Mechanical Engineers		
Journal, single copies	0.25	0.30
" per year	3.50	4.50
Transactions, per year	6.00	11.00
Year Book	1.00	2.00
(Other publications, same rate to E.I.C. members as to A.S.M.E. members.)		
Engineering Institute of Canada		
Journal, single copies	0.25	0.50
" " 6 months after issue	0.25	0.75
" " 1 year "	0.50	1.00
" per year	2.00	3.00
Transactions, per volume	1.50	3.00
Year Book	0.75	5.00
Pamphlets	0.25	0.40

**If subscription is received before January 1st, otherwise $10.00.*

†If received before February 1st, otherwise price $16.00.

Victoria and Halifax Branches visit H.M.S. Hood

The Victoria and Halifax branches of *The Institute* have been afforded, during the past few weeks, an opportunity to visit and inspect the world's mightiest battleship, H.M.S. Hood, which is one of the ships comprising the Special Service Squadron of the Royal Navy, now on a cruise around the world. The members of these branches (Victoria on June 21st, and Halifax on August 13th) were the guests of the officers of the Hood, and cannot speak too highly of the courtesies extended to them on the occasions of their visits. The tour of inspection was arranged so that small groups of the guests were conducted around the warship.

H.M.S. Hood has many remarkable features among which is her great speed of and her fuel capacity (oil only is used) which, with her turbine main engines of 140,000 h.p., capacity, enables her to travel for great distances. Other outstanding features are the huge areas covered by heavy armour, strong framing and compact engines and boilers. The cost of the Hood is reported at about £6,025,000 or £145 per ton. The complement of the Hood numbers 1,500, of which about 100 are officers. All trades that are required for a small town are represented on the battle cruiser. The conning tower is an enormous structure consisting of two shells the outer being 12 inches thick and the inner 9 inches thick with air space between.

BRANCH NEWS

Saguenay Branch

Burroughs Pelletier, A.M.E.I.C., Secretary-Treasurer

On Saturday August 9th, the Saguenay Branch held the second of its summer outings of the season. The outing consisted in a visit to Lake Kenogami reservoir as developed by the Quebec Streams Commission.

After assembling at Jonquière station as a starting point, the members proceeded by automobiles to a point at the village of St. Cyriac. Members were able to see that even this summer part of the village is inundated by the partial raising of the level of the lake. Next summer when the lake is raised to its highest level the village will entirely disappear.

Then by courtesy of Price Brothers and Company, the members embarked on one of the company's raft-towing boats, (technically called an "Alligator") and the trip was made by water to Portage des Roches, the largest of the dams built in connection with the reservoir. Here the dam was inspected and much admired. The members were entertained at luncheon by courtesy of the Quebec Streams' Commission and also of Mr. Cozzolino of the Nova Scotia Construction Company, the contractor.

During the lunch, O. O. Lefebvre, M.E.I.C., chief engineer of the commission, explained the nature and utility of the undertaking, the various types of dams at the various sites, and he also explained how various difficulties both forseen and unforseen had been or were to be overcome.

As time was pressing, Mr. Rutherford, one of the commissioners, briefly addressed the members and extended to them the thorough welcome of the Quebec Streams' Commission and of the Hon. Mr. Tessier who was enable to be present.

The party then re-embarked on the "Alligator" and the trip back on lake Kenogami was even more enjoyable than the coming as the morning clouds had entirely disappeared and the day had settled out fine. The party then proceeded by automobile to Pibrac, where again the members viewed the dams both finished and under construction at that site.

After viewing the Pibrac dams the outing terminated and all the members of the Saguenay Branch returned with the full conviction of having viewed a very remarkable undertaking, and also of having had a most enjoyable day.

Election of Officers

The general elections of the branch resulted in the following forming the personnel of the branch executive for the coming year.

Chairman.......... W. G. Mitchell, M.E.I.C.
Vice-Chairman..... H. G. Cochrane, A.M.E.I.Ç.
Secretary-Treasurer Burroughs Pelletier, A.M.E.I.C.
Executive.......... H. V. Bignell, A.M.E.I.C. (*one year*).
G. LaMothe, A.M.E.I.C. (*one year*).
C. N. Shanly, M.E.I.C. (*ex officio*).
Edouard Lavoie, M.E.I.C. (*two years*).
J. E. A. McConville, A.M.E.I.C. (*two years*).

Saskatchewan Branch

J. W. D. Farrell, A.M.E.I.C., Secretary-Treasurer.

Picnic at B-Say-Tah

Mr. and Mrs. M. B. Weekes invited the members of the Saskatchewan Branch and their wives to a picnic to be held at their summer cottage at B-Say-Tah Point, Qu'Appelle lakes. The party motored out from Regina on July 12th, and a very enjoyable day is reported by those who were present.

Summer Meeting at Saskatoon

At a regular meeting in April, the branch decided to follow the practice of former years and hold a summer meeting. This meeting was to be held at Saskatoon, and if possible, at the same date as the visit of the British Scientists.

Through the efforts of Prof. C. J. Mackenzie, M.E.I.C., and Prof. A. R. Greig, M.E.I.C., working with the Papers and Library Committee, speakers have been obtained and the following programme arranged:

Date, — Friday, August 22nd.
10 a.m., — Business Meeting, Saskatchewan University.
Afternoon and Evening, — Professional meetings to be addressed by Dr. Howe, professor of electrical engineering, University of Glasgow, and by Sir Charles Parsons, the inventor of the steam turbine. Members will also have opportunities to meet personally other prominent engineers with the British Scientists.

Calgary Branch

G. P. F. Boese, A.M.E.I.C., Secretary-Treasurer.
W. St.J. Miller, A.M.E.I.C., Branch Editor.

On July 19th a number of members set out on a tour of inspection of the power plants of the Calgary Power Company at Kananaskis on the Bow river, some 52 miles west of Calgary. This trip was undertaken in response to the kind invitation of F. J. Robertson and staff of the power company, who certainly went out of their way to entertain the visitors to their fullest ability. Cars were provided by branch members and some forty members took this opportunity of spending a most interesting and instructive time.

New Power Line to Calgary

On the way out it was interesting to note the work on the new power line actually progressing. This is being constructed in more substantial manner than the two existing lines into Calgary, the poles being in duplicate throughout with elaborately stayed poles at every mile of the route. It is anticipated that the line will be completed in ample time this year to assist at peak load periods or as an auxiliary supply as requirements demand. The three overhead cables are of stranded copper wire with a capacity for 125,000 volts.

On arrival at the lower Horseshoe Falls station, we were faced with a sumptuous repast in the community hall on the property, where we did full justice to the call of the inner man. Superintendent Robertson, A.M.E.I.C., P. Turner Bone, M.E.I.C., and others, made some fitting remarks at the conclusion of the luncheon, as did also P. J. Jennings, M.E.I.C., who acted as chairman in the unavoidable absence of R. S. Trowsdale, A.M.E.I.C., branch chairman.

Inspection of Plant

Following lunch parties were formed to fulfil the chief object of the visit, namely, the plant inspection. To many this was a first visit, and it was indeed a pleasant surprise to realize that we have two such up-to-date and efficient plants of this kind in the west. On entering the Horseshoe plant one looks down from a substantial gallery on to two 6,000-h.p., and two 4,000-h.p. turbines, direct connected to generators. Space will not admit of a detailed description of such things as turbines, generators, exciters, valve control apparatus, penstocks, motor-generators, etc., suffice it to mention that at both the upper and lower plants an advanced efficiency was most apparent. At the lower and original plant the horizontal type turbines are employed under a seventy foot (average) head and at the upper plant at Kananaskis, or Seebe, two of the more modern vertically mounted type of turbines and generators are installed, together with one smaller 200-h.p., turbo-generator, all working under an average head of 70 feet. Although full use is made of the head available at these sites the amount of water flowing over the weir at this season would indicate a greater horse power being available still for use. Of course winter conditions determine the actual amount available when maximum power is most needed.

All those who availed themselves of this opportunity to see these power plants are indeed grateful to Mr. Robertson, and his staff, for the cordial consideration extended and the manner in which they so willingly explained the various points of interest.

Members of Calgary Branch on visit to Power Plants of Calgary Power Company at Kananaskis on Bow River.

Halifax Branch

K. L. Dawson, A.M.E.I.C., Secretary-Treasurer.

On Wednesday, August 13, 1924, at 10 a.m., about forty of the members of the Halifax Branch left the dock at H.M. Dockyard for a visit to the H.M.S. "Hood" the flagship of the special service squadron which has been carrying the Union Jack to the ports of the world. On board we were the guests of the engineering staff of the ship. The party was split into groups of five each of which was provided with a petty officer as guide. The tour of the ship which followed was replete with acts of courtesy extended to us by officers and men and provided many lessons in the science of being economical of space. After spending two and one-half hours seeing as much as possible we felt we had only touched the high spots. At twelve o'clock the engineering officers of the ship entertained the members of the executive of the Halifax Branch in the Wardroom. Before leaving, F. A. Bowman, M.E.I.C., vice-president of *The Institute* for the maritime provinces extended to Engineer-Captain Goodwin and his staff the cordial thanks of the Halifax Branch for the opportunity of seeing the inside of the greatest battleship in the British Navy and for the many courtesies which had been extended. He also welcomed them to the maritime provinces on behalf of the members of *The Institute* living in them. For arranging the details of the visit and providing the launch to take us to the "Hood" which was anchored in the stream we are greatly indebted to Commander Wood, M.E.I.C., manager of H.M. Dockyard.

Ottawa Branch

F. C. C. Lynch, A.M.E.I.C., Secretary-Treasurer.

British Scientists visit Ottawa

The occasion of the visit of the British Association for the Advancement of Science to Ottawa on August 5th was of much interest to local members of *The Institute* who went to considerable trouble in assisting the entertainment plans of the local Reception Committee.

Charles Camsell, M.E.I.C., deputy minister of the mines department acted as chairman of the committee in the absence of Dr. Collins through illness. He also presided at the luncheon given to the British Association in the Chateau Laurier at which the Prime Minister gave the address of welcome. F. C. C. Lynch, A.M.E.I.C., and L. L. Bolton acted as joint secretaries and C. P. Edwards, A.M.E.I.C., as chairman of the Entertainment Committee. A drive to various points of interest in the city was arranged for the visitors and many members of *The Institute* loaned their cars or acted as guides in this connection. The British scientists were especially interested in the papermills and the industrial section surrounding Chaudiere falls.

Papers Presented by local Institute Members

A number of local members of *The Institute* prepared papers for presentation at the sessions of the British Association for the Advancement of Science in Toronto, including:

E. H. Finlayson, A.M.E.I.C., on Silviculture practices in Canada,
D. Roy Cameron, A.M.E.I.C., on fire protection methods in Canadian forests,
E. M. Dennis, A.M.E.I.C., on the work of the Topographical Surveys Branch,
W. H. Boyd, M.E.I.C., on the work of the Geological Survey,
Noel Ogilvie, M.E.I.C., on the work of the Geodetic Survey,
Dr. W. Bell Dawson, M.E.I.C., on the work of the Tidal and Current Survey,
A. M. Narraway, M.E.I.C., on magnetic surveys as practised by the Canadian Topographical Surveys,
J. B. Challies, M.E.I.C., on extent and administration of Canadian water powers,
D. W. McLachlan, M.E.I.C., on the St. Lawrence Power and Navigation question,
J. P. Henderson, A.M.E.I.C., on wireless time signals as employed by the Dominion Observatory.

Trade Publications

The Taylor Stoker Company have recently issued a very attractively prepared catalogue of fifty-four pages containing diagrams, illustrations and descriptive matter featuring the new Taylor Stoker. This catalogue will be supplied to members of *The Institute* upon request to Taylor Stoker Company, Limited, Toronto, Ont., or Montreal, Que.

Midwest (Canada) Limited, through their principals, Midwest Air Filters, Incorporated, have issued a new data book on air filters for compressors and internal combustion engines. This book contains twenty-four pages of illustrated matter, describing the principal features of these filters. Copies of the same may be obtained from Midwest (Canada) Limited, 83 Craig Street, West, Montreal.

Recent Additions to the Library

Transactions, Proceedings, Etc.

Presented by the Societies:—

Year Book of The Association of Professional Engineers of the Province of British Columbia, April 1924.
Proceedings of The American Concrete Institute, Twentieth Annual Convention, 1924, Volume XX.

Reports, Etc.

Presented by The Harbour Commissioners of Montreal.
The Harbour of Montreal, Annual Report, 1923.

Presented by R. Dawson Harling, of Canadian Office.
Manchester, Its Ports and Industries.

Presented by The Department of Labour of Canada.
Third Report on Organization in Industry, Commerce and the Professions in Canada (1924).

Presented by The Hydro-Electric Power Commission of Ontario.
Sixteenth Annual Report of the Hydro-Electric Power Commission of the Province of Ontario, for the year ended October 31st, 1923.

Presented by The Institution of Electrical Engineers, London, England.
Lord Kelvin, His Life and Work.

Presented by Librarian of McGill-University.
A Catalogue of Scientific Periodicals in Canadian Libraries.

Presented by The Canadian Engineer, Toronto, Ontario.
Bound volume of "The Canadian Engineer", January 1st, to June 30th, 1924.

Special Institute Meeting

On Thursday, September 25th, 1924, there will be a special meeting of The Institute in the form of a luncheon gathering, at one o'clock, at the Windsor Hotel, Montreal. Sir Ernest Rutherford will be the speaker of the day. The Council of The Institute felt that in securing Sir Ernest's consent to address a meeting, the occasion was of sufficient importance to warrant a general meeting.

Members residing outside of Montreal are requested to advise the Secretary if they intend to be present.

An Exhibit at Wembley

At the British Empire Exhibition, the C. A. Parsons and Co., who have recently appointed F. Jno. Bell, M.E.I.C., of Toronto as Canadian representative, have a number of interesting exhibits.

The principal exhibit is a 12,000 k. w., 3,000 r.p.m. tandem turbo-alternator and exciter, designed for railway traction. The plant is one of five sets with surface condensers constructed during 1923-24 for the Union of South Africa Electricity Supply Commission. These sets will be erected in the new power station at Colenso, Natal, for the electrification of the railway between Glencoe and Pietermaritsburg.

Another exhibit of special interest is a 1/12 scale model of a 50,000 k. w. turbo-alternator and condensing plant which is now nearing completion at Heaton Works, and will be erected in the new 500,000 k. w. station at Crawford Avenue, Chicago, U.S.A.

In order to show the layout of the plant in relation to the engine room, the model includes basement, walls, roof and crane. Some idea of the immensity of the station will be gained from the fact that the crane-rail span is 122 feet, and the height from basement to the apex of the roof is 113 feet.

This plant is the second set exported by the Parsons Company to Chicago, a 25,000 k. w. tandem turbo-alternator having been erected in the "Fisk Street Station" in 1913.

Of considerable historical interest is another exhibit, which is a small ½ kilowatt 2/3 horse power direct-coupled turbo-dynamo, running under steam at about 9,000 r.p.m. It was built some thirty years ago, and is of similar type to the first Parsons machine of 1884 which now rests in the Museum of Science and Technology at South Kensington.

Another interesting exhibit is a patented reflector, by means of which it is possible to vary the shape of the beam produced, from a parallel beam to a spreading beam whose dimensions at a range of one mile are 1,000 feet wide by 200 feet high, with proportional area at other ranges.

Western Canada Irrigation Association Convention

The Eighteenth annual convention of the Western Canada Irrigation Association was held in Calgary on July 29th, 30th, and 31st, and proved to be an entirely successful event.

On the first day A. S. Dawson, M.E.I.C., took the chair in the absence of Hon. Geo. Hoadley. Lieut.-Gov. Brett and Mr. Hoadley were however present on the other days of the convention. Mr. Dawson announced the fact that Calgary was the birthplace of the Association, which was formed here in July 1907. Members of *The Institute* who presented papers were R. S. Stockton, M.E.I.C., on "Profitable farming and the future development of the community", and W. H. Snelson, A.M.E.I.C., on "Irrigation investigations as an aid in the development of the community".

These subjects were as broad as the length of their titles might suggest, and proved amongst the most interesting of the sessions. Other excellent papers and addresses were presented by many from outside points.

At the conclusion of the session the delegates and friends enjoyed an automobile trip to the C.P.R. experimental farm at Strathmore, where an excellent luncheon was served and a very interesting tour of inspection made of the gardens, stock pens, and farm plots. It was on the homeward run that a persistent downpour of rain played havoc with the mental attitude of the irrigationists towards their favourite topic, and while many were caught unprepared, this however did not dampen their ardour concerning the vital necessity of irrigation in this province. Thus terminated, (at midnight for some!), a successful convention of "wets", not however, those who would irrigate the inner man, but rather those who are out:—

"To promote and diffuse knowledge concerning irrigation and other uses of water throughout western Canada.

To facilitate conference and deliberation among the people of the country concerning irrigation and related interests; and

To provide means of bringing the needs of the people as regards irrigation before the Dominion and Provincial governments."

(Extracts from the creed of the Western Canada Irrigation Association.)

University of Michigan Fellowship in Highway Engineering and Highway Transport

The Board of Regents of the University of Michigan will award the following Fellowships not later than November 1st, 1924. Two Fellowships may be awarded about September 10th to men who intend to be in residence during the first semester.

The Roy D. Chapin Fellowship in Highway Transport, which is offered to provide for the investigation of an approved subject relative to Highway Transport.

The Roy D. Chapin Fellowship in Highway Engineering, which is offered to provide for the investigation of an approved subject relative to hard surfaced roads and pavements.

Two Detroit Edison Fellowships in Highway Engineering, which are offered to provide for the investigation of approved subjects relative to moderate cost country roads.

The General Conditions are as follows: Each Fellowship pays the sum of $250 with an allowance of $50 for expenses. Fellows do not have to pay tuition fees. A Fellow must hold a Bachelor's Degree from a college of recognized standing. He must enroll as a graduate student in highway engineering or highway transport and as a candidate for the degree of Master of Science or Master of Science in Engineering. He must be in residence for one of the following periods: First Semester (October to February); Winter Period (December to March); Second Semester (February to June). An application for a Fellowship must include a concise statement of the candidate's educational training and engineering experience, and three references. Applications for Fellowships and requests for information pertaining to the twenty-five advanced courses in Highway Engineering and Highway Transport offered by the Graduate School should be sent to Professor Arthur H. Blanchard, M.E.I.C., 1026 East Engineering Building, University of Michigan, Ann Arbor, Michigan.

New St. Clair Avenue Bridge over Ravine, Toronto, Ont.

View of west Main Pier, showing Concrete Tower, St. Clair Avenue Bridge.

The St. Clair Avenue Bridge, now under construction, will replace the old steel bridge which for many years has occupied the site immediately adjacent, connecting the residential district of Moore Park with Yonge Street at St. Clair avenue. The new bridge will be a combination steel and concrete structure, and will be 508 feet long, with four girder spans and one arch span, its height from bottom of ravine to deck will be about 95 feet, and its width 86 feet. Ground was broken on October 19th, 1923, and first concrete poured on November 28th, 1923.

CORRESPONDENCE

Early Discussion on Railway Construction

St. John, N.B., June 23rd, 1924.

The Editor,
The Engineering Journal;

I attach herewith a copy of an interesting article which I took from an old copy of the *Charlotte Gazette*, printed in St. Andrews in 1847, which I happened to see recently.

As it deals with the proposed construction of one of the earliest railways in Canada, the St. Andrews and Quebec Railway, and gives at some length the views evidently current at that time as to how railways should really be built, (possibly from the Lumbermen's point of view), I thought you might be interested in reproducing it in *The Journal* at some convenient date.

Yours truly,
C. C. Kirby, M.E.I.C.,
District Engineer, Canadian Pacific Railway.

St. Andrews and Quebec Railway

Extract from "Charlotte Gazette", St. Andrews, January 21st, 1847.

D. S. Morrison, Esq., one of the directors of this incorporation, arrived here from St. Andrews on Monday last, and intimated his wish to lecture on the subject of railways. A public meeting was called, to be held the following day at the court house. The meeting was called to order by Charles Perley, Esq., and John Dibblee, Esq., was called to the chair.

Mr. Morrison delivered a most admirable lecture, which was listened to with much attention by a large and respectable audience.

The lecturer, by way of introduction, adverted to the great and wonderful changes which have effected by the invention of the steam engine and its adaptation to the propelling of steam vessels and railway cars. The nature and construction of wood railways was then explained, with the peculiar form and properties of guide wheel carriages, which it is evident answers all purposes, either on an iron or wood railway, much better than the common flange wheel car. On a wood railway the wear occasioned by locomotives and carriages, with guide wheels instead of flanges, is so small as scarcely to be perceptible; and from actual experiment in England, it was shown that a train could pass over a wood rail a number of times, equal to that of twelve trains a day, for seven years, without wearing the saw marks off the rails.

The lecturer next showed that owing to the great friction of iron upon wood, a locomotive could draw double the load, or ascend a plane twice as steep on a wood railway, as was practicable on rails of iron. This necessarily reduces the cost of making a railway to a very great extent, as an iron railroad would require immense excavations, where one of wood might be constructed with slight excavations or none at all. The expense of grading would thus be reduced more than one-half. It was also clearly proved that a curve of much smaller radius could be traversed by a guide wheel carriage on a wood railway, with greater speed and perfect safety, than it was possible to traverse on an iron structure, where flange wheel was employed. The effect of this simply is an uncommon facility in avoiding hills and ravines where great excavations and embankments are unavoidable and consequently great saving in expense in grading.

The next enquiry explained by the lecturer referred to the cost of material. His estimate, of which the particulars were given, made the cost of superstructure for a wood railway amount to £300 per mile while the superstructure for an iron road would cost from £1,580 to £2,000 for the same distance,—showing a decided superiority in favour of wood. The capability of wood to sustain any pressure necessary, and any reasonable wear for a great length of time, was from experiments at Vauxhall and Wimbledon Common, very satisfactorily proved. With a guide wheel carriage, a wood rail will endure the wear of twenty or more trains per day until it decays and rots from exposure to the weather. It was also stated, (a fact which no one can doubt), that wood exposed to the weather will last five years, before it is unfit for use from rot; and if the wood be prepared by a saturation of muriate of zinc, it will last from ten to fifteen years. It was then shown that wood could be relaid every five years, for less than half the interest of the money which an iron railway would cost or every ten years for less than one-fourth the interest; which is an indubitable proof that the inferior durability of wood as compared with iron is far more than compensated by its cheapness.

Tenders called by Department of Public Works

Cross Point, Que. Tenders for extension to wharf at Cross Point, County of Bonaventure, Que., are being received until Sept. 2nd, 1924, by Public Works Dept. in Ottawa. Plans and specification at Dept. in Ottawa, offices of the District Engineers, St. Lawrence Power Building, Rimouski, Que.; Post Office Building, Quebec, Que.; Postal Station "H", Montreal, Que., and Post Office, Cross Point, Que.

Denman Island, B.C. Tenders for wharf repairs at Denman Island, District of Comox-Alberni, B.C., are being received until Sept. 11th, 1924, by Public Works Dept. in Ottawa. Plans and specification at Dept. in Ottawa, at offices of the District Engineers, Old Post Office Building, Victoria, B.C., and at the Post Offices, Vancouver, and Denman Island, B.C.

Grondines, Que. Tenders for wharf extension at Grondines, County of Portneuf, Que., are being received until Sept. 2nd, 1924, by Public Works Dept. in Ottawa. Plans and specification at Dept. in Ottawa, at offices of the District Engineers, Post Office Building, Three Rivers, Que.; Post Office Building, Quebec, Que.; Postal Station "H" Montreal, and Post Office, Grondines, Que.

Lotbinière, Que. Tenders for reconstruction of a portion of wharf at Lotbinière, Lotbinière County, Que., are being received until Sept. 15th, 1924, by Public Works Dept. in Ottawa. Plans and specification at Dept. in Ottawa, offices of the District Engineers, Post Office Building, Three Rivers, Que., Post Office Building, Quebec, Que., Postal Station "H" Montreal, Que., and Post Office, Lotbinière, Que.

New Westminster, B.C. Tenders for the Fisheries Patrol Station at New Westminster (Poplar Island) B.C., are being received until Sept. 16th, 1924, by Public Works Dept. in Ottawa. Plans and specification at Dept. in Ottawa, at offices of the District Engineers, Post Office Building, New Westminster, B.C., Old Post Office Building, Victoria, B.C., and Post Office, Vancouver, B.C.

Port Colborne, Ont. Tenders for repairs to Western Breakwater at Port Colborne, Welland County, Ont., are being received until Sept. 9th, 1924, by Public Works Dept. in Ottawa. Plans and specification at Dept. in Ottawa, at offices of the District Engineers, Royal Bank Building, London, Ont., 22 Adelaide Street, East, Toronto, Ont., and at Post Office, Port Colborne, Ont.

Port Simpson, B.C. Tenders for wharf repairs at Port Simpson, B.C., are being received until Sept. 4th, 1924, by Public Works Dept. in Ottawa. Plans and specification at Dept. in Ottawa, at office of the District Engineer, Old Post Office Building, Victoria, B.C., and at the Post offices, Vancouver, B.C.; Prince Rupert, B.C.; Stewart, B.C., and Port Simpson, B.C.

Rimouski, Que. Tenders for reconstruction of breakwater-wharf at Rimouski, Que., are being received until Sept. 15th, 1924, by Public Works Dept. in Ottawa. Plans and specification at Dept. in Ottawa; offices of the District Engineers, St. Lawrence Power Building, Rimouski, Que.; Post Office Building, Quebec, Que., and Postal Station "H", Montreal, Que.

Sayward, B.C. Tenders for replacement of wharf at Sayward, B.C., are being received until Sept. 11th, 1924, by Public Works Dept. in Ottawa. Plans and specification at Dept. in Ottawa, at office of District Engineer, Old Post Office Building, Victoria, B.C., and at the Post Offices, Vancouver, B.C., and Sayward, B.C.

Ste. Croix, Que. Tenders for wharf repairs at Ste. Croix, County of Lotbinière, Que., are being received until Sept. 15th, 1924, by Public Works Dept. in Ottawa. Plans and specification at Dept. in Ottawa, at offices of the District Engineers, Post Office Building, Three Rivers, Que., Post Office Building, Quebec, Que., Postal Station "H", Montreal, Que., and at the Post Office, Ste. Croix, Que.

Publications

The Ontario Department of Mines, Toronto, have issued for circulation at The British Empire Exhibition 1924 an eighty-seven page guide-book reviewing the mineral resources of the province. While this guide-book contains only a brief general description of the mining industry in the province yet, there is given at the foot of the description of each of the minerals a bibliography of the more detailed reports which may be obtained from the department.

Building and Engineering Catalogue

The 1924 edition of this catalogue has just been issued by Specification Data, Limited, of Toronto, and contains as usual much interesting information regarding building and engineering equipment.

Preliminary Notice

of Applications for Admission and for Transfer

August 19th, 1924.

The By-laws now provide that the Council of the Institute shall approve, classify and elect candidates to membership and transfer from one grade of membership to a higher.

It is also provided that there shall be issued to all corporate members a list of the new applicants for admission and for transfer, containing a concise statement of the record of each applicant and the names of his references.

In order that the Council may determine justly the eligibility of each candidate, every member is asked to read carefully the list submitted herewith and to report promptly to the Secretary any facts which may affect the classification and election of any of the candidates. In cases where the professional career of an applicant is known to any member, such member is specially invited to make a definite recommendation as to the proper classification of the candidate.*

If to your knowledge facts exist which are derogatory to the personal reputation of any applicant, should be promptly communicated.

Communications relating to applicants are considered by the Council as strictly confidential.

The Council will consider the applications herein described in September, 1924.

FRASER S. KEITH, Secretary.

*The professional requirements are as follows:—

Member shall be at least thirty-five years of age, and shall have been engaged in some branch of engineering for at least twelve years, which period may include apprenticeship or pupilage in a qualified engineer's office, or a term of instruction in a school of engineering recognized by the council. The term of twelve years may, at the discretion of the council, he reduced to ten years in the case of a candidate for election who has graduated from a school of engineering recognized by the council. In every case the candidate shall have held a position in which he had responsible charge for at least five years as an engineer qualified to design, direct or report on engineering projects. The occupancy of a chair as a professor in a faculty of applied science or engineering, after the candidate has attained the age of thirty years, shall be considered as responsible charge.

An Associate Member shall be at least twenty-seven years of age, and shall have been engaged in some branch of engineering for at least six years, which period may include apprenticeship or pupilage in a qualified engineer's office or a term of instruction in a school of engineering recognized by the council. In every case a candidate for election shall have held a position of professional responsibility, in charge of work as principal or assistant, for at least two years. The occupancy of a chair as an assistant professor or associate professor in a faculty of applied science of engineering, after the candidate has attained the age of twenty-seven years, shall be considered as professional responsibility.

Every candidate who has not graduated from a school of engineering recognized by the council, shall be required to pass an examination before a board of examiners appointed hy the council. The candidate shall be examined on the theory and practice of engineering with special reference to the branch of engineering in which he has been engaged. This examination may be waived at the discretion of the council if the candidate has held a position of professional responsibility for five or more years.

A Junior shall be at least twenty-one years of age, and shall have been engaged in some branch of engineering for at least four years. This period may be reduced to one year, at the discretion of the council, if the candidate for election has graduated from a school of engineering recognized by the council. He shall not remain in the class of Junior after he has attained the age of thirty-three years.

Every candidate who has not graduated from a school of engineering recognized by the council, or has not passed the examinations of the first year in such a course, shall be required to pass an examination in the following subjects: geography, history (that of Canada in particular), arithmetic, geometry, euclid (books I, IV and VI), trigonometry, algebra up to and including quadratic equations.

A Student shall be at least seventeen years of age, and shall present a certificate of having passed successfully an examination equivalent to the final examination of a high school or the matriculation of an arts or science course. He shall either be pursuing a course of instruction in a school of engineering recognized by the council, in which case he shall not remain in the class of student for more than two years after graduation; or he shall be receiving a practical training in the profession, in which case he shall pass an examination equal to that prescribed for admission to the grade of Junior in the foregoing section and he shall not remain in the class of Student after he has attained the age of twenty-seven years.

An Affiliate shall be one who is not an engineer by profession but whose pursuits, scientific attainments or practical experience, qualify him to co-operate with engineers in the advancement of professional knowledge.

The fact that candidates give the names of certain memhers as references does not necessarily mean that their applications are endorsed by such memhers.

FOR ADMISSION

GAREY—JOHN DENNIS, of 401 Douglas Avenue, St. John, N.B. Born at St. John, N.B., Sept. 3rd, 1886; Educ., Amer. Sch. of Corr. private night schools; four years apprenticeship with Phoenix Foundry & Locomotive Works; four mos. as machinist, Dom. Iron & Steel Co., Sydney; two years operating engr., six years mech. supt., Murray & Gregory; ten years as chief engr., St. John Rly. Co. and New Brunswick Power Co.; At present chief engr., New Brunswick Power Company, St. John, N.B.

References: G. G. Murdoch, F. P. Vaughan, G. G. Hare, E. G. Cameron, G. Stead,

GODIN—CHARLES, of 1180 St. Denis Street, Montreal, Que. Born at St. Johns, Que. Aug. 19th, 1892; Educ., C.E., Ecole Polytechnique, May 1915; 1916-17, dftsman., L'Air Liquide Society; 1918-19, with Wayagamack Pulp & Paper Co.; with National Shiphldg.and Tidewater Shiphuilders; 1921-22, in charge of constrn. of lime plant for St. Maurice Lime Co., Three Rivers, Que.; 1923-24, asst. engr., Public Works, Canada, Three Rivers, Que.; June 1924 to date, engr. with Trussed Concrete Steel Co., Montreal.

References: B. Grand Mont, P. E. Mercier, A. Frigon, C. L. Arcand.

HASKETT—WESLEY IRWIN, of 197 Belmont Avenue, Ottawa, Ont. Born at Montreal, Que., April 22nd, 1903; Educ., matric., Ottawa Collegiate Institute, 1919. private study; 1920-22, machine design and mech. engrg.; 1920, junior dftsman., 1921 in charge of dfting. room staff of Harold C. Shipman & Co. of Ottawa; 1922, entered into a partnership and has since practised as a patent attorney under the firm name The Ramsay Company. At present vice-president and manager of the company, and a registered attorney-at-patents.

References: R. C. Berry, W. C. Gillis, J. H. G. Marshall, T. S. Nash, L. C. Prittie.

LUCAS—LESLIE, of Elk Lake Ont. Born at Annan, Scotland, Aug. 13th, 1896; Educ., complete engrg. course, Royal Technical College, Glasgow, Scotland, 1919-22; five years as pupil with Messrs. Mavor & Coulson Ltd., electrical engrs., Glasgow, Scotland, 1913-14 and 1919-23, and from Jan. to Aug. 1923, asst. to Chief Lester with same firm; 1923-24, dftsman., with Fraser Brace Ltd., Montreal; Feb. 1924 to date, supt. of power plant, transmission lines and substations,Great Northern Power Co. Ltd., Elk Lake, Ontario.

References: H. E. Pawson, J. H. Brace, J. B. D'Aeth, E. W. Neelands, H. W. Sutcliffe.

POOLER—MAX A., of St. John, N.B. Born at Austin, Minn., U.S.A., June 11th, 1880; Educ., B.S. Case School of Applied Science, 1904. E. E. Purdue Univ, 1905; 1905-07, Mahoning & Shenango Ry. & Lt. Co., Youngstown, Ohio; 1907-14, supt., New Castle Electric Co.. New Castle, Pa.; 1914-22, gen. mgr., Potomac Public Service Co. Hagerstown, Md.; At present, vice-president and general manager, New Brunswick Power Co., St. John, N.B.

References: F. P. Vaughan, G. G. Murdoch, A. Gray, C. C. Kirby, G. G. Hare.

RITCHIE—ALEXANDER, of 10757-86th Avenue, Edmonton, Alta. Born at Whitehills, Banffshire, Scotland, March 28th, 1887; Educ., engrg. course at Heriot Watt College, Edinhurgh. 1903-09, apprenticeship—4 years practical work in fitting shop, two years drawing office, Ramage & Ferguson, Ltd., Leith, Scotland; 1910-13, dftsman, Brown Bros., Rosebank foundry, Edinhurgh; 1913 to date with city of Edmonton — 1913-14, dftsman., 1914-19, filtration plant, and 1919 to date, technical engr., power plant dept.

References: A. W. Haddow, C. F. Corbett, W. R. Mount, R. S. Trowsdale, R. J. Gibb.

RUSSELL-CYRUS JAMES, of 165 Woodward Avenue, Sault Ste Marie, Ont. Born at Renfrew, Ont.' Jan. 17th, 1885; 2 years, elec. engrg., S. P. S. Univ. of Tor., 1907-09; 1909-10, electr'n., for T. & N. O., North Bay; 1910-11, elect'n., for contractor, North Bay; 1911-14, foreman of line and Meter depts.,Tagona Water and Light; 1914-18. gen. supt., water and light depts., city of Sault Ste Marie, Ont.; 1918 to date, gen. asst. to supt., and in charge of line constrn. and mtce., also of hydraulic data and reports, The Great Lakes Power Co. Ltd., Sault Ste Marie, Ont.

References: A. E. Pickering, R. A. Campbell, W. W. Van Every, A. G. Tweedie, C. H. Speer, W. S. Wilson, H. A. Morey, B. E. Barnhill.

STEPHENS—JOHN, of Fredericton, N.B. Born at Dublin, Ireland, May 19th, 1884; Educ., B.A. 1905, B. Eng., 1906, M. A. 1909, M. Eng. 1911, Dublin Univ.; Member, Inst. C.E. of Ireland, 1912; 1906, machine shop, Panhard & Levasser; London, England; 1908-09 (summers), assisted hy Dr. W. E. Lilly, M.I.M.E., in testing laboratory, Duhlin; 1916-19, overseas, Lieut., 2nd Seige Battery; With the Univ. of New Brunswick as follows: 1907, asst. prof. of engrg., 1908-14, prof. of mech. engrg. and drawing, 1914-16, prof. of mech. engrg., 1919 to date, prof. of mech. engrg., 1921 to date, dean of the faculty of applied science; Summer work included: installation of steam turhine and condensing equipment for Fredericton Gaslight Co. (plans and supervision); reports on power plants and combustion conditions; design of new boiler plant; plans and valuation—Randolph & Baker, Randolph, N. B.; consultation and plans, new geared steam turhine unit, Maritime Electric Co., Fredericton, N. B.; alterations to power plant, Fredericton Puhlic Hospital (design and supervision); tests and reports on engineering materials; Summer 1924, furnace modifications for the use of local fuel, Fredericton Public Hospital. Ventilation, Fredericton Puhlic Hospital. New heating plant, engrg. huilding, Univ. of New Brunswick, Design and supervision.

References: B. M. Hill, C. McN. Steeves, E. O. Turner, H. F. Bennett, R. F. Armstrong, W. J. Johnston.

YOUNG—HUGH ANDREW, of Ottawa, Ont. Born at Winnipeg, Man., April 3rd, 1898; Educ., B.Sc. in E.E., Univ. of Man. 1924; Three summer periods, bridge shop, Manitoha Bridge and Iron Works, Winnipeg, last period as foreman; At present with Royal Canadian Corps of Signals, Ottawa, Ont.

References: E. P. Fetherstonhaugh, N. M. Hall, E. V. Caton, C. F. Cameron.

FOR TRANSFER FROM CLASS OF JUNIOR TO HIGHER GRADE

COSSITT—MURRAY FREDERICK, of Corner Brook, Bay of Islands, Nfld. Born at Sydney, N.S., June 2nd, 1892; Educ., 4 years evening classes in maths., I.C.S.; 1911, rodman, N.S. Mines Dept.; 1914, transitman, on above work; 1915, in charge of survey work etc., for McKenzie, Pickings & McCallum; received P.L.S. cert.; 1918, asst. to chief engr. for Foley Bros. on Halifax Ocean Terminals; 1919, with Pickings & Roland on new layout of devastated area for Halifax Relief Commission; also making assessment survey and plans for city of Halifax; 1920 (Jan.-June), in charge of exams., surveys, etc., Hydro-Electric Development at head of St. Margarets Bay, N.S.; 1920-23, ill-health; 1923 (Jan.-May), private practice, Sydney, N.S.; 1923 (June-July), hydrographic survey, Little Bras d'Or channel, Dom. Public Works; 1923 (Aug.-Sept.), in charge surveys of dam, flowage area, pipe line and sewerage outfall, new town of Corner Brook, Nfld.; Oct. 1923 to date, engr for town constrn. dept. of the Nfld. Power & Paper Co. Ltd., Corner Brook, Nfld.

References: J. W. Roland, H. B. Pickings, C. St. J. Wilson, J. H. Winfield, R. M. McKinnon.

CRABTREE—HENRY SWIFT, of 41 Standish Avenue, Toronto, Ont. Born, at Halifax, England, March 29th, 1892; Educ., West Vale Mechanics Inst., Halifax, Eng., Toronto Technical School. Articled pupil, Tasker & Crossley, Halifax, Eng., and ap'tice to the Lumby Engineering Works, Greetland, Halifax, Eng.; 1911-13, dftsman., Smith, Kerry & Chace, Toronto; 1913 (Jan.-Feb.), dftsman., W. D. Beath & Sons, Toronto; 1913-17, dftsman., Routly & Summers, Haileybury; 1917-18, dftsman., on reinforced concrete design, Trussed Concrete Steel Co., Walkerville; 1918 (June-Nov.), chief dftsman and designer, Knight Metal Products, Toronto; 1918-21, dftsman., Dept. Public Highways, Ontario; 1921-22, Dominion Machinery Co., Toronto, director, engaged as salesman on machine tools etc.; 1922 (April-Oct.), dftsman., Dept. Public Highways, Ontario; Oct. 1922 to date, engaged on calculations of surveys, compiling geological plans and profiles, etc., Imperial Oil Company, Toronto, Ont.

References: N. R. Gibson, J. A. Brown, A. E. Jupp, G. Hogarth, H. T. Routly, H. W. Sutcliffe, A. Hay.

LIBBY—PHILIP NASON, of 851 University Street, Montreal, Que. Born at Gray, Maine, U.S.A. July 5th, 1896; Educ., B.S., Univ. of Maine, 1917; 1916 (June-Oct.), valuation survey with Bangor Rly. and Elec. Co., Bangor, Me.; 1917 (June-Oct.), forester for Great Northern Paper Co., Bangor, Me.; 1917-19, overseas with U. S. Army; 1919-21, dftsman., with Riordon Co. Ltd., Mattawa, Ont.; 1921 (June-Oct.), topog'l. survey with Donnacona Paper Co., Donnacona, Que.; 1921 (Oct.-Dec.), topog'l. survey with G.R. Heckle, M.E.I.C.; 1921-22, topog'l. survey with Laurentian Power Co., Beaupre, Que., as instr'man., asst. and map maker; 1922 (Apr.-July), in charge of mapping party, Wayagamack Pulp & Paper Co., Three Rivers; 1922-24, with Mead Fibre Co., Kingsport, Tenn., part time as asst. to res. engr. on constrn., later as mill engr. on mtce. and in charge of new constrn. work; June 1924 to date, dftsman. and designer on paper mill constrn., with H. S. Taylor, consltg. engr., Montreal.

References: G. L. Freeman, L. S. Dixon, G. R. Heckle, J. A. Beauchemin, J. R. Montague, James Ruddick.

FOR TRANSFER FROM CLASS OF STUDENT TO HIGHER GRADE

ADLARD—LEONARD STANLEY, of Lahore, Punjab, India. Born at Toronto, Ont., Dec. 3rd., 1893; Educ., B.A.Sc. Univ. of Toronto, 1915; 1912, C.N.R. location surveys; 1913, O. L. Surveys; 1914, Can. Geol. Surveys; 1915-17, sanitary engr., bacteriological and chemical, water supplies and sewage, military laboratories; 1917-18, rly. engr., light logging lines; 1918-19, attached air force (location and drainage of aerodrome sites, constrn. of camps, etc.); Sept. 1919 to date, asst. executive engr., Public Works Dept., Punjab, India, constrn. of roads, bridges, bldgs.

References: A. H. Harkness, C. S. L. Hertzberg, T. R. Loudon, P. Gillespie, J. R. Cockburn.

GREEN—FREDERICK GORDON, of 161 Charlotte Street, St. John, N.B. Born at St. John, N.B., Aug. 15th, 1895; Educ., B.Sc. (Chem. Eng.), McGill Univ. 1921; 1919 (Feb.-July), Royal Technical College, Glasgow; 1912-13, plant dept., Western Union Telegraph Co., St. John; 1914-15, line inspector; 1915-16, instructor in drawing and shop work, Mt. Allison Univ.; 1916-19, overseas; 1920 (summer), asst. chemist, Nashwaak Pulp & Paper Co., St. John, N. B.; 1921 (May-Nov.), chief chemist, D'Arcy Exploration Co., Rosevale, N. B., Wallace Process Oil Shale Plant (Experimental), and from Nov. 1921 to Mar. 1922, plant supt., with entire charge of plant, two engrs. and twenty-six men on staff; 1922-24, supt. N-T-U Co. (Inc. name), Santa Maria, Calif., standardizing operation of twenty ton experimental plant (oil shales), etc.; At present trying to interest local holders of oil shale lands to erect plant to treat Albert, N. B. shales.

References: H. W. McKiel, C. M. McKergow, R. F. Armstrong, G. H. Thurber, N. F. Nutter, R. A. Strong.

MAXWELL—HAROLD JAMES, of 232 Old Orchard Avenue, Montreal, Que., Born at St. John, N.B., July 17th, 1903; Educ., B.Sc. (C. E.), Univ. of N.B., 1923; July 1923 to date, structural detailer, Dom. Bridge Co., Lachine, Que.

References: D. C. Tennant, A. Peden, E. Peden, H. H. Hawkes, F. C. Jewett.

MUIRHEAD—STUART ROBERT, of 2038 Angus Street, Regina, Sask. Born at Chicago, Ill., U.S.A., May 6th, 1899; Educ., B.A.Sc., Univ. of Toronto, 1924; First employed with Sask. Govt. Telephones in 1915—three years experience in central office work, one year as head switchman in an automatic office, and at present, equipment supervisor.

References: W. R. Warren, H. B. Sherman, S. R. Parker, J. D. Peters, R. N Blackburn, R. W. Angus.

ROOT—STEPHEN EASTMAN, of McMasterville, Que. Born at Rochester, N. H., Jan. 3rd, 1898; Educ., McGill Univ. 1922, one year Mass. Inst. Tech.; 1922-23, field engr., St. Lawrence Paper Mills, Ltd.; 1923 (May-Nov.), asst. supt. of constrn., Donnacona Paper Co. Ltd.; 1924 (Jan.-Mar.), engr. for Church Ross Co.; 1924 (Mar.-May), engr. for H. S. Taylor; May 1924, instructor at McGill Survey School; At present, engr. in charge of constrn., Canadian Explosives, Limited.

References: F. O. White, J. J. O'Sullivan, J. A. Beauchemin, H. S. Taylor, A. A Richardson, J. O'Neill, C. A. Buchanan.

Engineering Index

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A

ACOUSTICS

Auditoriums. Acoustics in Auditorium Design, P. E. Sabine. Am. Architect, vol. 125, no. 2448, June 18, 1924, pp. 579-586, 7 figs. Study of acoustical difficulties which may be classed under two general heads: those arising from concentration of sound reflected from extended concave surfaces and those arising from excessive reverberation.

AERONAUTICAL INSTRUMENTS

Rate-of-Climb Recorders. Optical Rate-of-Climb Recorders —Their Uses, Theory, and Description, A. H. Mears and D. H. Strothers. Optical Soc. of Am. Jl., vol. 8, no. 6, June 1924, pp. 787-801, 7 figs. Describes instruments developed by staff of Bur. Standards at request and with financial assistance of Air Service, U. S. Army, and Bur. Aeronautics, U. S. Navy.

AIRCRAFT CONSTRUCTION MATERIALS

Three-Ply. Three-Ply and Its Uses in Aircraft Construction, R. N. Liptrot. Instn. Aeronautical Engrs., Min. of Proc. No. 8, 1923, pp. 7-17 and (discussion) 18-22. Discusses physical properties of plywood; shrinkage and prevention of warping; effect of number of piles; figures for use in design; method of manufacture; true monocoque fuselage, semi-monocoque type, and three-ply braced fuselages. Abstract of paper read before Instn. Engrs.' Club.

AIRPLANE PROPELLERS

Design and Performance Calculations. The Application of Propeller Test Data to Design and Performance Calculations, W. S. Diehl. Nat. Advisory Com. for Aeronautics, report no. 186, 1924. Study of test data on family of Durand's propellers (nos. 3, 7, 11, 82, 113, 139).

AIRPLANES

Wings. Calculation of self-contained Wings in Two-and-Three-Ribbed Rigid-Frame Form Zur Berechnung freitragender Flugzeugflügel in zwei- und dreiholmiger Steifrahmenform (Vierendeel-Rostträger)', K. Thalau. Zeit. für Flugtechnik u. Motorluftschiffahrt, vol. 15, no. 10, May 26, 1924, pp. 103-109, 15 figs. Calculations, for both two-ribbed and three-ribbed wings.

Experimental Results with Slotted Wings (Neuere Versuchsergebuisse mit Spaltflügeln), G. Lachmann. Zeit. für Flugtechnik u. Motorluftschiffahrt, vol. 15, no. 10, May 26, 1924, pp. 109-116, 20 figs. Influence of arrangement of slots; reduction of profile resistance with normal flight; improvement of steering capacity with lower speeds.

Wood, Use in Construction. Some Recent Developments in the Use of Wood in Airplane Construction, W. M. Moore. Jl. of Forestry, vol. 22, no. 4, Apr. 1924, pp. 353-371. Kinds of wood used, species of wood permitted by Air Service specifications, use of plywood, defects in wood which affect its suitability for airplane manufacture, storage of airplane parts, balloon baskets, and wood versus metal in airplane construction.

ALLOY STEELS

Development. The Development of Alloy Steels, R. Hadfield. Iron and Coal Trades Rev., vol. 108, no. 2939, June 27, 1924, pp. 1120-1122, 1 fig. Gives comprehensive survey, largely historical, of development of alloy steels and important position they have attained in metallurgical and engineering industries. Paper read before Iron and Steel Sec., Empire Min. and Met. Congress.

Locomotives. Alloy Steels versus Carbon Steels for Locomotives. Ry. Engr., vol. 45, no. 533, June 1924, pp. 198-200. Review of subject of alloy steel, advantages of "straight" carbon steels, case-hardening steel, special steels for locomotive work, and alloy steel "defects".

ALLOYS

Copper. *See Copper Alloys.*

Corrosion-Resisting, Properties of. Tabular Presentation of Chemical and Physical Properties of Corrosion-Resisting Alloys. Chem. and Met. Eng., vol. 31, no. 2, July 14, 1924, pp. 79-83. Tables incorporating that part of systemized compilation made by a committee of members of Am. Soc. for Testing Matls. of available data regarding those alloys having iron, nickel or copper as predominating element and offering resistance to various destructive agencies, which is of value to chemical engiueer.

ASPHALT

Sands for, Classifying of. Classifying Asphalt Sands by Graphical Method, W. C. D. Haarman. Eng. News-Rec., vol. 92, no. 26, June 26, 1924, pp. 1090-1091, 2 figs. Triangular diagrams offering simple and rapid means of classifying sands and proportioning sheet asphalt mixture.

AUTOMOBILE ENGINES

Air Cleaners. Testing of Air-Cleaners, A. B. Squyer. Soc. Automotive Engrs.—Jl., vol. 15, no. 1, July 1924, pp. 33-37, 5 figs. Requirements of a good air cleaner are maximum efficiency, minimum of attention from operator and minimum power-loss. Deals with development of laboratory methods to determine relative values of various air cleaners as such, especially first requirement, maximum efficiency.

Crankcase Oil Dilution. A Possible Solution of the Crankcase-Oil Dilution Problem, I. L. Anderson. Soc. Automotive Engrs.—Jl., vol. 15, no. 1, July 1924, pp. 43-46, 6 figs. Describes method which consists of removing gasoline from crankcase by ventilation; apparatus used and results of tests.

Water in Crankcase Oils, A. L. Clayden. Soc. Automotive Engrs.—Jl., vol. 15, no. 1, July 1924, pp. 47-50, 3 figs. Effect of using an emulsifying oil; amounts of water actually deposited because of cylinder-wall condensation; effects on lubrication; determination of water-deposition rate.

Oil Consumption and Dilution. Engine-Oil Consumption and Dilution, N. MacCoull. Soc. Automotive Engrs.—Jl., vol. 15, no. 1, July 1924, pp. 93-100, 15 figs. First results of tests made by Texas Co., New York City, on five 7½-ton trucks during regular course of business deliveries. Curves plotted from data obtained. Details of dynamometer tests. Description of dynamometer apparatus and engine used, and analysis of result of wear of test engine.

AUTOMOBILE MANUFACTURING PLANTS

Ford Motor Company of Canada. Ford's New $10,000,000 Factory at Ford. Can. Mfr., vol. 44, no. 6, June 1924, pp. 11-15, 5 figs. Layout of plant, construction of buildings and description of machine shop.

Parts Handling. Cutting Costs by the Use of Conveyors, F. H. Colvin. Am. Mach., vol. 60, no. 26, June 26, 1924, pp. 969-971, 7 figs. Some of the Maxwell methods of handling chassis and bodies in their various stages, and some time-saving devices employed.

AUTOMOBILES

Bodies, Manufacture of. Manufacturing All Steel Automobile Bodies, J. W. Meadowcroft. Am. Welding Soc.—Jl., vol. 3, no. 5, May 1924, pp. 24-26. Particulars of welding operations.

Brakes, Four-Wheel. Hydraulic Brakes on Test, H. F. Blanchard. Autocar, vol. 52, no. 1495, June 13, 1924, pp. 1070-1072, 5 figs. Further details of Lockheed four-wheel system with data gleaned from actual trials.

Chassis Construction. Lighter Chassis Is Not Likely Until Body Weight Is Decreased, W. L. Carver. Automotive Industries, vol. 51, no. 1, July 3, 1924, pp. 30-33, 4 figs. Advent of leather in place of steel panels among promising possibilities. Balloon tires, smaller wheels and tubular axles help decrease mass of unsprung parts. Present stiff and heavy frames considered necessary to prevent wearing and rattles.

Finishing Materials. What Basic Materials Go Into Automobile Finishes? Automotive Industries, vol. 51, no. 1, July 3, 1924, pp. 34-38. Information regarding nature of materials used in finishing of automobile bodies and chassis.

Headlighting Devices, Laboratory Tests for. Specifications of Laboratory Tests for Approval of Electric Headlighting Devices for Motor Vehicles. U. S. Bur. Labor Statistics—Bul., no. 350, Jan. 1924, 5 pp., 1 fig. Tentative American standard approved Nov. 11, 1922 by Am. Eng. Standards Committee.

B

BAGASSE

Drying with Flue Gases.. Calculation of the Economy of Fuel Realized on Drying Bagasse with Flue Gases, E. Mooyaart. Int. Sugar Jl., vol. 26, no. 305, May 1924, pp. 252-254. According to given calculations, if bagasse having 47 per cent of water be dried by means of flue gases to material having 15 per cent of water, an economy of 15 per cent of fuel can be realized.

BALANCING MACHINES

Dynamic. Balancing of Rotating Masses (Das Auswuchten Umlaufender Massen), M. Krause. Praktische Maschinen-Konstrukteur, vol. 57, no. 17, May 13, 1924, pp. 229-232, 20 figs. Shows that static balancing of machine parts is by no means adequate; describes machine which enables correct dynamic balancing.

BEARINGS, BALL

Function and Mounting of. Ball Bearings: Their Proper Function and Methods of Mounting, F. J. Taylor. Mech. Wld., vol. 75, no. 1953, June 6, 1924, pp. 353-354, 9 figs.

BEARINGS, ROLLER

Design. Roller Bearings Facilitate Speed, D. E. Batesole. Iron Trade Rev., vol. 75, no. 3, July 17, 1924, pp. 164-166, 6 figs. High-precision units of roller type withstand heavy load capacity and resistance to severe shock. Choice of bearing depends upon operating conditions and design. Describes principle of construction.

Mill Motors. Roller Bearing Service In Mill-Type Motors, L. J. Hess. Indus. Engr., vol. 82, no. 4, Apr. 1924, pp. 164-168, 6 figs. Methods of installation and results obtained from use of roller bearings in 300 heavy-duty motors.

BLAST FURNACES

British Practice. Modern British Blast Furnaces, F. Clements. Iron and Coal Trades Rev., vol. 108, nos. 2936 and 2937, June 6 and 13, 1924, pp. 959-965 and (discussion) 1024, 9 figs. Description with statistics of certain blast-furnace plants in England of a more modern type as representing position to which British design and practice has advanced. Paper read at Empire Mining and Metallurgical Congress.

Design. Progress Made in the Production of Pig Iron and the Construction of Blast Furnaces (Progrès réalisés dans la fabrication de la fonte et la construction des hauts fourneaux), J. Estour. Technique Moderne, vol. 16, no. 9, May 1, 1924, pp. 309-319, 13 figs. Notes on constitution of pig iron; manufacture and combustibility of coke; enrichment, briquetting and sintering of ore; cross-section and dimensions of blast furnaces; design; charging apparatus.

Fuel Economy. The Law of Heat Concentration and Fuel Economy in Blast Furnaces (La loi de la compression de la chaleur et l'économie de combustible dans les hauts fourneaux), A. Korevaar. Chimie et Industrie, vol. 11, no. 4, Apr. 1924, pp. 642-650, 2 figs. Deduction of law of heat concentration; variations of factors depending on carbon; problem of combustibility of fuels; factors depending on air and concentration of heat, and on furnace and concentration of heat; influence of conduction; analysis of fuel consumption in blast furnace; influence of inflammability of coke on fuel consumption; influence of preheating of air and of furnace diameter on carbon.

BLASTING

Aluminum Cap. A New Aluminum Blasting Cap, W. H. Pay. Can. Min. Jl., vol. 45, no. 25, June 20, 1924, pp. 604-605, 1 fig. Aluminum detonator is superior to copper detonators. Remarkable features of cap is its moisture-resisting qualities and in point of fact it is practically waterproof.

BOILER FURNACES

Coal vs. Oil Fuel. Fuel Oil or Coal for Steam Generation, F. H. Daniels. Steam Coal Buyer, vol. 1, no. 2, Feb. 1924, pp. 11-15, 8 figs. Shows that fuel oil cannot compete with coal for generation of steam in land plants except for short periods of time.

Firing. Firing a Hand-Fired Down-Draft Furnace, J. F. Barkley. U. S. Bur. Mines, Reports of Investigations, No. 2609, May 1924, 6 pp. Method used and results obtained in testing a hand-fired down-draft furnace at a plant in Wash., D. C. in order to determine method of firing that would give best results with a minimum of smoke.

Lining. Reducing the Cost of Relining Boiler Furnaces. Power, vol. 59, no. 26, June 24, 1924, pp. 1028-1030, 5 figs. Most successful and economical lining material has been found to be combination of crushed used firebrick, fireclay and sodium silicate (water glass) applied by means of air gun in form of spray.

BOILER PLANTS

Flue-Dust Separator. Flue Dust and Forced Draught. Engineer, vol. 137, no. 3,573, June 20, 1924, p. 696, 3 figs. Describes "cindervane" fan for Stepney power house which combines dual functions of dust separator and induced-draft fan.

Instruments. Modern Boiler-room Instruments, J. Wolf. Combustion, vol. 11, no. 1, July 1924, pp. 40-42. Discussion of place held by instruments in modern boiler room and of particular functions and advantages of some of the more important types.

BOILER OPERATION

Efficiency. Operation of Steam Boiler Plants, E. B. Ricketts. Power Plant Eng., vol. 28, no. 14, July 15, 1924, pp. 749-751.Discussion of some of the more important factors which contribute to efficient boiler operation. Emphasizes fact that basis of good boiler operation is a thorough knowledge on part of all men in plant of materials and apparatus with which they must deal and thorough and consistent co-operation of management and men in common aim of stopping all leaks and keeping them stopped. Address before Nat. District Heat Assn.

The Control of Power Production C. L. Hubbard. Factory, vol. 33, no. 1, July 1924, pp. 26-29, 96, 98 and 100, 13 figs. Fundamental functions of a good boiler.

BOILER ROOMS

Electric Drive. Motor Applications in the Boiler Room, H. W. Smith. Power Plant Eng., vol. 28, no. 13, July 1, 1924, pp. 700-703, 6 figs. d. c. motors and control for stoker and clinker grinders; 2 and 4 speed squirrel-cage motors; wound rotor motors; forced- and induced-draft fans; boiler feed pump; coal-handling equipment.

BOILERS

Combustion Control. Combustion Control for Boilers, R. J. S. Pigott. Paper, vol. 34, no. 9, June 19, 1924, pp. 368-371. What automatic regulation of boilers will accomplish in the way of efficiency and control of capacity. Principle of design.

Heat Transmission. Heat Transmission in Boilers, Chas. F. Wade. Power Engr., vol. 19, no. 219, June 1924, pp. 224-226, 4 figs. Discussion of principles and suggestions for improvements; deals with "luminous" flames, conduction, gas films and temperatures.

Heating, Smokeless. Smokeless Heating Boilers, T. N. Thomson. Plumbers Trade Jl., vol. 77, no. 1, July 1, 1924, pp. 26-28 and 29, 3 figs. Development and manufacture of Utica Imperial smokeless boiler.

Marine. *See Marine Boilers.*

BRAKES

Air. The Air Brake Problem. Car Foremen's Assn. of Chicago—Proc., May 1924, pp. 15-35 and (discussion) 35-55. Deals with maintenance discussing fundamentals of air brakes to the end that proper significance be applied to relative parts.

BRAZING

Production. Production Brazing, B. Heyman. Welding Engr., vol. 9, nos. 3, 5 and 6, Mar., May, and June 1924 pp. 19-21, 19-21 and 17-20, 9 figs. Underlying principles. Description of devices and methods employed in carrying through a series of machine-brazing operations on a single product in which numerous difficulties were encountered both from an engineering standpoint in design and also from operating standpoint in shop.

BRIDGES, CONCRETE

Arch. Design of LaBalme Concrete Arch Bridge, J. Polivka. Cornell Cic. Engr., vol. 32, nos. 3, 4, 5 and 6, Nov. and Dec. 1923, and Jan., Feb. and Mar. 1924, pp. 17-19 and VIII, 33-36 and VII, 50-52 and 56, 56-68 and IX, and 82-84, 11 figs. Describes highway bridge which crosses Rhone at Yenne; computation of roadway stresses and stresses in arch rib; results of experiments with glass model.

Reinforced Concrete Bridge with Arches of 590 ft. 6 in. Span, P. Calfas. Concrete and Constructional Eng., vol. 19, no. 6, June 1924, pp. 352-357, 4 figs. Particulars of new bridge to be built across estuary of Elorn between Brest and Daoulas, consisting of 3 huge reinforced-concrete arched bays supported by 2 piers built in stream and 2 abutments on banks. Will have total length of about 2,625 ft.

Arch, Abutment for. Novel Abutment Effects Economy In Concrete Bridge, A. G. Hayden. Eng. News-Rec., vol. 93, no. 1, July 3, 1924, pp. 26-27, 3 figs. Nofel type abutment of Park Avenue bridge over Bronz River Parkway Reservation near Tuckahoe, N. Y. Horizontal thrust taken by wing walls; vertical thrust distributed through abutments acting as vertical beam.

Pouring Method. How to Pour Concrete Bridges with Special Reference to Construction Joints, A. R. Carter. Mun. & County Eng., vol. 46, no. 5, May 1924, pp. 229-231. Relates policy adopted in Winnebago County, Ill., in pouring concrete structures.

BRIDGES, HIGHWAY

Hill-to-Hill. Design and Construction of the Hill-to-Hill Bridge, Bethlehem, Pa., F. W. Skinner. Mun. & County Eng., vol. 66, no. 6, June 1924, pp. 286-292, 7 figs. Bridge, chiefly of concrete-arch construction, serves 70,000 residents of city, crosses Lehigh River, Monocacy Creek, several streets and railway tracks; design; pile foundations; coffer dams; forms and falsework; mixer plants, etc.

BRIDGES, LIFT

Bascule. Completion of Johnson Street Bridge, F. H. Allwood. Can. Engr., vol. 46, no. 26, June 24, 1924, pp. 633-635, 5 figs. Describes construction of bascule bridge connecting Victoria and Esquimalt, B. C. Oxy-acetylene torch employed for demolishing old swing bridge; important features in erection of superstructure of highway and railway sections of bridge.

Vertical. The Vertical Lift Bridge, J. A. L. Waddell. West. Soc. Engrs.—Jl., vol. 29, no. 5, May 1924, pp. 209-216, 7 figs. Describes progress of vertical lift bridge designs with which author has been intimately associated for many years. References are given to other publications in which will be found more detailed information including statistics of bridges erected and detailed analysis of economics of movable spans.

BRIDGES, RAILWAY

Cantilever. Cantilevering a Heavy Bridge Span In Northern Quebec, J. P. Chapleau and C. M. Goodrich. Eng. News-Rec., vol. 93, no. 3, July 17, 1924, pp. 94-95, 2 figs. Special conditions surrounding construction of a railway bridge across Saguenay River led to a remarkable use of cantilever erection method. A 220-ft. double-track span was cantilevered for its full length from a 90-ft. approach span, because of rapid current in river. Construction data.

Plate Girder. The Design of a 50-Ft. Deck Span Plate Girder Railway Bridge, H. F. Cornick. Ry. Engr., vol. 45, nos 533 and 534, June and July 1924, pp. 193-195 and 252-255, 10 figs. Details of design of typical girder bridge, using modern methods of calculation. Summary of tending moments; proportions of main girders; calculation of steer stresses, girder bracing.

BUSES

Operating Results. Bus Operating Results in Providence, R. I. Elec. Ry. Jl., vol. 64, no. 2, July 12, 1924, pp. 43-45, 3 figs. Figures of operating costs and revenue possibilities in various kinds of service on United Elec. Rys. of Providence, R.I., a company which operates buses in coordination with railway service. Only one line of seven made profit although others substituted for rail lines show less than rail operation.

C

CABLES, ELECTRIC

Construction. Report of Sub-Committee on Aerial Cable Construction, T. W. Snell. Jl. of Elec., vol. 52, no. 11, June 1, 1924, pp. 443-445, 3 figs. Relative merits of various types of insulation for overhead conductors, and comparative costs of several types of construction designed to obviate trouble from accidental "grounds" or "shorts" caused by trees in line.

CABLES, HOISTING

Dynamic-Stress Determination. Dynamic Stress of Winding Cables (Die dynamische Beanspruchung der Förderseile), G. Berg. Glückauf, vol. 60, no. 20, May 17, 1924, pp. 400-402, 8 figs. Describes instrument for measuring and recording width between guides, also processes and trials for determining dynamic forces acting on cables.

CABLEWAYS

Aerial. Cableways and Suspended Railways (Schwebende Drahtseilbahnen und Schienenhänge-bahnen), M. Buhle. Bautechnik, vol. 2, no. 26, June 17, 1924, pp. 268-288, 88 figs. Describes and illustrates number of types manufactured by A. Bleichert & Co., Leipzig, for passengers and freight, on land and water, and installed in various parts of world.

Coal-Mine. Aerial Wire Ropeways, J. W. White. Instn. Min. Engrs.—Trans., vol. 67, Pt. 2, May 1924, pp. 114-128, 13 figs. Details of different types designed principally for colliery purposes.

CAMERAS

Photographing Moving Projectiles. A Camera for Studying Projectiles in Flight, H. L. Curtis, W. H. Wadleigh and A. H. Sellman. U. S. Bur. Standards, Technologic Papers, No. 255, Mar. 19, 1924, pp. 189-202, 10 figs. partly on supp. plates. Describes camera which will take pictures of objects moving with high speed, and also measure their velocity. Number of pictures depends on number of lenses, 50 pictures per second per lens being easily obtained.

CAR LIGHTING

Equipment. Report of Committee on Locomotive and Car Lighting, W. E. Dunham. Ry. Age (Daily Edition), vol. 76, no. 32, June 14, 1924, pp. 1558-1560, 3 figs. Discusses design of axle-generator belt drive and photometry of locomotive headlights. Report presented before Am. Ry. Assn.

CAR WHEELS

Chilled-Iron. The Chilled Iron Wheel in Railroad Service, E. Ruker. Assn. Chinese and Am. Engrs.—Jl., vol. 5, no. 3, Mar. 1924, pp. 11-16. Evolution, production, and use of this special kind of wheel and its action in service.

Rolled-Steel. The Manufacture of Solid Rolled Steel Car Wheels, G. A. Richardson. Ry. Club Pittsburgh—Official Proc., vol. 23, no. 5, Mar. 27, 1924, pp. 119-124 and (discussion) 124-126. Factors influencing delivery times and determining extra costs.

Specifications. Report of Committee on Wheels. Ry. Rev., vol. 74, no. 25, June 21, 1924, pp. 1211-1213, 3 figs. Cooling of rolled-steel wheels; specifications for cast-iron and steel wheels; development of cast-iron wheel design; wheel mounting gage; standard steel-wheel gage; tread-worn hollow wheels; grinding of cast-iron wheels. Report presented to Am. Ry. Assn. See also Ry. Age (daily edition), vol. 76, no. 36, June 19, pp. 1730-1735 and (discussion) pp. 1734-1737, 3 figs.

CARS, FREIGHT

DESIGN. Report of the Committee on Car Construction. Ry. Age (Daily Edition), vol. 76, no. 34, June 17, 1924, pp. 1634-1638 (including discussion), 1 fig. Reviews objects of fundamentals of design adopted by Association prior to development of present standard box-car designs; development of theoretical basis of car-framing design. Report presented to Am. Ry. Assn. See also Ry. Rev., vol. 74, no. 25, June 21, 1924, pp. 1186-1189, 1 fig.

SCRAPPING. Scrapping Steel Freight Cars. Welding Engr., vol. 9, no. 6, June 1924, pp. 21-23, 5 figs. Application of electric-arc cutting process to reclaiming and scrapping of rolling stock.

CARS, PASSENGER

HISTORY AND DEVELOPMENT. History and Development of Passenger Car Building, Geo. A. Richardson. Ry. Rev., vol. 74, no. 24, June 14, 1924, pp. 1133-1141, 26 figs. Account of history and present facilities of Bethlehem Shipbldg. Corp., Wilmington, Del., which was pioneer in manufacture of passenger cars.

CARS, TANK

SPECIFICATIONS. Report of Committee on Tank Cars. Ry. Age (Daily Edition), vol. 76, no. 35, June 18, 1924, pp. 1675-1680 and (discussion) 1680-1684, 3 figs. Specifications for Class V and VI tank cars; report on dome covers, bottom-discharge outlets, etc. Report of committee before Am. Ry. Assn. See also Ry. Rev., vol. 74, no. 25, June 21, 1924, pp. 1175-1177, on committee specifications for Class VI tank cars for transportation of helium gas.

CASE-HARDENING

STEEL. The Case-hardening of Steel R. N. Richardson. Eng. Production, vol. 7, no. 142, July 1924, pp. 214-215. Discusses heat treatment of case-hardened steel, methods for preventing carburizing of parts, case-hardening compounds, and causes of failure of case-hardened parts.

CAST IRON

GRAPHITE FORMATION IN. The Formation of Graphite in Cast Iron, L. Northcott. Foundry Trade Jl., vol. 29, nos. 409 and 410, June 19 and 26, 1924, pp. 515-521 and (discussion) 548-550, 37 figs. Describes work undertaken in order to examine process. Effect of annealing white cast iron at different temperatures and under such conditions as to produce temper-carbon or nodular graphite. Observations regarding precipitation of carbon. Experiments on a typical gray cast iron of good quality to determine mechanism of formation of flaky or primary graphite as commonly found in gray irons.

CEMENT

MAGNESIA. Plastic Magnesia Cements, P. Sachs. Asbestos, vol. 5, no. 12, June 1924, pp. 5-12. Describes new cement known as Sorel's oxychloride cement, having very great strength and very high bending power. Chemical nature has not been established with certainty but is believed to be hydrated basic mangesium oxychloride-3 mg 0. mg CI_2 10 H_2 0.

CEMENT, PORTLAND

STUDY OF. Some Requirements in the Study of Portland Cement, T. Merriman. Eng. News-Rec., vol. 93, no. 3, July 17, 1924, pp. 105-106. Outlines fundamental considerations that need to be given extended study in connection with development of tests which will more truly disclose quality of cement than do those now available. Characteristics of "ideal cement".

CENTRAL STATIONS

EUROPE. Central Station Practice in Europe, B. G. Jamieson. West. Soc. Engrs.—Jl., vol. 29, no. 6, June 1924, pp. 247-256, 5 figs. Some noticeable differences in electrical engineering practice including use of mercury-arc rectifiers in place of converters, high-voltage direct current and lack of interconnection of networks, extensive use of underground cable. Attention is given to appearance of central-station buildings and surroundings.

HEAT BALANCE. Heat Balance at Hudson Avenue Station (Brooklyn). Power Plant Eng., vol. 28, no. 13, July 1, 1924, pp. 706-709, 3 figs. Six sources of heat are involved in cycle; control is automatic; vertical isolation of phases is feature of electrical design.

CHAINS

CONNECTING LINKS, PULLING TESTS OF. Results of Pulling Tests of Chain Connecting Links (Mededeeling omtrent de resultaten van trekproeven met sluitings), I. R. Mulder. Ingenieur, vol. 39, no. 20, May 17, 1924, pp. 364-369, 8 figs. Photographs, diagrams and tables of test results for chain connecting links of various sizes. pin diameters varying from ¼ in. to 2 in.

CHIMNEYS

DESIGN. The Design of Chimneys, W. S. Findlay. Power Engr., vol. 19, no. 219, June 1924, pp. 226-228, 5 figs. Factors in design of chimney shafts, with special reference to their stability.

FLUE. Chimneys for Heating Boilers, A. G. King. Domestic Eng. (Chicago), vol. 106, no. 7, Feb. 16, 1924, pp. 20-23, 5 figs. Elements of a chimney flue and its proper position and construction.

CHROMIUM

USES AND ALLOYS. Chromium—Its Uses and Its Alloys, W. M. Mitchell. Forging—Stamping—Heat Treating, vol. 10, nos. 3 and 6, May and June, 1924, pp. 199-202 and 235-238, 7 figs. May: Sources of chromium, chemical properties and technical uses. June: Ferro-chromium; chromium steels.

CITY PLANNING

CANADA. Review of Town Planning in Canada, T. Adams. Can. Engr., vol. 46, no. 26, June 24, 1924, pp. 651-653. Status in Canada before and during War and since that period. Author considers that much progress has been made. Paper presented at Town Planning Inst. Conference.

KITCHENER AND WATERLOO, ONT. Planning of Kitchener and Waterloo, Ont., H. L. Seymour. Can. Engr., vol. 47, no. 2, July 7, 1924, pp. 125-130, 3 figs. Developments leading up to preparation of comprehensive town planning scheme now nearing completion; proposals by experts; summary of conclusions and recommendations submitted by consulting engineers; elimination of level crossings.

TRAFFIC IN RELATION TO. Street Traffic and City Planning. Pub. Works, vol. 55, no. 6, June 1924, pp. 201-206. Extent to which enormous development of city traffic made imperative street widening and other changes in structure and improvements in handling traffic; suggestions made.

CLUTCHES

CONICAL. Conical Clutch Designs, A. Clegg. Machy. (N.Y.), vol. 30, no. 11, July 1924, pp. 867-869, 5 figs. Advantages of conical clutches; construction of conical clutch for radial drilling machine; principles to be followed in design; conical clutch for lathe feed control and applied to planer drive.

COAL

CARBONIZATION. Practical Coal Carbonization, A. R. Powell. Mech. Eng., vol. 46, no. 7, July 1924, pp. 389-394, 6 figs. Enumeration of technical problems of low-temperature carbonization and classification and description of the various processes.

CLEANING. The Improvement of Coal by Mechanical or Thermal Methods of Treatments, J. B. B. Kershaw. Fuel, vol. 3, nos. 5 and 6, May and June 1924, pp. 165-170 and 189-195, 10 figs. Methods of removing impurities from small coal and from all kinds of washery waste and pit refuse, namely (1) hydraulic or wet methods; (2) methods involving use of oil; (3) electrostatic and other dry methods; (4) methods involving use of heat.

COAL BREAKERS

BAKER. Baker—The Latest Glen Alden Breaker. Coal Age, vol. 26, no. 3, July 17, 1924, pp. 76-81, 12 figs. Describes breaker of Glen Alden Coal Co. Reaching breaker from several sources, coal is crushed on ground level and product elevated to top of building; simplicity and neatness foster a good morale.

COAL HANDLING

PLANTS. Coal and Ore Handling Plant at Waalhaven, Rotterdam. Engineer, vol. 137, no. 3574, June 27, 1924, pp. 722-725, 8 figs. Details of installation of Coal Trading Assn. which, when completed, will comprise two quays 350 m. long, with accommodation for ocean-going vessels up to 10 m. draft, and between quays a dock 160 m. long available for river vessels with drafts up to 6 m.; description of transporter bridges, and transformer and load-equalizing station.

COAL MINES

ELECTRICITY, USE OF. Some Researches on the Safe Use of Electricity in Coal Mines, W. M. Thornton. Instn. Elec. Engrs.—Jl., vol. 62, no. 330, June 1924, pp. 481-491 and (discussion) 491-514, 10 figs. Results of investigation; deals with electrical ignition of coal dust alone, coal dust with gas present, of methane and associated gases by disruptive sparks, steady or impulsive, transient arcs, direct or alternating, with varied voltage and frequency, in all percentages of mixture with air; gives examples of application of results to promote safety in mines.

POWER PLANTS. Illinois Mine Generates Own Power Cheaply, A. Allen and H. F. Hebley. Coal Age, vol. 26, no. 1, July 3, 1924, pp. 3-7, 4 figs. Describes power plant of No. 4 mine of Donk Bros. Coal & Coke Co., in Madison County, Ill. All pickings and some slack burned; superheated steam used; exhaust from hoist and auxiliaries utilized in mixed-pressure turbine. Costs reduced to 1.6 cents per kw-hr. with plant at half capacity. Mine has a daily hoisting capacity of 6,000 tons.

ROCK DUSTING. How Old Ben Corporation with Rock Dust Extinguished Seven Mine Explosions, J. E. Jones. Coal Age, vol. 25, no. 25, June 19, 1924, pp. 907-911, 6 figs. Zone system vs. coating system; relative advantages of floor, rib and roof dust; frequencies of application; effectiveness of dust distributed by air current; sampling by vacuum cleaner. See also Coal Industry, vol. 7, No. 6, June 1924, pp. 243-246.

Rock Dusting. Min. Congress Jl., vol. 10, no. 7, July 1924. Contains following papers read at Am. Min. Congress: Actual Experiences with and Tried Methods of Applying Rock Dust, J. E. Jones, pp. 291-293, 1 fig., Occurrence, Characteristics and Behavior of Coal Dust, J. W. Paul, pp. 294 and 302, 1 fig., Investigations Into Rock Dusting for Coal Dust Explosion Prevention, G. S. Rice, pp. 295-296, 1 fig., Rock Dusting of Coal Mines; Efficacy, Methods and Costs, J. T. Ryan, pp. 297 and 302, Rock Dust Versus Water as a Preventive Measure for Mine Explosions, E. Steidle, pp. 298 and 302.

SAFETY METHODS. Mine Safety Methods of the Ford Collieries Company, C. L. Colburn. Nat. Safety News, vol. 10, no. 1, July 1924, pp. 31-33, 4 figs. Company operates 3 mines employing about 1,000 men. Management accomplishes marvelous results by watchword "Safety First".

VENTILATION. The Ventilation of Mines, D. Hay and R. Clive. Iron & Coal Trades Rev., vol. 108, no. 2938, June 20, 1924, pp. 1058-1061, 6 figs. Discusses objects and principles of ventilation, splitting of air, regulation of splits, influence of leakage, size of airway, and natural ventilation effect. From paper read before Min. Soc. Empire Min. & Met. Congress.

COKE MANUFACTURE

BY-PRODUCT. Making Coke to Combat Canada's Fuel Problem, H. P. Armson. Power House, vol. 17, no. 12, June 20, 1924, pp. 23-27, 4 figs. Description of processes by which Hamilton By-Products Coke Ovens Co. produce foundry and domestic coke, tar, ammonium sulphate, city gas, blue water gas and naphthalene.

COKE OVENS

PRACTICE. Comparative Survey of Coke-Oven Practice in Various Countries, G. A. Hebden. Colliery Guardian, vol. 127, no. 3310, June 6, 1924, pp. 1459-1460. Survey of Great Britain, Europe, the Dominions, and America. From paper read before Empire Min. & Metallurgical Congress.

COLUMNS

BUCKLING. Notes on Moments in Pillars Due to Deflection of Beams Monolithic Therewith, O. Faber. Concrete & Constructional Eng., vol. 19, no. 6, June 1924, pp. 342-349, 5 figs. Explains bending of pillars due to deflection of beams monolithic with them.

COMBUSTION

CONTROL. Combustion Control Based on CO_2 in Gas, G. E. Gaster. Power Plant Eng., vol. 28, no. 14, July 15, 1924, pp. 768-769, 2 figs. Variations in CO_2 operate rheostat controlling speed of fan motor.

The Evils of Close Regulation in Automatic Combustion Control, T. A. Peebles. Power, vol. 60, no. 1, July 1, 1924, pp. 13-14. Points out that close regulation is desirable from viewpoint of production or utilization; on other hand, it tends to introduce wear, hunting or surging, and other undesirable conditions; this is particularly true of combustion-control apparatus, as herein described.

COMPRESSED AIR

MACHINERY. Air Machinery, A. Hinz. Mech. Eng., vol. 46, no. 7, July 1924, p. 417. Possibilities of improvements in compressed-air plant operation. Translated and abstracted from Glückauf, nos. 15 and 16, Apr. 12 and 19, 1924.

CONCRETE

ALKALI ACTION. Volume Change a Measure of Alkali Action, D. G. Miller. Pub. Roads, vol. 5, no. 4, June 1924, pp. 12-13 and 17, 3 figs. Effect on concrete measured by changes in length.

CURING. Tests Show How Damp-Sand Curing Improves Quality of Concrete, F. D. Crook and H. Faulkner. Eng. News-Rec., vol. 92, no. 25, June 19, 1924, pp. 1050-1051, 4 figs. Effect of oil on pavements shown by tests on small blocks. Impermeability depends largely on method of curing.

CONCRETE CONSTRUCTION, REINFORCED

REINFORCEMENT EMBEDMENT. Should Reinforcement Embedment Vary with Size of Bar? A. S. Woodle, Jr. Eng. News-Rec., vol. 92, no. 26, June 26, 1924, pp. 1092-1093, 1 fig. Examination into stresses set up by temperature changes in surface areas of reinforced concrete.

CONCRETE MIXERS

STANDARDS. Concrete Mixer Standards Are Revised. Concrete Rec. & Eng. Rev., vol. 38, no. 24, June 11, 1924, pp. 606-608. Regulations adopted at a joint meeting of representatives of concrete mixer manufacturers and Associated General Contractors of America.

CONDENSERS, STEAM

EVAPORATIVE. The Evaporative Condenser, N. E. Webster. Instn., Min. Engrs.—Trans., vol. 67, Pt. 2, May 1924, pp. 192-198, 3 figs. Description of conditions for which this type of condenser seems peculiarly suitable.

CONVEYORS

PNEUMATIC. Experimental Investigation of Pneumatic Conveying Process (Die experimentelle Unter suchung des pneumatischen Fördervorganges), M. Gasterstädt. Zeit. des Vereines Deutscher Ingenieure, vol. 68, no. 24, June 14, 1924, pp. 617-624, 22 figs. Describes experimental plant and measuring arrangements. Effect of quantity conveyed and velocity on pressure drop in conveying system; shows uniform connection between quantity conveyed and drop in pressure, and between velocity of air current and of material.

COPPER ALLOYS

HARDNESS. The Variation in Hardness of Copper Alloys with Temperature (La variation de la dureté des alliages de cuivre avec la température), L. Guillet. Revue de Métallurgie, vol. 21, no. 5, May 1924, pp. 295-302, 7 figs. Results of tests show that variations of hardness with temperature follow laws which vary considerably for alloys of same category; but in same range of thermal diagram, variations follow same laws to great extent; ternary alloys conserve their hardness better than binary alloys.

CORE BOXES

VALVES. Making Globe Valve Corebox, W. C. Ewalt. Foundry, vol. 52, no. 12, June 15, 1924, pp. 483-485, 15 figs. Metal boxes are cast from carefully constructed wood master patterns where foundry output is large; in many cases pattern is built up from number of small segments.

COST ACCOUNTING

WASTAGE IN RELATION TO. The Wastage of Industrial Plant in Relation to Cost Accounting, A. Stewart. World Power, vol. 1, no. 6, June 1924, pp. 318-324, 4 figs. Nature of wastage; methods of measuring depreciation; plant register; cost of additions; repairs and renewals; inclusion of plant register.

CRANES

JIB. "Toplis" Luffing Cranes at Southampton Docks. Engineering, vol. 117, no. 3050, June 13, 1924, pp. 762-763, 4 figs. partly on p. 768. Patent horizontal-luffing type, consisting of travelling truck, in which is mounted a rotating steel lattice structure, forming a mast and carrying jib and combined machinery house and operator's cabin.

CRANKSHAFTS

FAILURES. Stress Distribution in Crankshafts and Its Relation to Crankshaft Failures, D. J. McAdam, Jr. and G. F. Wohlgemuth. Am. Soc. Naval Engrs. Jl., vol. 36, no. 2, May 1924, pp. 244-281, 29 figs. Causes of crankshaft failures; stress distribution in crankshafts as affected by restraint of journals; stress-strain relationship in typical naval crankshafts; measured and calculated angular deflections of Liberty crankshaft; typical crankshaft failures; desirable stress distribution in crankshafts.

CUPOLAS

FUEL ECONOMY. Economical Melting with Cupolas, H. Van Aarst. Foundry Trade Jl., vol. 29, no. 409, June 19, 1924, pp. 522-524, 3 figs. How to be economical with fuel in cupola. Influence of iron on fuel economy, influence of mechanical properties of coke, air supply, and cupola linings. See also Foundry, vol. 52, no. 13, July 1, 1924, pp. 514-515, 3 figs.

CYLINDERS

LOCOMOTIVE, WELDING OF. Locomotive Cylinder Welding, J. S. Heaton. Welding Engr., vol. 9, no. 6, June 1924, pp. 24-25, 10 figs. Firepot made of front end netting greatly reduces cost of preheating cylinders; special preheating torch.

D

DAMS

EARTH. Classification and Definition of Earth Dam Types, J. A. Holmes. Eng. News-Rec., vol. 92, no. 26, June 26, 1924, p. 1102, 7 figs. Descriptions based on methods of construction and materials employed.

FAILURES. The Failure of the Gleno Dam (Italy) (La rupture du barrage du Gleno), J. Boudet. Houille Blanche, vol. 23, no. 187, Mar.-Apr. 1924, pp. 33-47, 14 figs. Descriptive, critical and analytical study.

GRAVITY. Method for the Dimensioning of Gravity Dams (Ueber ein Verfahren Azur Dimensionierung von Gewicht-Staumauern), W. Kienast-Curti. Schweizerische Bauzeitung, vol. 83, no. 20, May 17, 1924, pp. 229-230, 4 figs. Describes methods being applied by Buss Corp. in Basel, Switzerland, according to Gutzwiller cell system, described in previous issue of same journal.

STURGEON FALLS, ONT. Concrete Dam at Sturgeon Falls Built During Temperatures as Low as 50 Below Zero, Geo. H. Kohl. Con. Rec., vol. 38, no. 25, June 18, 1924, pp. 614-617, 5 figs. Interesting construction procedure on dam built by spanish River Pulp & Paper Mills, Ltd. Describes plant and methods and give outline of design.

DIESEL ENGINES

FUEL INJECTION. Investigation of the Fuel-Injection Process in Diesel Engines (Untersuchungen über den Einspritzvorgang bei Dieselmaschinen), W. Riehm. Zeit. des Vereines Deutscher Ingenieure, vol. 68, no. 25, June 21, 1924, pp. 641-645, 10 figs. Discusses fundamentals of injection process; describes experimental plant, tests with water and oil, absorption of heat up to ignition.

LOW-POWERED. Low-Powered Diesel Engines (La question du Diesel de faible puissance), P. Simondet. Arts & Métiers, vol. 77, no. 42, Mar. 1924, pp. 81-105, 22 figs. Deals with technical, financial and manufacturing problems of low-power engines working on Diesel cycle,with special reference to difficulties which may account for comparatively restricted extent to which they have hitherto been employed; among types of engines described are Hindl and Hvid engines.

DREDGES

DIESEL-ELECTRIC. Diesel-Electric Dredge A. Mackenzie Completes Trials. Mar. Eng., vol. 29, no. 7, July 1924, pp. 409-411, 14 figs. Particulars of first of four new diesel-electric sea-going dredges for U. S. army.

OIL TYPE. Design Oil Type Harbor Dredge. Mar. Rev., vol. 54, no. 7, July 1924, pp. 289-292, 12 figs. Particulars of dipper dredge Hell Gate of U. S. Engineer Corps.

DROP FORGING

CRANKSHAFTS. Precautions Needed in Production of Automotive Drop Forgings. Automotive Industries, vol. 50, no. 26, June 26, 1924, pp. 1388-1391, 6 figs. Wyman-Gordon employ special machine to prove running balance of crankshafts and etch section to show direction of flow in finished product, in addition to standard tests.

DRYDOCKS

FLOATING. The Southampton 60,000-Ton Floating Dock. Engineering, vol. 117, no. 3051, June 20, 1924, pp. 789-791, 23 figs. partly on supp. plates. Detailed description of dock provided by Southern Ry. to enable even largest vessels in world, viz., the Majestic and the Leviathan, using port to be repaired and overhauled. Total weight of structure and equipment is 18,800 tons. Dock is of double-sided, self-docking type constructed in seven sections, any one of which can be lifted by others for painting or repairs.

DRYING

METHODS. Drying Methods in Modern Industrial Processes, Chas. L. Hubbard. Nat. Engr., vol. 28, no. 7, July 1924, pp. 309-314, 7 figs. Fundamentals of drying processes and basic factors affecting their operation.

E

EDUCATION, ENGINEERING

COURSES. Engineering Courses for the Functional Rather than the Industrial Divisions of Engineering, E. Bennett. Eng. Education, vol. 14, no. 10, June 1924, pp. 582-599. Functional divisions of engineering are considered to be functional divisions found within any of the large industrial organizations.

LEADERS AND ROUTINE PRACTITIONERS. Educating Leaders and Routine Practitioners, C. C. Williams. Eng. Education, vol. 14, no. 9, May 1924, pp. 528-535. Considers question of whether colleges can effectively train both leaders and routine practitioners simultaneously.

TABULATED RECAPITULATIONS, USE OF. Tabulated Recapitulations as a Means of Education, P. A. Cushman. Eng. Education, vol. 14, no. 8, Apr. 1924, pp. 450-458, 4 figs. Points out in what ways engineering students would gain by use of tabular recapitulations during their study of fundamental courses.

TEACHING, METHODS OF. At What Are We Aiming and With What? F. W. Springer. Eng. Education, vol. 14, no. 10, June 1924, pp. 565-581. Proposes a key or outline of educational theory and makes more apparent desirability and possibility of finding cues for application of theory to engineering education.

ELECTRICAL MACHINERY

ROTATING, TOOTH PULSATION IN. Tooth Pulsation in Rotating Machines, T. Spooner. A.I.E.E.—Jl., vol. 43, no. 7, July 1924, pp. 646-650, 12 figs. Presents experimental method of checking magnitude of flux pulsations in teeth of rotating machines where both members are slotted. Test results compared with pulsation amplitudes as calculated by two methods.

ELECTRIC CONDUCTORS

STEEL-ALUMINUM. Calculation of Steel-Aluminum Conductors (Uber die Berechnung von Stahlaluminiumleitungen), O. Strand. Elektrotechnische Zeit., vol. 45, no. 25, June 19, 1924, pp. 654-657, 6 figs. Develops formulas and diagrams for determining distribution of tension in Fe-Al cables at varying temperatures.

ELECTRIC DISTRIBUTION SYSTEMS

CANADA. Electric Power Transmission and Distribution in Canada, J. C. Smith and C. V. Christie. Eng. Jl., vol. 7, no. 7, July 1924, pp. 421-446, 17 figs. Current practice in design and operation of electrical transmission and distribution systems in Canada. Paper read at World Power Conference.

COST ESTIMATES. Appraisals Based on Number of Meters Connected, R. B. Sleight. Elec. World, vol. 83, no. 26, June 28, 1924, pp. 1322-1323. Analysis of cost estimates on small-town distribution systems; limitations and practical application of method.

NETWORKS, INTERCONNECTING SYSTEM FOR. New Type of High-Tension Network, P. H. Thomas. A.I.E.E.—Jl., vol. 43, no. 7, July 1924, pp. 610-618, 1 fig. Presents a new type of interconnection for high-tension networks for economic supply of electric power over large areas having an already well developed load. Central idea is superposition of a high-tension network of single-circuit lines over whole district for purpose of supplying a medium in which current may flow in any general direction as changing conditions may dictate.

ELECTRIC DRIVE

GROUP AND INDIVIDUAL. When to Use Group and Individual Drives, R. W. Drake. Indus. Engr., vol. 82, nos. 2, 3 and 4, Feb., Mar. and Apr., 1924, pp. 56-60 and 106-107; 118-122; and 174-177, 15 figs. Comparative advantages and disadvantages of group and individual drives in industrial plants; points on layout, installation and operation; fan drives; line-shaft losses.

ELECTRIC FURNACES

DEVELOPMENT. Electric Furnace Development, F. Hodson. Blast Furnace & Steel Plant, vol. 12, no. 7, July 1924, pp. 314-318, 8 figs. Many supposed limitations now being removed suggests unlimited growth.

ELECTRODES. The Use of Söderberg Self-Baking Electrodes in Electric Steel Furnaces (Die Verwendung der Söderbergschen Dauerelektrode an Elektrostahlöfen), W. Eilender and L. Lyche. Berichte der Fachausschüsse des Vereins deutscher Eisenhüttenleute, Stahlwerksausschuss, report no. 78, Jan. 30, 1924, 5 pp. Use of self-baking electrode in 6-ton Héroult furnace; results show decrease in use of electrodes per ton steel; reduction of current consumption per ton steel; reduction in production cost per ton electrodes.

IRON-MELTING. Melts Iron in Twin Furnaces, A. W. Bryant. Foundry, vol. 52, no. 14, July 15, 1924, pp. 556-559, 4 figs. Two electric units mounted on turntable 180 deg. apart and having one set of electrodes, provide small batches of hot iron at short even intervals.

METALLIC-RESISTOR. The Metallic Resistor in Industrial Heating Furnaces, E. F. Collins. Chem. & Met. Eng., vol. 30, nos. 24 and 25, June 16 and 23, 1924, pp. 936-941 and 981-985, 18 figs. Application and design of electrical heating equipment; comparison of types of resistors; advantages of furnace. Chemical physical and economic laws governing use of equipment.

STEEL. Some Applications of Electric Heat to the Reheating of Steel, E. F. Collins. Fuels & Furnaces, vol. 2, nos. 6 and 7, June and July 1924, pp. 575-578 and 655-660, 2 figs. Brief review of past and present day conceptions of heat and laws governing it. Metallic resistors in unmuffled furnaces.

ELECTRIC GENERATORS, A.C.

OPERATION. Operation of A.C. Generating Equipment, V. E. Johnson. Power Plant Eng., vol. 28, nos. 2, 3, 6, 8, 11 and 14, Jan. 15, Feb. 1, Mar. 15, Apr. 15, June 1, and June 15, 1924, pp. 142-144, 183-186, 339-342, 438-440, 600-603, and 758-759, 53 figs. Fundamental considerations which serve as foundation for practical study. Jan. 15: Representing alternating currents by vectors. Feb. 1: Effect of capacity in a.c. circuits; power factor; wattless component. Mar. 15: 3-phase alternator, principles of construction and operation. Apr. 15: Study of characteristics of generators under various conditions. June 1: Conditions necessary for parallel operations, synchronizing, division of load, power-factor correction. July: Summary and principles as applied to generators; hints regarding care of machines.

Power Loads from, Totalizing of. Totalizing Alternating-Current Power Loads, V. H. Todd. Power, vol. 60, no. 2, July 8, 1924, pp. 47-49, 7 figs. Methods that may be used to obtain a combined reading of a number of power loads supplied from a.c. generators.

ELECTRIC LAMPS, INCANDESCENT

Statistics. Statistics on Use of Incandescent Lamps. Elec. News, vol. 33, no. 12, June 15, 1924, pp. 53-54, 2 figs. Gives demand by sizes, lamp-price changes and recent developments.

ELECTRIC LOCOMOTIVES

Current-Generating System. Railway Electrification (Considérations sur l'électrification des chemins de fer), E. Stassano. Génie Civil, vol. 84, no. 20, May 17, 1924, pp. 742-745. Notes on Stassano system of generation of current on locomotive. Supplementary note is appended on observations on Stassano system of traction, setting forth its shortcomings.

Development. Development of the Electric Locomotive, F. H. Shepard. Ry. Age (Daily Edition), vol. 76, no. 32, June 14, 1924, pp. 1568-1579, 17 figs. History of development, with tabulation of practically every electric locomotive in world, built or under construction; showing wheel and cab arrangement of each type in diagram; advantages and disadvantages of each type of drive. Paper presented before Am. Ry. Assn.

ELECTRIC METERS

Transmission of Readings. The Transmission of Meter Readings by the Impulse Method, B. H. Smith. Elec. Jl., vol. 21, no. 5, May 1924, pp. 219-221, 5 figs. System recently developed for making use of d.c. impulses controlled by watthour meter sender and special receiver.

ELECTRIC MOTORS, A.C.

Single-Phase. A New Type of Single-phase Motor, S. R. Bergman. A.I.E.E.—Jl., vol. 43, no. 7, July 1924, pp. 599-603, 11 figs. Development of a constant-speed a.c. motor for application to single-phase current. Describes derivation of this new type of motor from plain repulsion motor. Has characteristics of a shunt motor over running range, and series type characteristics during starting and acceleration. Possesses high power factor.

ELECTRIC POWER

Great Lakes District's Consumption in 1950. Middle West Power in 1950. Elec. Wld., vol. 84, no. 2, July 12, 1924, pp. 64-65, 3 figs. Survey for part of Great Lakes district which has just been completed shows that per capita consumption will amount to 1,760 kw-hr. per annum in 1950. Main reliance will be steam plants connected by transmission systems.

ELECTRIC TRANSMISSION LINES

Long Span. Long Span on Cheat River, C. F. Sheakley. Elec. World, vol. 83, no. 25, June 21, 1924, pp. 1277-1278, 3 figs. West Virginia-Maryland Power Co. has strung at George a 5-conductor span 4,317 ft. long, made with mixed copper and "copper weld" conductors; details of towers and installation.

Protection. Rises in Pressure and Protection of Alternating-Current Circuits, G. W. Partridge. Elec. Rev., vol. 94, no. 2430, June 20, 1924, pp. 992-994, 5 figs. Describes system of actual prevention and protection from rises in pressure installed on an a.c. system after careful observations and experiment over a period of some five years.

Tension Calculation. Computing Tension in Transmission Lines, E. S. Thayer. Elec. Wld., vol. 84, no. 2, July 12, 1924, pp. 72-73, 1 fig. Describes method having correct mathematical and physical basis and giving results that are accurate within 1 per cent.

ELECTRIC WELDING

Boiler Tubes. The Repair of Boiler Tubes by Electric Welding (Réparation des tubes à fumée), Renaud. Revue Générale des Chemins de Fer & des Tramways, vol. 43, no. 5, May 1924, pp. 341-347, 7 figs. Methods and machinery employed at shops of Sotteville-les-Rouen, France.

Spot-Welding Machines. Reflex Action of Material to be Welded on Current and Tension Conditions of a Spot-Welding Machine (Rüchwirkung des Schweissgutes auf die Strom- und Spannungsverhältnisse der Punktschweissmaschine), F. H. Hellmuth. Elektrotechnische Zeit., vol. 45, no. 25, June 19, 1924, pp. 657-658, 3 figs. Tests with 15-kv. spot-welding machine as to effect of large masses of sheet iron, in form of plane or cylinder between electrodes.

ELECTRICITY, APPLICATIONS OF

Canada. Utilization of Power. Eng. Jl., vol. 7, no. 7, July 1924. Group of papers read at World Power Conference. Introductory Statement to Symposium, P. T. Davies, pp. 447-451; Electricity in the Canadian Home, F. A. Gaby, pp. 451-458, 8 figs.; Electrical Service for Rural Districts, F. A. Gaby, pp. 458-472, 19 figs.; Utilization of Power in the Pulp and Paper Industry, R. W. Leeper, pp. 473-476, 6 figs.; Use of Power in the Mineral Industries of Canada, H. E. M. Kensit, pp. 477-483, 6 figs.; Use of Electric Power in the Cement Industry of Canada, W. G. H. Cam, pp. 484-485, 3 figs.; Use of Power for Port Facilities, M. T. S. Casey, pp. 486-488, 2 figs.; Power Requirements in the Lumbering Industry in British Columbia, A. M. Smith, pp. 488-492, 5 figs.; Application of Compressed Air in Industry, F. A. McLean, pp. 492-498, 5 figs.; Electro-Chemical and Electro-Metallurgical Uses of Power, L. E. Westman, pp. 498-501, 3 figs.; Power in Transport, D. E. Blair, pp. 502-505, 32 figs.; Illumination, W. H. Woods, pp. 522-526, 11 figs.; Recent Developments in Electric Lamps, J. T. Scott, pp. 526-527.

ELEMENTS

Non-Metallic. The Non-Metallic Elements. Connections between their Dielectric and other Physical Properties, G. L. Addenbrooke. Lond., Edinburgh, & Dublin Philosophical Mag. & Jl. Sci., vol. 47, no. 281, May 1924, pp. 945-965, 1 fig. Consideration of two actions taking place when dielectric is placed in electric field; relation of attraction to energy reversibly stored; comparison of relative electric values found with relative values of other physical properties; comparison of electric actions with absolute melting points and with absolute boiling points; relation of relative molecular electric actions to heat of vaporization; relations with surface tensions; comparison with capillarity; etc.

EMPLOYMENT MANAGEMENT

Personal-Interview Method. Pitfalls of the Employment Interview, D. A. Laird. Indus. Mgt. (N. Y.), vol. 68, no. 1, July 1924, pp. 58-62, 4 figs. Pitfalls of personal interview employment procedure, and suggestions for eliminating them.

EMPLOYEES, TRAINING OF

Railway, in Air-Brake Equipment. Instructing Railway Employees in Air Brake Equipment, J. P. Stewart. Ry. Rev., vol. 74, no. 24, June 14, 1924, pp. 1131-1132. Methods of interesting and instructing employees in operation and maintenance of air-brake equipment; value of instruction cars and instruction rooms; class instruction preferred. (Abstract.) Paper read before Air Brake Assn.

ENERGY

Transforming and Distributing. The Value of Efficiency in Transforming and Distributing Energy, Chas. E. Lucke. Mech. Eng., vol. 46, nos. 6 and 7, June and July 1924, pp. 317-324 and 380-385, 10 figs. Importance of energy costs; estimates of costs for primary energy and for its power- plant transformation into electrical energy through appropriate steps.

ENGINEERS

Highway, Training of. Technical Training for Highway Engineers, R. DeL. French. Can. Engr., vol. 47, no. 2, July 7, 1924, pp. 141-142. Shows why highway engineer needs thorough and careful training; student natural qualities necessary in three divisions of highway engineering course are technical, finance and economics. Paper read at annual convention of Can. Good Roads Assn.

Responsibility of. The Engineer's Responsibility, M. Knowles. Engrs.' Soc. West. Pa.—Proc., vol. 40, no. 4, May 1924, pp. 143-158 and (discussion) 159-162. Definition of engineer; public influence of engineering work; distribution of responsibility; what engineer can do for himself; directing public opinion; etc.

F

FILTERS

Trickling, Dosing Control of. Butterfly Valve Dosing Control for Trickling Filters, H. R. King. Eng. News-Rec., vol. 92, no. 25, June 19, 1924, pp. 1049-1050, 2 figs. Suggests for trial a method for operating trickling filters so that a good sewage distribution may be maintained, and if possible, filter bed capacities thereby increased. Sliding cam to control valve on outlets to the several filter dosing areas.

FLOW OF GASES

Aeration of Jet of Gas. The Entrainment of Air by alet of Gas issuing from a Small Orifice in a Thin Plate, J. S. G. Thomas. Lond., Edinburgh, & Dublin Philosophical Mag. & Jl. Sci., vol. 47, no. 281, May 1924, pp. 1048-1056, 4 figs. It is shown that constant value of aeration of jet of gas issuing at different pressures from orifice, as referred to in Technologic Paper no. 193 (1921) of Bur. of Standards, characterizes induction-flow system in which induction of air is effected under conditions such that flow of stream of air induced by jet is considerably reduced from its normal value in free air by restricting effective area of induction tube or otherwise.

FLUE-GAS ANALYSIS

CO Indicator. A New Instrument for the Continuous Indication of Carbon Monoxide in Boiler-Flue Gases, W. O. Andrews. S. African Instn. Engrs.—Jl., vol. 22, no. 10, May 1924, pp. 145-152 and (discussion) 152-153, 3 figs. Instrument devised by author as simple and inexpensive means of indicating, by means of color of liquid, presence or absence of small quantities of combustible carbon gases in flue gas.

CO_2 Recorders. Electrically Heated Platinum Tubes Used in CO_2 Recorder. Power Plant Eng., vol. 28, no. 13, July 1, 1924, pp. 729-730, 1 fig. In new recorder made by Uebling Instrument Co., Paterson, N. J., novel scheme is employed to secure motive power for actuating recorder by burning combustible in electrically heated platinum tubes.

FLUMES

V-Section. Irrigation Flume of V-Section Supplies Oregon Project. Eng. News-Rec., vol. 93, no. 1, July 3, 1924, pp. 9-10, 2 figs. Design of 352-ft. V-shaped flume for Silver Lake irrigation district, a recently constructed project in Lake County, Ore. Its advantages. Wedging system makes nails unnecessary to hold plank in place. Only standard sizes of lumber used.

FOUNDRIES

Automobile. Metallurgical Control in Automobile Foundry Practice, A. Harley. Foundry Trade Jl.,vol. 29, nos. 395 and 396, Mar. 13 and 20, 1924, pp. 207-210 and 235-237, 19 figs. Modern conditions and tendencies; organization of labour conditions; discusses cast iron, semi-steel, malleable iron, and cast steel castings; molding sands; non-ferrous metals castings; production of a cast-iron cylinder.

Malleable-Iron. Operates New Malleable Foundry, E. C. Boehringer. Iron Trade Rev., vol. 75, no. 1, July 3, 1924, pp. 29-33, 6 figs. Describes plant, including equipment, and practice of Belle City Malleable Iron Co., Racine, Wis. See also Foundry, vol. 52, no. 13, July 1, 1924, pp. 521-526 and 533, 13 figs.

FUEL ECONOMY

Metallurgical Works. Works Problems and Methods in Fuel Economy, R. Hadfield. Iron & Coal Trades Rev., vol. 108, no. 2938, June 20, 1924, pp. 1066-1067. Certain problems met with in practice and some methods by which they may be attached; general considerations regarding heat balance; furnace efficiency; importance of high-temperature research, use of pyrometers, and temperature colors. Abstract of paper read before Iron & Steel Sec., Empire Min. & Met. Congress.

FUELS

Canadian Resources. Canada's Fuel Problem, C. Camsell. Combustion, vol. 11, no. 1, July 1924, pp. 46-50. Discussion of Canada's fuel resources and fuel requirements and of possibilities for eliminating uncertainties due to importation of fuel.

The Fuel Resources of Canada and Their Utilization for the Production of Power and Other Purposes, B. F. Haanel. Eng. Jl., vol. 7, no. 7, July 1924, pp. 361-382, 15 figs. Fuel resources; production, consumption, imports and exports; preparation of solid fuels for industrial and other uses; value of Canadian solid fuels for steam raising and production of a power and industrial gas; carbonization of peat, oil shales, and lower-grade coals and relation of carbonization of coals to production of power. Paper read at World Power Conference.

Combustion. An Investigation of the Maximum Temperatures and Pressures Attainable in the Combustion of Gaseous and Liquid Fuels, G. A. Goodenough and G. T. Felbeck. Univ. of Ill. Bul., Eng. Experiment Station, No. 139, Mar. 1924, 158 pp., 27 figs. Details of investigation to study conditions of equilibrium and establish necessary equilibrium equations, and to incorporate these equilibrium equations into a formulation by means of which maximum temperature resulting from combustion of a fuel under predetermined conditions may be calculated.

Pulverized Coal. *See Pulverized Coal.*

FURNACES, ENAMELING

Electricity vs. Oil Heating. Electricity Versus Oil for Heating Iron Enameling Furnaces H. A. Mulvancy. Jl. of Elec., vol. 52, no. 12, June 15, 1924, pp. 487-490, 6 figs. Description of application of electricity to manufacturing with resultant improvement in product, reduced spoilage and decreased cost of production.

FURNACES, HEATING

Regenerative, Fuel Oil Atomizing Agents for. Atomizing Agents for Fuel Oil in Regenerative Furnaces, G. H. Heine. Fuels & Furnaces, vol. 2, no. 7, July 1924, pp 650-652, 1 fig. Gives results of series of experiments made to determine proper oil atomizing agent for regenerative re-heating furnaces of Stevens type.

Re-heating. Operation Costs of Re-heating Furnaces Reduced, H. L. Read. Iron Age, vol. 113, no. 26, June 26, 1924, pp. 1864-1865, 2 figs. Installation of burners for coke-oven gas in which air proportion is maintained automatically.

FURNACES, HEAT-TREATING

Continuous, Conveyor-Type. Heat Treating at the Chevrolet Plant. Iron Age, vol. 114, no. 3, July 17, 1924, pp. 129-131, 2 figs. Describes conveyor-type continuous heat-treating furnace of new design recently made in axle and gear plant of Chevrolet Motor Co., Detroit, and its operation. Is a combination continuous hardening and drawing furnace of a double-deck type and a unique feature is that drawing furnace is located above hardening furnace and is fired by waste heat from latter.

FURNACES, METALLURGICAL

Oil-Fired Melting. Use Oil in Malleable Furnace, B. R. Mayne and C. Joseph. Foundry, vol. 52, no. 12, June 15, 1924, pp. 472-475, 5 figs. New method installed when costs become prohibitive; use same construction as was employed in coal-fired furnace; oil consumption considered low.

G

GAGES

Precision Measurement with. Fine Measurement, J. E. Sears. Machy (Lond.), vol. 24, nos. 607, 609 and 610. May 15, 29 and June 5, 1924, pp. 209-212, 266-271 and 299-303, 22 figs. Deals with precision measurement in its relation to mechanical work; methods by which control of standard gages is effected in laboratory; recent developments in methods of precision measurement. Paper read before Instn. Mech. Engrs.

GAS MAINS

Rubber as Jointing Material. Further Experiments and Experiences in Connection with Rubber as a Jointing Material for Gas-Mains, W. Hole. Gas Jl., vol. 166, no. 3189, June 25, 1924, pp. 899-901, 5 figs. Tests carried out to prove that suitably prepared rubber is practically immune from deleterious action by either coal gas or gaseous liquor.

GAS PRODUCERS

Coke. Experiments with Gas Producers (Untersuchungen an Koksgeneratoren), E. Terres and J. Schierenbeck. Gas-und Wasser-fach, vol. 67, nos. 19, 20, 21, 22, and 23, May 10, 17, 24, 31 and June 7, 1924, pp. 257-263, 279-282, 296-299, 311-314 and 325-327, 11 figs. Discusses experiments carried out with gas producers to replace empirical data by exact experimental data and to study effect of constructional changes on processes under consideration. Discusses experimental arrangements, results with flat grates and inclined grates, composition of gas, etc.

GAS TURBINES

Development. History of the Progress of Gas and Oil Turbines (Die Arbeit an der Gas- und Oel-turbine). W. Gentsch. Brennstoff- und Wärmewirtschaft, vol. 6, nos. 2, 3 and 4, Feb., Mar. and Apr. 1924, pp. 28-35, 48—55 and 71—79, 18 figs. Various attempts to solve problem of economical internal-combustion turbine are recorded and described, including Brown, Boveri, Schneider, Westinghouse, Stodola, General Electric, Francke, Rateau, Nash Eng. Co., etc.

GASES

Combustion, Dewpoint Temperature of. The Dewpoint Temperature of Gases from Combustion, J. N. Waite. Elec. Rev., vol. 94, nos. 2429 and 2430, June 13 and 20, 1924, pp. 954-956 and 994-996, 6 figs. Methods of calculating dewpoint temperature for gases resulting for a given fuel taken being a medium grade bituminous coal having a medium hydrogen and moisture content. Effect of change of fuel analysis on dewpoint temperature of resultant gases of combustion. Curves and tables.

Combustion of. The Combustion of Gases [Die Verbrennung von gasförmigen Brennstoffen (Generatorgas)], A. Dosch. Sprechsaal, vol. 57, nos. 14, 15 and 16, Apr. 3, 14 and 17, 1924, pp. 147-149, 157-159 and 171-173, 5 figs. Processes of combustion of various gases analyzed and explained. Quantities of air required for combustion of various gas mixtures computed and illustrated with aid of several examples.

GASOLINE ENGINES

Two-Cycle. Two-Cycle Gasoline Engines (Il motore a benzina a due tempi), Pasquale Borracci. Industria, vol. 38, no. 1, Jan. 15, 1924, pp. 7-11, 4 figs. Discusses their advantages in relation to their possible application in automotive work.

GEARS

Helical. High-Grade Helical Spur Wheel Gears, E. Meyer. Eng. Progress, vol. 5, no. 6, June 1924, pp. 113-117, 7 figs. Cutting teeth; materials; tooth load and velocity; angle of pitch and pitch of teeth; bearings of pinion shaft; toothed wheeled gears for vertical shafts; ratio of gearing and putput; assembly; lubrication; efficiency; silent running; life and use.

Hob Tooth Form. Hob Tooth Form, H. E. Merritt. Machy, (Lond.), vol. 24, no. 613, June 26, 1924, pp. 391-395, 4 figs. Shows that a hob can produce teeth which are mathematically exact involute teeth (neglecting effect of gashes in hob) and examines necessary axial section which hob teeth must have in order to achieve this result.

Lubrication. Gearing and Gear Lubricants, A. F. Brewer. Indus. Mgt. (N. Y.), vol. 68, no. 1, July 1924, pp. 18-24, 10 figs. Specialized needs of various types of modern gears.

H

HARDNESS

Metal-Products Hardness Testing. The Logical Course of Development of Additional Apparatus for Investigating the Hardness of Metal Products in Works' Practice, H. A. Holz. Testing, vol. 1, nos. 3 and 4, Mar. and Apr. 1924, pp. 247-262, and 308-325, 29 figs. States that logical course of development of additional apparatus for investigating hardness of metals and metal products lies entirely in direction of appliances for application of Brinell test to problems for which this method has not been or could not be applied heretofore. Discusses some of the results established by Bur. Standards in its investigation of Brinell Meter, developed by F. H. Schoenfuss.

HEAT TRANSMISSION

Research. Research in Heat Transmission, E. Buckingham. Mech. Eng., vol. 46, no. 7, July 1924, pp. 386-388. Conduction, radiation, and convection; conduct of research in heat transmission; employment of dimensional analysis; variables involved in complete mathematical theory of heat transmission; suggestions in regard to planning of research programs.

HEATING, HOT-AIR

Furnaces and Heating Systems. Investigation of Warm-Air Furnaces and Heating Systems—II, A. C. Willard, A. P. Kratz, V.S. Day. Univ. of Ill. Bul., Eng. Experiment Station, No. 141, May 1924,149 pp.,91 figs. Details of investigation to determine efficiency and capacity of commercial warm-air furnaces; satisfactory and simple methods for rating furnaces; methods of increasing efficiency and capacity of furnace heating equipment; heat losses in furnace heating systems; proper sizes and proportions of leaders, stacks, and registers; etc.

HEATING, STEAM

Central. Low Pressure Steam for District Heating, H. A. Woodworth. Power Plant Eng., vol. 28, no. 14, July 15, 1924, pp. 763-768, 4 figs. Service to customers insures success. Estimating radiation, advantages of district heating, customer's installations, atmospheric steam heating, and operation of a heating system.

HOBBING MACHINES

Spur-Gear. An Interesting Gear Cutting Development. British Machine Tool Eng., vol. 3, no. 27, May-June 1924, pp. 61-62, 1 fig. Describes automatic, spur-gear hobbing machine.

HOUSING

Zoning and. Views on Zoning and Housing. Nat. Mun. Rev., vol. 13, no. 5, May 1924, pp. 274-288. Contains following articles: What the Banker Thinks of Zoning, Geo. S. Edie. What One Realtor Thinks of Zoning, J. W. Cree, Jr., pp. 277-279; Reducing the Cost of Housing by Eliminating Building Law Requirements, I. H. Woolson; Do We Need Rent Control Laws Permanently? Clara S. Taylor.

HYDRAULIC TURBINES

15,000-b. h.p. 15,000 h.p. Water Turbine for the Tata Hydro-Electric Supply Company. English Electric Jl., vol. 2, no. 6, Apr. 1924, pp. 185-293, 8 figs. Description of unit for extension of existing Khopoli Station of Tata Hydro-Electric Supply Co., in India; head 1655 ft., output 15,000 b.h.p., speed 300 r.p.m. Brief reference to geographical situation of Tata power system.

Runner Design. Hydraulic Turbine Progress, F. J. Taylor. Elec. Times, vol. 65, no. 1703, June 5, 1924, pp. 659-661, 6 figs. Trend of runner design. Increased speeds with lighter runners and lower heads.

Storek-Kaplan. Tests on Storek-Kaplan Hydraulic Turbines, H. Mikyska. Mech. Eng., vol. 46, no. 7, July 1924, pp. 420-421, 3 figs. Tests carried out on turbines of various sizes by firm of Ignaz Storek, licensees for Kaplan turbine.

HYDRO-ELECTRIC DEVELOPMENTS

Canada. The Generation of Hydro-Electric Power in Canada, H. G. Acres. Eng. Jl., vol. 7, no. 7, July 1924, pp. 383-420, 65 figs. Progress in Canadian practice in connection with hydraulic power development. Paper read at World Power Conference.

N. E. L. A. Report. Many Developments in Hydro-Electric Field. Power Plant Eng., vol. 28, no. 14, July 15, 1924, pp. 759-763, 6 figs. Report of Hydraulic Power Committee of Nat. Elec. Light Assn., giving features of equipment of new projects and problems of operation.

Pacific Coast, United States. Hydro-Electric Practices and Equipment on the Pacific Coast, S. Barfoed. A. I. E. E.—Jl., vol. 43, no. 7, July 1924, pp. 641-646, 1 fig. Physical features having deciding influence on design and construction of hydro-electric plants.

HYGROMETERS

Types. Humidity and Its Measurement. Sci. and Art of Min., vol. 34, nos. 22 and 23, May 24 and June 7, 1924, pp. 342-343 and 358-359, 2 figs. Deals with chemical and physical hygrometers of different types.

I

ICE PLANTS

New York, N. Y. Mammoth Ice Plant Adopts New Methods, V. H. Vandiver and A. S. Taylor. Compressed, Air Mag., vol. 29, no. 5, May 1924, pp. 851-856, 18 figs. Describes plant and equipment of Artic Hygeia Ice Mfg. Co., New York City; 1,000 tons ice per day capacity; electric drive and raw-water system replace steam drive and distilled-water system.

Raw-Water. Oil Engine-Driven Raw Water Ice Plant at Mattoon, Ill. Ice and Refrigeration, vol. 66, no. 6, June 1924, pp. 513-517, 8 figs. Description of 30-ton plant of Mattoon Crystal Ice Co.; intended primarily for production of ice for refrigerator car service; 50 per cent of production to be used for requirements of local ice trade.

Serv-Ice Co. Builds New Electrically Driven Raw Ice Plant in Columbus, Ind. Power Plant Eng., vol. 28, no. 14, July 15, 1924, pp. 734-738, 5 figs. Describes new 30-ton compression system ice plant built to supply local retail trade. Unusually clear product is obtained by use of lime and soda softening and high-pressure agitation.

INDICATORS

Precision Weak-Spring. A New Precision Type Weak-Spring Indicator, J. Geiger. Oil Engine Power, vol. 2, no. 5, May 1924, pp. 278-279, 9 figs. Advantages of author's new type of engine indicator are illustrated.

INDUSTRIAL MANAGEMENT

Branch Plants, Management of. How We Get Uniform Output from Widely Separated Plants, P. W. Litchfield. Factory, vol. 33, no. 1, July 1924, pp. 23-25, 116, 118 and 120-123, 2 figs. How to manage branch plants so that they function as one; how to do it and get a uniform product; how economies of one plant get themselves adopted in others located at distant points.

Budgeting. Applying the Budget System to Railroads, H. Bruere and A. Lazarus. Indus. Mgt. (N. Y.), vol. 68, no. 1, July 1924, pp. 35-46, 12 figs. Review of present practice and forecast of future possibilities.

Control of Idleness. The Control of Idleness in Industry, W. L. Conrad. Mech. Eng., vol. 46, no. 7, July 1924, pp. 402-404. Points out that one of chief causes of loss in industry is idleness of plant and personnel, due both to lack of orders or to causes within plant itself; accounting system can be made to show not only cost of idleness, but also its causes, and to indicate means of their control.

Definition of. Who Can Hire Management. H. S. Dennson. Taylor Soc.—Bul., vol. 9, no. 3, June 1924, pp. 101-110. Notes on what is "managing", who manages, and who can best choose managers.

Sales Management. An Example of Scientific Marketing Procedure, S. Cowan, Taylor Soc.—Bul., vol. 9, no. 3, June 1924, pp. 143-151, 3 figs. Method of analyzing buying groups and circulation; comparing occupational and income groups; analysis of magazine circulation; circulation by occupational groups. Practical applications.

STORES ACCOUNTING. Balance-of-Stores Accounting System, I. D. Murfield. Elec. Wld., vol. 84, no. 2 July 12, 1924, pp. 66-69, 5 figs. Description of a store accounting system which has resulted in a reduction of amount of money tied up, also a reduction of stock carried. Maximum and minimum stocks to be carried are specified by utility department heads.
STORES MANAGEMENT. The Care and Control of Raw Materials. Factory, vol. 33, no. 1, July 1924, pp. 34-35 and 135-136, 1 fig. Practice at plant of Bausch Lomb Optical Co.
TIME STUDY. *See Time Study.*

INDUSTRIAL PLANTS

RAILWAYS. Industrial Transportation Over Definite Lines of Travel, M. W. Potts. Indus. Mgt. (N. Y.), vol. 68, no. 1, July 1924, pp. 50-57, 10 figs. Summary of advantages and limitations of industrial railway as a means for efficient handling of materials.

INSULATION, HEAT

AIR SPACES. The Heat Insulating Capacity of Air Spaces (Die Isolierfähigkeit von Luftschichten nach, neueren Forschungen), H. Hamester. Wärme- und Kälte Technik, vol. 26, no. 8, Apr. 30, 1924, pp. 64-66. Modern investigations covering conduction connection and radiation of heat through air spaces are reported.

INSULATORS, ELECTRIC

HIGH-TENSION. The Application of High-Tension Insulators, T. B. Fleming. Elec. Jl., vol. 21, no. 5, May 1924, pp. 217-218, 2 figs. It is shown that one-half wet flashover of either suspension string or pin-type insulator can be taken as working voltage under average conditions; locality must be studied and graded in order to determine amount of insulation required either below or above base line of one-half flashover; insulation above actual requirements is good practice.

INTEGRATION

GRAPHIC METHODS. Graphic Integration Methods (Graphische Integrationsmethoden), C. Runge. Zeit. für Technische Physik,vol. 5, no. 5, 1924, pp. 161-165, 6 figs. Discusses linear and quadratic interpolation, calculation of values of whole functions, graphic integration and differential of curves, graphic integration of linear differential equations of first order.

INTERNAL-COMBUSTION ENGINES

CHEMICAL STRUCTURE. Chemical Structure of Motor Engine, E. Sokal. Oil and Gas Jl., vol. 23, no. 5, June 26, 1924, pp. 88, 126-127 and 130-131. Catalytic coating for surface of cylinder head suggested for counter-acting carbon and detonation. Accelerates combustion.
HEAT TRANSMISSION FROM WORKING FLUID. The Rate of Heat Transmission from the Working Fluid in an Internal Combustion Engine, A. H. Gibson. Lond., Edinburgh, & Dublin Philosophical Mag. & Jl., Sci. vol. 47, no. 281, May 1924, pp. 883-895. Results from investigations and conclusions.
[*See also Automobile Engines; Diesel Engines; Gasoline Engines; Oil Engines.*]

IRON AND STEEL

CANADIAN INDUSTRY. The Iron and Steel Industry in Canada, C. S. Cameron. Iron and Coal Trades Rev., vol. 108, no. 2936, June 6, 1924, pp. 971-974. Data regarding different steel works. Confines attention to fundamental processes, smelting of ore and production of primary forms of steel and those made directly from them, such as merchant bars, structural shapes, rails, plates, wire rods, and generally those that are sent from works of origin to others for further fabrication. From paper read at Empire Mining and Metallurgical Congress.
CHEMICAL SPECIFICATIONS. Are Chemical Specifications for Iron and Steel Too Rigid? Iron and Steel Engr., vol. 7, no. 7, July 1924, pp. 130 and 133. Investigation by British Chemical Standards movement. From paper read by C. H. Ridsdale at joint mtg. of Cleveland Instn. Engrs., Soc. Chem. Industry and Inst.

L

LABOR

WAGES AND HOURS. Wages and Hours of Labor in the Automobile Tire Industry, 1923. U. S. Bur. Labor Statistics—Bul., no. 358, Apr. 1924, pp. 1-58. Report shows results of study of wages and hours of labor in automobile tire industry in 1923. Information compiled covers 22,535 male wage earners and 1624 female wage earners working in 49 representative establishments located in Connecticut. Indiana, Massachusetts, Michigan, New Jersey, New York, Ohio, Pennsylvania and Wisconsin. Tables show earning as per hour, full time or curtomary hours per week, hours and days actually worked, and earnings actually received in representative pay period taken.

LATHES

INSPECTION IN BUILDING. The Inspection System in a Lathe Building Plant, H S. Riggs. Machy. (N. Y.), vol. 30, no. 11, July 1924, pp. 835-841, 12 figs. Checking accuracy of lathe parts, assembled units and completed machines.
INTERCHANGEABLE MANUFACTURE. Building Lathes Interchangeably. Machy. (Lond.), vol. 24, no. 613, June 26, 1924, pp. 389-392, 8 figs. Manufacturing methods used to facilitate assembly of machines and supply of replacement parts.
SEMI-AUTOMATIC. Semi-Automatic Lathe of Interesting Design, C. C. Walker. Machy. (N. Y.), vol. 30, no. 11, July 1924, pp. 870-873, 6 figs. Construction of machine; character of work; special form cutter used.

LIGHTING

RESEARCH. Co-ordination of Research in Illuminating Engineering and Some Practical Applications, J. S. Dow. Illuminating Engr.,vol. 17, nos. 1-3, Jan.-Mar. 1924, pp. 6-15 and (discussion) 16-18. Classification of research; research on photometry and standards of light illuminants and lighting appliances; research on glare collection of statistical data on illumination; facilities for research.
HIGHWAYS. Street Lighting in Its Relation to Highway Safety, C. A. B. Halvorson, Jr. and S. C. Rogers. Safety Eng., vol. 283-289, 13 figs. Objects should be seen at night in silhouette rather than by direct light. Glare; cost of lighting; use of signals; etc.
STREET. Some Facts About Street Lighting, G. H. P. Dellman. Jl. of Elec. vol. 52, no. 11, June 1, 1924, pp. 404-408. Review of practice, showing changes which street lighting systems have undergone in past years; modern practices; essential features of proper lighting; methods and financing of lighting; etc.

LIQUIDS

DISTILLING, EVAPORATING AND CONDENSING. Distilling, Concentrating, Evaporating and Condensing Liquids. Abridgments of Specifications, class 32, period 1916-20, 1924, 152 pp. Patents for inventions.
THERMAL CONDUCTIVITY. Convective Cooling in Liquids—Some Thermal Conductivity Data, A. H. Davis. Lond., Edinburgh, and Dublin Philosophical Mag. and Jl. Sci., vol. 47, no. 281, May 1924, pp. 972-975. Direct determinations of thermal conductivity at various temperature, to supplement information previously given.

LOCOMOTIVES

BEHAVIOUR OF WHEELS ON TRACK. Behaviour and Movement of Locomotive Wheels on the Track, J. Buchli. Int. Ry. Congress Assn.—Bul.,vol. 6, no. 6,June 1924, pp. 417-437, 30 figs. Trials carried out on model which reproduced conditions encountered in practice as accurately as possible with object of ascertaining lateral adhesion of wheel on rail under most widely different service conditions. Translated from Schweizerische Bauzeitung.
DIESEL-ELECTRIC. The American Diesel-Electric Locomotive is Here. Oil Engine Power, vol. 2, no. 5, May 1924, pp. 257-259, 5 figs. 300-b. h.p. locomotive constructed by Gen. Elec. and Ingersoll-Rand Companies, with 6-cylinder airless-injection 4-cycle type Ingersoll-Rand oil engine directly connected to 200-kw. Gen. Elec. generator.
ELECTRIC. *See Electric Locomotives.*
ERECTION. An Improved Method of Locomotive Erection by the Use of Erecting Forms, S. R. Limerick. Baldwin Locomotives. vol. 3, no. 1, July 1924, pp. 28-32, 8 figs. Describes mechanical erector, developed by Baldwin Locomotive Wks., a device for absolute control of work of erecting a locomotive, eliminating all possibility of errors in alignment, inequalities of measurement and all variances formerly existent in locomotives incidental to exercise of personal judgment or skill on part of workman. Erection of locomotive by this method.
4-6-0 TYPE. A New Pennsylvania R. R. Locomotive. Ry. Gaz., vol. 40, no. 25, June 20, 1924, pp. 891-892, 2 figs. Particulars of first of a new class of locomotives designed for passenger train service and built at company's shops at Altona, Pa.; 4-6-0 type, with outside cylinders driving middle pair of coupled wheels; steam being distributed to cylinders by piston valves actuated by Walschaerts valve gear; light reciprocating parts; high tractive effort.
RODS, BORING AND TESTING OF. Fixtures for Boring and Testing Locomotive Rods, F. H. Colvin. Am. Mach., vol. 60, no. 26, June 26, 1924, pp. 947-949, 8 figs. Some of the methods and tools used by Lima Locomotive Works in boring and testing side rods of plain and articulated types.
STEAM-TURBINE. A New Geared Turbine Condensing Locomotive. Ry. Engr., vol. 45, no. 533, June 1924, pp. 200-201, 2 figs. Constructed on Reid-Macleod system and patented by North Brit. Locomotive Co.
THERMAL EFFICIENCY. Engineering and Business Considerations of the Steam Locomotive, W. H. Winterrowd. Ry. Age, vol. 76, no. 30, June 13, 1924, pp. 1468-1471 and (discussion) 1471-1473, 3 figs; also Ry. Rev., vol. 74, no. 24, June 14, 1924, pp. 1103-1108, 4 figs. Author disputes impression that steam locomotive is inefficient and losing its vitality; comparison of thermal efficiency curves of locomotive and stationary boiler proves conclusively that locomotive boiler is more efficient generator of steam; and by further development of superheated steam, larger grate area and higher boiler pressure, still greater maximum thermal efficiency can be obtained. Paper read before Am. Ry. Assn.
THREE-CYLINDER. Lehigh Valley Three-Cylinder Locomotive. Ry. Age (Daily Edition), vol. 76, no. 32, June 14, 1924, pp. 1585-1587, 6 figs. Details of 4-8-2 type, weighing 369,000 lb.; boiler is of inverted wagon top type. See also article, entitled, Performance of 3-Cylinder Locomotive No. 5000, in Ry. Rev., vol. 74, no. 24, June 14, 1924, pp. 1079-1093, 13 figs. Gives details of construction and record of results.
The Three-Cylinder Locomotive, J. G. Blunt. Ry. Age, vol. 76, no. 30, June 13, 1924, pp. 1473-1476 and (discussion) 1476-1479, 7 figs. Normal tractive force; economy of 3-cylinder locomotive; crank-axle driving box; middle main rod, valve gear and crosshead.

M

MACHINE SHOPS

EQUIPMENT. American Machinist Shop Equipment Review. Am. Mach., vol. 61, no. 3, July 17, 1924, pp. 89-131, 238 figs. Semi-annual résumé of machines, tools, and accessories described in Shop Equipment News section of Am. Mach. during first six months of 1924.
PROGRESS. Six Months in the Machine Shop Field. Am. Mach., vol. 61, no. 3, July 17, 1924, pp. 81-87. A review, in seven articles, of progress made during first half of 1924 in machinery field, railroad field, automotive industry, electric power and manufacturing industries, distribution of materials and supplies, and in exporting.

MACHINE TOOLS

DEVELOPMENT, NEW ENGLAND. Development of Machine Tools in New England, G. Hubbard. Am. Mach., vol. 60, nos. 4, 5, 6, 7, 8, 12, 17, 24 and 26, Jan. 24, 31, Feb. 7, 14, 21, Mar. 20, Apr. 24, June 12 and 26, 1924, pp. 129-132, 171-173, 205-209, 255-258, 271-274, 437-441, 617-620, 875-878 and 951-954, 70 figs. Jan. 24: American exhibit at Crystal Palace; famous Enfield (England) Armory equipped with machinery and tools from New England; gages sent from England made of wood. Jan. 31: Hartford plant of Robbins & Lawrence turns out world-famous products and finally becomes part of Pratt & Whitney plant. Feb. 7: Windsor machine tools still in use; development of drilling machine, Feb. 14: Examples of early milling machines; first universal milling machine; edging or profiling machine. Feb. 21: Lathes and swiveling headstocks; tailstocks with square spindles; an early bolt-threading machine; evolution of turret lathe. Mar. 20; Officers of Robbins & Lawrence Co.; New England mechanics who have become famous. June 12: Drawings of machine tools in colors; interchangeable work at Harper's Ferry. June 26: Circumstances that led to formation of Jones & Lamson Machine Co.
SPEED CHARTS. Alignment Charts for Speeds (Fluchtlinientafel für Drehzahlen), H. Behr. Werk-staattstechnik, vol. 18, no. 11, June 1, 1924, pp. 294-296, 3 figs. Plotting of alignment chart for determination of geometrically arranged revolution numbers, magnitude of average cutting-speed drop, and of quotients of geometrical series.

MANGANESE STEEL

WELDING OF. Welding of Manganese Steel. Am. Welding Soc.—Jl., vol. 3, no. 5, May 1924, pp. 10-23, 14 figs. Discusses briefly what manganese steel is, its properties, and why it has those properties. Investigations of what happens during welding of manganese steel, how actual operation may be best conducted, and what structural results of welding are in both base metal and weld. Preliminary report of Gas Welding Committee of Am. Bur. Welding.

MAPPING

VARIATIONS IN FIGURE OF EARTH, EFFECT OF. Effect of Variations in the Assumed Figure of the Earth on the Mapping of a Large Area, W. D. Lambert. U. S. Coast & Geodetic Survey, 1924, Serial No. 258, Special Publication No. 100. 35 pp., 11 figs. Various determinations of earth's mean figure, spheroids actually in use for geographic purposes, effect of change in dimensions of spheroid on computation of triangulation, effect of change of spheroid on triangulation covering large area. Gives formulas and makes calculations. Tables.

MARINE BOILERS

TESTS. Tests of Marine Boilers, H. Kreisinger, J. Blizard, A. R. Mumford, B. J. Cross, W. R. Argyle and R. A. Sherman. U. S. Bur. Mines, Bul. 214, 1924, 302 pp. 181 figs. partly on supp. plates. Describes evaporative tests of marine water-tube boilers, and of Scotch marine boiler, including description of method of conducting tests, and of such special studies as were made of: combustion in furnaces; heat absorption by boilers; flow of gases through boilers by means of temperature, pitot-tube, and draft measurements; insulation of furnace walls; circulation of water in boiler; effect on heat transmission of blowing soot off heating surfaces with steam blowers; and use of special equipment to improve combustion or to improve heat absorption.

MATERIALS

RUPTURE. Conditions Causing Rupture of Material (Betingelserna für materialbrott), A. F. Samsioe. Teknisk Tidskrift, vol. 54, no. 24, June 14, 1924, pp. 221-223 (Allmanna Avdelningen), 7 figs. Older theories are recorded. Guest's experiments with tough metals are described. Shearing stress or greatest difference between stresses occurring in different directions are proved to cause ruptures of material. Mohr's theory for brittle materials is explained.

MATERIALS HANDLING

ECONOMIES OF. Fundamental Economies of Materials Handling, M. L. Begeman. Mech. Eng., vol. 46, no. 7, July 1924, pp. 405-409 and (discussion) 410. Discusses advantages of handling materials mechanically without, reference to particular types of equipment; deals with necessity for substitution of mechanical handling of materials for labor and economies to be gained by such substitution; points to be considered in analysis of proposed installation.

MACHINE SHOPS. Train-Despatching in an Automotive-Parts Shop, R. S. Spencer. Am. Mach., vol. 60, no. 26, June 26, 1924, pp. 945-946, 3 figs. How a force of 250 truckers has been reduced to 9 men by application of railroad train-despatching methods to inter-departmental transportation of materials.

MEASURING INSTRUMENTS

THREAD RECORDER. Some Uses of the Thread Recorder in the Measurement of Physical Properties, J. L. Haughton and W. T. Griffiths. Jl. of Sci. Instruments, vol. 1, no. 8, May 1924, pp. 225-233, 9 figs. Methods of employing thread recorder for recording changes of dilation and resistivity of metals and alloys with temperature. Describes also method of combining recorded time-temperature and time-property curves to give a single temperature-property curve.

TORSION METER. The Moulin Torsion Meter. Engineering, vol. 117, no. 3050, June 13, 1924, pp. 764-765, 12 figs. Apparatus for measuring torque in shafts up to in. diam. and transmitting 1500 h.p.

MERCURY-VAPOR PROCESS

PRINCIPLES AND APPLICATIONS. Mercury Vapor as an Industrial Heating Medium, C. Field. Chem. and Met. Eng., vol. 30, no. 25, June 23, 1924, pp. 987-991, 8 figs. Outline of system, with discussion of various other sources of heat at high temperature available for industrial use.

METALS

COLD WORKING. Effect of Severe Cold Working on Scratch and Brinell Hardness, H. S. Rawdon and W. H. Mutchler. Am. Inst. Min. and Met. Engrs.—Trans., No. 1340-N, May 1924, pp. 3-14, 4 figs. Discussion of above paper, presented at New York Mtg., Feb. 1924, and issued as Paper No. 1291-M, with Min. and Metallurgy, Jan. 1924.

Interpretation of Cold Working on the Basis of Electric Measurements (Zur Deutung der Kaltbearbeitung auf Grund elektrischer Messungen), W. Geiss and J. A. M. van Liempt. Zeit. für Anorganische und Allgemeine Chemie, vol. 133, no. 1, Feb. 11, 1924, pp. 107-112. Discusses deformation of metal crystals in cold working and current hypotheses; application of X-ray analysis and its limitations.

CORROSIVE AGENTS, BEHAVIOR UNDER ACTION OF. How Metals Stand Up Against Corrosion. Chem. and Met. Eng., vol. 31, no. 2, July 14, 1924, pp. 70-79. General and specific data from many sources on behavior of iron and steel, copper, aluminum, lead, nickel, tin, and zinc, under action of many destructive agencies encountered in industrial world.

FATIGUE. An Investigation of the Fatigue of Metals, H. F. Moore and T. M. Jasper. University of Ill.—Bul., vol. 21, no. 39, May 26, 1924, 86 pp., 22 figs. Theory of fatigue of metals; evidence of existence of endurance limit for wrought ferrous metals and of improvement in strength of such metals by cycles of reversed stress at or below that limit; resistance to reversed axial stress (tension-compression); miscellaneous tests and results; resistance to repeated stress other than reversed stress. Bibliography.

SURFACES, PROPERTIES OF. The Properties of Metallic Surfaces, J. B. Nevitt. Birmingham Met. Soc.—Jl., vol. 8, no. 10, pp. 425—440 and (discussion) 441-446. Reviews means by which variations in surface conditions may be produced, and outlines effect of these surface conditions upon properties of metal.

MINES

VENTILATION. The Ventilation of Mines, D. Hay and R. Clive. Colliery Guardian, vol. 127, no. 3310, June 6, 1924, pp. 1447-1449, 2 figs. Principles of ventilation. Reviews modern practice and draws attention to recent progress in technique. From paper read before Empire Mining and Metallurgical Congress.

WATER POWER, USE OF. Water Power in the Mining Industry. Can. Min. Jl., vol. 45, no. 27, July 4, 1924, pp. 648-652, 4 figs. General resume of study made by Dominion Water Power Branch, Dept. Interior, of extent to which need of ample supplies of power available at cost that will permit of production and treatment of large quantities of raw materials in districts in which mines occur, has been met by development of Canadian advantageously-located water powers.

MINING

SKIP CHANGING. Homestake Method of Changing Skips, Felix Edgar Wormser. Eng. and Min. Jl.—Press, vol. 117, no. 26, June 28, 1924, pp. 1044-1045, 4 figs. Change is made at bottom of shaft instead of on surface.

MOULDING MACHINES

APPLICATIONS. Molding Machine Practice, R. R. Clarke. Metal Industry (N. Y.), vol. 22, nos. 6 and 7, June and July, 1924, pp. 237-238 and 272-275, 8 figs. Range of application, difficulties, and solution of difficulties. Various methods of pattern mounting.

PERMANENT. Discusses Permanent Molds, R. J. Anderson and M. E. Boyd. Foundry, vol. 52, nos. 12 and 13, June 15 and July 1, 1924, pp. 463-468 and 510-513, 17 figs. Describes five different permanent-mold processes and discusses principles involved; typical molds; materials for molds and cores; mold design; methods of gating; various types of commercial alloys and typical castings. Annual exchange paper of Am. Foundrymen's Assn. presented at Inst. Brit. Foundrymen. See also Foundry Trade Jl., vol. 29, nos. 407 and 408, June 5 and 12, 1924, pp. 464-468 and 477-485, 17 figs. Bibliography.

MOTOR BUSES

SIX-WHEEL. Six-Wheel Bus, Marketed by New Concern, Has Novel Features, H. Chase. Automotive Industries, vol. 51, no. 2, July 10, 1924, pp. 97-100, 9 figs. Particulars of new bus recently announced by a new concern to be known as Six-Wheel Co. of Philadelphia. Easy riding qualities and design which permits all important units to be detached quickly and replaced by spares. Frame of massive and rigid construction. Six-cylinder Continental engine is mounted on rubber blocks.

MOTOR TRUCKS

ELECTRIC. A Front-driven Electric Van, W. F. Bradley. Motor Transport (Lond.), vol. 38, no. 1007. June 16, 1924, pp. 745-746, 3 figs. Details of a battery-driven vehicle which is being used in France for load-up to half a ton; presented by Société d'Applications. Electro-Mécaniques; also steered by its front wheels; compound-wound electric motor of 4 kw. capacity; capable of taking a temporary overload of 300 per cent.

N

NITROGEN

FIXATION. The Air-Nitrogen Processes, J. M. Braham. Commerce Reports-Supp., Trade Information Bul. no. 240, June 16, 1924, pp. 1-41. Describes arc, cyanamide, synthetic ammonia and miscellaneous nitrogen fixing processes; interrelation of nitrogen-fixing processes and products

O

OIL

DEVELOPMENTS IN CANADA. Oil Developments in Canada during 1923, G. S. Hume. Am. Inst. Min. and Met. Engrs.—Trans., no. 1321-P. Feb. 1924, 4 pp.

OIL ENGINES

SURFACE-IGNITION. Types of Modern Power-Plant Oil Engines. Oil Engine Power, vol. 2, no. 5, May 1924, pp. 271-272, 3 figs. New model of Italian surface-ignition engine has crosshead and main oiling system entirely separated from cylinder bore, arrangement whith results in low lubricating-oil consumption; Corliss-type valve controls admission of scavenging air, amount of which is regulated by governor.

OPEN-HEARTH FURNACES

DESIGN AND CALCULATION. Performance and Efficiency as Fundamentals for the Design and Calculation of Open-Hearth Furnaces (Leistung und Wirkungsgrad als Unterlagen für Bau und Berechnung der Siemens-Martin-Oefen), H. Bansen. Berichte der Fachauss-chüsse des Vereins deutscher Eisenhüttenleute, Stahlwerksausschuss, report no. 82, May 10, 1924, 23 pp., 19 figs. Functions of furnace; working conditions for temperature drop; heat circulation; relations of fuel supply and preheating to furnace efficiency and fuel consumption; calculation of heat required and efficiency; special means of influencing temperature drop, combustion, temperature conditions and heat transmission; heat accumulators; waste-heat utilization.

EFFICIENCY. The Efficiency of Open-Hearth Furnaces (Wirkungsgrade im Betriebe des Siemens-Martin-Oefens), G. Bulle. Berichte des Fachausschüsse des Vereins deutscher Eisenhüttenleute, Stahlwekrsausschuss, report no. 80, May 10, 1924, 3 pp. Committee report on metallurgical, furnace and producer performance.

ORE TREATMENT

ELECTROLYTIC REFINING. Improvement in Electrolytic Refining During the Last Decade, S. Skowronski. Am. Electrochem. Soc., paper presented at mtg. Apr. 24-26, 1924, No. 30, pp. 391-402. Deals with refining of a erude metal anode into a refined cathode, which process is strictly "electrolytic refining", and recovery of metals from solutions obtained from ores, coneentrates or metallurgical products, using various solvents.

P

PAINTING

INDUSTRIAL-PLANT PRACTICE. Standardization of Painting Practice, R. C. Sheeler. Indus. Mgt. (N. Y.), vol. 68, no. 1, July 1924, pp. 25-28, 5 figs. Extremes of moisture or steam cause all metal surfaces to rust and corrode with extreme rapidity; other surfaces come in contact with gaseous fumes, weak acid vapors, etc. Much money wasted and much good paint condemned through use of wrong material for protective coat to withstand such contact. Discusses application of standardization to maintenance of plant and equipment through proper use of paint and varnish.

PAPER

AREA AND WEIGHT STANDARDS. Standards for Area, Count and Weight, S. L. Willson. Paper Trade Jl., vol. 79, no. 2, July 10, 1924, pp. 51-51, 58 and 64. Shows that in manufacturing size to-day there is little or no relation to use of papers in this size. Discusses proposed plan of changes and benefits to be drived.

PAPER MACHINERY

BEATERS. Modified Beater for Bamboo. Paper, vol. 24, no. 9, June 19, 1924, pp. 379-380, 1 fig. Describes improved machine pateuted in England by W. A. R. MacRae.

FINISHING-ROOM MACHINERY. Finishing Room Machinery, O. C. Cordes and W. W. Spratt. Paper, vol. 34, no. 10, June 26, 1924, pp. 422-425, 8 figs. Describes and illustrates operation of calender drives, platers and cutters by Westinghouse dual-frequency system.

HIGH-SPEED. High Speed Machine Construction, E. J. Neese. Paper, vol. 34, no. 10, June 26, 1924, pp. 428-431. Increased width and speed of newsprint machines bring many improvements in design and construction.

PAPER MANUFACTURE

BEATING. New Ideas on Beating, J. W. Brassington. Paper, vol. 34, no. 11, July 3, 1924, pp. 461-464 3 figs. More speed and less weight of rolls is suggested in describing new type of beater using centrifugal force.

BIBLIOGRAPHY. Bibliography of Papermaking for 1923, Compiled by C. J. West. Paper Trade Jl., vol. 78, nos. 17, 18, 19, 20, 22, 23, 24 and 25, Apr. 24, May 1, 8, 15, 22, 29, June 5, 12 and 19, 1924, pp. 52-54, 49-54, 53-56, 49-52, 45-47, 51-52, 55-57, 45-46 and 41-43.

BLEACHING BEATERS. Function of the Washing Drum, R. Haas. Paper, vol. 34, no. 11, July 3, 1924, pp. 471-475, 6 figs. Determines consumption of energy and best method of operating washing drum of bleaching beater. Translated from Papierfabrikant.

CENTRIFUGAL FORCE, APPLICATION OF. Flywheel Power or Centrifugal Force, J. W. Brassington, paper, vol. 34, no. 9, June 19, 1924, pp. 365-367, 2 figs. Possibilities of application of centrifugal force to manufacture of pulp and paper. Now used in a limited way.

DRYING. Methods of Drying Paper, T. J. Keenan. Paper, vol. 34, no. 10, June 26, 1924, pp. 427-428. Principles of drying by steam-heated drums and review of recent novelties and difficulties caused by faulty ventilation.

PIERS

CONCRETE, CONSTRUCTION OF. Mobile Tower Chuting Plant Builds Concrete Pier at Havana. Eng. News-Rec., vol. 93, no. 2, July 10, 1924, pp. 52-54, 4 figs. Describes concreting plant and form construction in connection with construction of a massive concrete pier deck and house on concrete piles in deep water in Havana. Stiff-leg tower, having a counterweight chute, travels on apron around pier house. Deck forms suspended from pile tops.

INTERSECTIONS, VOLUMES AND AREAS OF. Formulas for Volumes and Areas of Pipe Intersections, G. Paaswell. Eng. News-Rec., vol. 93, no. 1, July 3, 1924, pp. pp. 28-29, 3 figs. Data covering determination of volumes of cylinder intersections such as those at junction of arches or in special pipe castings.

PIPE, CAST-IRON

WELDING WITH BRONZE. Welding Cast Pipe with Bronze, H. Y. Carson. Iron Trade Rev., vol. 75, no. 2, July 10, 1924, pp. 97-98, 2 figs. In method developed by author for welding cast iron, an ordinary welding rod of tobin bronze is used, joint being pre-heated by playing an oxy-acetylene flame back and forth transversely across joint area; bronze rod is melted and allowed to flow along joint spreading about one inch in width entirely around pipe. Only moderate temperatures required. Abstract of paper read before Nat. Gas Assn. Am. See also Foundry, vol. 52 no. 12, June 15, 1924, pp. 469-470, 2 figs.

PLATES

FLANGING TESTS. Tests on the Flanging of Thin Plates (Essai d'emboutissage sur tôles minces), M. Guillery. Revue de Métallurgie, vol. 21, no. 5, May 1924, pp. 303-311, 17 figs. Describes two machines for testing thin plate, in order to determine their resistance to cold flanging; method of testing, and results of tests.

PRESSES

INCLINABLE. Design of Inclinable Power Presses, P. A. Friedell. Machy. (Lond.), vol. 24, no. 613, June 26, 1924, pp. 409-411, 1 fig. Calculations for designing gearing, driving shaft, back-shaft bearing, flywheel and pulleys.

PRODUCER GAS

COMBUSTION, EXCESS AIR DETERMINATION IN. A Graphical Chart for Determining Excess Air in the Combustion of Producer Gas, G. M. Peltz. Am. Ceramic Soc.—Jl., vol. 7, no. 6, June 1924, pp. 437-441 and (discussion) 441-443, 1 fig. Presents a calculating chart by which it is possible to determine percentage of excess air existing in any producer-gas-fired furnace when analysis of gas and percentage of CO_2 in products of combustion are known.

PROSPECTING

ELECTRICAL. Electrical Prospecting in Canada, S. F. Kelly. Am. Zinc Inst.—Bul., vol. 7, no. 5, May 1924, pp. 21-39, 14 figs. Review of principles and procedure of two methods of Schlumber for electrical prospecting and considers their application to Canadian deposits.

PULLEYS

PRESSED-STEEL BELT. Application of Pressed Metal to Pulleys, S. G. Gaillard, Jr. Forging—Stamping—Heat Treating, vol. 10, no. 6, June 1924, pp. 226-229, 12 figs. Various operations in manufacture of pressed-steel belt pulleys.

PULVERIZED COAL

COMBUSTION OF. The Combustion of Pulverized Coal, E. Audibert. Colliery Guardian, vol. 127, nos. 3306 and 3307, May 9 and 16, 1924, pp. 1188-1189 and 1251-1252, 4 figs. Details of experiments made by Comité Central des Houillères de France, primary object of which is measurement of duration of combustion, and subsidiary object determination of essential conditions for use of a given coal in form of powder. Translated from Revue de l'Industrie Minérale.

SYSTEMS. Pulverized-Fuel Systems, A. L. Cole. Power, vol. 59, nos. 23, 24, 25 and 26, June 3, 10, 17 and 24, 1924, pp. 900-905, 16 figs.; 940-945, 17 figs.; 985-988, 16 figs.; and 1022-1027, 26 figs. Different types of equipment in general use for drying, pulverizing, transporting and burning coal in pulverized form. June 3: Types of dryers. June 10: Types of pulverizers used in unit and multiple systems. June 17: Systems used for conveying coal in pulverized form, construction and operation. Type of feeders and burners used with different systems of firing coal in pulverized form; review of earlier types; typical boiler settings designed in last four years.

PUMPS

AIR-LIFT. Experimental Study of Air Lift Pumps and Application of Results to Design, C. N. Ward and L. H. Kessler. Univ. of Wis.—Bul., Eng. Experiment Station, vol. 9, no. 4, 1924, 166 pp., 60 figs. partly on supp. plates.

VACUUM. An All-metal High-vacuum Pump System, I. Backhurst and G. W. C. Kaye. Lond.,Edinburgh, and Dublin Philosophi cal Mag.and Jl.,Sie.,vol. 47, no. 281, May 1924, pp. 918-929, 3 figs. Describes pump system of two-stage type, constructed wholly of metal and consisting of (1) mercury-vapor jet pump in series with (2) mercury-vapor condensation pump; advantages of system. Bibliography. See also paper by same authors, entitled, A Metal Annular-Jet Vacuum Pump, describing modification of pump described in first paper, pp. 1016-1020, 2 figs.

PUMPS, CENTRIFUGAL

INTERNAL LEAKAGE. Determination of Internal Leakage in Centrifugal Pumps, A. F. Sherzer. Eng. News-Rec., vol. 92, no. 25, June 19, 1924, pp. 1056-1058, 5 figs. Facts regarding coefficient of discharge established by research in hydraulic laboratory of Univ. of Mich.

SUCTION PIPES, EVACUATING. Evacuating the Suction Pipes of Centrifugal Pumps, W. S. Douglas. Power Engr., vol. 19, no. 219, June 1924, pp. 205-207, 4 figs. Study of conditions obtaining during process; develops formulas for predetermination of pump capacities, etc., for given plants.

R

RADIOTELEGRAPHY

MODERN EQUIPMENT. Modern Wireless Equipment. Electrician, vol. 92, nos. 2404 and 2406, June 13 and 27, 1924, pp. 728 and 796-798, 12 figs. Survey of wireless apparatus exhibited at British Empire Exhibition, including, broadcast receiving apparatus, headphones, sectional sets, wireless beam transmitter, receiving valves, molecular vacuum pump, etc.

PROPAGATION PHENOMENA. On Propagation Phenomena and Disturbances of Reception in Radio-Telegraphy, F. Kiebitz. Inst. Radio Engrs.—Proc., vol. 12, no. 3, June 1924, pp. 233-241. Study of propagation of electromagnetic waves over earth's surface, particularly for very long distance transmission, for which it is deduced that short waves are inherently unsuitable; methods of quantitatively determining strength of received signals are shown to be necessary; investigates simultaneous appearance of disturbances of reception at widely separated points and conclusions therefrom.

RAILLESS TRACTION

ROCHESTER, N. Y. Rochester Trackless Trolley Construction. Elec. Ry. Jl., vol. 64, no. 1, July 5, 1924, pp. 11-13, 4 figs. Line is about 3 mi. long and runs through densely populated district; it crosses five electric-car lines and one steam railroad at grade; some of overhead equipment is of special design.

RAILS

FROGS AND CROSSINGS, FINISHING OF. Finishing Steel Track Equipment, F. B. Jacobs. Iron Trade Rev., vol. 74, no. 26, June 25, 1924, pp. 1701-1702, 3 figs. Notes on methods and equipment used at plant of Indianapolis Switch & Frog Co., Springfield, O., in production of solid manganese-steel frogs, switches and crossings.

QUALITY IMPROVEMENT. How the Quality of Rails Can Be Improved, C. W. Gennet, Jr. Ry. Age, vol. 77, no. 2, July 12, 1924, pp. 63-65, 2 figs. Suggestions for changes in specifications to secure a better grade of steel.

RAILWAY ELECTRIFICATION

ILLINOIS CENTRAL. Electrification Progress on the I. C. R. R. Elec. Traction, vol. 20, no. 6, June 1924, pp. 256-257, 4 figs. Work on complete elimination of grade crossings from Chicago to Kankakee are well under way; next cars purchased will be completely equipped for electrical operation.

UNITED STATES. The Electrification of Foreign Railways including Recent Developments and Projects, S. Parker Smith. World Power, vol. 1, no. 6, June 1924, pp. 338-346, 4 figs. United States of America.

RAILWAY MANAGEMENT

PURCHASES AND STORES. Purchases and Stores, Ry. Age (Daily Edition), vol. 76, no. 34, June 17, 1924, pp. 1641-1659, 6 figs. Contains following articles: Purchasing Function of the Government, H. C. Smither; Committee recommendation: Stores Department Book of Rules; Method for Material Procurement, E. J. Remensnyder; Committee report on Material Accounting and Office Appliances; report of Committee on General Accounting; Bonus System for Efficient Stockmen, J. E. Mahaney; Report on Department Buildings and Facilities; Duties of a Travelling Storekeeper,W. Dixon; and other addresses. Papers and reports presented before Am. Ry. Assn. See also Ry. Rev., vol. 74, no. 25, June 21, 1924, pp. 1204-1211.

S. P. Houston Store Has Many Fine Features. Ry. Rev., vol. 74, no. 24, June 14, 1924, pp. 1094-1103, 22 figs. Among practices followed at purchases and stores department of Southern Pac. Co., are unit piling of materials, stores delivery and supply-train operation.

SUPERVISORY FORCES, TRAINING OF. Proper Training of Shop Supervisory Forces, L. W. Baldwin. Ry. Rev., vol. 74, no. 26, June 28, 1924, pp. 1256-1258. Discusses training of supervision and developing of men better fitted for mechanical positions. Systematic record of progressive steps should be kept and stipulated examinations at stated intervals should be given. From paper read before Am. Ry. Assn. annual convention.

RAILWAY MOTOR CARS

HYDRAULIC-DRIVE. Gasoline Passenger Car with Hydraulic Drive. Ry. Age, vol. 76, no. 31, June 14, 1924, pp. 1507-1509, 5 figs. Combination passenger and baggage unit car propelled by 150-h.p. Ricardo engine through transmission consisting of one hydraulic variable-delivery pump and two hydraulic variable-speed motors; in operation on New York, New Haven & Hartford.

RAILWAY OPERATION

CAR SWITCHING. Switching Devices (Hilfsmittelzum Verschieben), Wernekke. Fördertechnik u. Frachtverkehr, vol. 17, no. 8, Apr. 30, 1924, pp. 103-105, 6 figs. Various devices for switching railway cars by means of wire ropes; for use in cases where use of switching locomotives would not be economical. Types of electric motors and controllers for devices.

RAILWAY REPAIR SHOPS

DELIVERY SYSTEM. Transportation of Material in the Roanoke Shops, Jas. M. Thomas. Ry. Rev., vol. 74, no. 24, June 14, 1924, pp. 1126-1130, 9 figs. Describes delivery system of shops of Norfolk & West. Ry.; how materials are delivered to and from shops and yards; organization and system; schedules maintained and equipment used.

DESIGN. Report on Design of Shops and Engine Terminals. Ry. Age, vol. 76, no. 30, June 13, 1924, pp. 1464-1468. Seven specific recommendations for freight-car and repair shops. Am. Ry. Assn. committee report and discussion.

RAILWAY SHOPS

EQUIPMENT STANDARDIZATION. Standardized Shop Work at Topeka, F. H. Colvin. Am. Mach., vol. 61, no. 2, July 10, 1924, pp. 63-64, 1 fig. Outline of how equipment is standardized and manufactured at Topeka shops of Santa Fe, and economies effected by standardization.

MACHINE TOOLS FOR. Machine Tools for Railway Shops, Ry. Engr., vol. 45, nos. 532 and 533, May and June, 1924, pp. 171-173, and 204-206, 8 figs. Boring and turning mills; extra-heavy wheel lathe; cylinder grinding machine; boring rolling-stock wheels; drilling and ovaling rails; boring axle-boxes; new boiler-shop tool; car-wheel-center boring machine.

TRAINING OF FORCES. The Training of Shop Supervisory Forces, L. W. Baldwin. Ry. Age (Daily Edition), vol. 76, no. 34, June 17, 1924, pp. 1627-1630. Selection of apprentices; supervision and encouragement of mechanic; selecting men for promotion; duties of foreman; study of new tools and appliances. Address before Am. Ry. Assn.

RAILWAY SIGNALING

COLORED-LIGHT SIGNALS. Canadian National Color-Light Signals, T. A. Allen. Ry. Signaling, vol. 17, no. 7, July 1924, pp. 268-270, 6 figs. Expanded steel trusses in place of bridges save money; main line switches electrically lighted.

NEON, APPLICATION OF. Neon—A New Gas for Electrical Use, C. S. Treacy. Ry. Signaling, vol. 17, no. 7, July 1924, pp. 279-280, 1 fig. Development of new gas and its application to signal lights and lightning arresters.

RAILWAY TIES

TREATED VS. UNTREATED. Superiority of Treated Ties Proved by a Nine Years' Test on Chicago & North Western Railway. Wood Preserving News, vol. 2, no. 5, May 1924, pp. 72-73. Seven varieties of timber, untreated and treated by three standard processes, installed on eight divisions show great economy of the preservation.

RAILWAY TRACK

CROSSING GATES. Electrically Operated Gates at Mount Pleasant Crossing, Southampton, Southern Railway, W. J. Thorrowgood. Ry. Gaz., vol. 40, no. 25, June 20, 1924, pp. 379-382, 4 figs. Results of power tests of gates; describes operating mechanism; emergency arrangements.

STRESS ON, RELATION TO LOCOMOTIVE DESIGN. Relation of Track Stress to Locomotive Design, C. T. Ripley. Ry. Age (Daily Edition), vol. 76, no. 32, June 14, 1924, pp. 1457-1553 and (discussion) 1553-1558, 10 figs. History of study of track stresses; describes stremmatograph and its use in measuring rail stresses and gives results of number of tests run on A. T. & S. F. Paper read before Am. Ry. Assn.

RAILWAY YARDS

FLOOD LIGHTING. Floodlighting Railroad Yards, E. G. McAllister. Elec. World, vol. 83, no. 26, June 28, 1924, pp. 1329-1332, 6 figs. Adoption of this practice has materially increased operating efficiency and safety on Norfolk & West. R. R.; details of installation; costs and operating results.

RAILWAYS

GOVERNMENT REGULATION. The Development of Railroad Regulation, F. McManamy. Ry. Age (Daily Edition), vol. 76, no. 34, June 17, 1924, pp. 1623-1627. Review of scope and effect of what U. S. Government has done in way of legislation affecting railroads; unification; provisions to stabilize credit. Paper read before Am. Ry. Assn.

MATERIALS SPECIFICATIONS. Report on Specifications and Tests for Materials. Ry. Age (Daily Edition), vol. 76, no. 34, June 17, 1924, pp. 1638-1639, 1 fig. New proposed form for specification of welding wire and rods; specifications for lumber; etc. Report presented to Am. Ry. Assn.

REAMERS

TAPER. Taper Machine Reamers, F. Cooke. Machy. (Lond.), vol. 24, no. 613, June 26, 1924, pp. 385-388, 8 figs. Deals with back piloting roughing reamers and finishing reamers; gives dimensions and formulas.

RECTIFIERS

MERCURY VAPOR. Power Factor of Mercury Vapor Rectifiers (Der Leistungsfaktor der Quecksilberdampf-Gleichrichter), G. W. Müller. Elektrotechnische Zeit., vol. 45, no. 24, June 12, 1924, pp. 624-626, 14 figs. Explains and calculates power factors; gives curves of power factors based on measurements of existing mercury vapour rectifier plants.

REFRIGERATING MACHINES

CO_2 COMPRESSORS. The Carbon Dioxide Compressor, H. J. Macintire. Refrig. Wld., vol. 69, no. 6, June 1924, pp. 16-18, 2 figs. Improvements in recent years have followed along same lines as in ammonia-compressor design.

PRE-COOLING IN. Pre-Cooling by Primary Evaporation and Multiple Effect Compression, as Applied to CO_2 Refrigerating Machines, Henry Brier. Cold Storage, vol. 27, no. 315, June 19, 1924, pp. 246-248, 6 figs. Shows that multiple-effect compression is pre-eminently suited for dealing satisfactorily with two evaporations in closed cycle of CO_2 refrigerating plant arranged for pre-cooling by partial or primary evaporation.

REFRIGERATION

BRINE AND DIRECT-EXPANSION COOLING. Comparison of Direct Expansion and Brine in Applying Refrigeration, H. J. Macintire. Chem. & Met. Eng., vol. 30, no. 26, June 30, 1924, pp. 1027-1029, 4 figs. Conditions governing application of cooling by two methods, with particular emphasis on brine cooling.

REFUSE DISPOSAL

DESTRUCTORS. Refuse Destructor with Unique Features. Contract Rec. & Eng. Rev., vol. 38, no. 26, June 25, 1924, pp. 641-644. Birmingham, England, has installed plant to handle 36,000 tons of refuse per year. Dust conveyed to barges by air pressure; special magnetic separator for cleaning clinker.

RIVETED JOINTS

STRESSES IN. Stresses in the Riveted Joints of Steel Structures (Die Beanspruchung des Nietverbindungen bei Eisenkonstruktionen), Mülleuhoff. Zentralblatt der Bauverwaltung, vol. 43, nos. 101-102, Dec. 19, 1923, pp. 607-611, 13 figs. Theoretical investigations and scientific measurements of stresses occurring. Great influence of quality of workmanship is emphasized.

RIVETING

MACHINES FOR. Giant Portable Compressed Air Riveting Machine, J. C. Hanna. Compressed Air Mag., vol. 29, no. 5, May 1924, pp. 861-863, 4 figs. Description of 150-ton riveter designed and manufactured by Hanna Eng. Wks., Chicago, Ill.; makes use of compressed air in forming rivet heads, and compressed air is also drawn upon in rotating machine as well as in tilting it. Character of work that it performs.

ROADS

BATES EXPERIMENTAL. Results and Application of the Bates Road Tests, Ider. West. Soc. Engrs.—Jl., vol. 29, no. 5, May 1924. Conclusions derived from experiments conducted by State Highway Department at Bates Test Road.

MAINTENANCE COST KEEPING. Establishing a Cost-Keeping System, J. L. Boulanger. Can. Engr., vol. 47, no. 1, July 1, 1924, pp. 113-115. Legislation and organization leading to establishment of accurate system of cost-keeping for road maintenance in Quebec province. Paper read at annual convention of Can. Good Roads Assn.

RESURFACING. Resurfacing and Surfacing Treatments and When They are Justified, Wm. A. VanDuzer. Cornell Civ. Engr., vol. 32, no. 6, Mar. 1924, pp. 78-79 and VI-VIII. Factors in determining resurfacing; preliminary maintenance steps; resurfacing macadam road; application of bituminous material; unbound macadam.

SAND-CLAY AND TOP-SOIL. Sand Clay and Top Soil Roads in Georgia, W. R. Neel. Eng. & Contracting (Roads & Streets), vol. 62, no. 1, July 2, 1924, pp. 16-18. Describes methods of construction and maintenance. From paper read before Am. Soc. Mun. Improvements.

ROADS, ASPHALT

BLACK-BASE-FOUNDATION. "Black Base" Construction in Mercer County, New Jersey, H. F. Harris. Eng. & Contracting (Roads & Streets), vol. 62, no. 1, July 2, 1924, pp. 39-42, 4 figs. Methods and cost of constructing bituminous base for sheet asphalt on heavy traffic highway.

SAND-ASPHALT. Design and Construction of Sand Asphalt Pavements, S. R. Murray. Mun. & County Eng., vol. 66, no. 6, June 1924, pp. 253-256, 9 figs. In author's opinion and based on his experience, this is least expensive type of durable road which can be built in sand community and should give good service for at least 12 to 15 years.

TYPES OF PAVEMENTS. The Design and Construction of Asphalt Pavements, P. Hubbard. Mun. & County Eng., vol. 66, no. 5, May 1924, pp. 221-229. Constituents and types of asphalt pavements; asphalt macadam; asphaltic concrete; sheet asphalt; hot-mix construction; asphalt block; foundations; subgrades; traffic tests on various designs of pavements.

ROADS, BITUMINOUS

SERVICE RENDERED BY. Bituminous Treatment Limitations, I. W. Patterson. Can. Engr., vol. 46, no. 25, June 17, 1924, pp. 621-625, 4 figs. Discussion of service rendered by surface treatments and bituminous macadam pavements under modern traffic; accounting for variable results. Paper read at conference on highway engineering, Univ. of Mich.

ROADS, CONCRETE

CRUSHING AND HEAVING OF BASES. A Study of Crushing and Heaving of Concrete Pavement Bases, R. M. Green. Mun. & County Eng., vol. 66, no. 5, May 1924, pp. 216-219. Change in practice; effect of rise in temperature; effect of change in moisture content; results of tests and conclusions.

DESIGN AND CONSTRUCTION. Developments in the Design and Construction of Concrete Highways, C. R. Ege. Cornell Civ. Engr., vol. 32, no. 9, May 1924, pp. 113-115, IX-X and XII, 4 figs. Independent investigations in various localities, which have made for rapid progress as well as variations in practice.

PONTAM CONSTRUCTION HELLICAL. Pontam Reinforced Concrete Pavements in France. Highway Engr. & Contractor, vol. 2, no. 1, July 1924, pp. 45-46, 2 figs. Pontam is made of reinforced concrete and has been laid chiefly in precast sections heretofore but may also be laid in same manner that other paving is put down, that is by continuous operation not limited to definite dimensions on areas. One of principal advantages of this method lies in fact that coefficient of wear of cast-iron braces is less than that of concrete between braces.

SURFACE FAULTS. Surface Faults in Concrete Roads, J. H. Walker. Surveyor & Mun. & County Engr., vol. 65, no. 1692, June 20, 1924, pp. 569-570, 12 figs. Causes of and remedy for grooving. Surface treatment of concrete.

ROAD CONSTRUCTION

METHODS. Modern Methods of Road Maintenance and Construction, T. Somers. Surveyor & Mun. & County Engr., vol. 65, no. 1691, June 13, 1924, pp. 551-553. Subsoil and surface drainage; foundations; materials; rubber paving; tar and bituminous macadam; asphalt macadam; construction of new roads; etc. Paper read before Instn. Mun. & County Engrs.

ROLLING MILLS

BUTT-WELD. New Butt Weld Mills at Indiana Harbor. Iron Age, vol. 914, no. 1, July 3, 1924, pp. 1-4, 5 figs. Mills, which are part of expansion program of Youngstown Sheet & Tube Co., will roll pipe from ⅛ up to 3 in. and will produce 400 tons daily.

PLATE MILLS. New Three-high Plate Mill at the Clydebridge Works of Messrs. David Colville & Sons, Ltd. English Elec. Jl., vol. 2, no. 6, Apr. 1924, pp. 311-319, 8 figs. Ilgner drive with slow-speed motor direct-coupled to mill and flywheel energy embodied in a separate motor-generator equalizer set. Plant designed to deal with 3,000 tons of plates per week.

S

SAND BLAST

SANDS FOR. Sand Blast Sand, W. M. Weigel. U. S. Bur. Mines, Reports of Investigations, no. 2615, June 1924, 6 pp. Discusses different grades of sand, mining and preparation, and utilization of waste blast sand.

SAND, MOLDING

STEEL CASTINGS. Moulding Sands for Steel Castings, A. Rhydderch. Foundry Trade Jl., vol. 29, nos. 406 and 407, May 29 and June 5, 1924, pp. 445-448 and 460-463, 6 figs. Refractoriness, naturally-bonded sand, examination of clay grades, stripping properties of sands, "compos," mechanical strength and permeability, controlling variables, standardization of testing methods, preparation, strength as affected by milling, drying of sands and compo molds, etc.

TESTING. The Testing of Molding Sands, H. Ries. Sibley Jl., Eng., vol. 38, no. 6, June 1924, pp. 136-138 and 156, 5 figs. Describes three tests thus far adopted, namely permeability, bonding-strength, and fineness test.

SCREWS

LEAD SCREWS, CHASING. Chasing Lead-screws, Chas. O. Herb. Machy. (N. Y.), vol. 30, no. 11, July 1924, pp. 883-884, 2 figs. Practice of Am. Tool Works Co.

SEWAGE DISPOSAL

IMHOFF TANKS. Operation of Imhoff Sewage Tanks, E. L. Waterman. Can. Engr., vol. 46, no. 26, June 24, 1924, pp. 655-657. Discusses essential features of tank; utilization of gas; careful and systematic operation necessary to obtain satisfactory results; schedule of operation generally followed. Paper read at conference on Sewage Treatment at Iowa State College.

SLUDGE DIGESTION. Separate Sludge Digestion, W. DeWitt Vosbury. Pub. Works, vol. 55, no. 6, June 1924, pp. 184-185. Advantages of separation of mechanical sedimentation and biological digestion as compared with combining both processes in septic or two-story tanks. Principles of design.

SEWER CONSTRUCTION

WINNIPEG. Construction of Renfrew Street Sewer, W. Aldridge. Can. Engr., vol. 46, no. 25, June 17, 1924, pp. 626-627, 2 figs. Large main sewer, 72 in. diameter, constructed in Winnipeg to relieve unemployment in winter; construction carried out in zero weather; Ferguson segment vitrified clay block chosen for sewer; is not effected by alkali ground water.

SEWERS

RUN-OFF COEFFICIENT. The Coefficient of Run-Off in Storm Sewer Design, Le Roy K. Sherman. Mun. & County Eng., vol. 66, no. 6, June 1924, pp 297-301, 3 figs. Describes procedure for determining percentage "C" of rainfall run-off for sewered areas by rational method.

SILICON STEEL

ANNEALING, EFFECT OF. Effect of Annealing on the Magnetic Properties of Sheets of Silicon-Steel Employed in Electrical Construction (Influence du recuit sur les propriétés magnétiques des tôles au silicium employées dans la construction électrique), R. Cazaud. Académie des Sciences—Comptes Rendus des Séances, vol. 178, no. 20, May 12, 1924, pp. 1610-1611. Results of a study of effect of varying conditions of annealing of rolled sheets of steel containing various percentages of silicon, on magnetic permeability, hysteresis losses, reluctivity, and Foucault losses.

SMOKE

FILTRATION OF. Electrical Smoke Filtration (Elektrisk gasrening, Cottrell-Möllers metod), Ake Dahlgren. Teknisk Tidskrift, vol. 54, no. 19, May 10, 1924, pp. 34-38 (Kemi), 11 figs. Historical review of development of art of smoke filtration and detailed description of electrical method proposed by Cottrell and a later improved upon by Möller. Number of photographs and figures showing recent installations in Europe.

SOLIDS

INTERNAL PRESSURES OF. The Internal Pressures of Solids, T. W. Richards. Am. Chem. Soc.—Jl., vol. 46, no. 6, June 1924, pp. 1419-1436, 1 fig. Brief analysis of nature of an approximate hyperbolic pressure-volume equation for solids; relation of this hyperbolic equation to an equation of state, in which each of the quantities has definite physical meaning; method which gives a plausible means of calculating internal pressure of isotropic elements from coefficient of expansion by means of a certain equation.

SPRINGS

MANUFACTURE OF. Quality a Vital Factor in Spring Manufacture, H. P. Armson. Can. Machy., vol. 31, no. 25, June 19, 1924, pp. 19-21 and 42, 4 figs. Practice at Hamilton plant of Wallace Barnes Co., work facilitated by equipment of specialized nature; unusual variety of sizes and materials in industry.

632

STEAM

SPECIFIC HEAT. The Specific Heat of Steam, H. L. Callendar. World Power, vol. 1, nos. 5 and 6, May and June 1924, pp. 274-280 and 324-328, 1 fig. May: Explains principles of new methods of research, and illustrates difficulties to be encountered in neighborhood of saturation, which have led to abandonment of many of older methods. June: Rational equation for steam up to its critical point; comparison with experimental results for CO_2

STEAM ACCUMULATORS

TYPES. High-, Medium- and Low-Pressure Accumulators (Der Gefällespeicher für Hoch-, Mittel-, und Niederdruck), C. Hiesselbach. Wärme, vol. 47, no. 17, Apr. 25, 1924, pp. 175-177, 4 figs. Discusses necessary conditions for economic working, describes Ruths and other types, also new type said to fill requirements.

STEAM METERS

TYPES AND CHARACTERISTICS. Meter Types and Their Characteristics, C. D. Zimmerman. Power Plant Eng., vol. 28 no. 13, July 1, 1924, pp. 696-698. Temperature recorders; instruments for boilers in small boiler plants and power plants; economizer instruments, turbine and miscellaneous instruments; improvements.

STEAM PIPES

COVERINGS, HEAT LOSS THROUGH. Heat Loss through Insulating Materials, R. H. Heilman. Power Plant Eng., vol. 28, no. 14, July 15, 1924, pp. 742-745, 1 fig. Method for calculating heat loss through pipe covering used for high steam temperatures. Outlined before A.S.M.E.

STEAM POWER PLANTS

ANTHRACITE-SLUSH-BURNING. Pulverized Anthracite Slush Burned at Lykens (Pa.). Power, vol. 60, no. 1, July 1, 1924, pp. 2-7, 9 figs. One of first power plants to utilize anthracite slush in pulverized form, coal mixed with 75 per cent water pumped 2,500 ft. under 400 ft. head and dewatered at plant; boiler plant contains six 5,000 and six 6,000-sq. ft. water-tube boilers; present generating capacity 6,400 kw.

ISOLATED PLANT VS. CENTRALIZED POWER. Slow-speed Steam Engines for Industrial Purposes, D. S. Capper. World Power, vol. 1, no. 6, June 1924, pp. 353-357, 6 figs. Deals with factors which combine to determine best method of power supply, namely first, cost, working cost, suitability to particular work, liability to stoppage, and insurance risk.

STEAM POWER PLANTS

PINE GROVE, PA. Electrical Features of Pine Grove Station, C. D. Gray and M. M. Samuels. Elec. Wld., vol. 84, no. 2, July 12, 1924, pp. 56-62, 13 figs. How electrical features of a large steam plant, built at mouth of a mine, remote from load center, differ from those of large city plant. Power house of East Penn Elec. Co., on Swatara Creek at Pine Grove, Pa., used to illustrate the various electrical features involved.

RECONSTRUCTION OF. Rebuilding an Old Steam Engine Plant. Power Plant Eng., vol. 28, no. 14, July 15, 1924, pp. 746-748, 7 figs. Description of plant of Stearns Light & Power Co., Ludington, Mich., which is being rebuilt. Owners bought steam under contract, used it to generate electric power and then sold it back to original owners after it had served its purpose.

STEAM TURBINES

CROSS-COMPOUND. The Cross-Compound Turbine Adaptable to a Variety of Conditions, E. H. Thompson. Power, vol. 60, no. 2, July 8, 1924, pp. 50-51, 1 fig. Applications of cross-compound principle indicate a growing appreciation of desirable characteristics of this type. Consideration of such units of to-day brings to light a number of ways in which this construction may be utilized and suggests an increasingly important field in future.

PARSONS LINE. Is the Parsons Line Straight or Curved? C. F. Merriam. Power, vol. 60, no. 1, July 1, 1924, pp. 8-10, 4 figs. Shows fallacy of assuming that Parsons line is necessarily straight.

REACTION. Largest Straight Reaction Turbine—How Internal Conditions Vary with Load, E. H. Thompson. Power, vol. 59, no. 26, June 24, 1924, pp. 1016-1019, 6 figs. Turbine of Brooklyn Edison Co.'s Hudson Ave. station contains no impulse velocity wheel and is entirely a reaction type; it is served by largest surface condenser so far constructed; conical cylinder bores give improved efficiency.

STEEL

ALLOY. *See Alloy Steels.*

BLOWHOLES. An Hypothesis on the Origin of Blowholes in Steel Ingots (Une hypothèse relative à l'origine des ruchages de soufflures dans les lingots d'acier), K.-G. Troubine. Revue de Métallurgie, Jl. 21, no. 5, May 1924, pp. 288-294, 6 figs. Author propounds theory on origin of blowholes. Translated from Russian.

COMBINED IRON AND. Notes on Combined Iron and Steel, H. H. Shephard. Metal Industry (Lond.), vol. 24, no. 24, June 13, 1924, pp. 577-578 and 588, 3 figs. Uses; composition; testing. Author's experience with "combined iron and steel" and "composite steel" is that failures of these materials are due chiefly to faults in manufacture of ingots or billets.

HIGH PRESSURES AND TEMPERATURES. Steel for Higher Pressures and Elevated Temperatures, V. T. Malcolm. Power, vol. 59, no. 26, June 24, 1924, pp. 1020-1021, 3 figs. Physical properties resulting from fine, dense structure.

MANGANESE. *See Manganese Steel.*

SILICON. *See Silicon Steel.*

SPECIAL, DEVELOPMENTS IN METALLURGY OF. Modern Developments in the Metallurgy of Special Steels, W. H. Hatfield. Iron & Coal Trades Rev., vol. 108, no. 2938, June 20, 1924, pp. 1055-1057. Discusses improvement in process of manufacture and manipulation resulting in increased reliability, modified and new compositions resulting in improved or new properties, and more intimate knowledge of properties of steel from designer's viewpoint. From paper read before Iron & Steel Soc., Empire Min. & Met. Congress.

STEEL, HEAT TREATMENT OF

DEFINITIONS. Comparison of Heat-Treatment Definitions. Mech. Eng., vol. 46, no. 7, July 1924, p. 435. Varying v ews held by committees of Am. Soc. Steel Treating, Soc. Automotive Engrs., and Am. Soc. Testing Matls.

HARDENING, CYANIDE PROCESS. Development of a Novel Cyanide Hardening Process, C. Ringstrom. Gas Age-Rec., vol. 53, no. 25, June 21, 1924, pp. 871-873, 3 figs. Describes new and economical process where use of proper fuel has proven necessary for complete success.

TEMPERING, OIL. Modification of Oil Tempering Bath Makes It a Success, E. Ogur. Fuels & Furnaces, vol. 2, no. 7, July 1924, pp. 647-649, 3 figs. Electric heaters at bottom of bath did not heat oil uniformly. Oil is now pumped through cylinder where it is brought to temperature by electrically heated grids.

THEORY AND PRACTICE. The Heat Treatment of Steel. Eng. Production, vol. 7, no. 142, July 1924, pp. 205-207, 5 figs. Discusses thermal critical points of steel, annealing, hardening and tempering, alloy steels, and some practical considerations.

STEEL, HIGH-SPEED

PROPERTIES AND TREATMENT. High Speed Steel, A. R. Page. Birmingham Met. Soc.—Jl., vol. 8, no. 10, pp. 447-463 and (discussion) 463-468, 14 figs. partly on supp. plate. Composition; theory of high-speed steel; microstructure; heat treatment; testing.

STEEL INDUSTRY

SHEET STEEL. Sheet Steel Industry, W. S. Horner. Blast Furnace & Steel Plant, vol. 12, no. 7, July 1924, pp. 319-325. Address of president of Nat. Assn. Sheet and Tin Plate Mfrs. before second annual meeting of sheet steel executives at White Sulphur Springs, W. Va., May 13, 1924.

STEEL WORKS

ELECTRIC POWER STATIONS FOR, AUTOMATIC. Automatic Electric Stations for Steel Mills, C. Lichtenberg. Iron & Steel Engr., vol. 1, no. 5, May 1924, pp. 252-256, 6 figs. Review indicating briefly operation of a typical automatic station and application of some of the equipments. Mentions several unique designs which are especially adapted for steel-mill service.

OPEN-HEARTH, CAR UPKEEP. Reducing Open Hearth Car Upkeep, C. L. Newby. Blast Furnace & Steel Plant, vol. 12, no. 7, July 1924, pp. 331-333, 7 figs. Anti-friction bearings now an important factor in production.

STOKERS

ELECTRIC DRIVE FOR. Motors and Control for Stoker Drive, R. Kelly. Elec. Jl., vol. 21, no. 5, May 1924, pp. 221-224, 7 figs. Discusses factors in selection of motors and control equipment.

UNDERFEED. Solving Clinker Problems with Underfeed Stokers, Jos. G. Worker. Steam Coal Buyer, vol. 1, no. 3, Mar. 1924, pp. 20-26, 4 figs. Shows progress made in securing better combustion and reducing clinkers in burning low-grade high-ash Mid-West coals.

STREET RAILWAYS

CAR MAINTENANCE. 217,728 Car-Miles per Pull-In, Robert M. O'Brien. Elec. Ry. Jl., vol. 63, no. 25, June 21, 1924, pp. 969-971, 5 figs. Well-organized system of inspection and repair has enabled New Orleans Public Service, Inc., in 3½ years to eliminate 95 per cent of pull-ins and cut maintenance costs to half.

SUBSTATIONS

CENTRAL-STATION SERVICE, APPLICATION TO. Application of Automatic Substations to Central Station Service in Metropolitan Districts, C. W. Place. A.I.E.E. Jl., vol. 43, no. 7, July 1924, pp. 634-641, 16 figs. Present trend to interconnection and installation of large-capacity stations, with changing character of city load, make relief of operating crew of a system of greatest importance. This can best be done by use of automatically-controlled substations in the various types of service. Equipment for each class of service is in successful operation showing great dependability and any particular problem of operating companies can be attached, keeping in mind certain fundamentals of design, construction and application.

RAILWAY. Automatic Substations for Supplying 1,500 Volts Direct Current to Suburban Railways, C. A. Butcher. A.I.E.E.—Jl., vol. 43, no. 7, July 1924, pp. 622-626, 3 figs. Important points which should be given careful consideration by those contemplating electrification.

SUPERHEATED STEAM

ADVANTAGES. Convenient Analysis of Modern Plant and Application to Ship Propulsion. Power, vol. 60, no. 1, July 1, 1924, pp. 18-20, 7 figs. Net plant efficiencies with stage bleeding or reheating which may be quickly obtained from simple diagrams with appropriate corrections.

SUPERHEATERS

DETACHABLE-TUBE. A New Detachable Tube Superheater. Engineer, vol. 137, no. 3572, June 13, 1924, pp. 667-668, 4 figs. Improved form evolved by Thos. Sugden.

DEVELOPMENTS. Superheaters and their Latest Developments, B. N. Broido. Combustion, vol. 11, no. 1, July 1924, pp. 42-45, 4 figs. Developments in design of superheaters to meet demands of modern power plants.

T

TAPS

MANUFACTURE. Taps and Tapping, H. Appleyard. Mech. Wld., vol. 75, no. 1954, June 13, 1924, pp. 366-367, 11 figs. Description of how taps are made.

TERMINALS, LOCOMOTIVE

TURNTABLES. A Remarkable Record in a Turntable Renewal. Ry. Age, vol. 76, no. 37, June 21, 1924, pp. 1759-1761, 5 figs. Southern Pacific bridge crews replace 70-ft. structure with 100-ft. in 1 hr. 46 min.

TERMINALS, RAILWAY

EFFICIENCY. Improvement of Efficiency on Terminals, Chas. Burlingame. St. Louis Ry. Club—Proc., vol. 29, no. 2, June 1924, pp. 31-42. Gives general discussion on topic.

TEXTILE MACHINERY

PARTS MANUFACTURE. Making Textile Machine Parts, H. R. Simonds. Foundry, vol. 52, no. 14, July 15, 1924, pp. 537-541, 14 figs. Complicated parts are made of gray-iron and malleable castings and offer interesting problems to foundrymen; find application for roll tamp and special stripping machines.

TIME STUDY

COMPILED FORM OF. Making and Using Time Studies, H. K. Reed. Indus. Mgt. (N.Y.), vol. 68, no. 1, July 1924, pp. 29-34, 5 figs. Deals with compiled form of time study.

TOLERANCES

LIMITS. Requirements of a System of Limits, M. E. Steczynski. Sibley Jl. Eng., vol. 38, no. 6, June 1924, pp. 139-146 and 155-156, 5 figs. Fundamental principles involved in logical development of satisfactory system.

TRACTORS

FARM. The General Purpose Farm Tractor, F. A. Wirt. Agricultural Eng., vol. 5, no. 5, May 1924, pp. 102-104, 1 fig. An efficient source of mechanical power that can be used not only for customary tractor drawbar and belt operations, but also, when properly equipped and adjusted, for efficient cultivating and other light drawbar work now more commonly done with horses. Why next big development in tractor industry is expected to be a general-purpose tractor.

TRAFFIC

CONGESTION RELIEF. Projects for Relief of Traffic Congestion in New York and Its Environs, E. P. Goodrich and H. M. Lewis. Am. City Mag., vol. 31, no. 1, July 1924, pp. 29-31, 2 figs. Summary of causes of congestion and of important specific suggestions for relief.

TRANSFORMERS

Cooling. Transformer Cooling, E. R. Stauffacher. Jl. of Elec., vol. 52, no. 11, June 1, 1924, pp. 451-463, 25 figs. A new development of A.B.O. type transformer; description of some cooling systems; experiments on cooling transformer oil in automobile type radiators; automatic reclosing circuit breaker; status of automatic a.c. substations; relays and relay application; calculating tables for calculating short-circuit currents on system; proposed change in transformer polarity; etc.

Insulation Tests. Insulation Tests of Transformers as Influenced by Time and Frequency, F. J. Vogel. A.I.E.E.—Jl., vol. 43, no. 7, July 1924, pp. 627-633, 26 figs. Types of insulation failure and methods of testing. Application of data to tests on apparatus.

TRANSPORTATION

Metropolitan Planning for Future Requirements. Metropolitan Planning for Future Transportation Requirements, J. R. Bibbins. Engrs. & Eng., vol. 41, no. 5, May 1924, pp. 119-135, 22 figs. General survey of growth, trends and conditions; what some cities have done and have not done; the transportation plan.

Street Railways vs. Trolley- and Motor Buses. Operation of Tramways, Trolley Omnibuses and Motor Omnibuses. Surveyor & Mun. & County Engr., vol. 65, no. 1689, May 30, 1924, pp. 509-510. Advantages and disadvantages of the three systems. Report of Lond. County Council Highways Committee.

TUNNELING

Methods. Advantageous Practices in Tunneling, C. S. Hurter. Du Pont Explosives Service Bul., no. 10, Apr. 1924, 8 pp., 11 figs. Some practical ways of securing greater progress in tunnel operations and lower costs.

V

VALVES

Materials, Tests of. Tests on Valve Materials Made Under Working Conditions. Automotive Industries, vol. 51, no. 2, July 10, 1924, pp. 110-112, 1 fig. Results of tests of poppet-type valves for aircraft engines, made of different materials, described in paper presented to Am. Soc. for Testing Matls. at Atlantic City by J. B. Johnson and S. A. Christianson.

VARNISHES

Photomicroscopic Record of Exposures. Photomicroscopic Records of Varnish Exposures, H. A. Gardner. Paint Mfrs.' Assn. of U. S.—Sci. Section, no. 204, June 1924, 11 pp., 17 figs. Presents photomicrographs that illustrate permanent records made from month to month as deterioration proceeds may be made.

VENTILATION

Air-Duct Calculations. Duct Work in Connection with Ventilation, C. W. Kimball. Architectural Forum, vol. 41, no. 1, July 1924, pp. 33-35. Describes duct system and different materials used.

VIADUCTS

Plate-Girder. Construction Features of the Spring Street Viaduct, Atlanta, J. H. Reed. Contractors' & Engrs.' Monthly, vol. 8, no. 5, May 1924, pp. 47-49, 3 figs. Plate girder structure coated with gunite has eliminated grade crossings and expedited vehicular traffic.

VOLTAGE REGULATION

Regulators. The Application of the Saturated-Core Reactor and Regulator, D. K. Blake. A.I.E.E.—Jl., vol. 43, no. 7, July 1924, pp. 604-607, 4 figs. States briefly use of voltage regulators and reactors in transmission and distribution systems and mentions operating requirements which might be best met by use of saturated-core type regulators or reactors.

W

WAGES

Minimum-Wage Laws. Minimum Wage Legislation in Canada and its Economic Effects, J. W. MacMillan. Int. Labour Rev., vol. 9, no. 4, Apr. 1924, pp. 507-537. Applies almost exclusively to women and girls and is administered by independent boards or commissions; its main effect on wages has been to reduce inequalities previously existing within single industry, while it has not tended to reduce higher wages; it has had marked effect in reducing hours of work and making them more uniform, and no deleterious effect on employment has been noted; relations between employers and workers have been improved.

WATER MAINS

Costs of. Costs of Water Supply Mains of Four Different Materials, D. H. Maury. Eng. News-Rec., vol. 92, no. 25, June 19, 1924, pp. 1052-1054, 1 fig. Estimates for long lines and large sizes of cast-iron, steel, concrete and wood-stave pipe. Abstract of paper and discussion before Am. Water Wks. Assn., May 1924.

WATER POWER

Canada. Utilization of Water Power in Canada. Can. Engr., vol. 46, no. 24, June 10, 1924, pp. 601-604, 1 fig. Review of water-power development in relation to coal production, importation and consumption in Canada. Water-power development has relieved situation, particularly in acute fuel area by saving in coal consumption. See also Eng. Wld., vol. 24, no. 5, May 1924, pp. 287-289.

Water Powers of Canada, J. B. Challies. Eng. Jl., vol. 7, no. 7, July 1924, pp. 323-358, 44 figs. partly on supp. plate. Their nature, extent and administration, a national review. Paper read at World Power Conference.

Flathead River. Power Possibilities of the South Fork, Flathead River, B. E. Jones and E. E. Jones. Eng. News-Rec., vol. 93, no. 3, July 17, 1924, pp. 96-98, 4 figs. Large reservoir site makes economic development of power possible. Increased height of Flathead Lake objectionable.

WATERPROOFING

Asphalt for. United States Government Master Specification for Asphalt for Waterproofing and Dampproofing. U. S. Bur. Standards, Circular No. 160, Master Specification No. 85, Apr. 8, 1924, 9 pp., 3 figs. Specification officially adopted by Federal Specifications Board on Dec. 29, 1923, for use of Departments and Independent Establishments of the Government in purchase of asphalt for waterproofing and dampproofing.

Coal-Tar Pitch for. United States Government Master Specification for Coal-Tar Pitch for Waterproofing and Damp Proofing. U. S. Bur. Standards, Circular No. 155, Master Specification No. 83, Apr. 8, 1924, 11 pp., 3 figs. Specification officially adopted by Federal Specifications Board on Dec. 29, 1923, for use of Departments and Independent Establishments of the Government in purchase of coal-tar pitch for waterproofing and damp proofing.

WATER TREATMENT

Chlorination. Report on Experimental Use of Chlorine Gas in the Chlorination Plant at Köpenick, I. Reichle and M. Weldert. Gesendheits-Ingenieur, vol. 47, no. 24, June 14, 1924, pp. 237-243. Addition of small quantities of chlorine gas has given good results.

WATER WORKS

Planning. Planning Municipal Water Works System. Can. Engr., vol. 46, no. 26, June 24, 1924, pp. 636-638. Points that have to be considered when town contemplates establishing water works system; services of competent engineer must be secured; pumping plant and distributing system must be large enough for increase in population.

WELDING

Aluminum Castings. Hints for Welding an Aluminum Casting, E. E. Thum. Am. Welding Soc.—Jl., vol. 3, no. 5, May 1924, pp. 26-30, 3 figs. Details of actual practice.

Car and Locomotive Parts. Autogenous and Electric Welding. Ry. Age (Daily Edition), vol. 76, no. 36, June 19, 1924, pp. 1718-1723 and (discussion) 1723-1728, 17 figs. Notes on rolled steel wheels; low-carbon-steel; wrought iron; cast iron; torch cutting; recommendations; regulations for welding. Report of committee presented before Am. Ry. Assn.

Electric. *See Electric Welding.*

Manganese Steel. *See Manganese Steel.*

WHARVES

Steel-Pile. Steel Sheetpiling in Salt Water at Havana, Cuba. Eng. News-Rec., vol. 92, no. 26, June 26, 1924, pp. 1086-1088, 4 figs. Particulars of new bulkhead for wharf consisting of steel sheetpiling topped with a concrete wall which extends 2 ft. below water line; steel piling given two coats of red oxide paint; rock is channeled to receive piles. Notes on construction methods and plant.

WINDING ENGINES

Mines. Electric Winding-Engines, D. Weir. Instn. Min. Engrs.—Trans., vol. 67, Pt. 2, May 1924, pp. 129-143 and (discussion) 143-148, 11 figs. Advantages of electric drive for winders; description of different types of winders; controllers; etc. Winding diagrams.

WIRE ROPE

Manufacture. How Wire Rope Is Manufactured and Used and How Its Life May Be Prolonged in Mine Service, L. W. Bevan. Coal Age, vol. 25, no. 24, June 12, 1924, pp. 872-875, 5 figs. Physical and chemical tests constantly check wire-drawing process; saturated core acts as cushion and lubricant; care of ropes and their application to mine-hoist problems.

Z

ZINC

World Conditions. World Zinc Conditions As At 1st May, 1924, A. J. M. Sharpe. Am. Zinc Inst.—Bul., vol. 7, no. 5, May 1924, pp. 14-16. Zinc market in Germany, Poland, Upper Silesia and Great Britain.

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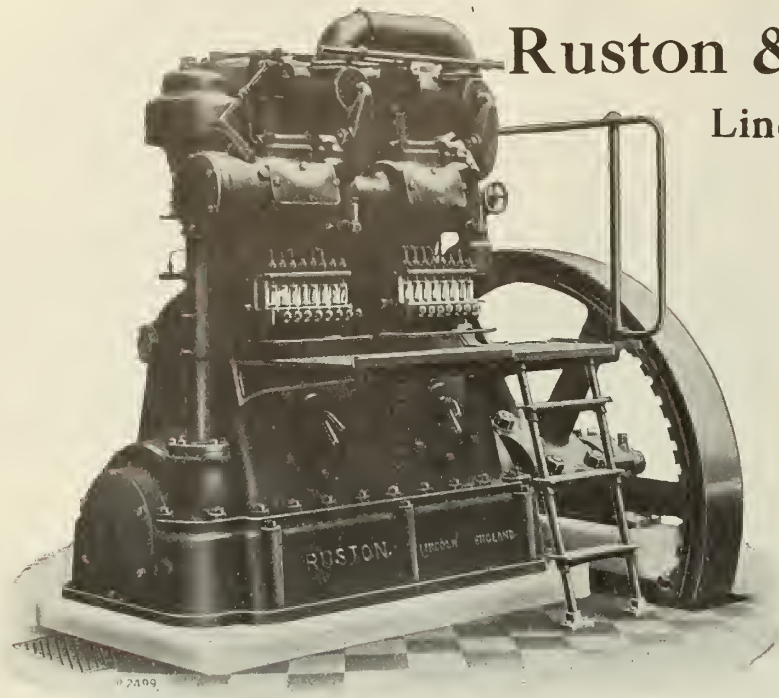

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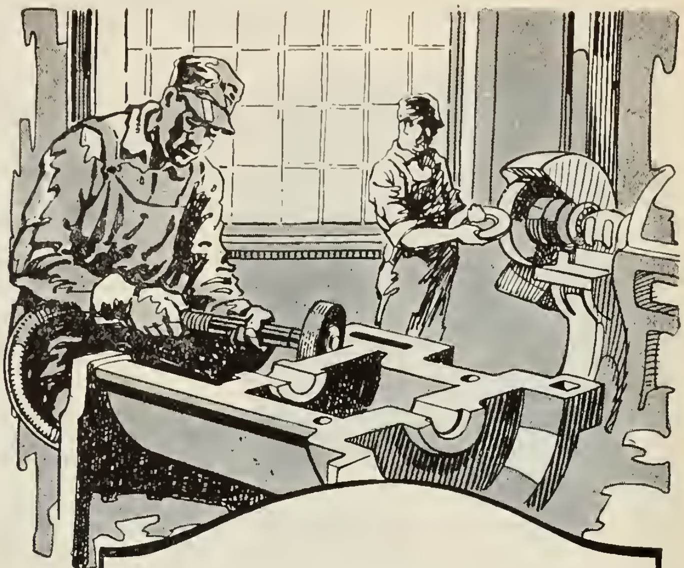

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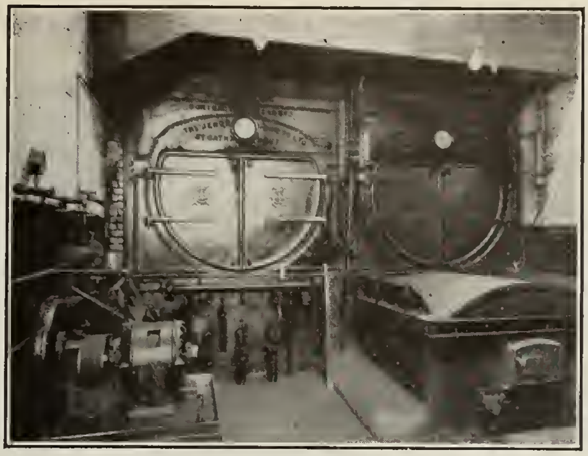

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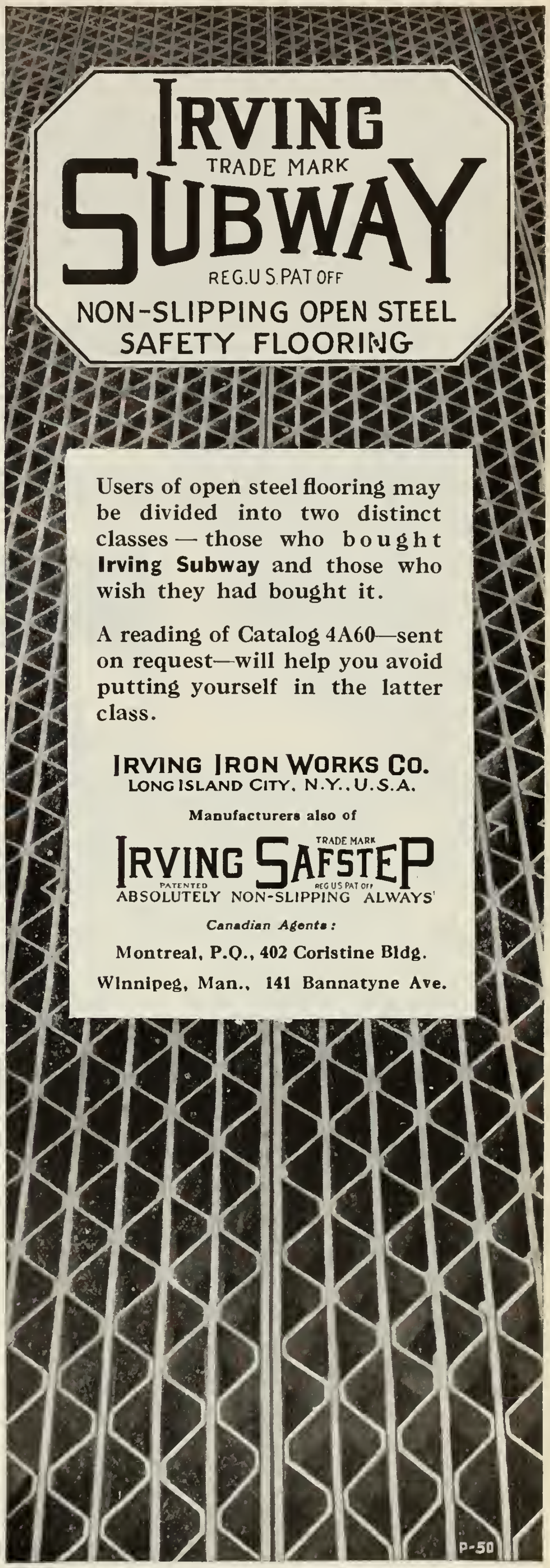

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A Selected List of Equipment, Apparatus and Supplies

For Alphabetical List of Advertisers see page 50

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Midwest Canada Limited.
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Double Hot-Dip Galvanized

Photo courtesy, Bird & Son, Hamilton

Wherever power is distributed by overhead systems there you see Peirce and Slater pole line hardware; particularly Peirce Secondary Racks are replacing other less efficient methods of distribution.

Sold through Electrical Distributors

N. Slater Co., Limited
Hamilton, Ontario

Store in HORTON Tanks

Flat-bottomed tanks fabricated at our Bridgeburg plant are in service in all parts of the Dominion. Our long experience in tank building has won for us the good will of Canadian tank buyers.

We are prepared to handle promptly your inquiries on elevated tanks, flat-bottomed tanks, gas holders, riveted-up tanks, penstocks, smokestacks and all kinds of plate work. Our new plant is in full operation and enables us to handle orders with the utmost dispatch.

335

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Estimates and tenders furnished on all classes of Construction Work.

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WE SOLICIT YOUR ENQUIRIES

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TENDERS

CITY OF KITCHENER

Sealed tenders plainly marked as to contents, will be received by the undersigned until 5 P. M., Wednesday, September 3rd, 1924, for the supply of material and construction of a reinforced concrete Lock Joint Pipe Sewer 42" and 48" diameter and 4,000 feet long.

Plans and specifications may be seen, and tender forms obtained at the office of the City Engineer.

The City is not bound to accept lowest or any tender.

STANLEY SHUPE, B.A.Sc.,
City Engineer.

DEPARTMENT OF RAILWAYS AND CANALS

WELLAND CANAL

NOTICE TO CONTRACTORS

SEALED TENDERS, addressed to the undersigned and marked "Tender for Repairs to East Pier at Port Maitland" will be received at this office until *12 o'clock noon (standard time), on Wednesday, September 10, 1924.*

Specifications and form of contract to be entered into can be seen on and after this date at the office of the Chief Engineer of the Department of Railways and Canals, Ottawa, and at the office of the Superintending Engineer, Welland Canal, St. Catharines, Ont.

An accepted bank cheque on a chartered bank of Canada for the sum of $20,000, made payable to the order of the Minister of Railways and Canals, or War Loan Bonds of the Dominion of Canada, to the same amount, or War Loan Bonds and accepted cheques, if required to make up the amount, must accompany each tender which sum will be forfeited if the party tendering declines entering into contract for the work at the rate stated in the offer submitted.

The cheque or bonds thus sent in will be returned to the respective contractors whose tenders are not accepted.

The cheque or bonds of the successful tenderer will be held as security or part security, for the fulfilment of the contract to be entered into.

The lowest or any tender not necessarily accepted.

By order,

J. W. PUGSLEY,
Secretary.

Department of Railways and Canals,
Ottawa, August 23, 1924.

INDEX TO ADVERTISERS

Members are urged to consult The Journal's advertising pages.

PROFESSIONAL CARDS

THE REES RoTURBo

A Centrifugal Pump for Any Service

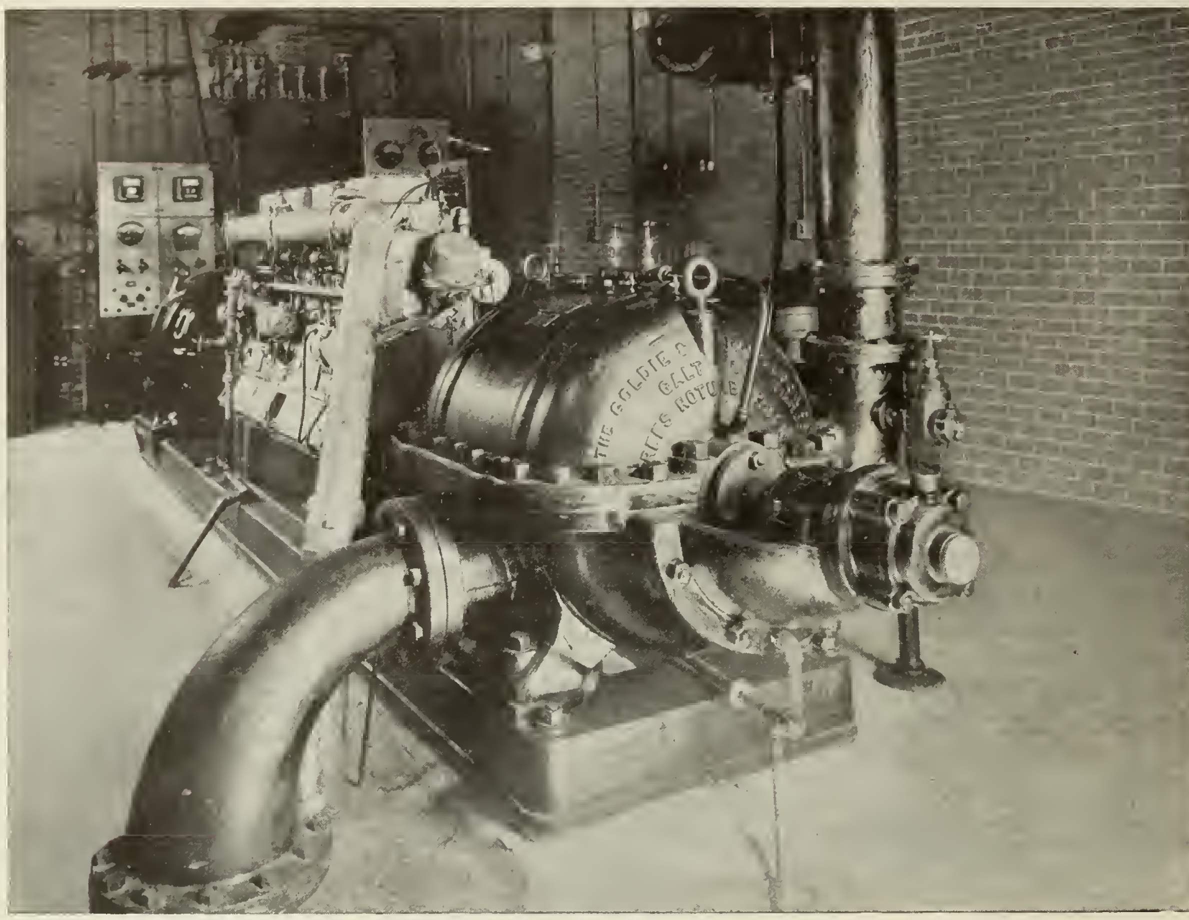

Illustration shows the Waterworks Pumping Station at Oakville, Ont., equipped with Rees Roturbo Pump, Gasoline Engine Driven.

REES RoTURBo PUMPS are in operation in Hundreds of Waterworks and Industrial Plants all over Canada. They are giving real service as evidenced by the many letters of recommendation we have received.

Write us for Catalogues, Prices, etc. if interested.

Babcock-Wilcox and Goldie-McCulloch, Limited

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EASTERN BRANCH:
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ALGOMA STEEL CORPORATION LIMITED

SAULT STE. MARIE, ONTARIO

The Algoma Steel Corporation
LIMITED

announce to their customers and the Canadian trade that they can supply all standard sections of ANGLES from 6″ x 6″ down to 1¼″, ZEE BARS for cars builders and general purposes; small and large ROUNDS, SQUARE and FLAT BARS. The quality of the product is already well known to the trade, and is exclusively steel made by the Open Hearth process, and can be furnished in all grades from the softest rivet stock to high carbon special spring material.

MARK OF
ALGOMA
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QUALITY

Order from us and you will get both quality and prompt service. A trial is convincing.

Our extensive warehouse facilities ensure prompt delivery.

Open Hearth - Alloy Steels

Chrome-Vanadium,
Chrome-Nickel,
Nickel-Steel

All of these steels we supply in Hot Rolled Bars or Billets.

WE ALSO FURNISH

Blooms, Billets, Slabs,
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Concrete Reinforcing Bars,

STEEL RAILS, Open Hearth quality, all sections from 12 lbs., to 105 lbs., per yard.

Angle Bars, 100% Joints,
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PIG IRON

Basic, Foundry, Malleable.

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THE JOURNAL OF THE ENGINEERING INSTITUTE OF CANADA

"TO FACILITATE THE ACQUIREMENT AND INTERCHANGE OF PROFESSIONAL KNOWLEDGE AMONG ITS MEMBERS, TO PROMOTE THEIR PROFESSIONAL INTERESTS, TO ENCOURAGE ORIGINAL RESEARCH, TO DEVELOP AND MAINTAIN HIGH STANDARDS IN THE ENGINEERING PROFESSION AND TO ENHANCE THE USEFULNESS OF THE PROFESSION TO THE PUBLIC"

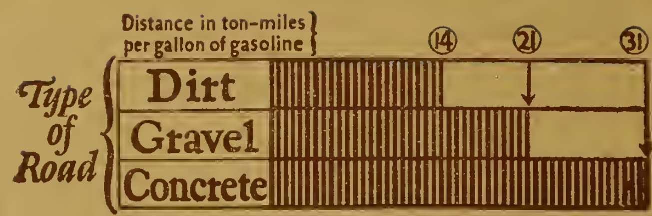
THE ENGINEERING INSTITUTE OF CANADA FOUNDED 1887

OCTOBER 1924

PUBLISHED MONTHLY BY THE ENGINEERING INSTITUTE OF CANADA

AT 176 MANSFIELD STREET, MONTREAL

Vol. VII No. 10



Concrete Saves Gasoline

You will find the simple chart, shown above, worth more than a passing glance. It points out a lesson in economy directly connected with every motorist's check book.

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Note that a gallon of gasoline carries you more than twice as far on a Concrete Road as on a dirt road and one-third farther than on gravel.

In addition to being skid-proof, rigid and lowest in maintenance cost, Concrete Roads assure a marked saving in gasoline. Their all-around economy goes a long way toward paying for them.

Send for our booklet R-3 which tells many other interesting things about Concrete Roads. Write this office for your copy.

PORTLAND CEMENT ASSOCIATION

111 West Washington Street
CHICAGO, ILL., U. S. A.

A National Organization to Improve and Extend the Uses of Concrete

OFFICES IN 29 CITIES

ONE HUNDRED YEARS 1824 1924 OF PORTLAND CEMENT

Reads Direct to Ten-thousandths

The Super-Micrometer

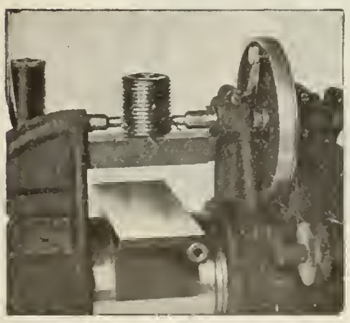
With this new measuring instrument different operators of average skill can make measurements which will agree to the nearest ten-thousandth of an inch.

IN precision manufacturing the ten-thousandth part of an inch is now the accepted unit of linear measurement.

A micrometer in fair condition can be depended upon to measure thousandths, but repeated tests by the most highly skilled toolmakers and inspectors prove that micrometer readings cannot be relied upon to the ten-thousandth.

The P. & W. Standard Measuring Machine is relied upon to sub-divide ten-thousandths but these machines are too fine to place in the shop for general use.

The Super-Micrometer covers the intermediate field because it will duplicate measurements to the nearest ten-thousandth. Simple construction, ruggedness and relatively low price allow its use in the toolroom or workshop where preliminary measurements can be made on work in process, assuring its acceptance by the final inspector.



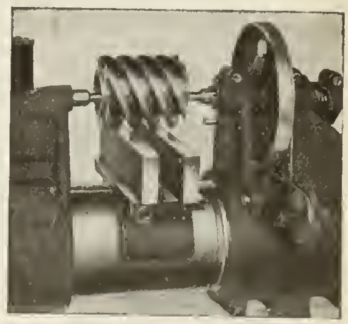
Measuring a Thread Plug

Accuracy is assured by the use of Standard Inches which are guaranteed permanently accurate to five-millionths of an inch.

The measuring screw is hardened, seasoned, ground and lapped. Our experience in developing the P. & W. Standard Measuring Machines enables us to produce a thread that is accurate under the most rigid and careful methods of inspection.

Whether the work be the making of precision gages or the building of machines to close limits, the Super-micrometer offers a definite help in obtaining the desired accuracy. Measuring Range 0 to 8 inches.

The new Circular No. 291 describes it fully.



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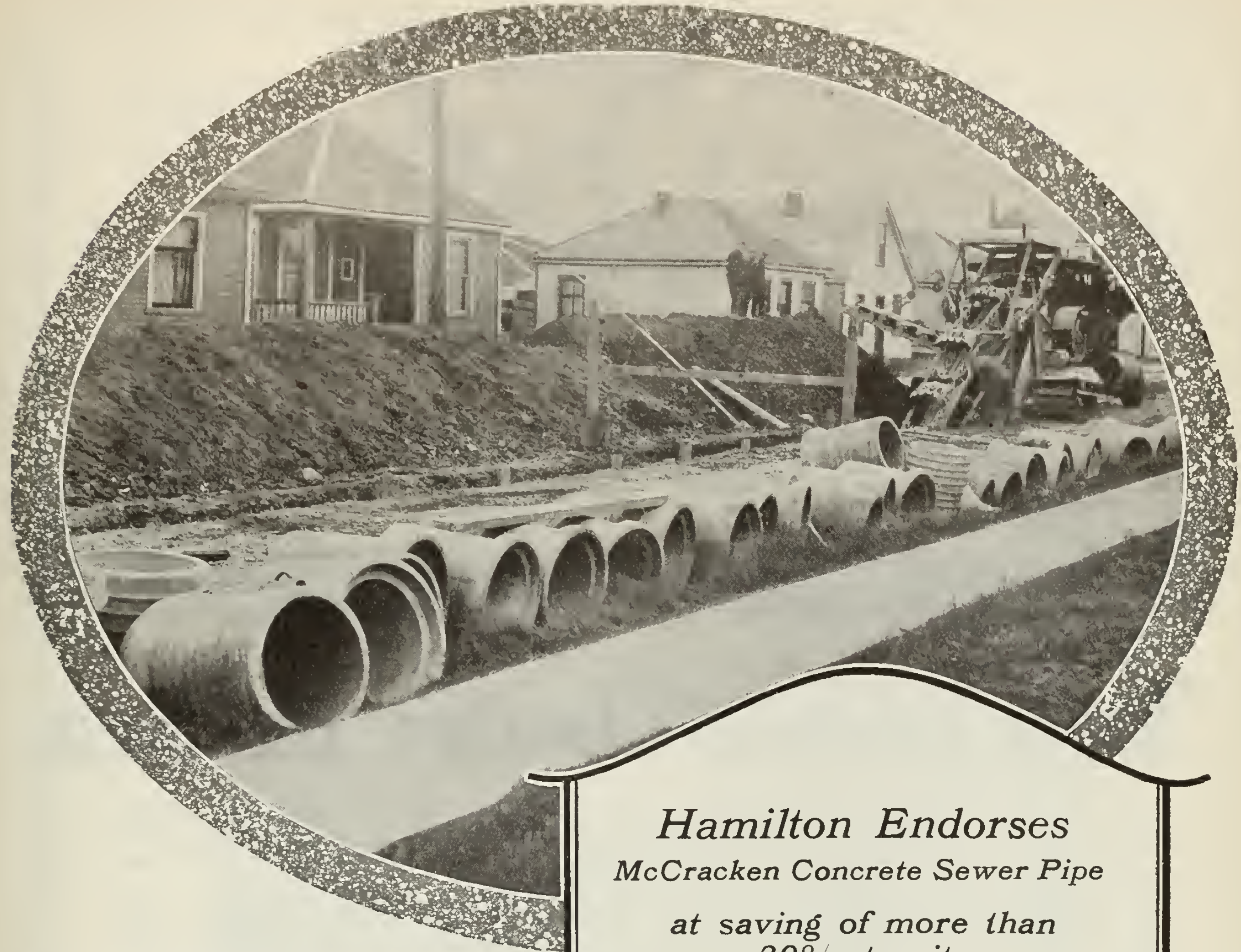
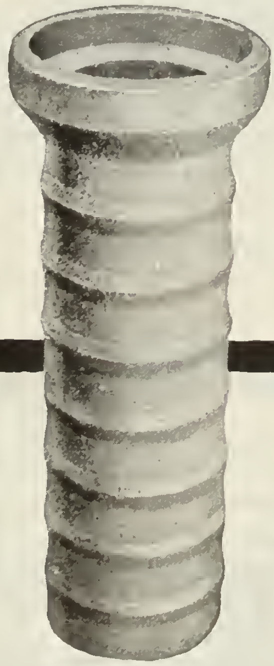
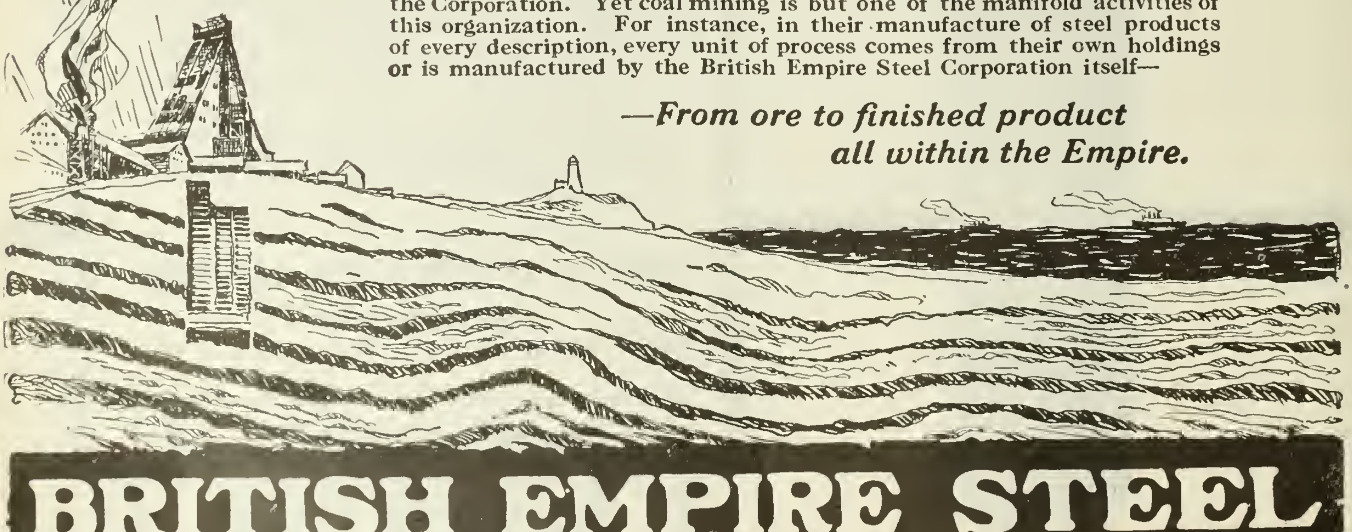


McCracken Concrete Sewer Pipe being laid on Weir Ave., Hamilton, Ontario, November 20th, 1923, to convey sanitary sewage and storm water.





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Provincial Government Buildings at Edmonton, Alberta

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No ordinary valves would do for this stately Government Building. Quality was the determining factor so, naturally, the choice was genuine "Jenkins"—the Valves with the quality that is world famous.

High grade materials, coupled with Jenkins design and workmanship make "Diamond" Trade marked Valves the choice where quality is essential.

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SINCE 1864

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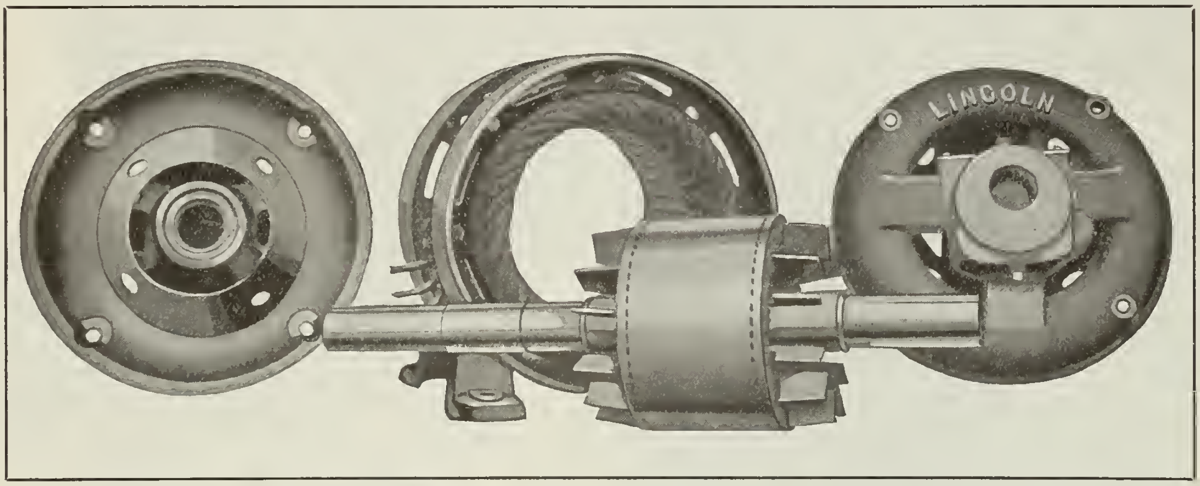
THE BEST TESTIMONIALS ARE UNINTENTIONAL

We recently received a letter from an old and valued customer which begins as follows:—

"We have in our factory one of your motors which we use for testing, which is, according to the nameplate, 5 H.P. 3 phase 25 cycles 550 volts, 1500 R.P.M. We do not know the efficiency of this motor at different loads but have run it as high as 10 H.P. in testing centrifugal pumps".



Parts of New Type D Lincoln Motor.

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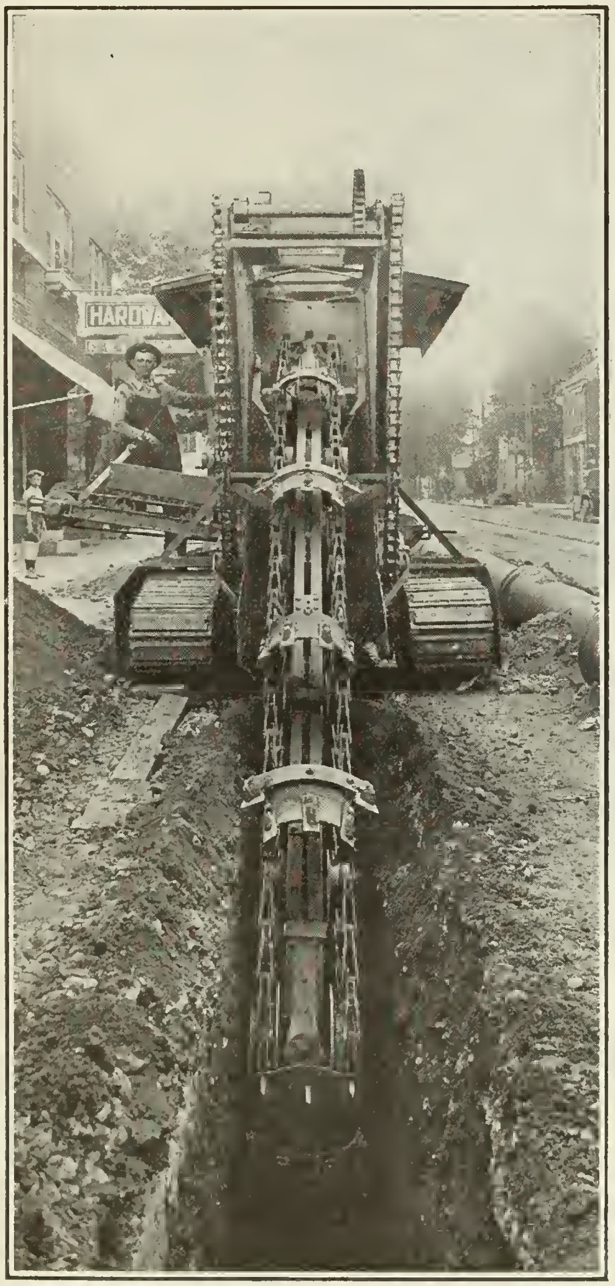

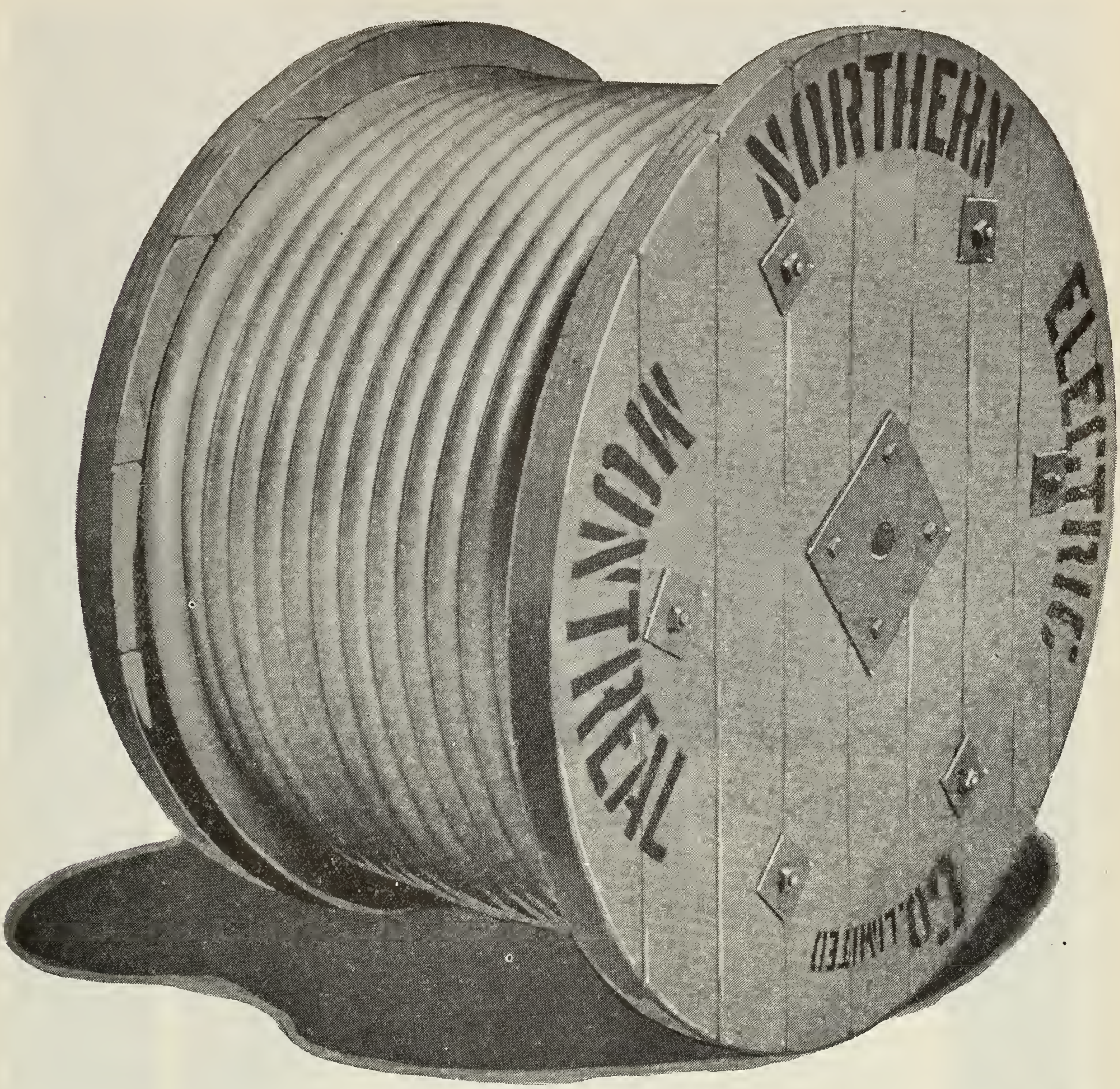

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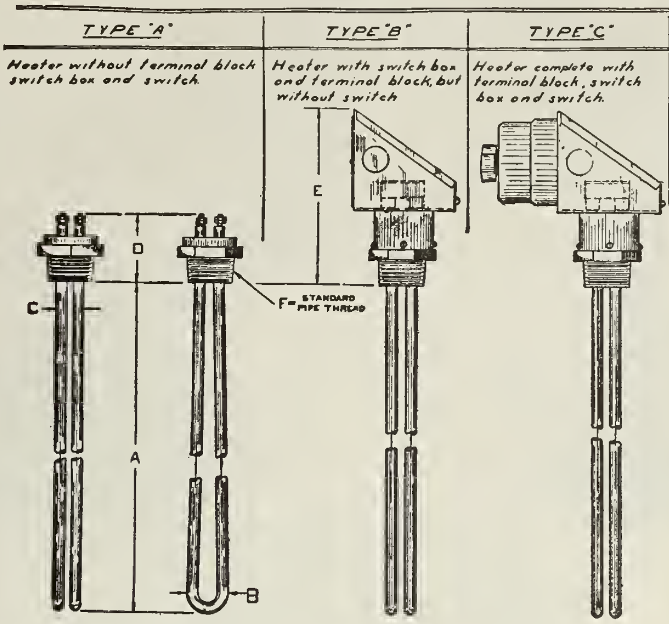

Catalog No.	Type	Watts	Volts	No. of Heats	Dimensions (in inches) A	B	C	D	E	F
W34–A	A	2000	220	3	11	$1\frac{11}{32}$	1	$2\frac{3}{4}$	6	$1\frac{1}{4}$
W34–B	B									
W34–C	C									
W35–A	A	3000	220	3	17	$1\frac{11}{32}$	1	$2\frac{3}{4}$	6	$1\frac{1}{4}$
W35–B	B									
W35–C	C									
W36–A	A	5000	220	3	22	$2\frac{1}{4}$	$1\frac{3}{8}$	$2\frac{11}{16}$	6	2
W36–B	B									
W36–C	C									
W37–B	B	10000	220	3	22	$1\frac{11}{32}$	1	$2\frac{3}{4}$	6	3
W37–B	B									
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AN ideal construction for use in large liquid heating applications. Made in three stages of assembly to meet all requirements.

Type "A" is the bare heating element for use where switch box construction is built on the job.

Type "B" is equipped with switch box but no switch, for use on continuous service and to be controlled by service switch.

Type "C" is the complete heater with three heat switch, a popular heater for heating hot water in Apartment blocks and Institutions. It is also used in many forms of Industrial application.

A special 10 Kw. water heater is made for very large installations. Cat. No. W37.

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REQUIRED CAPACITIES FOR VARIOUS TANKS

Diameter of Tank	Length of Tank	Volume Imp. Gals.	Kilowatt Capacity
20″	4′	55.0	3
20″	5′	70.8	3
24″	5′	100.0	5
24″	6′	116.6	5
30″	4′	125.0	5
30″	5′	150.0	7
30″	6′	183.0	8
30″	7′	208.2	10
30″	8′	246.0	10
36″	6′	262.3	10
36″	10′	437.5	20
42″	6′	358.0	15
42″	7′	416.0	20
42″	8′	479.0	20
42″	10′	600.0	25
42″	12′	720.0	30
42″	14′	834.0	35

The above table shows volume in gallons and suitable kilowatt capacities for tanks most commonly used in apartment blocks. To give best satisfaction, tanks should be covered in each case.

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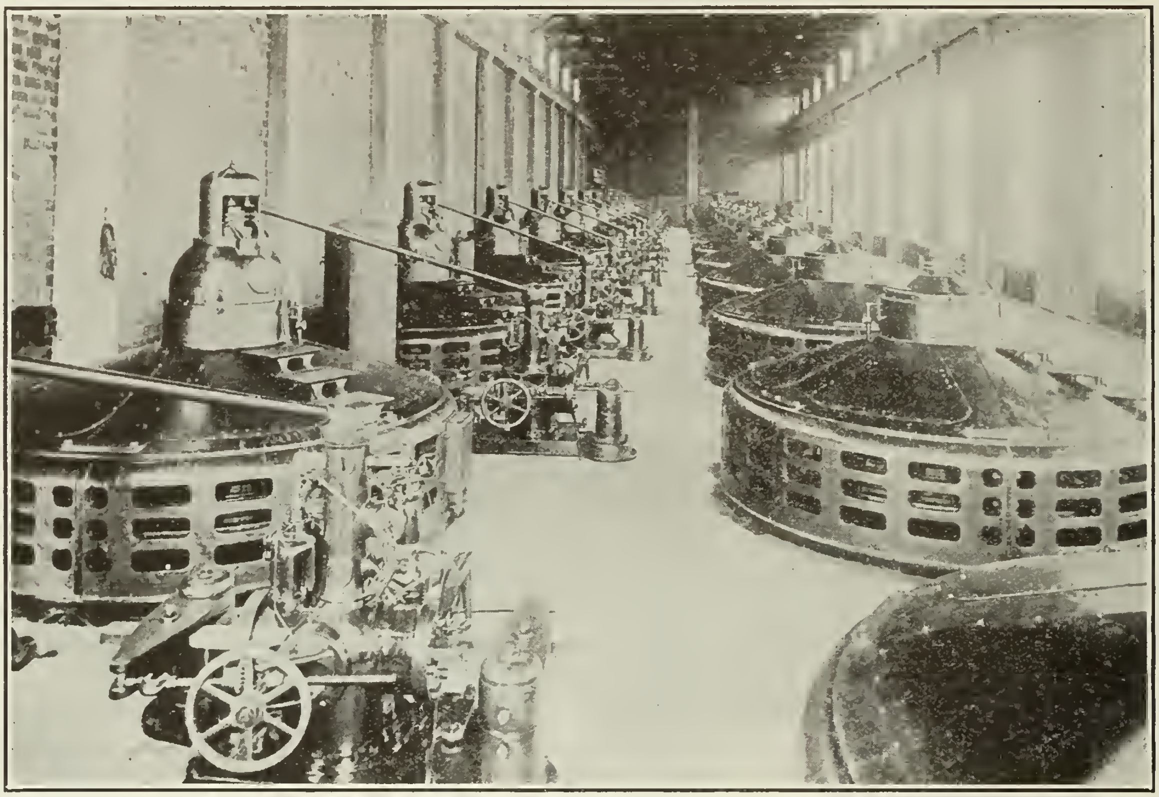
Vertical Water-Wheel Generators



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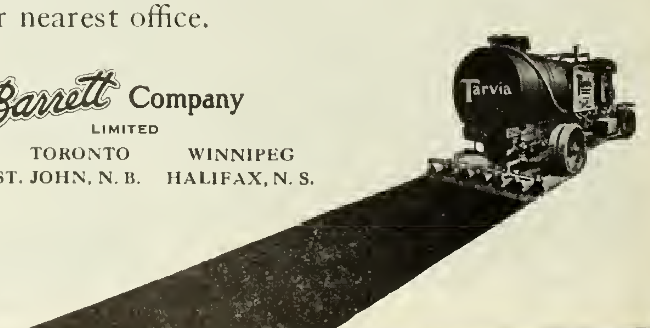
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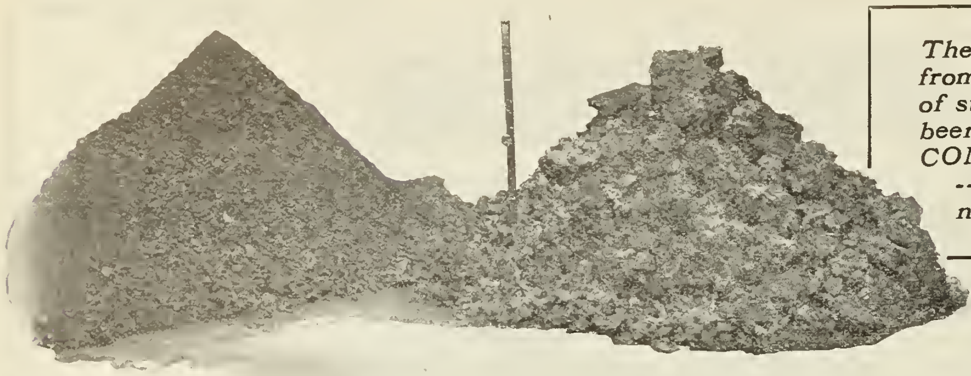

These two piles of ashes are from the same coal and type of stoker. The left pile has been passed through the COMBUSCO Ash Conveyor ---That on the right has not.

THE COMBUSCO ASH CONVEYOR

THE COMBUSCO ASH CONVEYOR consists of a double chain scraper or drag conveyor moving in a trough containing water, the trough being located under the ash discharge of the stoker. Ashes and clinker fall from the stoker or through the clinker grinder directly into this trough and are quenched and immediately carried along by the conveyor and deposited in a large storage hopper or car.

The Combusco Ash Conveyor, as distinguished from the usual conveyors used for this purpose, operates continuously as opposed to periodic or intermittent operation. It is made in two forms of types—the single and duplex. The conveyor is primarily intended for use with stokers in which the ash is discharged continuously and automatically, such as multiple retort stokers with clinker grinders and travelling or chain grate stokers. It has demonstrated in a practical manner that much of the cost of high basements may be saved—that dust, smoke, hot gas and clouds of steam are unnecessary—that the removal of ashes may be the cleanest job in the plant.

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- Dispenses with manual labor.
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- Improves the efficiency of the boilers by preventing air leakage.
- Operates automatically and continuously.
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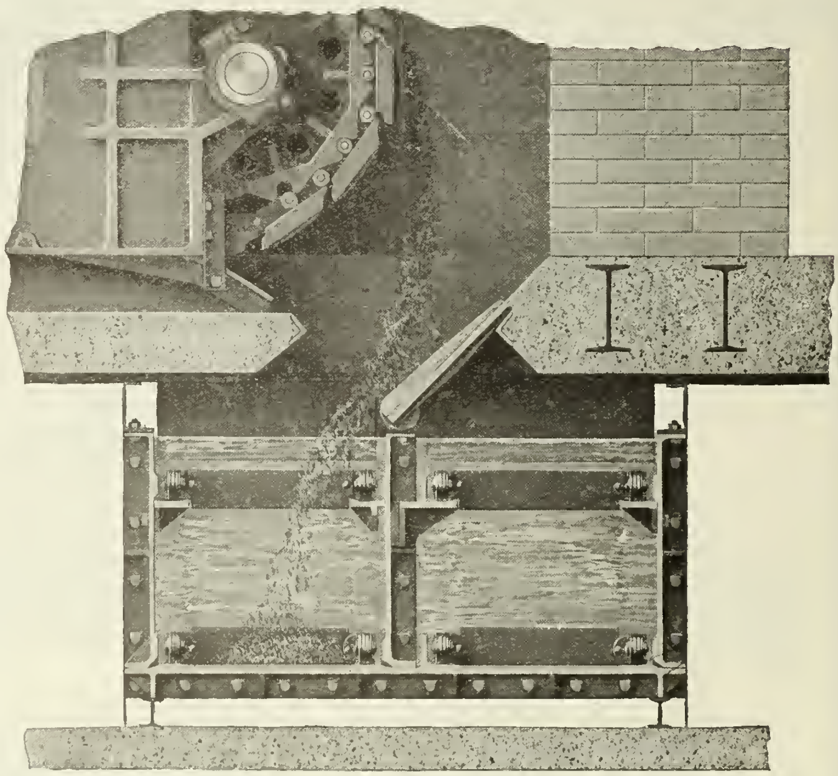

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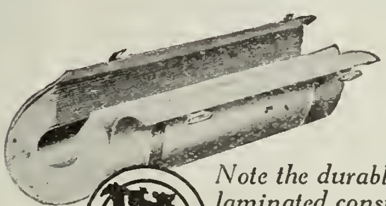

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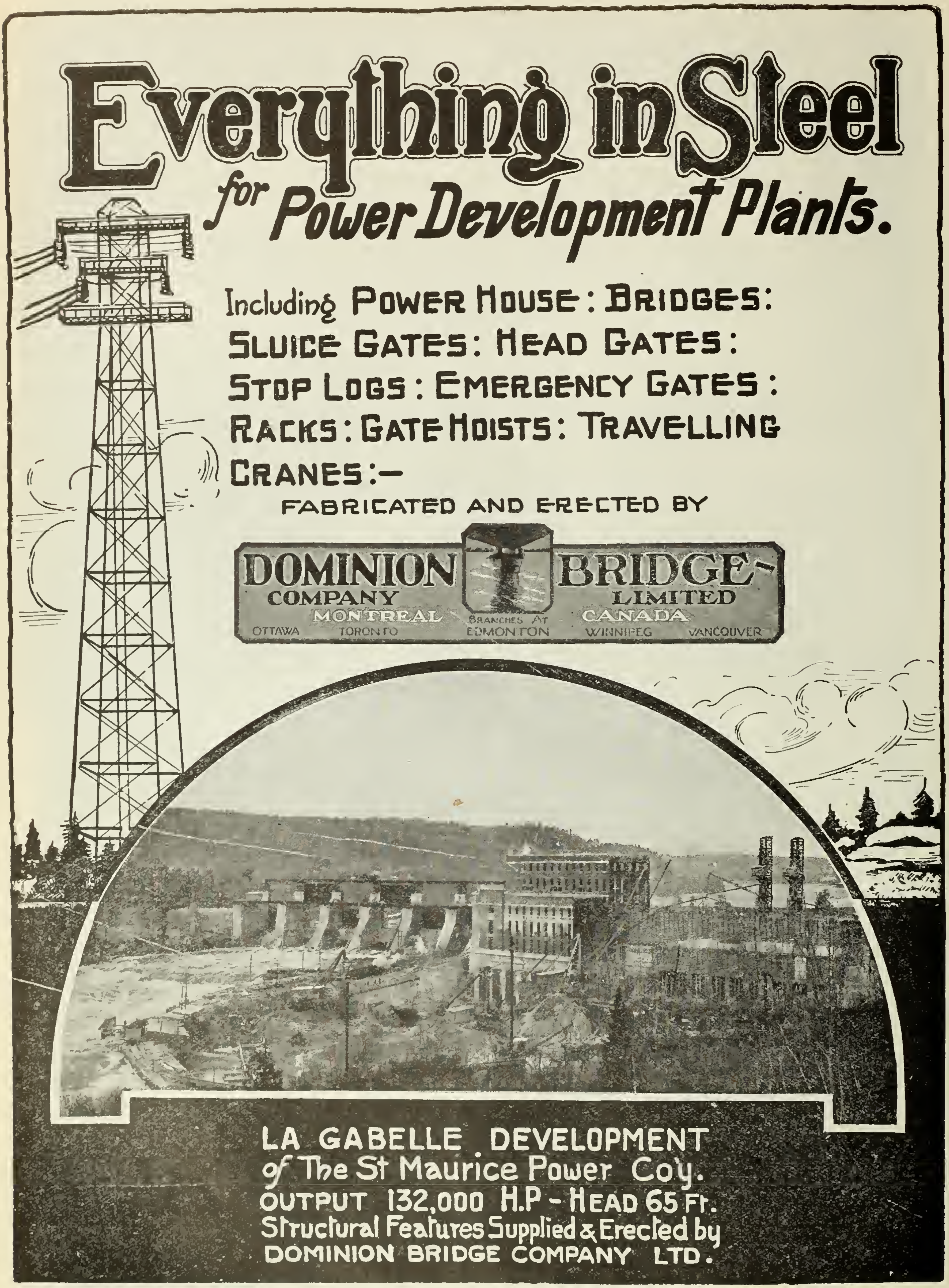
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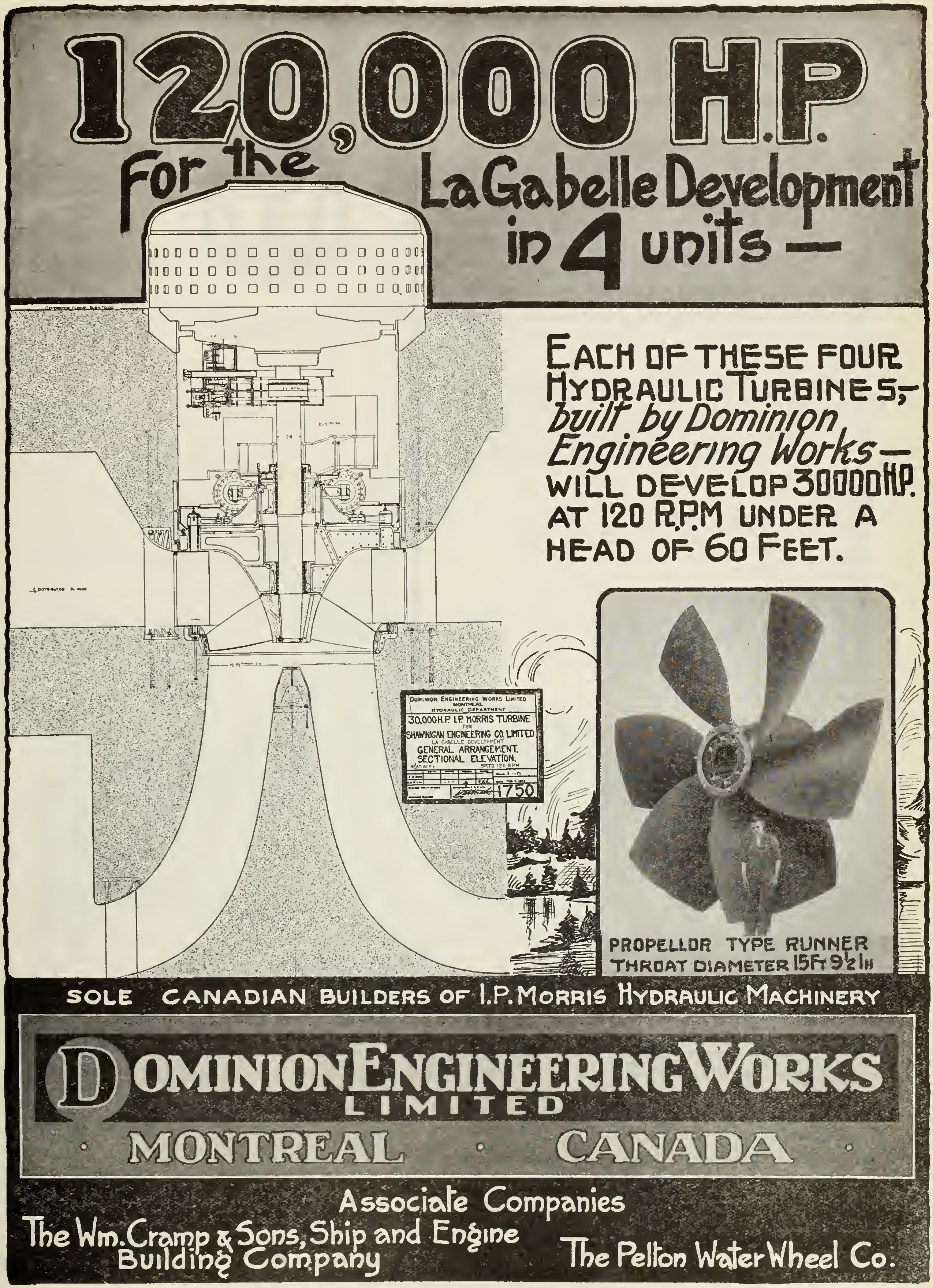

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OF CANADA

OCTOBER 1924

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Hydraulic Efficiency Tests on 43,000-h.p. Unit by the Gibson Method and the Allen Method

A Description of Tests Carried on Under Operating Conditions.

W. R. Way, B.Sc., Jr.E.I.C.

Chief System Operator, Shawinigan Water and Power Company.

Paper read before the Montreal Branch, The Engineering Institute of Canada, January 17th, 1924.

For economical operation of hydro-electric power stations it is very essential that all the machinery be operated most efficiently at all times. In order to obtain ideal conditions, the percentage of total losses to total output should be kept to a minimum. The losses which occur in hydro-electric power stations may be divided into two classes, namely: — (1) Losses in electrical equipment, such as generators and transformers; (2) losses in the turbine and water passages.

Progress in the art of manufacturing of generators and transformers has advanced to such a stage of development that it is quite common to hear of generators having an efficiency of 97.5 per cent and transformers of 99 per cent efficiency when operated at their rated capacity.

In regard to the hydraulic turbine and water passages such general figures of efficiency cannot be given on account of the fact that so many variables exist. The length and design of the water passages, the available head, the size and type of the turbine and the specific speed of the runner are factors which are generally quite different in various developments. These factors have a direct bearing on the hydraulic efficiency.

Method of Measuring Quantity of Water

The measurement of the efficiency of a turbine may be regarded in the same manner as that of any piece of machinery, namely the measurement of the input and the output. The measurement of the output would suggest using some sort of brake to measure the torque, but on account of the enormous output of present day turbines, it would be practically impossible to provide a brake of sufficient capacity. Furthermore, it is generally impossible to disconnect the generator from the turbine. The output of the turbine, therefore, is usually measured by means of a wattmeter or watthour meter in the generator terminals, a correction being made for the losses caused by the generator.

The input to the turbine necessitates accurate readings of the quantity of water and the head. Many methods are available at the present time for measuring large quantities of water but it will be found on investigation that most of them have such a limited field of application or are so expensive or liable to inaccuracies that their use is prohibitive. Among the numerous methods commonly known may be mentioned the following:—

(1) The weir
(2) Venturi meter
(3) Current meter
(4) Color velocity method
(5) Salt solution, titration or chemical method
(6) Pitot tube
(7) Moving screen

Coincident with the many recent developments in the design and construction of features to improve the efficiency and operation of hydraulic turbines, came the introduction of two vastly improved methods for measuring the large quantities of water required by present day units. These methods are the "Pressure-Time" or Gibson method and the "Salt-Velocity" or Allen method.

Both these methods have been extensively described in the technical press, but in order to appreciate their application in this particular case, it will be necessary to give a general description of the theory of each method and a more detailed description of the application.

Description of Installation Under Test

On October 11th, 1922, the Shawinigan Water and Power Company placed in service, in their No. 2 Power House at Shawinigan Falls, a modern hydro-electric unit of large capacity. The turbine was built by the Dominion Engineering Works at Lachine, Que. The manufacturers' rating of this unit is 41,000 h.p., at 145-foot head at 138.5 r.p.m. It is of the single-runner vertical-shaft type with General Electric thrust bearing. The original Moody draft tube with the short cone is used.

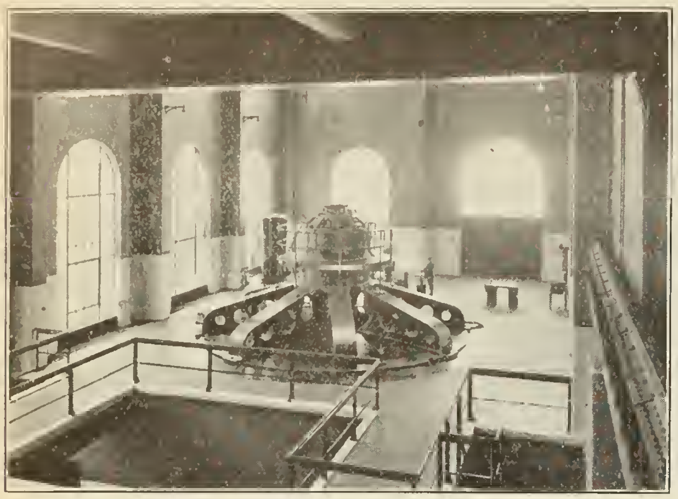

Figure No. 1.—View of 43,000-h.p., Unit Installed at Shawinigan Falls.

The generator was supplied by the General Electric Company of Schenectady, N.Y. The rating of the generator is 40,000 kv.a., at 75 per cent power factor, 11,000 v., 3-phase, 60-cycles. (See figures Nos. 1 and 6).

Tunnel

In order to supply water to this unit, a concrete lined tunnel approximately 500 feet long was constructed. It is of circular cross-section 20 feet in diameter. Approximately 75 feet of the lower portion is lined with steel plate 1⅜ inch thick. At the lower end of the tunnel is a Johnson valve with an inlet of 20 feet in diameter and an outlet of 13 feet in diameter. As the entrance to the spiral casing of the turbine is 14 feet in diameter, a short conical section 25 feet long connects the spiral casing to the Johnson valve.

Inlet

The upper end of the tunnel terminates in a gathering tube which is supplied through five inlets. Four of these inlets are of rectangular cross-section 12 feet wide by 16 feet high, while the fifth inlet is of elliptical section, 11-foot horizontal axis and 16-foot vertical axis. The five inlet tubes vary in length and dimension before joining the gathering tube to the tunnel. The design of the intake was developed by Messrs. R. D. Johnson and P. Wahlman of New York. While the dimensions appear to be very irregular the function of the intake is to cause a uniform flow of water in each of the five inlets, and to accelerate the water gradually from the forebay to the penstock with a minimum of disturbance. This peculiar design of intake presented an unusual case in the application of the Gibson method.

In order to determine whether the unit would meet the guarantee of the manufacturers as regards efficiency, the writer was instructed to conduct efficiency tests on the generator and turbine. The tests on the generator were made jointly by engineers of the General Electric Company and the writer. The deceleration method was used to separate the various losses. Oscillograms were taken to show wave shape and short circuit conditions. It is interesting to note here that the generator showed an efficiency of 97.59 per cent at 35,000 kv.a., 100 per cent power factor, 11,000 v., and at normal speed. However as this paper deals mainly with the hydraulic tests no detailed description of the electrical tests will be given.

The Gibson Method for Measuring the Flow of Water in Closed Conduits

The Gibson method* was developed and perfected by Norman R. Gibson, M.E.I.C. hydraulic engineer of the Niagara Falls Power Company, Niagara Falls, N.Y. The basic principle of this method is found in Newton's Second Law of Motion, which states that "Change of Momentum is proportional to the impressed force and takes place in the direction in which force acts". When expressed in symbols this law becomes:—

$$\text{Force} = \text{Mass} \times \text{acceleration}$$

$$\text{or } F = Ma = \frac{MdV}{dT}$$

where F is the force applied to a body of mass M and $\frac{dV}{dT}$ is the differential coefficient of velocity with respect to time and which is the resulting acceleration or retardation of the moving body due to the action of this force.

A second principle used in this method is the relation between change of pressure and change of velocity of a column of water enclosed in a conduit expressed in terms of the rate at which the change of pressure is transmitted. The transmission of the change of pressure occurs by the propagation of waves and the rate of transmission is the velocity of the pressure waves. (A full description of this principle may be found in Mr. Gibson's paper in the transaction of the American Society of Civil Engineers, page 707, 1920. A more detailed description of the Gibson method was given in New York on December 6th, 1922, by Mr. Gibson before the American Society of Mechanical Engineers.)

In applying these principles practically, consider a typical hydraulic installation consisting of a penstock of length L and mean area A, through which water is passing at a velocity V. The velocity may be kept constant by controlling the turbine gates. Assume the turbine gates are closed gradually in a time T so that the velocity of the water is gradually reduced to zero when the gates are finally closed.

During the closure of the gates, the pressure at a given point rises and after the gates are closed the pressure falls and rises in periodic waves until damped out by friction. This rise of pressure as the gates are being closed is the result of the forces exerted to stop the flow of the mass of water in the pipe. If, therefore, the mass of the water in the pipe is known and the time taken to stop the flow and the average force required in doing so are measured, the original average velocity of the column of water before the closure may be readily determined.

In order to show this in a condensed form, it will be more convenient to resort to symbols.

Let a = Mean area of water passage square feet.
L = Length of pipe in feet.
V = Mean velocity of flow of water in pipe.
T = Time taken to stop flow in seconds.
P = Average pressure in feet of water exerted in stopping the flow in time T.
g = Gravitational constant, — foot-pound units.
w = Weight of cubic foot water.

The mass of water in pipe = length × area × $\frac{w}{g} = \frac{L\,a\,w}{g}$

Average rate of retardation = $\frac{V}{T}$ *f. p. s. s.*

Average force exerted to stop flow = pressure × w × area = $P\,a\,w$

Substituting the original formula of:—

$$F = M\frac{dv}{dt}$$

$$P\,a\,w = \frac{L\,a\,w}{g} \times \frac{V}{T}$$

*Method and Apparatus Pat. Canada 1919-1920, U.S. Oct. 13 and Nov. 22, 1921 Sweden 1923, Norway 1923, other patents applied for in foreign countries.

$$\text{or } V = \frac{P\,g\,T}{L}$$

It is necessary, therefore, in order to find the original velocity to determine $P\,g\,T$ and L. L is the measured length of the pipe, while g is the acceleration due to gravity, which is well known. The quantities P and T are, therefore, the ones required. It is not necessary, however, to determine separately the value of P and T and what is done is to produce a diagram, the net area of which is proportional to the product of P and T.

It will now be in order to describe the apparatus devised by Mr. Gibson which is used to obtain the diagram.

Apparatus

The apparatus consists of U-tube, one end of which is connected to a ¼-inch piezometer plate on the penstock while the other end is open to the atmosphere by means of a ¼-inch riser of uniform bore steel tubing. The length of the steel riser depends, of course, in the difference in elevation of the forebay and of the tap in the penstock. On the lower portion of the other side of the U-tube, a glass tube of uniform bore is placed and held in position by suitable stuffing boxes.

Sufficient mercury is poured into the U-tube so that under running conditions, the pressure in the penstock will maintain the level of the mercury at a point about 3 or 4 inches from the upper end of the glass tube. It is very essential that all air be excluded between the mercury column and the penstock connection. Small valves and blowoff cocks are provided for this purpose.

It may be seen, therefore, that the difference in level of the mercury column is a measure of the pressure existing in the penstock at the point where the tap is made. Changes of pressure in the penstock produce corresponding changes in the level of the mercury column. If the ratio of the areas of the riser and glass tube be known, it follows that records showing changes of level of the top of the mercury in the glass tube will bear a direct relation to corresponding pressure changes in the penstock itself.

In order to record such pressure changes, photographic methods are used. A box is used containing a photographic lens and manually operated shutter, and a pendulum which may be adjusted to beat seconds. One end of this box has a longitudinal slot with a metal shrouding which is clamped to the glass portion of the U-tube. The other end of the box is slotted also and is arranged to receive a revolving drum which may be revolved in a light proof cylinder. On the outside surface of the revolving drum there may be attached, as required, a sensitized photographic film in which the pressure time diagram is to be recorded. Suitable shutters are provided so that transportation of the "loaded" film holders may be made from the dark room to the point where the apparatus is set up.

The drum to which the film is secured may be revolved at a uniform rate by means of a small mechanical motor through suitable pulleys. Constant speed is maintained by means of a governor and flywheel. A mercury vapor lamp is located opposite the glass tube so that light may pass through the water to the film but is stopped by the column of mercury. Therefore, in combination with the revolution of the drum with the film attached and the rise and fall of the mercury column due to changes in pressure in the penstock, an actual photograph is obtained showing the change of pressure conditions, as they actually exist in the penstock.

Calibration

The calibration of the apparatus is performed just before the test with the equipment set up in place. A film is wrapped around one of the drums and the drum placed in the holder and secured in its position on the box. The valve connecting the penstock to the U-tube is closed, an exposure is made on the film and the distance of the top of the mercury from the top of the riser is measured by means of a special micrometer to a 1/1000th of an inch. By means of air pressure the mercury column is depressed slightly and a similar set of measurements taken. This procedure is continued in successive intervals until the working range of the mercury in the glass tube has been covered. The film is then taken out and developed. Now the changes in level of the mercury in the riser tube are divided by changes in level of the mercury in the glass tube as scaled off the film, the quotient being the average value of R or the ratio of the areas of the two tubes. This method of calibration also includes any corrections that might be necessary for parallax or variation in scale.

l = length of diagram in inches.
M = s.p.g. of mercury.
S = value of 1 sec. in inches on diagram.
r = No. of inches on diagram representing 1 foot water $= \frac{1}{12}\left\{M(R+1) - 1\right\}$

$$\text{Now } P = \text{mean rise of pressure} = \frac{\text{area of diagram}}{l \times r}$$

$$T = \frac{\text{length of diagram}}{\text{value of 1 sec. in inches on diagram}} = \frac{l}{S}$$

Substituting these values in the former equation for velocity.

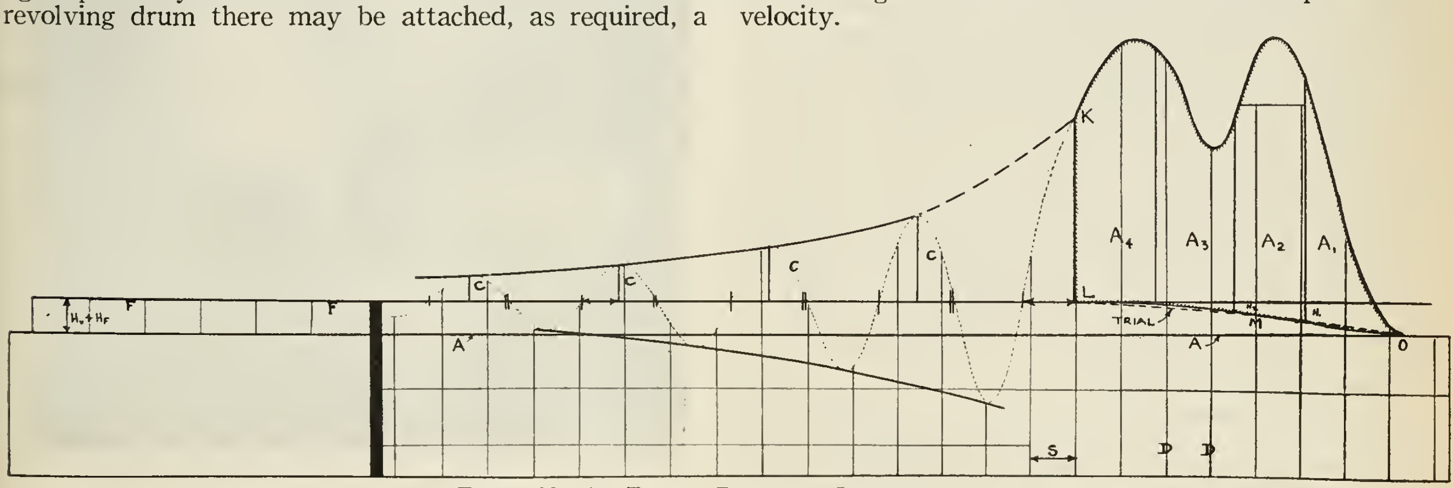

Figure No. 2.—Typical Diagram, Gibson Method.

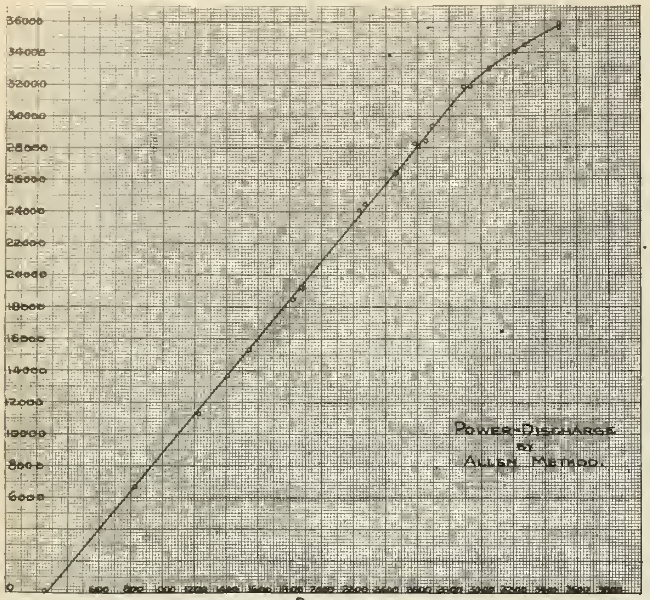

Figure No. 3.—Power Discharge Curve by Gibson Method.

$$V = \frac{P\,g\,T}{L} = \frac{A}{lr} \times \frac{g}{L} \times \frac{l}{S} = \frac{Ag}{r\,s\,L}$$

$\frac{g}{r} = K$ for a given glass tube and riser.

Therefore $V = \frac{K\,A}{S\,L}$

Where A = net area of the diagram in sq. in.
K = a constant.
L = length of penstock along from Gibson tap to point of relief in forebay.
S = value of 1 sec. in inches on diagram.

The quantity = Q = weighted mean area of penstock ×

$$V = a_1\,V = \frac{K\,A\,a_1}{S\,L} = \frac{K\,A}{S \Sigma \frac{Lv}{q}}$$

Where q is an assumed quantity and v the velocity based on the assumed q at the various sections if any in the penstock, weighted in respect to the length of each section.

The actual operation of recording one of these diagrams during a test on an hydro-electric unit is very interesting. Observers are stationed for reading head and tail race, gate opening, power output, etc. A bell signal system, controlled by the operator of the Gibson apparatus, ensures that all readings will be synchronized. The operator of the Gibson apparatus places the loaded film holder in position, the shutter on film holder and lens being closed. The governor is now adjusted so as to keep constant load on the generator. At a given instant, the operator rings two bells and all parties concerned begin to take readings. Approximately two minutes later, conditions still being steady, the operator opens the film holder shutter, starts the motor and pendulum and opens the shutter on the lens. About two seconds later he rings one bell. This is the signal for the switchboard operator to close the turbine gates. These gates are closed in 8 to 20 seconds, depending upon conditions, the load being automatically transferred, the other generators operating in parallel.

During the operation the pendulum keeps swinging to and fro in front of the lens, cutting off of the light each second and causing a break to be recorded on the film at regular intervals. This shows how accurately the time may be obtained as one second may be recorded as one inch or more in length.

After the turbine gates are closed, a break may be observed in the action of the mercury column. Period oscillations then appear and these are recorded for a few seconds. The whole operation lasts about one-half minute. The manually controlled shutter on the lens is then closed. When conditions have become quiet a short exposure is made under the normal static head and two bells are rung to notify the observers to discontinue taking readings and for the switchboard operator to open the gates and take up load again so that the process may be repeated. The shutters are closed and the film taken to the dark room for developing. In a similar manner several diagrams are made for different values of load, gate opening, etc., sufficient points being obtained so that an accurate efficiency curve may be drawn later.

When the films have been developed, blueprints are made from them, leaving a suitable margin on the blueprint so they may be secured to a drawing board. A typical pressure time diagram is shown in figure No. 3. The dark space denotes the mercury in the glass tube. The line of division between the dark and light spaces shows the movement of the mercury column, *A.A.* is the running level. *O* is the beginning of closure and *K L* the end of closure. *C.C.* shows the damped waves which follow the closure. The lines *D.D.* denote the spaces made by the seconds pendulum as it passes in front of the lens. These spaces denote time in seconds. The line *F.F.* is the static line taken a few seconds after the closure when the column of water is at rest. It denotes the final position of the mean line of the damped wave.

Delineation of the Pressure Time Diagram

In order to determine the mean velocity of the water from the pressure time diagram, certain graphical methods must be employed. The running level line *A.A.* and the static line *F.F.* are drawn parallel to the line on the blueprint formed by the cross hairs. The end of the closure is determined from an examination of the damped harmonic pressure waves which follow the closure. The rate of damping may be shown by lines touching the peaks of these after waves. The equation for such a series of curves is $Y = e^{\left(\frac{-r}{K}\right)}$ A curve has been prepared using various values of K. By scaling off the heights of

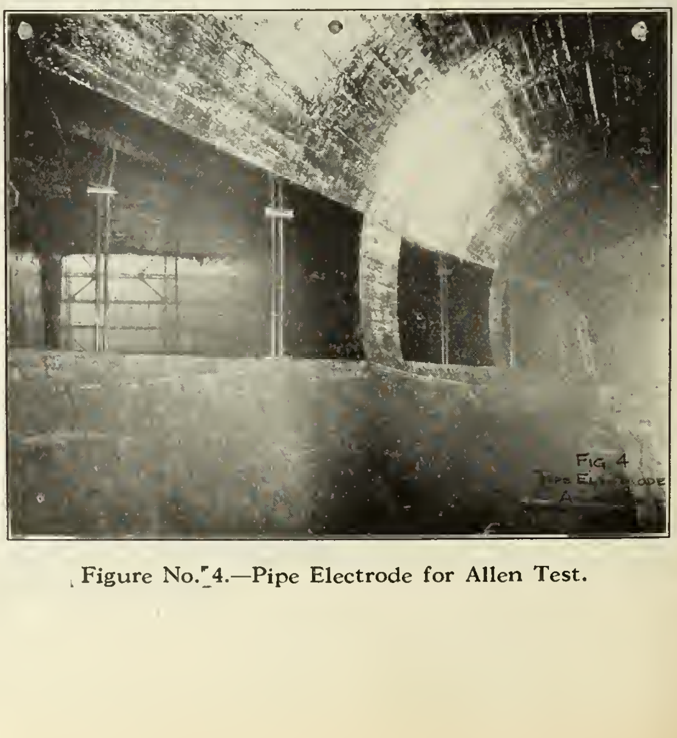

Figure No. 4.—Pipe Electrode for Allen Test.

two or more of the damped waves from the static level line and taking their ratio which shows the rate of damping, the horizontal distance to the ordinate through K may be readily found. This marks what is called the end of the diagram or in other words the beginning of the first damped wave.

Recovery Line

The next problem is to determine the behaviour of the recovery line of friction and velocity heads. A number of vertical lines are drawn dividing the diagram into the areas A_1, A_2, A_3, A_4, etc. A sum of these areas may be called "A". A trial recovery line *O.M.L.* is drawn. It may be shown that when ½ the velocity is destroyed, only ¼ the velocity and friction heads remain. It is simply a matter, therefore, of taking the area in small units and using the above relation to determine lengths h_1, h_2, h_3, etc. After one or two trials the recovery line is readily determined. The sum of the areas a_1, a_2, a_3, a_4 may be obtained by means of a planimeter.

Surges

In certain cases it will be necessary to correct the total area for the effect of surges or disturbances in forebay or surge tanks at the entrance to the conduit. This may be readily done by observing or recording the height or duration of such surges and substracting a corresponding area from the area A. If the surges are very pronounced the conduit may be tapped at two points below the intake or surge tank and a differential diagram obtained. The surges in this case will not have to be taken into account on the diagram. Furthermore, if these two points be located at sections of equal area in the penstock, the velocity head will not appear on the diagram. This is called the differential application of the Gibson method.

Corrections in Area

The gross area of the diagram having been obtained, certain corrections are necessary to find the net area. A correction for the width of slot must be made. This is done by scaling off one side of the diagram the vertical projections of all the upward strokes and multiplying total by 1/32 inch which is the width of slot. This area must be substracted from the gross area.

In regard to the blueprint, stretching or shrinking is bound to occur, and this must be allowed for. The film is taken as correct and in the case of stretching, the gross area after correcting for slot width must be decreased in the proportion of the width of the film to width of blueprint.

Having the net area of the diagram the quantity of water is obtained from the formula given previously.

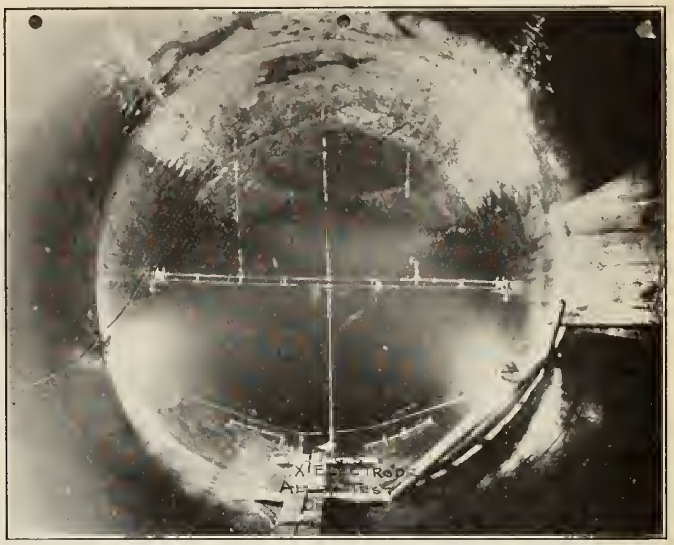

Figure No. 5.—Electrode "X" for Allen Test.

$$Q = \frac{KA}{S \sum \frac{Lv}{q}}$$

Leakage

The amount of leakage through the turbine gates after closure is determined previous to the test by closing the head gates and turbine gates and taking observations of penstock pressure against time. The rates of discharge may be calculated under falling head conditions and the rate of discharge under full head exterpolated.

Where a Johnson valve is available, the valve may be cracked sufficiently to allow the leakage through the turbine gates to take place and at a given instant the valve is closed and a diagram taken on the Gibson apparatus. Since the leakage through the Johnson valve is negligible when closed, the area of the diagram when delineated will represent the leakage under full head.

The leakage should be added to the "quantity" as found by means of the equation in the preceding paragraph.

Loss of Head

The distance ($Hv + Hf$) between the running and static lines when referred to the proper scale, is the sum of the velocity head at the point of tapping and the friction head from the forebay to the tap.

The velocity head may be substracted from the sum since $Hv = \frac{V^2}{2g}$ where V = velocity at the point where

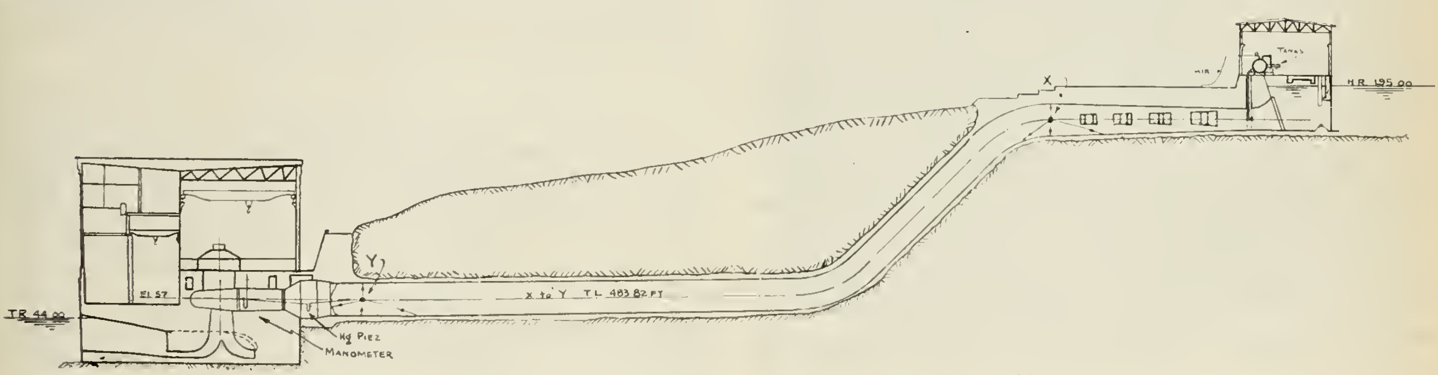

Figure No. 6.—General Arrangement, Salt Velocity Test.

the Gibson tap is placed. The remainder is the loss of head by friction which should be substracted from the gross head to give the net head at the turbine.

The efficiency of the turbine may be, therefore. calculated in the usual manner.

In testing this unit by the Gibson method which was accepted by both parties, the Gibson apparatus was set up in the testing chamber at station 125.50 about 10 feet upstream from the Johnson valve. In the Gatehouse the surge recorder was set up in the middle bay to obtain an average value of the surge so that the diagrams could be corrected.

Physical Dimensions of Conduit

On account of the nature of the water passage, it was found more convenient to determine $\Sigma\frac{LV}{q}$ rather than the average area and length. An arbitrary quantity of 2,700 c.f.s. was chosen and the quantity of water discharged by each inlet was assumed to be equal or 540 c.f.s. $\frac{LV}{q}$ was calculated from the Gibson apparatus to the centre line of the racks for each inlet and the total divided by 5 to obtain the average value. $\Sigma\frac{LV}{q}$ was found under these conditions to be 1.804. It was later found that the flows in the various inlets were unequal to the extent of 5 per cent. On reviewing the calculations $\Sigma\frac{LV}{q}$ was found to be 1.807, a difference of only 1/6 of one per cent showing that unequal flows in the inlet had little effect on the true value.

It was intended to check the above results by the differential application of the Gibson method but due to the cold weather it would not have been practical as a water pipe extending 500 feet on the surface of the ground would have had to be laid and it undoubtedly would have frozen.

Head Readings

Wooden gauges were set up in suitable locations in the head race and tail race to obtain the gross head. The net head was obtained by substracting the loss of head in the penstock and Johnson valve from the gross head. The loss of head in the penstock and intake was obtained from the Gibson diagrams.

The loss of head in the Johnson valve and approach to the spiral casing was measured by means of a mercury piezometer, one end of which was tapped to the U-tube of the Gibson apparatus while the other end was connected up to 4 piezometer plates immediately in front of the spiral casing.

$$H = \text{friction loss feet} = \text{defl. hg. in ft.} \times 12.58 - \frac{Q^2}{2g}\left(\frac{1}{A_1^2} - \frac{1}{A_2^2}\right)$$

Output Readings

Standard indicating and integrating wattmeters were used to obtain the output. The indicating meter was read every 10 seconds while the integrating meter which was a rotating standard was read using a stop watch and snapswitch for 30 seconds to one minute immediately preceding the run. All the meters and metering transformers were calibrated by the meter engineer at the conclusion of the test.

Load Conditions

To minimize the disturbance which would be caused to the large synchronous load and paper mill load connected to the Shawinigan system, when the load on this unit was to be dropped, it was arranged to operate the 43,000-h.p. unit in parallel with two 15,000-k.w. generators on an isolated system. For this purpose use was made of an electric steam generator. On this account the load was limited to 33,000 k.w. which corresponded to 0.73 gate opening.

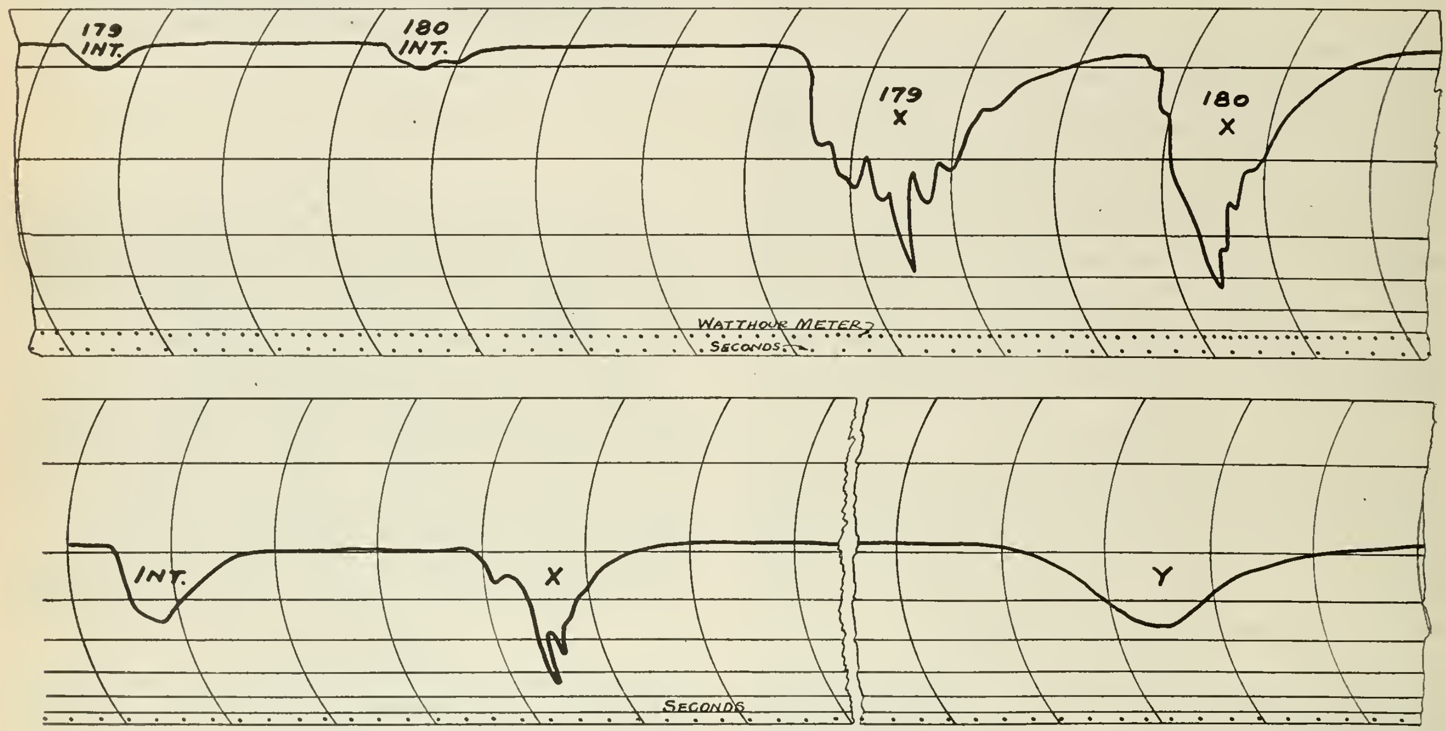

Figure No. 7.—Sample Curves Obtained by Salt Velocity Method.

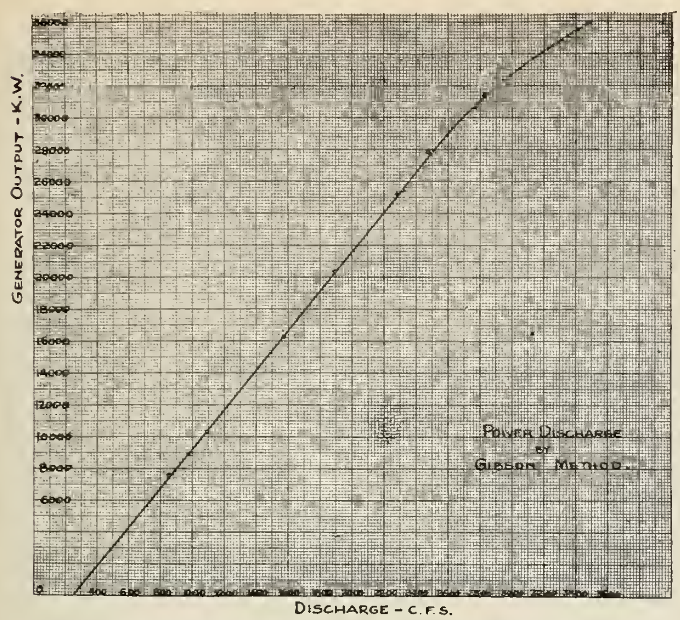

Figure No. 8.—Power Discharge Curve by Salt Velocity Method.

Gate Opening

The gate opening was measured on the operating piston of the governor engine. This had been previously calibrated against calipered readings between the guide vanes so that true gate opening readings could be secured.

Due to the limited time at our disposal only eleven runs could be made. The actual time in making these runs was three hours. The apparatus was set up and the test completed in the field in less than 24 hours.

The essential points brought out by this test were as follows:—

1. The maximum turbine efficiency was found to be 91.0 per cent.
2. The turbine shows very high part gate efficiencies.
3. The maximum overall efficiency was found to be 88 per cent.
4. The total loss of head from turbine to head race at the economical point of operation was measured to be 1.8 foot.

Test by Salt Velocity Method

Since at the time the Gibson test was being made on the 41,000 h.p. unit, we were conducting hydraulic tests on two other plants in the vicinity under the supervision of Prof. Allen, it was considered inadvisable to miss the opportunity of a comparative test. The salt velocity test was conducted, therefore, about eight days later.

General Description

The salt velocity method for the measurement of water in large conduits has been developed during the last four years by Prof. Charles M. Allen, Head of the Hydraulic Dept. of Worcester Polytechnic Institute, Worcester, Mass. After exhaustive experiments in the laboratory and considerable field work, Prof. Allen has brought the method to a state where it may readily be adopted for commercial use.

The principle of this method is that salt in solution will increase the electrical conductivity of water. If a quantity of salt solution can be quickly released at the entrance to a closed conduit, the passage of this solution may be determined by one or more pairs of electrodes inserted in the stream flow further down the conduit. A graphic ammeter may be used for recording the passage of the salt solution.

The passage of the salt solution is accurately timed and knowing the volume of the conduit between the electrodes, the discharge may readily be calculated since volume (cu.ft.) over time (sec.) = cu.ft. per sec. No empirical coefficients or corrections are necessary for accurate results. (A full description of the experimental and field work in connection with this method was presented on December 6th, 1923, before the American Society of Mechanical Engineers at New York by Professor Allen.)

Apparatus

Considering the requirements just given, it was necessary in testing this unit to provide suitable equipment.

Salt Introduction

The apparatus for the salt introduction was installed in the gate house and consisted of a 300-gallon open top mixing tank connected by hose to the gate house water supply and to a 1,200-gallon pressure tank. A 4-inch pipe led from this pressure tank through five 3-inch pipes to ten 2½-inch pipes which terminated at the centre line of the inlet openings in ten 2½-inch pop valves. A 4-inch quick opening valve and five 3-inch valves controlled the distribution of salt solution to the inlet openings. Each of the inlet openings were, therefore, equipped with two pop valves. One pop valve in each bay was equipped with a short electrode in order to denote the instant the charge of brine was introduced into the water. These electrodes were numbered 1, 2, 3, 4 and 5, to correspond to the number of the bay in which it was located.

Pipe Electrodes

At the end of inlet tubes Nos. 2, 3, 4 and 5 two pairs of pipe electrodes were installed. This made eight pairs of vertical electrodes which were designated *A* to *H* inclusive. These electrodes were put in so that the distribution of flow in the complete intake could be determined. The pipe electrodes consisted of extra heavy iron pipes 1½ inch diameter, 1½ apart. The ends of the pipe were fitted into hardwood blocks which had previously been soaked in oil to prevent absorption of salt and surface leakage. The pipes and hard wood blocks were wedged into position.

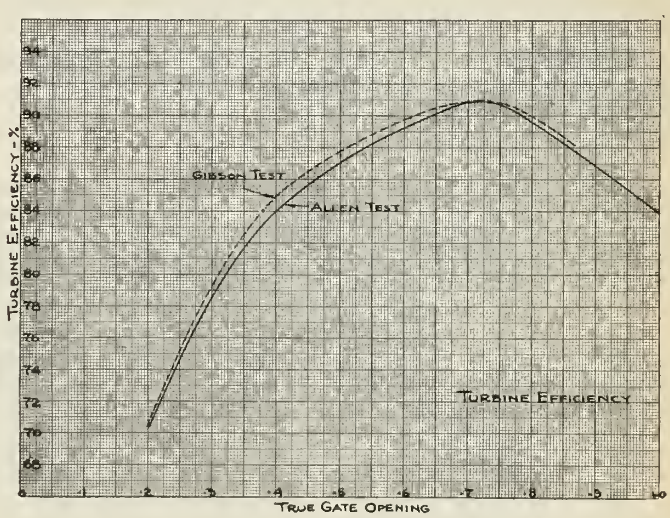

Figure No. 9.—Comparative Efficiency Curves by the Two Methods.

Individual wires were run to each pipe and the completed wiring brought up through conduit to the gatehouse floor. It will be seen that in measuring the flow in each bay salt was introduced into that bay only. As the salt left the pop valve, its passage was recorded on the meter and as it passed the pipe electrodes its passage was again recorded. The time and volume being known the flow in that bay could be readily calculated.

For No. 1 bay, of course, the distance was less than 6 feet, and, therefore, the time was too short to be measured by this method. The flow through this bay was obtained by substracting the sum of the quantities through Nos. 1, 2, 3 and 4 bays from the total discharge, the load being maintained steady.

Main Electrodes

At the junction point of the inlet and the tunnel was located a horizontal electrode *X*. At the lower end of the penstock 483.82 feet below was located a similar electrode *Y*. The general arrangement is shown in figure No. 4. The electrodes were connected in parallel electrically. Each of these electrodes consisted of two steel bars 4 inches by ½ inch, 19.8 feet long, spaced 4 inches apart by porcelain bus bar insulators. Rubber packing was used throughout to prevent chipping of the porcelain when the bolts and turn buckles were tightened. The supports were made of 8-inch by 8-inch by 1-foot angles securely bolted to the inside of the tunnel. Insulated guy wires were extensively used to obtain rigidity and for reasons of safety. The volume of the penstock between *X* and *Y* was calculated to be 152,000 cubic feet.

Electrical Arrangements

All the electrodes were connected in parallel through single pole knife switches to a common bus, one side of which was connected through a Bristol strip chart recording ammeter and a Westinghouse watthour meter. The current used was 110-volt, 60-cycle. The chart on the recording mechanism was arranged to be driven from a variable speed motor so that the most suitable chart speed could be obtained.

Time

The time was recorded on the chart by means of a contact making seconds pendulum and a spark coil. At the lower extremity of the seconds pendulum a pair of permanent magnets were secured which lifted up a small armature at each passage or at intervals of one second. The spark coil, therefore, punctured the chart each second and a suitable graphic record was obtained.

Communication between generator room and gate house was maintained and readings synchronized by connecting up a portable telephone set.

Piezometer across Johnson Valve

A mercury piezometer was connected across the Johnson valve in order to calibrate it for use as a Venturi meter, so that when it is deemed advisable a recording water meter could be installed to obtain a continuous record of the input to the turbine.

Net Head

The net head was measured by means of a mercury manometer located one foot upstream from the entrance to the scroll case. Temporary board gauges were used to obtain head and tail race readings.

Output Readings

The generator output readings were obtained in precisely the same manner as has been already described for the Gibson test.

Nature of Test

Including trial shots, 265 individual tests or charges of salt solution were used and these were grouped into 50 runs of from 1 to 9 shots each. Figure No. 7 shows example of the charts obtained. The time of passage of the salt solution between electrodes was computed by counting the seconds spaces and fractions of seconds between the centres of gravity of the two curves.

In order to determine the centres of gravity quickly and accurately, a watthour meter was inserted in the circuit. On the shaft of this watthour meter there was attached a 24-segment commutator connected to a second spark coil. Normally with a certain *initial* reading the watthour meter disk would rotate at constant speed and a series of holes would be punctured in the paper at regular intervals. If the current through the ammeter tended to increase, the speed of the watthour meter and, therefore, the number of the punctures would increase in direct proportion. Therefore, having the curve practically translated into a straight line, it was an easy matter to determine the centre of gravity quickly and accurately.

Distribution of Flow in Intake

During the test, at three gate openings, 45 per cent, 66 per cent, and 75 per cent, it was possible by holding the loads steady and injecting salt solution in one inlet at a time to obtain the time of passage between the introduction and pipe electrodes and between *X* and *Y*. By this means the percentage of water that each inlet delivered to the main penstock was readily obtained so that the distribution could be calculated. The results show the following distribution of the total:—

Inlet No. 1	—	19.5%
" 2	—	21.5%
" 3	—	22.3%
" 4	—	20.0%
" 5	—	16.7%

The variation in the flow through these inlets may be partially accounted for by the presence of part of an old crib in the forebay which could not be excavated very readily.

For six different runs and five different gate openings simultaneous curves were obtained for the introduction electrodes, *X* and *Y*. The accuracy of the Salt Velocity method was well demonstrated under these conditions as the variation in discharge observed between the introduction electrodes and *X* and between *X* and *Y* was less than one per cent in each case and the average for the six runs checks exactly. The following show the results obtained.

Run No.	Q. Int. to X.	Q. X to Y.	Variation per cent
10	2655	2651	+ 0.2
10A	2618	2604	+ 0.5
11	1884	1891	— 0.4
11A	1874	1891	— 0.3
12A	1595	1584	+ 0.7
16	2904	2924	— 0.7
		Average	0.0

The main points brought out by the Salt Velocity test were:—

1. The maximum overall efficiency is slightly over 87 per cent at 0.72 gate opening.
2. The maximum turbine efficiency is 90.9 per cent at 0.70 gate and 85 per cent full load.
3. The Johnson valve may well be used as a Venturi meter to obtain a continuous record of the flow of water to the unit under steady load.

In reviewing in a general way the tests on this unit, the following points should be noted:—

1. Accuracy. The curves, (see figure No. 9), show the turbine efficiency by both methods. The maximum discrepancy is one per cent but this is confined to only a portion of the curves. The values are practically identical near the point of maximum efficiency.
2. The power discharge curves, (figures Nos. 3 and 8), show how consistently the points form a smooth curve. In the salt velocity test each point represents the average of 1 to 10 values.
3. No serious inconvenience was caused to the load on the system due to these tests.
4. The tests on the intake by the salt velocity method show the remarkable accuracy obtained even with very short and irregular water passages.
5. The choice of either of these methods for measuring the water used by an hydro-electric unit may only be made after a complete study of the local conditions.

Pulverized Fuel for Canadian Locomotives

A review of the Possibilities of Economy in the Use of Fuel for Railway Purposes

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Paper to be presented before the Ottawa Branch, The Engineering Institute of Canada.

Burning coal in a pulverized form has been thoroughly developed and is now widely used for the generation of steam in industrial boiler plants, and in this application has demonstrated its dependability and high efficiency, but in the use of pulverized coal on locomotives, where the possibilities of saving are much greater than in standard power plants, the development has been retarded by a series of circumstances.

During the war when the United States government took over control of the American railroads, five important roads were conducting tests with locomotives which had been equipped to burn pulverized coal, and one of these was making preparation to equip twenty Consolidation locomotives. Government control and war demands made it impracticable to continue this work and it has not since been revived. However, the wide interest in fuel conservation and the great possibility for economy presented by this method of firing would seem to make the time propitious for a resumption of the work.

Fourteen Consolidation locomotives on the Central Railway of Brazil have been equipped to use pulverized coal and have been in operation since 1917. The Imperial Tiawan Railroad in Japan has three so equipped and the Imperial Government Railways have one on order.

Essentials of Pulverized Fuel System

One of the essentials of a pulverized fuel system for locomotives is the coal preparation plants, which should be located at convenient divisional points, and in which the raw coal is pulverized by means of mills, and, in cases where the coal has a high initial moisture content, is first dried before being pulverized. The pulverized coal is then stored in suitable bins where it can be fed by gravity to the locomotive tenders.

The structural changes in apparatus necessary on each locomotive consist essentially of a specially designed closed pulverized coal bin on the locomotive tender, suitable fuel feeding device which is easily driven by a small steam turbine, and a turbine driven air pressure set which conveys the powdered fuel from the bin on the tender to the burner located near the bottom of the fire box. Very few changes are required in the locomotive fire box. The whole layout of a typical Lopulco locomotive system is illustrated by figures Nos. 1 and 2.

It is essential that all the apparatus be rugged and built for continuous service. Altogether its operation is extremely simple, and when a number of engines on a division are equipped it may be expected that no unusual operating difficulties will develop and many of the present inconveniences and abuses will be abolished.

The firing requires no manual effort and is accurately controllable by the fireman from his seat. The team work on the part of the engine driver and fireman permits a locomotive to be put over the division with the minimum possible fuel requirement, as the fireman can in every instance anticipate the action of the engine driver, so that full boiler pressure can be maintained under all conditions and without waste of fuel.

In general, what is desired by the operating department of a railway is motive power in the most flexible form. It is intended, in what follows, to indicate how

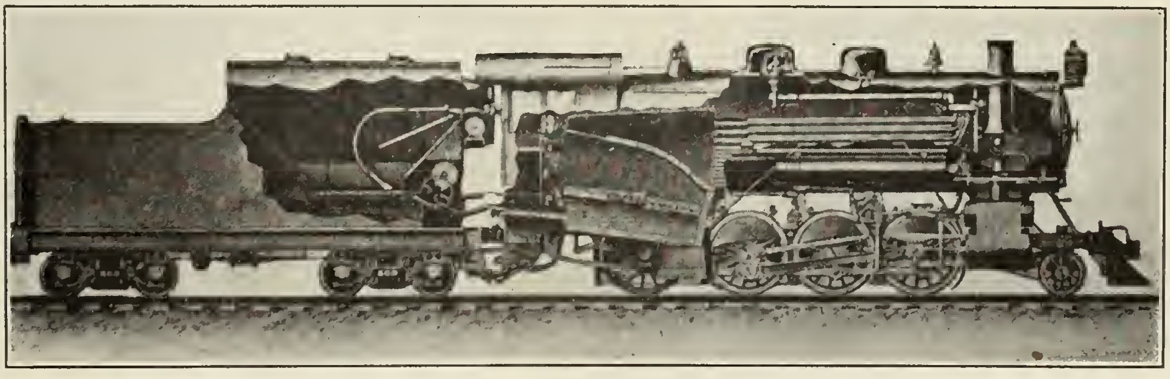


Figure No. 1.—Explanation of Lopulco Pulverized Fuel System for Locomotives.

the use of pulverized fuel, in actual service, would fulfill the above condition.

Regulation of Fuel for Any Service Demand

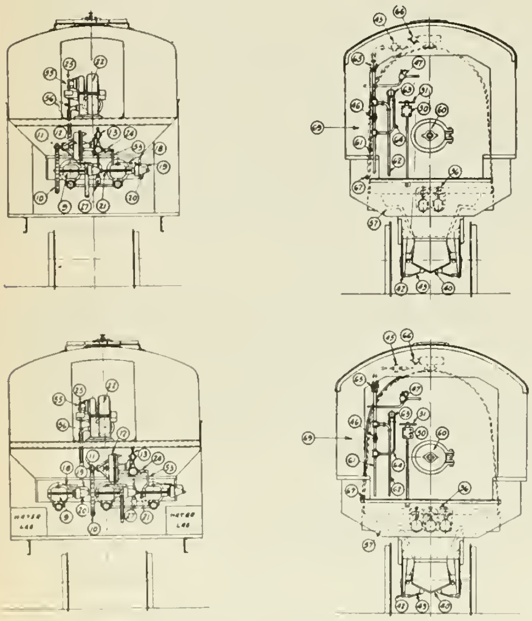
The amount of fuel fired, per unit of time is under the direct and constant control of the fireman. Each fuel feeder has a capacity range of from 500 to 3,000 or more pounds of fuel per hour, and as from one to five of these feeders may be applied to a locomotive according to its size, and as any number of these feeders may be operated simultaneously, it will be seen that the total amount of fuel required can be regulated to cover any service demands made upon the boiler up to practically the capacity of the injectors. The fuel burns completely immediately as it is introduced into the furnace regardless of the amount fired, provided always that more is not fed than the boiler needs. When the work of the engine eases off the fuel supply can be at once reduced accordingly, and on long drifts or where the train is set off along the road, the supply may be stopped entirely, thus putting out the fire. This flexibility of steam generation has been demonstrated in regular service by the heaviest Consolidation type of locomotive ever built, operating under exceptionally heavy train loads.

Availability for service on call is much enhanced by the use of pulverized fuel. Where engines are required to go out on short notice, the elimination of fire and ash pan cleaning is a great advantage, both in time and labour. A pulverized fuel burning locomotive can be on the train, ready to go, in one hour from the time the fire is started, under ordinary engine-house conditions.

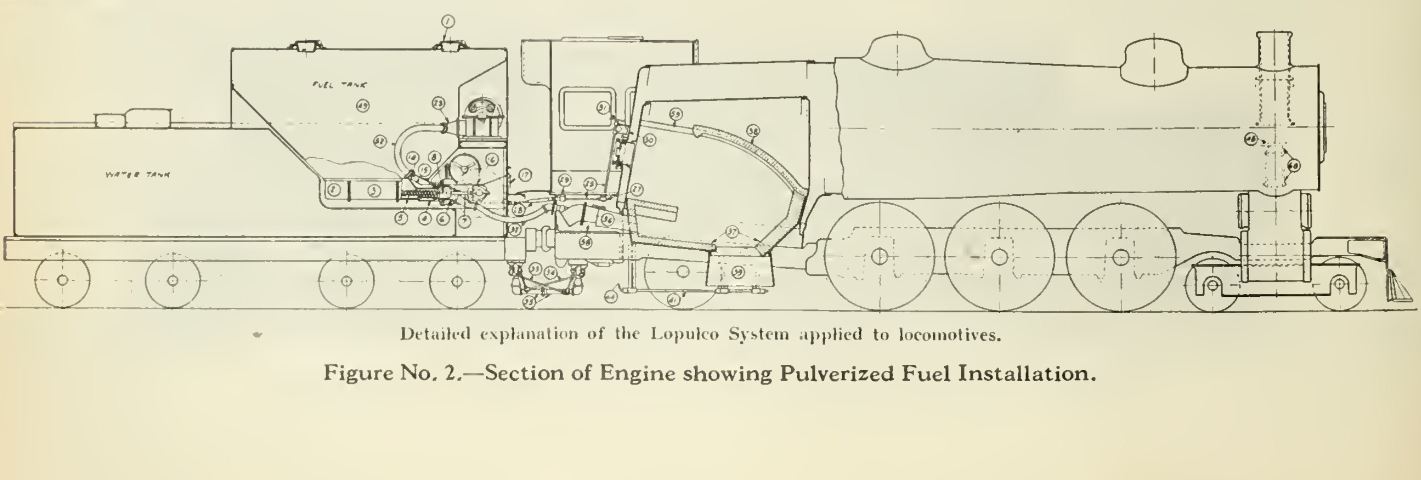
Delays at the fueling plant will not be of moment as fuel is now taken at an average rate of about ten tons in from ten to twelve minutes, and this can be accelerated by enlarging the fueling outlets. It should also be borne in mind that this fuel does not freeze in the bins and make the fueling of engines the very difficult operation which it now often is during the winter months.

Safety in Operation

Safety in train operation is enhanced by the fact that the fireman rides his seat practically over the entire road, and can and should devote a large part of his attention to track and signals. There is little noise from the operation of the apparatus to distract attention of the crew from their other duties, and the glare from the firebox door, especially at night when it sometimes seriously hampers track observations, is eliminated. The fireman's duties, when the train is once on the road, are, in so far as the firing is concerned, of such relatively simple nature that many of them can be performed almost without taking his eyes from the track. After a little practice, work of this kind becomes almost automatic with a man, and the amount of physical and mental labour required is so small that the fireman is able, at all times, to assist the engine driver in whatever way is desirable to enhance the safe and speedy handling of the train. We may go further, however, as regards safety, and say that the use of pulverized fuel will react to give us higher grade engine drivers in the future than we could expect if the laborious hand-firing methods are continued. The



2-BURNER EQUIPMENT				3-BURNER EQUIPMENT			
ITEM NO	NAME	ITEM NO	NAME	ITEM NO	NAME	ITEM NO	NAME
	FURNISHED BY COMBUSTION ENG. CORP.				FURNISHED BY COMBUSTION ENG. CORP.		
1	MANHOLES	40	SLAG PAN DOORS	1	MANHOLES	40	SLAG PAN DOORS
2	CONVEYOR TROUGHS REAR SECTION	41	" " OPERATING RODS	2	CONVEYOR TROUGHS REAR SECTION	41	" " OPERATING RODS
3	" " MIDDLE "	42	" " " HANGERS	3	" " MIDDLE "	42	" " " HANGERS
4	" " FRONT "	43	" " " LINKS	4	" " FRONT "	43	" " " LINKS
5	" SCREWS	44	" REVERSIBLE RATCHET WRENCH	5	" SCREWS	44	" " REVERSIBLE RATCHET WRENCH
6	" NOZZLES	45	PRESSURE REDUCING VALVE	6	" NOZZLES	45	PRESSURE REDUCING VALVE
7	" SHAFTS	46	GLOBE VALVE	7	" SHAFTS	46	GLOBE VALVE
8	MIXING PADDLES	47	QUICK OPEN BLOWER VALVE	8	MIXING PADDLES	47	QUICK OPEN BLOWER VALVE
9	GEAR CASINGS	48	COMBINATION TURBINE & BLOWER [illegible]	9	GEAR CASINGS	48	COMBINATION TURBINE & BLOWER [illegible]
10	HERRINGBONE GEAR			10	HERRINGBONE GEAR		
11	" PINION			11	" PINION		
12	VARIABLE SPEED STEAM TURBINE			12	VARIABLE SPEED STEAM TURBINE		
13	GOVERNOR FOR " "		FURNISHED BY CUSTOMER	13	GOVERNOR FOR " "		FURNISHED BY CUSTOMER
14	DAMPER " BLAST AIR	49	FUEL TANK COMPLETE	14	DAMPER " BLAST AIR	49	FUEL TANK COMPLETE
15	" LINK FOR OPERATING DAMPERS & CLUTCHES	50	CHANGES NECESSARY IN WATER TANK & EQUIPMENT	15	" LINK FOR OPERATING DAMPERS & CLUTCHES	50	CHANGES NECESSARY IN WATER TANK & EQUIPMENT
16	" ROD " " " "	51	" " ON ENGINE TO SUIT OUR "	16	" ROD " " " "	51	" " ON ENGINE TO SUIT OUR "
17	HAND LEVER FOR " " "	52	AIR PIPES	17	HAND LEVER " " " "	52	AIR PIPES
18	BELL CRANK " " " "	53	STEAM PIPE FOR VARIABLE SPEED TURBINE	18	BELL CRANK " " " "	53	STEAM PIPE FOR VARIABLE SPEED TURBINE
19	CLUTCH YOKE " " " "	54	EXHAUST " " " " "	19	CLUTCH YOKE " " " "	54	EXHAUST " " " " "
20	FRICTION CLUTCHES	55	STEAM " " TURBINE BLOWER	20	FRICTION CLUTCHES	55	STEAM " " TURBINE BLOWER
21	MAIN SHAFT	56	EXHAUST " " " "	21	MAIN SHAFT	56	EXHAUST " " " "
22	STEAM TURBINE BLOWER	57	FIRE PAN	22	STEAM TURBINE BLOWER	57	FIRE PAN
23	3-WAY MANIFOLD	58	SUPPORT FOR LOPULCO DUPLEX BURNER	23	3-WAY MANIFOLD	58	SUPPORT FOR LOPULCO TRIPLEX BURNER
24	STRAINER FOR VARIABLE SPEED TURBINE	59	ARCH TUBES	24	STRAINER FOR VARIABLE SPEED TURBINE	59	ARCH TUBES
25	" " TURBINE BLOWER	60	FIRE DOOR	25	" " TURBINE BLOWER	60	FIRE DOOR
26	RODS FOR GOVERNOR OPERATING MECHANISM	61	STEAM PIPE TO VAR. SPEED TURBINE	26	RODS FOR GOVERNOR OPERATING MECHANISM	61	STEAM PIPE TO VAR. SPEED TURBINE
27	GEAR CASINGS " "	62	" " " TURBINE BLOWER	27	GEAR CASINGS " " "	62	" " " TURBINE BLOWER
28	UNIVERSAL JOINTED SHAFT "	63	DUPLEX STEAM GAUGE	28	UNIVERSAL JOINTED SHAFT " "	63	DUPLEX STEAM GAUGE
29	ROD BEARINGS " "	64	" " " CONNECTION	29	ROD BEARINGS " "	64	" " " CONNECTION
30	BRACKET WITH INDICATOR " "	65	GLOBE VALVE	30	BRACKET WITH INDICATOR " "	65	GLOBE VALVE
31	HANDWHEEL " "	66	ANGLE "	31	HANDWHEEL " "	66	ANGLE "
32	FUEL HOSES	67	STD. ENGINE HOUSE STEAM CONNECTION WITH STRAINER	32	FUEL HOSES	67	STD. ENGINE HOUSE STEAM CONNECTION WITH STRAINER
33	STEAM JOINT CONNECTION FOR VAR. SPD. TURBINE	68	EXHAUST PIPE AND NOZZLE	33	STEAM JOINT CONNECTION FOR VAR. SPD. TURBINE	68	EXHAUST PIPE AND NOZZLE
34	" " " TURBINE BLOWER	69	ALL STEAM & EXHAUST PIPES WITH FITTINGS	34	" " " " TURBINE BLOWER	69	ALL STEAM & EXHAUST PIPES WITH FITTINGS
35	BALL EXHAUST " " " & BLOWER			35	BALL EXHAUST " " " & BLOWER		
36	LOPULCO DUPLEX BURNER			36	LOPULCO TRIPLEX BURNER		
37	FIRE PAN BRICK LINING			37	FIRE PAN BRICK LINING		
38	ARCH BRICKS			38	ARCH BRICKS		
39	SLAG PAN			39	SLAG PAN		



Detailed explanation of the Lopulco System applied to locomotives.

Figure No. 2.—Section of Engine showing Pulverized Fuel Installation.

modern big locomotive hand-fired is not the most attractive proposition in the world for any young man, and mechanical stokers on locomotives are not in general use.

These notes are not purely theoretical, as there are a sufficient number of engines which have been running for a long enough time, in regular train service, to demonstrate the truth of the theory. It can be definitely stated that the firing of locomotives with pulverized fuel will be a big step forward in the economical operation of railways.

The following are the conclusions as set forth in the report of the Standing Committee on Powdered Fuel before the eighth annual convention of the International Railway Fuel Association at Chicago, May 15th, 1916:

"Summing the results that are being obtained in locomotive service, these may be stated as:—

1. Smokeless, sparkless and cinderless operation.
2. Maintenance of maximum boiler pressure within a uniform average of three pounds without popping.
3. An increase of from 7½ to 15 per cent in boiler efficiency as compared with burning lump coal on grates.
4. Saving of from 15 to 30 per cent in fuel of equivalent heat value fired.
5. Enlarged exhaust nozzle area, resulting in greater drawbar pull and smoother working of locomotive.
6. Elimination of ash-pit delays, facilities, and expense; also reduces time required for firing up.
7. Maintenance of a relatively high degree of superheated steam.
8. No accumulation of cinders, soot or ashes in superheater or boiler flues, smokebox or on superheater elements.
9. No trouble from overheating of firebox, new or old sheets, seams, rivets, patchbolts, stays or flue beads.
10. Elimination of arduous manual labour for building, cleaning and dumping fires and for firing.
11. Eliminates the necessity of front-end and ash-pan inspection and for special fuels, firing tools and appliances for building fires and for stoking and cleaning fires.
12. Equal provision for engine driver and fireman to observe signals and track, thus reducing liability of accident.

"Your committee is of the opinion that the effectiveness and utility of fuel in pulverized form has been demonstrated from the past year's development and that the progress in the use of this method of stoking and burning bituminous and anthracite coals and lignites for generating power, heat and light on railways, will be quite marked from now on.

"The constantly increasing cost of railway fuel at the mine; the scarcity of fuel oil; the domestic and export demand for larger sizes of coal; the prohibitive cost of briquetting the smaller sizes of coal and of lignite for railway use; the payment of labour on the run-of-mine basis for mining bituminous coals; and the necessity for eliminating smoke, sparks and cinders, will all tend towards the inauguration of this practical means and method for increasing the efficiency of steam boiler operation which to-day affords the greatest opportunity for improving locomotive and power plant costs and performance, and for changing public sentiment by smoke abatement."

The burning of anthracite, bituminous or lignite fuels in pulverized form offers opportunity for even greater accomplishment in the steam railway field than has been obtained through its use in industrial furnaces and stationary power plants, where the present annual consumption in the United States of approximately twenty million tons of pulverized bituminous coal has demonstrated the effectiveness and economy of this method of combustion.

Efficiency in Steam Power Plant Operation

The Possibility of Effecting Economy in the Operation of Steam Power Plants

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Paper to be read before the Kingston Branch, The Engineering Institute of Canada.

On starting out to save coal in a steam boiler plant, the first thing to do is to find out at what efficiency the plant is operating. This may be done by means of a boiler trial lasting anywhere from ten to twenty-four hours, according to conditions and the particular data required. The method of making these tests may be found in many handbooks and texts, the most authoritative, perhaps being that found in the Power Test Code published by the American Society of Mechanical Engineers.

The efficiency of a boiler is obtained by dividing the heat, (B.t.u.), in the steam obtained from a boiler in a certain time, by the heat contained in the coal burned in the same period of time or if E = efficiency,

$$E = \frac{\text{B.t.u.'s given to steam per 1 pound of combustible}}{\text{B.t.u.'s in 1 pound of combustible}}$$

combustible being defined as coal free from ash and moisture.

The main object in boiler plant operation is to increase this fraction without injuring the boiler or furnace.

Preparations for a Boiler Test

In making a boiler trial the following data should be procured. All water evaporated must be weighed or measured accurately, and all coal fed to the furnace during the trial must be weighed. These are the main items, but other data which should be recorded at half-hour intervals during the test are, steam pressure, draft over the fire, draft in last pass of boiler, (these are measured by means of a water manometer and recorded in inches of water), temperatures of feed water, of the flue gas in breeching near the boiler, and room temperature, dryness of steam, and if it is desired to make out a complete heat balance for the test, analyses of the flue gas should be made at frequent intervals, and an average

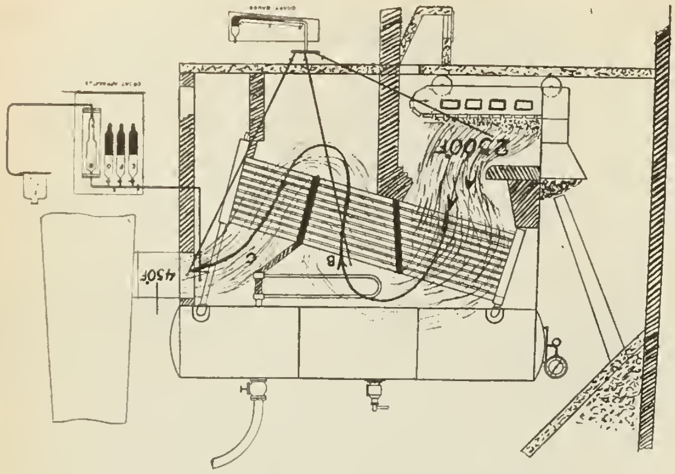

Figure No. 1.—Section through Boiler Plant showing Arrangements made for conducting Test.

sample of the gas should be taken and analyzed after the test.

Before starting the test the height of the water in the gauge glass should be noted and a string tied around the glass to mark the height, the water should be kept as near this point as possible during the test and at its conclusion the water should be at the string. The condition of the fire should be the same at the beginning and the end of the test. From each three or four hundred pounds of coal burned, a ten-pound sample should be taken and kept in a covered box. At the end of the test, an average sample of this coal should be placed in an air tight container, or mason jar, and from this sample the analysis of the coal made, and the B.t.u. content per pound determined. Samples of the ash should be taken as well and a mason jar saved for analyzing, the same as for the coal.

Precautions to be taken before making the test are as follows: —

(a) See that the boiler blow-off cocks are tight and that no water is leaking from the blow-off pipes.

(b) See that there is no possibility of water getting into the boiler except that passing through the meter or weigh tanks.

(c) Have all cracks in the brick setting and openings between the brickwork and metal of the boiler calked with asbestos packing and plastered to prevent air leaks into the boiler.

(d) Take precautions against the boilers blowing off during the test. If this happens, the time the safety valves are open should be taken, so that the proper correction may be made.

From the above data we can find the boiler efficiency as follows: — From the calorimetric test we find the B.t.u.'s in one pound of dry coal, and from the coal analysis we know the percentage of ash. From this we determine the B.t.u.'s per pound of combustible which gives us the denominator of the efficiency fraction. The numerator of the fraction, i.e., the B.t.u.'s given to the steam per pound of combustible, is found by dividing the water evaporated per hour by the combustible burned per hour, which gives the steam produced per pound of combustible. To find the B.t.u.'s in this number of pounds steam, we make use of the steam tables. For example, if the feed water goes to the boiler at an average temperature for test of 190°F. and the average dryness of the steam is 98 per cent = x, then we know from the steam tables that the total heat H in one pound of dry and saturated steam for the absolute boiler pressure is given by the equation $H = xr + q$, where r = the heat of vaporization and q = the heat of the liquid in the steam, but this is above the temperature 32°, therefore for water at 190°F. the total heat $H = xr + q - (190\text{-}32)$, multiply this by the number of pounds of steam evaporated per pound of combustible and we get the numerator of the fraction which gives efficiency.

Heat Losses

As has been said, the whole object in boiler plant operation is to increase the efficiency without injuring the boiler. The best plants operating to-day have reached an efficiency of 90 per cent, but a great many of the smaller plants do not reach an efficiency of 60 per cent and it is in such plants that by properly analyzing results and making changes in equipment and methods of operation that coal may be saved.

This low efficiency is accounted for by heat losses between the point where the coal enters the furnace to be burned and where the hot gases are finally rejected to the chimney.

These main losses of heat are: — (a) Loss due to coal dropping through the grate; (b) loss due to moisture in coal; (c) loss due to incomplete combustion; (d) loss due to heat rejected to the chimney. One of the most important is (d), the heat rejected to the chimney and this is the one that must be watched most carefully.

For example, a heat balance for a boiler based on one pound of combustible might be as follows:—

	B.t.u.	Per cent
B.t.u. per pound of combustible 15,500 by test		
Heat absorbed by the boiler	12,000	77.4
(a) Loss coal through grate	100	0.6
(b) Loss due to moisture	600	3.84
(c) Loss due to incomplete combustion	75	0.48
(d) Loss due to heat rejected to stack	1,600	10.43
(e) Loss due to radiation and unaccounted for	1,125	7.25
		100.00

By separating the losses as above and knowing what percentage should be expected in each case, it is a simple matter to locate the trouble and apply the remedy if a plant is not working efficiently.

Loss (a) is obtained by taking a sample of the ash and testing it in a calorimeter for B.t.u. content in the same way that coal is tested.

Loss (b) is given by the equation,—Heat loss per lb. of combustible = $(9H + W)\{212 - t + 970.4 + .48(T - 212)\}$ where H and W are the percentages of hydrogen and water in one pound of combustible, and t = temperature of air in the boiler-room, and T = the temperature of the flue gases in degrees fahrenheit.

Loss (c) is due to the carbon in the coal burning to carbon monoxide CO, instead of CO_2 and is obtained from the formula:— Heat loss $= 10150 \left\{\frac{CO}{CO + CO_2}\right\} \times C.$

Where C is the percentage of carbon in the combustible and where CO, CO_2 = percentage of carbon monoxide and carbon dioxide respectively in the flue gas. This formula follows from the fact that if carbon burns to CO, there are liberated 4,350 B.t.u., while if it burns completely to CO_2, 14,500 B.t.u. are liberated, the difference represents the loss per pound of carbon due to incomplete combustion.

In order to obtain this loss and loss (d), we must make an analysis of the flue gas by means of the Orsat apparatus as follows,—

For the purpose under consideration, flue gas may be said to contain four constituents, — Carbondioxide, CO_2;

carbon monoxide, CO; oxygen and nitrogen. As air contains 21 per cent by volume of oxygen and 79 per cent of nitrogen, the sum of the free oxygen, CO and CO_2 will never be more than 21 per cent. The Orsat apparatus commonly used for analyzing flue gas, is made as follows, see figure No. 1.

The Orsat Apparatus

G is a glass tube bent in the form of the letter U and half filled with the reagent caustic potash (KOH). *F* and *E* are U-tubes the same as *G*, but contain the reagents pyrogalic acid and cuprous chloride respectively. *H* is a measuring burette graduated in centimeters. *I* is a bottle filled with water and connected to the Orsat by a rubber tube as shown. *K* is a capillary tube connecting reagent tubes with the measuring burette and *J* is a three-way cock, which may be turned so as to connect *K* to the outside air or to the gas supply pipe. To draw in a charge of the gas to be analyzed, cock *J* is opened to the air and the water bottle raised. Water will be forced out at *J*. This is done several times to clear the pipe of air. The cock *J* is now opened to the boiler and the bottle lowered, gas follows the receding water and fills the burette *H*. Cock *J* is now closed and cock *G* opened, the bottle raised and the gas forced over in contact with the reagent, this removes the CO_2. The percentage being read off directly, when the level of the water in the bottle is brought to the same level, as that in the measuring burette *H*. By passing the gas over the reagents in *F* and *E* respectively, the oxygen and carbon monoxide are removed. The operation of the Orsat is a purely mechanical one and a workman of average intelligence can learn it in a short time. To show how a gas analysis as obtained above, may be used to find the heat lost up the chimney, we know that this loss is made up of, the weight of the gas going up the chimney, multiplied by the specific heat of the gas, multiplied by the difference in temperature between the outside air and the flue gas, it may be put in the form of an equation as follows,—

Heat loss per pound of combustible = weight of gas per pound of combustible × rise in temperature × specific heat....................................(1).

The weight of gas passing per pound of combustible = $3.03 \left\{ \frac{N}{CO_2 + CO} \right\} \times C$,..........(2) where N, CO_2 and CO represent the percentages of nitrogen, carbon dioxide, and carbon monoxide in the flue gas and C = the percentage of carbon in the combustible. Now from equation (1), in order to keep the heat loss up the stack low, we must keep the weight of gas passing, as small as possible, and the temperature of the flue gas low. It will be seen from equation (2) that in order to keep the weight of gas small, we must make the denominator of the fraction large and as the percentage of CO_2, is always large compared with the CO, it means that the percentage of CO_2 should be large.

Causes of Low Percentage of CO_2

If the percentage of CO_2 is found to be low, look for the cause, it may be any one of the following.

First, — there may be air leaks in the boiler setting, cracks in the brick work or openings where the brick work has drawn away from the metal of the boiler, these leaks will result in large quantities of oxygen being drawn in with the air, which will not combine with the carbon of the coal, but appear in the analysis as free oxygen, and consequently the percentage of CO_2 will be lowered. The best method of detecting these leaks, is to go over the surface of the boiler setting with a lighted candle, while the boiler is operating, when the flame of the candle will be drawn in wherever there is an opening. When located these openings should be calked with asbestos, rope and then plastered with a substance which will stand considerable expansion and contraction without cracking.

Second, — the fire may be too thin, which allows the air to pass up through the coal bed without combining with the coal.

Third, — there may be holes in the fire which gives the same result as mentioned in item two.

Fourth, — the draft may be too strong for the thickness of the fire and the kinds of coal used.

The methods of correcting troubles 2, 3 and 4 are self evident and a summary of the results to be obtained from a gas analysis is given in figure No. 2.

The loss due to radiation, etc., is obtained by adding the heat absorbed by the boiler to the losses a, b, c, and d, and subtracting this amount from the B.t.u.'s in the original pound of combustible. What has been said in regard to the main loss (d) and the use of the gas analysis, may be summarized as in figure No. 2.

Summary of Procedure to Ascertain Causes of Low Boiler Efficiency

As a general summary of the method of diagnosing the case of a boiler plant which is suspected of using too much coal for the steam furnished, I would suggest that first the temperature of the flue gas be taken, if the plant is operating without an economizer and the temperature is found to be much above 500°F. look for the causes as indicated in figure No. 2, and apply the proper remedy.

Next by the aid of a water manometer as shown in figure No. 1, take the draft at different points in the boiler and furnace, for natural draft conditions and good opera-

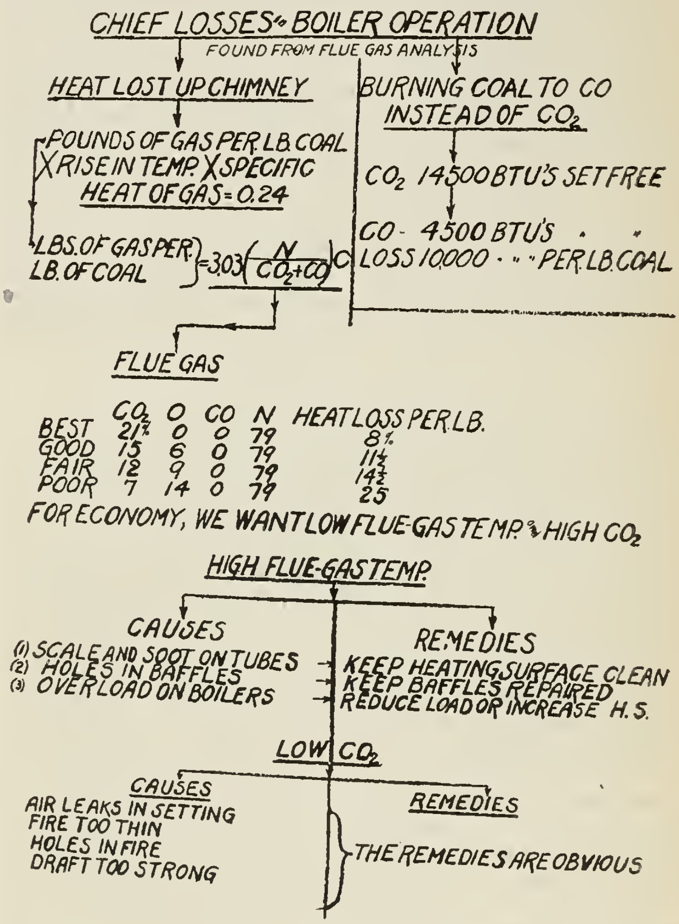

Figure No. 2.—Summary of General Losses in Boiler Operation.

tion, you might expect to get a loss of draft from the furnace to the last pass in the boiler, i.e., in figure No. 1 from the point marked *A* to that marked *C* of about 0.3 inches of water, the loss between the ash pit and the furnace will vary with the kind of coal burned and the type of grate or stoker used and the quantity of coal burned per square foot of grate surface per hour, (see figure No. 1). This may vary from 0.15 inch for run of mine bituminous to 1.0 inch for No. 1 anthracite buck-wheat, when burning the fuel at the rate of 25 pounds per sq. ft. of grate surface per hour. The loss of draft between the boiler and the chimney is usually estimated at 0.1 inch for each 100 feet of steel flue and 0.05 for each right angle bend, and the sum of the above losses should give the draft required at the point where the flue enters the chimney, for example take the case of the No. 1 anthracite assuming 100 feet of flue and two right angle bends, the total draft required would equal,—

From ash pit to furnace.....	=	1.0 inch
From furnace to flue........	=	0.3 "
From flue to chimney.......	=	0.2 "
		1.5 inch of water

To give this draft would require a chimney nearly 250 feet high, and a chimney of this height would be inadequate if we wanted to burn the coal at a higher rate per square foot of grate surface per hour. This indicates the impossibility of burning these finer grades of anthracite without forced draft. It also illustrates how to check up on the draft and the height of chimney required, if the draft is too small a sluggish and smoky fire will result. If the draft is found to be correct, the next thing to do is to analyze the flue gas as indicated above and this will show the excess of free air entering the boiler and whether combustion is complete.

It is clear from what has been said above that there is a certain difference of draft required, between the ash pit and the last pass of the boiler to give best results, now by placing a double draft gauge on the front of the boiler and connecting it to these two points it can be made a real aid to the fireman, by operating the damper to give different draft readings and using the Orsat to analyze the gas at these different damper settings, the proper readings on the draft gauge may be determined to give best results for the given conditions, then by marking these points on the gauge, the fireman can duplicate the best operating conditions by keeping his drafts correct.

CO_2 Recorders

From the Orsat apparatus described above, a gas analysis may be made, giving the percentages of CO_2, O and CO, in the flue gas and while it is advantageous to have all this information, the percentage of CO_2 is the most important. A low percentage of CO_2 is always accompanied by a high percentage of free oxygen and often by an absence of CO, and the reasons that this represents a wasteful condition even with complete combustion as indicated by the absence of CO, is that it means that a large excess of free air is entering the furnace, is being heated from room temperature to that of the flue gas and discharged to the chimney. On the other hand, as the air entering the furnace is cut down, the percentage of CO_2 will increase and if carried too far will result in incomplete combustion and a high percentage of CO. But as a rule, the percentage of CO_2 can be taken as an indication of the condition of combustion in the furnace. For this reason, a number of different makes of CO_2 recorders have been placed on the market. These machines work continuously, automatically draw in a charge of gas, analyze it and record the result on a chart. While there is no doubt that in many cases, these machines are giving satisfaction, the writer knows of many instances, especially in the smaller plants, where they have been tried and have been discarded on account of the time and care required to keep them in operation.

They are a great help when working properly and some large companies have stimulated interest in the proper operation of the boiler plant by offering a bonus to the fireman, based on the average percentage of CO_2 obtained, during a shift, above a minimum limit of, say, 10 per cent.

In addition to periodic boiler tests such as described above, the plant should be equipped with recording instruments by which the evaporation from and at 212°F. per pound of coal, as fired may be found for each day or part of a day. These instruments are, — *First*, some form of water measuring or weighing device, it may be in the form of a venturi meter, an orifice machine,or some form of automatic weigher, in any case there should be an integrating scale giving the total water per hour, and a recording chart from which the variations in the water fed to the boilers may be seen at a glance. On this same chart the temperature of the feed water and the steam pressure may be recorded. *Second*, a coal weigher by which all the coal is weighed before it goes to the furnace. With the information obtained from the above apparatus, the boiler horse power may be obtained and the economical operating rate determined, showing when a second boiler should be put in service.

If the evaporation per pound of coal is less one day than another or during one part of the day, than another, it points the way to finding the trouble and, therefore, improving the efficiency of the boiler operation.

In figure No. 2, the first gas analysis shown is, of course, theoretical, as it is impossible to get, in boiler operation, combustion represented by 21 per cent CO_2, CO = zero and 79 per cent N., but under favourable conditions it should be possible to approximate the condition marked "good" representing a loss per pound of combustible of 11½ per cent, and it should not be at all difficult to attain the condition marked "fair" which shows a loss of 14½ per cent. But the majority of the steam plants in operation in Canada today, especially the smaller ones, are operating according to the condition marked "poor" or worse, with a loss of at least 25 per cent of the heat units of every pound of combustible burned going up the stack.

In 1921 there were burned in Canada for steam making purposes about 25,000,000 tons of soft coal, as a conservative estimate we may say that at least 15,000,000 tons of this was burned under the condition indicated as "poor". If by means of a little more intelligent operation and the use of a little more equipment to help the engineers and firemen, the condition "poor" could be changed to "fair", it would result in a saving of 1,500,000 tons of coal per year which at $6.50 per ton would represent nine and three-quarters million dollars. Or assuming that we had this coal to burn in a fairly efficient plant, we could operate a 150,000 boiler h.p., plant 24 hours per day for one year, and assuming a water rate for direct connected turbines and generators of 10 pounds of steam per kilowatt we could operate a 450,000 k.w., plant with this heat that is wasted up the chimneys.

Here is an economic waste which should be stopped, not only for the benefit of the owners of the plants but for the benefit of the country at large, as the supply of coal for Canada has become a question of national importance.

The author does not claim that there is anything original in the above paper, except perhaps in the method of presenting the well known facts mentioned. The object in writing it is to again remind steam power plant owners and engineers in charge of such plants of the possibilities of savings which may be effected.

Considerations on a Project of Town Planning for the Island of Montreal

An outline of a plan for the establishment of a Town Planning Commission to investigate and report on a project for the Island of Montreal.

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Paper read before the Montreal Branch, The Engineering Institute of Canada, April 17th, 1924.

Much has been said and written during the last decade regarding town planning. All of us have listened to lectures on this subject, so interesting, yet so little understood. I will not undertake to tell you here what should be done to make Montreal more beautiful, nor will I tell you about new boulevards, widening of streets, opening of new parks and playgrounds or about re-arranging our system railroads. It will be the task of the commission to study out and solve these problems. I will confine myself to a few remarks on the organization, scope and aim of a town planning commission such as I see it; a commission which shall seek the means of gradually and methodically rendering life easier and more cheerful to our urban dwellers. I have the firm conviction that any commission of that nature, starting out without a well-defined programme will fail to produce results, and that any town planning commission for Montreal or for elsewhere which has not the approbation and co-operation of the public and civic authorities will invariably fail.

I will cite one case only, that of Ottawa. Ten or twelve years ago the federal government and the city of Ottawa appointed a commission to prepare a plan of embellishment and development of Ottawa and the surrounding country. The commission worked faithfully and published a lengthy report with maps, etc. The whole was carefully worked out. The report tells about creating a federal district, similar to the District of Columbia at Washington; it tells about a national park extending from Hull to and including the Laurentian hills; it recommends shifting of railroad tracks and many other important improvements. The report failed to receive attention from the public with the result that both the government and the city of Ottawa ignore it completely, with the net result; loss of time and money.

Plan Should Cover Entire Island

The task of a town planning commission is to seek and to formulate "ways and means" to guide the economical and methodical development of a city or district with due regard for public health, comfort and amenity of the population and to its social, commercial and industrial development. The need of such a commission is, to-day, universally recognized. In Europe, this question has been developed a long time ago. In the United States the movement started in Chicago about 1893, (White City of Daniel H. Durnham), and at the present time fifty per cent of all American towns of 100,000 population and over have a town planning commission of one form or another. In France, all communities of 10,000 people and over, must have a town planning organization. In Canada the province of Saskatchewan has taken the lead and in 1917 its legislature passed a law to the effect that all cities and villages must have an organization governing the method of their growth.

Regarding Montreal, a town planning commission should have jurisdiction over the whole of the island of Montreal, because the island forms a natural metropolitan district, and it contains a large proportion of the population of the province of Quebec. The population of the province of Quebec is 2,361,200; the population of the island of Montreal is 1,000,000 (census of 1921). Again, of all the means at the disposal of a town planning commission for the carrying out of its task, the control over the subdivisions of tracts of land, transportation systems and zoning, is, without doubt, the most effective. How can a commission arrive at any satisfactory result if its control does not extend over the whole island?

The Russell Sage Foundation in New York

I have often thought that Montreal occupies, towards Canada, a position similar to that of New York towards the United States. The two cities have the same destiny. What is happening in New York to-day? I met, in Mexico City in 1909, Mr. Nelson P. Lewis, at that time chief engineer of the Board of Estimates and Apportionment of New York and at the present time chief engineer of an organization having for its object the preparation of a regional plan of New York and vicinity. Lately, following letters exchanged, Mr. Lewis sent me a pamphlet entitled, "*Plan of New York and Its Environs*", containing the minutes of a meeting held on May 10th, 1922, which meeting had been called by the trustees of the Russell Sage Foundation. The Russell Sage Foundation, you perhaps know, is an association organized under the terms of Mrs. Russell Sage's will, having in view the improvement of social and living conditions for the benefit of New York and vicinity. The following are a few extracts from the pamphlet which will make known the object of the association and the means taken to arrive at the desired results.

"The problems created by the concentration of the population in and about the city of New York are growing daily in seriousness and are engaging the attention of an increasing number of our citizens. The trustees of the Russell Sage Foundation, organized for the improvement of social and living conditions, have appointed, to consider the subject, a committee consisting of.................

"Substantial progress has already been made in the organization of a series of basic studies looking forward to the formulation and promotion, in co-operation with all concerned, of a regional plan of New York and its environs. It is now desired to hold an informal conference of those who are naturally interested:—the public officials, architects, engineers, artists, city planning experts and other public-spirited men and women who in their own special field and in their own localities are already forcing these problems...

"The first question you may instinctively ask is, —whether it is not a project far beyond the resources of the Foundation. Unquestionably it is, if the Foundation alone is expected to carry this project to fruition. All that the Foundation can wisely do is to outline an initial plan in reliance on the co-operation of others to perfect it and to carry it out.

"Another question which may be properly asked is, whether any such plan can be carried out without the action of public authorities, city and state, and this question may lead to another, as to why some of the public officials of at least the larger cities concerned should not be members of any committee on this subject. Unquestionably no such plan can be carried out except by and through the public authorities, but the Foundation has thought it unfair to these authorities to involve them in a plan at the present time. Ultimately any plan must be presented to these authorities for modification, acceptance or rejection. These authorities to perform their proper functions as representing the people should be left at this initial stage in an absolutely judicial position. They should not now be embarrassed by being asked to take a leading part nor should the Foundation and its advisers be now embarrassed by any personal or political considerations.

"The project of the Foundation while not ignoring congested Manhattan and almost equally congested Brooklyn, involves a regional plan of New York and includes not only Greater New York but its environs. With present methods of transportation the real New York includes every locality within commuting or motor distance and embraces parts of the states of New Jersey and Connecticut. It is perhaps in these environs that city planning has its greatest opportunity."

All of which applies equally to Montreal. Our friends in New York are therefore:—1. Looking ahead and seeking the means of improving the social and living conditions in a large territory around New York. 2. Elaborating a plan of development on a large scale. This is being done by a special organization and not by city employees. 3. Intending to submit the plan, when completed, to the public and to the local authorities.

If adopted in its original form, or modified, the municipalities interested will carry out the recommendations contained in the plan, which will cover, not only the city of New York, but a large territory around New York, because, town planning can accomplish perhaps more in a territory around a city than in the city itself.

Montreal's Favourable Situation

Montreal is the Metropolis of Canada, owing to its geographical location and to other favourable conditions. This however is not a reason why we should not make an effort to help it along. I doubt if there is in Canada and perhaps America, excepting New York, a place where town planning can show better results than around Montreal. We have all the elements needed, and it is up to us to keep and to increase its supremacy over all other Canadian cities. If we wish to grow we must not only keep our population, but we must invite our neighbours to join us, and the best way to arrive at this result, is to make life easier and more agreeable to all classes of the community. This is precisely the aim of a town planning commission.

Regarding the advantageous position of Montreal from a commercial and an industrial point of view, and regarding the beauty of its situation, with a mighty river flowing at its feet and a most beautiful mountain in the centre of the city, much could be said. I will only say that upon my return here, after an extended absence, I found that few of our citizens realize the importance of the city and the part it is called upon to play in our national existence. Many of us still think that we are in a village or a country town. We must give up these ideas and accustom ourselves to think of our city as one of the big cities of the world. Let us have immediately a strong commission which will do effective work. The longer we wait, the more complicated will be the problem. We must not wait until we have reached such intolerable conditions as exist to-day in New York.

In the matter of a town planning commission with jurisdiction over all the island of Montreal, the first action must be taken by the Montreal city council, which should petition the Quebec legislature to create a commission, to define its functions, scope, power and to provide the money. If we assume that such a commission shall have jurisdiction over all the island of Montreal, the legislature must act because the Montreal civic authorities have no power and no control over the other municipalities of the island. Besides, there is the question of funds. It is useless to expect that the various municipalities will furnish the money which the commission will need. Equally useless is it to form a commission if it has no money at its disposal. Therefore, the matter of jurisdiction and money can be arranged only through the legislature.

Obviously, a group of citizens could be brought together in the interest of a plan of improvement, but, without power and money, nothing worth while can be done. In this respect, the conditions in Montreal and in New York are very different. The Russell Sage Foundation has voluntarily undertaken the task of preparing a regional plan of the district surrounding New York but they have the means of doing it. In Montreal we have no such advantages, and the legislature must come to our assistance in the manner suggested below.

As a matter of interest, I may state here that the regional plan of New York covers a territory of 5,500 square miles in which there are 400 different political units, — three states, counties, cities, towns, villages, boroughs, and townships. In that area there is to-day a population of 9,000,000. If the population grows, as it did in the past fifty years, it is expected that the territory will have a population of 20,000,000 in 1960 and 37,000,000 in the year 2000. The New York Census Committee has called attention to the fact that 22.6 per cent of the city's population lives on 1.6 per cent of its area and that 68.8 per cent lives on 10 per cent of its area.

Organization, Staff, Authority

Before speaking of organization, I will read to you what Dr. Robert H. Whitten said in a conference in Detroit in 1915:—

"In American state and city government, almost every expansion of government activity is initiated through the instrumentality of a new commission. There is a fear of entrusting the working out of new functions to existing officials. Existing officials are already loaded with work, and it is thought that they will have neither the time, the inclination nor perhaps the ability to develop the new idea. A new commission composed usually of unpaid members, is used to plan and care for the new undertaking at least during its development period. Often the new function fails to take root as a permanent institution, and the commission dies. If, on the other hand, the new function becomes a recognized governmental function it is sooner or later merged with the governmental organization. The new function is transferred to the proper official or department and the commission disappears. That is inevitable; otherwise, municipal government would soon become an utterly disorganized tangle of boards and commissions.

"The city planning movement will doubtless be no exception to the rule... Doubtless the commission method will be used largely in the earlier stages of the movement but, if the city planning movement endures, it will ultimately be made a part of the general governmental organization. The city plan is so vitally connected with every phase of municipal activity that it must be worked out in as close touch as is possible with the existing administrative and legislative authorities."

This appears to be logical, especially when we deal with town planning, because town planning is a thing not easily defined, — it is hard to say where it begins and where it ends. What is appropriate to one city is not appropriate to another. We must take into consideration the local conditions, even the mentality and temperament of the population. For all these reasons it is better that the researches and studies be entrusted to a special commission.

Then, as I conceive it, the programme should be:— Adoption by the civic authorities of the city of Montreal, of a resolution asking the Quebec legislature to create a town planning commission covering the entire island. The Montreal civic authorities, or, if we prefer it, the legislature, shall define the functions, the scope and the powers of the commission. The legislature shall grant to the commission the necessary powers to raise the money which it will need for the carrying out of its work.

The commission should be composed of from six to ten members, all ratepayers serving without remuneration, all representative men, financially, commercially, and socially. The mayor, the chief executive, and one or two aldermen of the city of Montreal, should be members of the commission. Westmount, Outremont and other municipalities around Montreal should be represented on the commission either singly or in groups. There should be a president, a secretary, (who may or may not devote all his time to the work of the commission), and others. Among the members of the executive body, I would like to see a prominent engineer and a prominent architect. Then, there shall be a paid staff,—first a chief engineer, (a man well up in municipal improvements and familiar with our history, our temperament, aspirations and traditions), and then, engineers, architects, landscape architects, surveyors, draughtsmen, etc., according to the magnitude of the task on hand and to the money at the disposal of the commission. The paid staff shall execute all the work, prepare the plans and maps and write the final report; all in accordance with the instructions received from the executive body of the commission.

The commission itself will not have executive powers, which at all times must remain with the municipalities interested, but it may consult the local authorities and it shall be obligatory upon the municipalities interested, companies, corporations and individuals, to furnish information and documents which may be required or asked for by the commission.

It goes without saying that the suggestions and recommendations of local authorities, city councils or others should receive special attention from the commission. For example, the zoning and restrictions regarding construction should be studied jointly by the commission and the aldermen. Likewise the street traffic problem should be studied out jointly with the tramway commission and the tramways company, and so on.

As soon as the report with plan or plans is completed, it should be submitted to the public and to the municipalities interested, for criticism, modification or approval. The commission should weigh and carefully consider all opinions, suggestions and criticisms, and should make the modifications which it considers judicious. The report and plan should be approved by the Montreal city council, and by the majority of the municipal authorities interested, after which the plan and report should be forwarded to the Quebec legislature for approval and to be transmitted afterwards to the municipalities interested, with instructions to carry out the recommendations and conclusions of the report.

Then, what shall we do with the commission? Simply reduce the staff, but keep the commission alive, for the report will require many modifications and revisions. On this subject Mr. Nelson P. Lewis says, in his book "The Planning of Modern Cities":—

> "The creation of a proper plan will require years of patient work, and the men who do it will be forgotten before it is finally carried out. It is no one-man job and it is never actually finished. However carefully and skillfully the first plan may have been made, unforeseen changes will take place, new methods of transportation will be developed, new inventions will powerfully affect the social life of the community, and the plan, when still susceptible of changes, will be modified to meet these changed conditions."

It is necessary that the commission be kept in existence to interpret its own work, to act as arbitrators in case of dispute, and to make changes in the plan necessitated by changing conditions in the district.

Scope of Work

We must bear in mind from the beginning that the aim of a town planning commission is as much to avoid the repetition of the errors of the past rather as to correct the errors themselves. In reality a commission, even if it had the power to do so, would not recommend, much less order, immediate, radical and costly changes in existing conditions. What has been done is done good or bad. It is very logical that we should seek to correct the errors of the past, but it must be done slowly and gradually, and we must choose the time when the cost will not be excessive. No expropriation or radical changes in the layouts of our city can be made without increasing an already huge debt or increasing the contributions of a taxpayer already heavily burdened. The efforts of a town planning commission should be to prepare for the future, as well as to improve presents conditions. In short, a commission should make certain recommendations only regarding the past and present, excepting however in the case of sanitation, and urgent needs but on the other hand, it must formulate rules and regulations concerning the future. Also, we must bear in mind that results will be slow, and that a town planning commission will labour for our children and grandchildren and not for ourselves.

We must not come to the conclusion, however, that a town planning commission can do nothing to improve the existing conditions within the town itself. On the contrary, it may do much, and that without increasing the debt to any considerable extent. For instance, it may contribute to the beautifying of our parks; it may oppose the erection of ugly signs and posts along our main streets; it may have something to say in regard to building restrictions and should co-operate with the city authorities, the tramways commission and the tramways regarding new car lines and extensions to existing lines.

The first duty of the commission should be the preparation of a general map of the territory under its jurisdiction. This map should be at a scale or scales as required, and should show all the streets, highways, boulevards, parks and parkways, public places, existing subdivisions and an outline of the future subdivisions of tracts of land as laid out by the commission itself, because we must not lose sight of the fact that the "raison d'être" of the commission itself is the control it must exercise over the future subdivisions of land, on the means of transportation and on the zoning of the district, as explained later. Then it will review the laws and by-laws which have contributed to the development of the district or have retarded it.

The question comes up: What will happen, if the commission, in laying out a general plan of development, injuriously affects the interests of a landowner? The law of Saskatchewan, "The Town Planning and Rural Development Act" in this respect says, in section 20, that, when an owner is injuriously affected, the municipality interested shall compensate him for the whole amount of the loss, provided a claim to that effect is filed within a specified time. Section 21 of the same act likewise states that when a property is increased in value by the making of a plan of development, the municipality interested is entitled to one-half of the increased value provided a claim to that effect is filed within a specified time. It is claimed that this arrangement should be satisfactory to all concerned.

It shall be within the power of the commission to:—

1. Gather all information and statistics which it may need, make a brief historical review of each municipality of the island. Prepare a general plan of the island.

2. Divide the territory into four zones, residential, commercial, industrial and indeterminate.

3. Choose the site for new parks, playgrounds and public places. Recommend if needs be enlargement and improvements for existing parks and playgrounds.

4. Choose sites for monuments, historical and otherwise, public and semi-public buildings. Make a preliminary study of location for new bridges between the Island and adjoining municipalities.

5. Study carefully the manner of making all future subdivisions of tracts of land. Determine in a general way the area and form of lots. Determine the grade, width and direction of main highways, width and grade of streets. In short, though leaving freedom of action to proprietors of tracts of land and to real estate agents, the commission or the local authorities shall exercise an effective control on the development of suburbs. No sub-division shall be registered until approved by the commission.

6. Recommend, if needs be, the widening of certain streets and the opening of new thoroughfares in urban districts. This of itself is a large task.

7. Make a thorough investigation of the best means of improving traffic conditions in such congested streets as Sherbrooke, St. Catherine, Notre Dame, St. James, Craig and St. Denis, where circulation is now or soon will have reached the saturation point, especially the tramways service. In reference to the congestion in our main arteries of travel, I will quote here a few figures obtained from Judge J. F. St. Cyr, president of the Montreal Tramways Commission.

"Between five and six o'clock in the afternoon, 302 tramway cars pass the corner of Craig and St. Denis streets; 122 cars pass the east side of Place d'Armes square; 157 pass the west side of the same square; and 420 cars pass the corner of Bleury and Ste. Catherine streets. This is at the rate of one car every 8½ seconds During the same period 366 vehicles pass the same corner of Bleury and Ste. Catherine."*

This will logically lead the commission to study new lines of travel for the tramways and the opportunity of building elevated lines and subways; look into the possibility of establishing new civic centres in the suburbs where the surrounding population will find all its needs in matters of finance, shopping and amusements. The subject of decentralization to-day is the object of a great deal of attention by town planners. It is my belief that the problem of relieving the congestion in our main streets should receive deep and immediate attention if we wish to avoid the intolerable conditions which to-day exist in New York.

8. Control the construction of trunk sewers, water pipes and other public improvements, which sooner or later will serve more than one municipality.

*These figures are as of February 12th this year.

9. Recommend, if advisable, changes ni our system of railroad stations, freight yards and lines of railway, which now prevent or delay the development of certain districts. Control over the location of new stations, freight yards and line of railways.

10. Forbid unhealthy grouping of houses in workmen's districts; establish for each zone the percentage of ground not built upon and number of houses per acre; see that houses receive the maximum amount of air and light; order the removal of slum conditions when health is endangered.

11. Investigate and make recommendations on any other subject coming logically under the jurisdiction of the commission.

Finance

I have already said that we must not depend on our citizens or our municipalities for the necessary funds with which to carry out the work of the commission. On the other hand, such a commission can do nothing without money; that is self-evident. It is impossible to say at present what such a plan would cost, but as a basis for discussion, I estimate that it would cost $200,000.00, and the time required would be three to four years. Please remember that we have no correct plan of the island, all that we have are compilations, more or less correct. A correct topographical map will cost money and will take time to prepare. The legislature must help us to find this sum of $200,000.00. It could be made the object of a special loan, payable in 20 years, principal and interest, by all the municipalities interested, pro rata their population according to official census of 1921.

Summary

First and foremost, we must endeavour to get the public interested; we must explain our project; show the results we are seeking and the means which we wish to employ to solve the problem. Without the approbation and co-operation of the public, nothing can be done.

Once the general public has a clear idea of the utility and scope of the problem, the competent authorities, which are the mouth-pieces of the public, should ask the Quebec legislature to create a town planning commission with jurisdiction over the whole island of Montreal. The powers and scope of the commission should be defined by the legislature or by the petitioners and the legislature should authorize the commission to raise the money which it will require.

There should be an executive body composed of say six to ten persons, all interested in civic matters and representative men of the island in social, commercial and industrial circles. The mayor, the chief executive, and one or two aldermen of Montreal should be members of that body. Then there should be an expert town planner, with engineers, architects, landscape architect, draughtsmen, etc., according to work in hand and money available.

The subjects to be investigated and solved and the various problems which shall have the attention of the commission have been clearly enumerated above.

A report accompanied by plan or plans will be prepared and submitted to the public and municipal authorities for opinions, criticisms or approval. The commission will weigh all opinions and criticisms and will make whatever changes it deems judicious. The report and plan or plans will receive the approval of the Montreal city council and of the majority of the municipalities of the island after which it will be transmitted to the Quebec legislature which shall approve it with or without modifications and will make it obligatory upon the various municipalities of the island to carry out the terms of the report within their respective territory.

There are two reasons why the commission's report should be approved by the legislature. First, the city of Montreal has no authority over the other municipalities of the island, and could not enforce the execution of the terms of the report beyond the limits of the city. Secondly, I believe that a provincial law will have a better chance of being faithfully carried out than a mere by-law. It is so easy and sometimes so tempting to have a municipal by-law amended.

At least the executive body of the commission should be kept alive for the purpose of interpreting its own work, to supervise its application and to make modifications when events and circumstances make it necessary.

Lastly, I believe the task can be accomplished at a cost of approximately $200,000.00, which sum the legislature may authorize the municipalities of the island to borrow, and which may be amortized in 20 years by means of 20 annual payments, each municipality paying its pro rata per capita according to 1921 census.

The creation of a town planning commission for Montreal is an urgent necessity and should not be postponed. It is useless to try to solve the Montreal problems piece-meal by men who can devote only a few leisure hours to them. It has got to be done by men who devote their whole time to them and who will have an opportunity to survey the whole situation as well as to go into the details of each problem.

It has been said that some aldermen fear that a town planning commission will curtail their power and liberty of action. I do not believe that there is any serious ground for that fear. On the contrary, I should think that the aldermen would be glad to be shielded by the law when any unreasonable demands are made upon them by the taxpayers. As to reasonable demands, I am sure the commission will never refuse to grant them. It should not be forgotten that the report of the commission would have to be approved by the Montreal council before it is sent to the legislature.

The whole charter of the city of Montreal, which is a fair-sized book, is a code of restrictions and limitations of power for the executive, the city council and employees. A few more restrictions concerning problems outside the city limits will not curtail the power and usefulness of the city council. Again, a town planning commission, it should be borne in mind, is created for the benefit of the whole community and not to impose needless and harmful restrictions upon its inhabitants.

Evolution of City Planning, Regional Plan

In the early days of city planning in America, the territory covered by the projects were of small extent, for example a scheme of civic centre. Very few, if any, of these projects were ever carried out, simply because the cost was out of proportion to the result obtained. Subsequently it was sought to treat a larger area, such as a residential section, or an industrial centre. Some success was achieved in that direction, but it was soon discovered that the treatment was only local. Later, the idea of town planning was enlarged to embrace a whole city. Efforts were made to remedy the obvious mistakes of the past, due to the haphazard growth of the older built-up portions, and, at the same time, an attempt was made to guide the development of the town along more rational, economical and hygienic lines, where it was yet possible to do so. It was soon recognized that, although in the right direction, the field was yet too limited because immediately beyond the city limits, where the civic authorities had no jurisdiction, the errors of the past could and in fact were repeated, thus nullifying the benefits of the planning within the town itself. In the course of a few years the territory might be annexed, with its ill-advised system of streets and land sub-division. It became evident that any town planning scheme to be effective, must cover not only the town proper but also its environs. Proper legislation to that effect was sought and obtained. Regional planning, so called, thus came into existence and so it came about that, to-day, town planning means a project embracing not only the town proper but a large territory around it. The best example of such a scheme is the one now worked out by the trustees of the Russell Sage Foundation for New York and vicinity. It covers an area of 5,500 square miles, or 30 times the area of the entire island of Montreal.

THE

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President Surveyer to be Honoured

The occasion of the centennial celebration of Rensselaer Polytechnic Institute, the oldest college of science and engineering in any English speaking country, at Troy, New York, October 3rd and 4th, 1924, marks an event of historic interest in the engineering world.

It will be memorable from the fact that it will witness the celebration of the hundredth anniversary of Rensselaer Polytechnic Institute, that it will witness the presence of a distinguished gathering, including the presidents of the outstanding engineering societies of the world, as well as the presidents of a number of the leading universities, and also from the fact that President Arthur Surveyer, of *The Engineering Institute of Canada*, will on this occasion number as one of the distinguished guests, and will receive the degree of Doctor of Engineering at a convocation to be held on the morning of October 3rd. In addition to President Surveyer, who will address the convocation, degrees will be conferred upon the Honorable Herbert Hoover, secretary of commerce of the United States, the Honorable Alfred E. Smith, governor of the state of New York, the Honorable Harry E. Clinton, mayor of Troy, President Frank Pierrepont Graves of the University of the State of New York, President Sir Charles Langbridge Morgan, of the Institution of Civil Engineers of Great Britain, President Henri Abraham, of the Society of Electrical Engineers of France, President Luigi Luiggi, of the Society of Civil Engineers of Italy, and Honorary President Roberto Gayol, of the Society of Engineers of Mexico.

There will also be unveiling of tablets in the afternoon, and in the evening a dinner in the State Armory, addressed by President Livingston Farrand, of Cornell University, followed by a pageant on the campus illustrating scenes in the history of science and engineering during the last one hundred years.

On the morning of October 4th, a second convocation will take place at which the following have been selected to receive honorary degrees, and who will address the meeting:—President Angell, of Yale University, President Birge, of the University of Wisconsin, President Stratton, of the Massachusetts Institute of Technology, President Grunsky, of the American Society of Civil Engineers, President Low, of the American Society of Mechanical Engineers, President Kelly, of the American Institute of Mining and Metallurgical Engineers, President Osgood, of the American Institute of Electrical Engineers, and President Michelson, of the National Academy of Sciences.

In the afternoon there will be a reception by President and Mrs. Ricketts of Rensselaer Polytechnic Institute, and in the evening a pageant and Alumni smoker.

Canadian engineers will appreciate the fact that a distinguished Canadian engineer is among the number of notable men to be honoured on this unique occasion.

Concrete Committee makes Progress

A general meeting of *The Institute's* committee on the Deterioration of Concrete in Alkali Soils, was held at the University of Saskatchewan on May 16th and 17th, 1924, at which were present Professor C. J. Mackenzie, chairman; Messrs. A. G. Blaikie, W. P. Brereton, M.E.I.C., J. N. Finlayson, M.E.I.C., J. R. C. Macredie, M.E.I.C., J. W. Shipley, G. M. Williams, A.M.E.I.C., secretary, and Doctor Thorvaldson, in charge of the chemical research.

After discussing the business features of the committee's activities, and additional members, Professor Finlayson, summarizing the field tests in Winnipeg, stated that no data relating to the Deacon blocks were available other than reported last fall after the 1923 inspection of the blocks. Mr. Williams summarized the results of this spring's inspection of the blocks at Cassils, which report had just been received from Mr. Dawson. Owing to high water at Grandora lake no inspection had been made of the Grandora blocks since the fall of 1923. Deterioration seems to be more rapid at Cassils than at the other two sites.

Doctor Thorvaldson outlined briefly the different phases of the chemical work which is being carried on. He was followed by Mr. Larmour, one of his assistants, who has been studying the colloidal changes which take place in mortar bars exposed to alternate wetting and drying. The relative changes in length of bars in distilled water and in different salt solutions were shown by diagrams and lantern slides.

Doctor Shelton, who has been making petrographical studies of the various constituents found in cements, described in detail the preparation of these compounds in the pure state, and outlined the difficulties encountered with the different types of high temperature furnaces. He showed numerous lantern slides to illustrate the different products formed when these pure compounds are hydrated with distilled water and various salt solutions.

On Saturday morning, May 17th, Doctor Thorvaldson continued the discussion of the chemical research, outlining in detail the products formed when tricalcium silicate is hydrated with water and with sulphate solutions. These results show that the presence of sulphate brings about a much more rapid and complete release of the free lime from the silicate compound, and that it is the subsequent combination of the lime with the sulphate which is mainly responsible for disintegration. A possible method for preventing this reaction with the sulphate was outlined.

The afternoon was devoted to a discussion on the chemical data presented and the necessity for getting completed portions of the chemical research on record so that priority and protection may be afforded it.

Although the committee is not in a position to promise a definite solution of the problem, it is certain that splendid progress has been made, the results of which it is anticipated will fully justify all the splendid effort that is being made by the committee.

Fuel Committee's Recommendations

Since its appointment on April 23rd, 1923, the Fuel Committee of *The Institute* has been constantly at work, the members of which, for their untiring efforts in this connection, deserve the thanks of the entire profession.

It was felt at that time, in view of the importance of the fuel problem of Canada, and believing that the profession could do much to add to its solution, that a committee was necessary and one was consequently appointed, the object of the committee being to use the information available on the fuel situation and take advantage of the collective opinions of the various members of the committee.

The Fuel Committee laid down a policy to govern its scope in the early stages of its work that the main Fuel Committee should concern itself solely with the sources, production, transportation and distribution of fuels to the various parts of Canada as a whole. In relation to branch fuel committees, which were also appointed, the committee believed they should confine themselves to the economical utilization of the different fuels available in each locality, and to educational campaigns regarding proper use of heating equipment and domestic fuel, for the benefit of the householder.

The first meeting of the committee was held in Montreal, May 31st, 1923, consisting largely of Montreal members and representatives of the Dominion Fuel Board and the Canadian Institute of Mining and Metallurgy. On June 8th, the E.I.C. Fuel Committee issued its first circular to its members, followed by another on July 25th. These circulars covered:—

(1) Requests for co-ordination of work of the general Fuel Committee with branch fuel committees.

(2) Requests for suggestions and comments.

(3) Requests for views on one or two specific fuel points, and intimation of arrangements for holding meeting of representatives of general E.I.C. Fuel Committee.

Shortly afterwards the committee prepared a special review in draft form of the coal situation in Canada which was first circularized to the Montreal members of the Fuel Committee, followed by a meeting of the local members, the result of which was a circular sent to the general membership of the committee. This circular considered the problem from:—

(1) The Eastern Region of Canada — which apparently is in a position to economically supply from purely Canadian sources all the coal necessary in this region, both for household and power purposes.

(2) The Western Region — where it was considered feasible to supply coal or carbonized lignite briquettes for household purposes from purely Canadian sources, although in some of the larger centres the Alberta coals cannot compete economically with American bituminous coals.

(3) Central or acute fuel area — (a) Ontario and the western portion of Quebec constitute the acute fuel area of Canada, which area imports roughly 13,000,000 tons of bituminous coal per year and 4,500,000 of anthracite. It may also be termed the coal consuming area of Canada. (b) It is non-economic under present conditions to expect coal from any Canadian source to compete in this region either in the householder or power fields with coals coming from the United States. (c) That for household purposes Welsh coal, briquettes of various kinds, and coke, form desirable and apparently economic substitutes for the American anthracite at present consumed.

A copy of the Coal Review, together with a digest of the opinions of the various members was mailed to every member of the Fuel Committee on November 10th, and a letter asking for suggestions on fuel policy and for criticisms on the Coal Review.

A general meeting of the committee was held at headquarters in Montreal, on March 8th, 1924, with fifteen members or representatives present. The discussion at this meeting included:—

(1) Grading and sizing of the coals and regulation of the delivery.

(2) High mining costs in Alberta.

(3) Transportation costs.

(4) The future possibilities of Nova Scotia coals.

(5) General discussion on coke.

Since that time the chairman of the committee, Mr. F. A. Combe, M.E.I.C., and the secretary, Mr. Lesslie R. Thomson, M.E.I.C., have had in hand the preparation of the final report which has now been completed. It includes:—

Section I — Summary of conclusions.

Section II — Introduction. Appointment of committee, terms of reference, personnel and officers.

Section III — Review of preliminary activities. Methods of work, circulars issued, replies received, coal review and criticisms of same, short digest of review.

Section IV — Proceedings of meeting of representatives of whole committee. Five points discussed and opinions expressed.

Section V — Findings and recommendations.

The final conclusions of the committee respecting the fuel problem of Canada are:—

(I) That a solution of the general fuel problem of Canada will only be reached by a very careful study of the different phases of the problem, and the gradual development of a policy. In this connection your committee feels that the work of the Dominion Fuel Board is of very great importance, and wishes to touch upon this matter again under the heading of "Recommendations".

(II) That a solution of the fuel problem in the acute fuel area will be forwarded by a co-ordinated policy of water power and fuel power development. As the use of water power increases coal will be released for heating purposes. In the congested centres also, central heating and steam plants will be conducive to more efficient utilization of coal both for power and heat.

(III) For off-season heating, peat offers a desirable substitute for imported coal, and your committee wishes to record its appreciation of the work accomplished at Alfred by the Peat Committee financed by the Federal and Ontario governments. This is just being put upon a commercial basis.

A number of recommendations are included:—

(1) That the Council of *The Engineering Institute of Canada* memorialize the Federal government to set on foot an inquiry into the actual cost of moving coal in train load lots in order to place this matter beyond the realm of half-informed controversy, and suggests that this duty might be discharged with propriety by the Railway Commission of Canada, but that its findings be not made public without including in the final figure proper allowance for overhead, depreciation and profit. Any other course of action might seriously prejudice the whole question of a long haulage movement of coal.

(2) That Council urge the Federal government to take appropriate action in order that each of the provinces concerned should adopt, after discussion, standards of sizing and grading of coals. Until this is done the public in their purchasing of coal will not be protected in any way.

(3) That the Council place on record with the Federal government its appreciation of the valuable work at present being undertaken by the Dominion Fuel Board, that the government be urged to prosecute this work vigorously, and, further, that any so-called national fuel policy should only be adopted after receiving recommendations and reports by the Dominion Fuel Board.

(4) That Council go on record as opposing any tendency to force the railways to haul commodities at less than cost except in times of national peril; and further, that, if for national reasons, it be desirable to have Ontario become a market for Alberta coals, the Council urge upon the Federal government the wisdom of bringing about a result by subsidies or tariffs, rather than by imposing non-economic operation on the transportation systems.

(5) That Alberta operators be urged to concentrate their efforts on the production of the high grade coals for supply to the western region rather than on the shipment of their low grade coals to Ontario.

(6) That the Canadian Furnace Manufacturers have their attention called in some suitable manner to the desirability of providing furnaces especially designed to burn coke and fuels other than American anthracite.

(7) That the branch fuel committees continue their activities in connection with the solving of local difficulties in regard to fuel; and finally suggests very respectfully that the Council consider the possibility of appointing a standing committee on fuel and fuel policy in order that the professional engineers of this country may be able to express their united views from time to time on a matter that is so vitally important to the national welfare.

OBITUARIES

William Arthur Begg, A.M.E.I.C.

Deep regret is expressed at the death of William Arthur Begg, A.M.E.I.C., of Regina, Saskatchewan, which occurred at his late residence in Regina on August 30th, 1924.

The late Mr. Begg was born in Hamilton, Ontario, in 1882 and he received his early education in the public schools of that city. In 1907 he graduated from the University of Toronto in the Faculty of Applied Science. He spent some years in the mining fields of northern Ontario, later he was engaged in survey work for the Dominion government in Alberta. In 1912 he entered the service of the Saskatchewan government as engineer and surveyor with the Department of Highways. In 1921 he was appointed director of town planning under the Department of Municipal Affairs, which position he held at the time of his death.

The late Mr. Begg took a keen interest in all matters relating to town planning and rural development, being a pioneer in this work in the west where he has done much to improve conditions and to place the subject of town planning before the public in its proper light.

Mr. Begg was a member of the Saskatchewan Land Surveyors' Association, the Dominion Land Surveyors' Association, the Canadian Town Planning Association, and on August 20th, 1917, he was elected an Associate Member of *The Institute.*

In the death of Mr. Begg the engineering profession throughout Canada and more particularly in the west has suffered a distinct loss.

Andrew Johnston Riddell, A.M.E.I.C.

Regret is expressed at the death of Andrew Johnston Riddell, A.M.E.I.C., of Windsor, Ontario, which occurred on April 21st, 1924. Mr. Riddell was born at Rutherglen, Scotland, on August 29th, 1861, and received his education at Glasgow Technical College, Scotland, following which he served his apprenticeship for five years being articled to the late John Douglas of Glasgow, Scotland. Prior to coming to Canada in 1906 he was engaged in Scotland principally on municipal work. His first work in this country was in the capacity of construction engineer on the Walker theatre at Winnipeg, and in 1909 he was engaged in the same capacity with the Canadian Pacific Railway Company on bridge construction over the Old Man river, at Macleod, Alta. Subsequently, in 1909, Mr. Riddell carried on the practice of his profession as an architect in the city of Winnipeg. Later he affiliated with the Trussed Concrete Steel Company of Canada, Limited, and remained with them for a period of upwards of five years, finally going to the town of Walkerville and taking charge of one of the departments of the head office there. He left this company to resume the practice of his profession and affiliated himself with Gilbert Jacques in the city of Windsor, and practised with this party for several years. Later he dissolved this affiliation and commenced practice under his own name, as he had in the city of Winnipeg, and was engaged in his profession at the time of his death. Mr. Riddell was elected an Associate Member of *The Institute* (then the Canadian Society of Civil Engineers), on April 9th, 1910.

Joseph Gosselin, Jr., Affiliate E.I.C.

Joseph Gosselin, Jr., Affiliate E.I.C., died at his home at Levis, Quebec, on July 4th, 1924. The late Mr. Gosselin was vice-president and general manager of Jos. Gosselin, Limited, general contractors, lumber merchants and manufacturers. He was born at St. Nicholas, on November 15th, 1873, and was educated at Levis college. Since completing his schooling he was continuously associated with his father in the contracting and manufacturing business. Mr. Gosselin was a member of the Engineers' Club of Montreal, and the Quebec Automobile Club, and was elected an Affiliate of *The Institute* on September 25th, 1917.

PERSONALS

W. Stanley Vipond, M.E.I.C., has been re-elected president of the Northern Electric Engineering Society, Montreal.

G. B. Elliot, S.E.I.C., of Westmount, Quebec, has been appointed to the sales staff of the A. R. Williams Machinery Company, Montreal. Mr. Elliot is a graduate of McGill University of the class of 1922.

John Buss, S.E.I.C., who has been located with the Bogalusa Paper Company, Inc., Bogalusa, Louisiana, as chief chemist, has returned to Canada and is with the Provincial Paper Mills, Limited, at Thorold, Ontario.

A. E. Eastman, A.M.E.I.C., is with the St. Lawrence Valley Power Company of Potsdam, N.Y., on hydro-electric power plant construction. Mr. Eastman was formerly engaged with Huff Daland and Company, Inc.

H. J. Whiting, Jr.E.I.C., has been appointed to the staff of the Barrett Company, Limited, Montreal. Mr. Whiting was previously with the Newfoundland Power and Paper Company, Montreal.

Lt.-Col. K. M. Perry, D.S.O., A.M.E.I.C., has resigned from the chair of tactics at the Royal Military College, Kingston, Ontario, on appointment to be general staff officer of military district No. 4, Montreal. Lt.-Col. Perry is attached to the Royal Canadian Regiment.

C. R. Davis, S.E.I.C., has been appointed sales engineer with the Canadian International Filter Company, Limited, at Toronto. Mr. Davis graduated from the University of Toronto last spring, and was until recently with the St. Regis Paper Company at Godbout, Que.

Herbert P. Heywood, A.M.E.I.C., who recently joined the staff of the Sterling Appraisal Company, of Toronto and Montreal, is engaged at present in the appraisal of the Western Sanitarium. In his present position Mr. Heywood will devote his time to the appraisal of industrial plants, buildings and institutions.

Frederick E. Bronson, A.M.E.I.C., has been elected vice-president of the Ottawa Light, Heat and Power Company, the holding company and owners of the stock of the Ottawa Electric and Ottawa Gas Companies, of both of which he has also been appointed vice-president, in succession to the late Warren Y. Soper.

C. C. Kirby, M.E.I.C., G. G. Hare, M.E.I.C., and J. N. Flood, A.M.E.I.C., have been appointed a committee to superintend the erection of a war memorial monument to be placed in King square, the principal park of the city of St. John, N.B. The base of the monument will be made of Spoon island, New Brunswick granite.

John Tomkins, S.E.I.C., has been appointed construction engineer for the Temiskaming mill of the Riordon Pulp Corporation, Limited. Following his graduation from Queen's University in 1923, Mr. Tomkins was with the Howard Smith Paper Mills, Limited, at Cornwall, Ontario.

Allan T. Bone, A.M.E.I.C., is with the Geo. A. Fuller Company, Limited, on the construction of the twenty-one storey building in Toronto. Mr. Bone was previously with the Shawinigan Engineering Company Limited at La Gabelle, Quebec, on design and estimating on the new power development of the St. Maurice Power Company, at that site.

Ralph Allingham, A.M.E.I.C., chief engineer for A. W. Menkins, engineers and contractors, on the construction of grain elevators for the government of the Union of South Africa, has returned to Canada. Mr. Allingham has been engaged on this work in South Africa since August 1921 and has returned to this country following the completion of the work.

Garnet Rankin, A.M.E.I.C., of Toronto, sailed for Hong Kong, China, from Vancouver on September 25th to take over his duties as reinforced concrete and structural engineer for the firm of Little, Adams and Wood, lower Albert Road. Mr. Rankin is a graduate of the University of Toronto of the class of 1915, and until recently has been with the city architect's department, of the city of Toronto.

L. S. Dixon, M.E.I.C., consulting engineer with the Riordon Pulp Corporation, Temiskaming, Quebec, is with the Bogalusa Company Inc., Bogalusa, Louisiana. Mr. Dixon was previously assistant engineer with the Riordon Company under G. L. Freeman, M.E.I.C., during the construction of the Kipawa plant, and in 1923 was appointed chief engineer of the Eddy Paper Corporation, Three Rivers, Michigan.

Professor W. G. Hardy, A.M.E.I.C., of the Nova Scotia Technical College, has returned to Halifax after making a holiday trip of eighteen thousand miles, visiting New York, Panama Canal, Los Angeles, Portland, Oregon, Puget Sound, San Francisco, New Orleans and Montreal. While in Los Angeles, Prof. Hardy collaborated in the preparation of a report for the extension of the Los Angeles water supply which is at present serving 1,000,000 people and by 1946 it is estimated will be serving 4,000,000.

Edward Hughes, A.M.E.I.C., has accepted a position with Geo. M. Campbell, railway contractor, at Calumet, Michigan, on the engineering staff of the contracting department. Mr. Hughes was engineer with the Crow's Nest Pass Coal Company, Limited at Fernie, B.C., previous to which he had been engaged on a number of railway construction works in western Canada. He was also assistant on Canadian Geological Survey work for two summers previous to 1919.

Members of *The Institute* who have recently been appointed by the Canadian Ingersoll-Rand Company, Limited to take an eight months course in their works with a view to later appointments to sales and executive positions in the company, are as follows: —Francis G. Ferrabee, S.E.I.C., graduate from McGill university in mechanical engineering last spring; Richard R. Gilbert, S.E.I.C., graduate of 1924 from Nova Scotia Technical College; and Harold J. Maxwell, S.E.I.C., who received his degree from the University of New Brunswick in 1923.

Norman D. Wilson, A.M.E.I.C., of the firm of Wilson and Bunnell, consulting town planning and transportation engineers, has recently left for Mexico city to report on traffic problems there for the Mexico Tramways Company. Mr. Wilson has for the past three years been engineer on traffic study for the Toronto Transportation Commission, assisting in the problems incidental to extensions, re-routing, etc. One of the latest problems handled by Mr. Wilson for the Transportation Commission was a report and recommendation on the transportation requirements of York township, which has since been adopted by the township.

V. R. Davies, A.M.E.I.C., has been appointed acting assistant professor in civil engineering at the University of Saskatchewan, relieving assistant professor R. A. Spencer, A.M.E.I.C., who has been granted leave from the university for one year. Mr. Davies graduated from McGill University in 1920 and received his degrees of B.Sc., and M.Sc., from that university, and M.C.E., from the University of Manitoba in 1923. His post graduate course in McGill University was taken during the season of 1922-1923, when, as demonstrator in the department of geodesy and surveying, he carried on his post graduate work in hydraulics.

A. P. Theuerkauf, M.E.I.C., has been appointed chief engineer of the Dominion Iron and Steel Company and the subsidiary steel plants at New Glasgow and Sydney Mines, succeeding Geo. D. Macdougall, M.E.I.C., who recently resigned from this position. Mr. Theuerkauf joined the Dominion Iron and Steel Company in 1901 as mechanical draughtsman and designer. In 1909 he became designer for the Dominion Coal Company Limited, at Glace Bay and the following year joined the staff of the Canadian Foundry Company, Toronto, in the same capacity. In 1911 he returned to the Dominion Iron and Steel Company as squad leader and was later appointed chief draughtsman and subsequently technical engineer and assistant chief engineer with the company.

Lesslie R. Thomson, M.E.I.C., who for the past six years has been secretary of the Lignite Utilization Board of Montreal, announces that he has opened an office as consulting engineer, specializing in the fields of structural engineering and fuel economy. Mr. Thomson graduated from the University of Toronto in 1905 in mechanical engineering, securing his degree of B.A.Sc. (hydraulics and strength of materials) in 1906, and graduating in civil engineering in 1907. After lecturing in civil engineering in the University of Manitoba for two years, from 1910 to 1912, Mr. Thomson became associated with the Dominion Bridge Company as assistant engineer, in which capacity he remained until 1918. He is at present special lecturer in structural engineering, Department of Architecture, McGill University, Montreal.

H. M. Bigwood, A.M.E.I.C., Receives Promotion

H. M. Bigwood, A.M.E.I.C., chief draughtsman, Public Works Department, Victoria, B.C., has received promotion to assistant district engineer on Vancouver Island, with headquarters at Alberni. On the occasion of his departure, the Victoria Branch tendered Mr. Bigwood a farewell luncheon and presentation, and on motion by G. B. Mitchell, M.E.I.C., seconded by E. P. Girdwood, M.E.I.C., a hearty vote of thanks was extended to him for services as past-chairman and secretary, in making the annual and general meetings outstanding successes.

Mr. Bigwood has made many staunch friends in Victoria and Vancouver, and while they regret his leaving Victoria, good wishes and congratulations accompanied him.

E. T. Spidy, A.M.E.I.C., leaves for New Zealand

E. T. SPIDY, A.M.E.I.C.

E. T. Spidy, A.M.E.I.C., superintendent, Dominion Engineering Works, Montreal, has resigned his position and has left for New Zealand. Mr. Spidy spent the early years of his life in that country, and while his present trip is in the interests of his health, he will in all probability locate there. At the age of twelve Mr. Spidy left New Zealand and returned to Brighton, England, the place of his birth, where he entered the mechanical engineering course at the Brighton Technical College. He has been in Canada for the past fifteen years having joined the staff of the Canadian Pacific Railway Company at the Angus shops in 1909. During the past three and a half years he has been with the Dominion Engineering Works, and in practically all his work in Canada he has specialized on production methods and cost production. One of the specialties which Mr. Spidy has carried out in all his work is the introduction of piece work or premium method of wage payment.

Sir Ernest Rutherford (left) and Sir David Bruce, on the occasion of their visit to Canada to attend the meetings of the British Association for the Advancement of Science. Sir Ernest was the guest of honour at a special luncheon given by the Engineering Institute of Canada at the Windsor hotel, Montreal, on Thursday, September twenty-fifth, when he addressed the members of The Institute on the Advancement of Science.

ELECTIONS AND TRANSFERS

At the meeting of Council held on September 23rd, 1924, the following elections and transfers were effected:

Members

CHISHOLM, Donald Cameron, B.A.Sc., (Univ. of Tor.), division engineer, C.P.R., Fort William, Ont.

STEWART, Robert Meldrum, B.A., M.A., (Univ. of Tor.), director, Dominion Observatory, Ottawa, Ont.

THOMAS, George Nevil, (Elec. and Mech. Engrg., Durham Univ.), supt. of constrn. and in charge of constrn. estimating, Canadian General Electric Company, Ltd., Toronto, Ont.

THORNTON, Major-General Sir Henry Worth, K.B.E., B.Sc., D.Sc., M.Inst.C.E.. Order Leopold of Belgium, Comm. Legion of Honour, Am.D.S.M., chairman and president, Canadian National Railways, Montreal, Que.

Associate Members

AGAR, George, (City and Guilds of London), chief mechanical dftsman. and estimator, Canadian Vickers, Limited, Montreal, Que.

CASSELS, Westcote Lewis Lyttleton, B.Sc. (McGill Univ.), partner, Farley & Cassels, and Cassels & McDougall, Ottawa, Ont.

CHINA, Ernest, asst. engr., highways dept., Regina, Sask.

CRAWLEY, Frederick Austin, divn. engr., divn. No. 3, Provincial Highways Board, Halifax, N.S.

DELISLE, Joseph Lorenzo, B.A.Sc. (Univ. of Tor.), in charge of electrical and mechanical department, Chicoutimi Pulp Company, Chicoutimi, Que.

FORTIN, Joachim, B.Sc. (Levis College), supt. for the Nova Scotia Construction Co., at Portage des Roches, Que.

JOHNSON, Lancelot Llewellyn, C.E. (Renss. Poly. Inst.), unit director of administration, for prov. of Alberta, D.S.C.R., Calgary, Alta.

JONES, Morris Herbert, asst. engr., pulp and paper machinery dept., Port Arthur Shipbuilding Co. Ltd., Port Arthur, Ont.

McDONALD, Claude Knox, dftsman., Canadian Line Materials Ltd., Toronto, Ont.

NUTTALL, Albert, (City and Guilds of London), asst. engr., city of St. Lambert, Que.

RAMSAY, Robert, asst. chief engr., Canadian Vickers, Limited, Montreal, Que.

SHECTOR, Sidney Samuel, B.Sc. (Univ. of Wis.), engr. supt. in full charge of constrn. of elevators for John S. Metcalf Co. Ltd., Montreal, Que.

STODART, James, engr., Messrs. Cope & Sons, contractors, Hamilton, Ont.

SWINNERTON, Aylmer Aberffraw, B.A.Sc. (Univ. of Tor.), chemist in charge oil shale investigations, Department of Mines, Ottawa, Ont.

VALIQUETTE, Adrien, C.E., B.Sc.A. (Univ. of Montreal), Quebec Streams Commission, Montreal, Que.

JOHNS, Charles D., estimator, asst. supt., John V. Gray Construction Co., Windsor, Ont.

MARCH, Joseph Wade, B.Sc. (N.S. Tech. Coll.), transmission line work, Nova Scotia Power Commission, Bridgewater, N.S.

ROSS, Donald Grant, B.Sc. (Dalhousie Univ.), engr. in charge of constrn., section 2, transmission line, with Sir W. G. Armstrong Whitworth & Co., Humber development scheme, Newfoundland.

STEEVES, Darrell Darrington, dftsman., John S. Metcalf Co., Ltd., Montreal, Que.

Transferred from the class of Associate Member to that of Member

BARNES, Harry Fairweather, B.Sc. (Univ. of N.B.), municipal engr., British Municipal Council, Tientsin, China.

DeLAPORTE, Antoine Valentine, B.A.Sc. (Univ. of Tor.), special lecturer to the course in municipal engrg., Univ. of Toronto, asst. sanitary engr., and in charge experimental station, Prov. Board of Health of Ontario, Toronto, Ont.

JEFFREYS, Arthur Gerald, The Grove, Lincoln Avenue, Montreal, Que.

MacNAUGHTON, William Gilbert, B.A., B.Sc., (McGill Univ.), secretary, Technical Association of Pulp and Paper Industry, New York, N.Y.

MIEVILLE, Arthur Leonard, general manager, Howden-Ljungstrong Preheaters (Land) Ltd., Govan, Scotland.

RUSSELL, Benjamin, B.Sc. (McGill Univ.), chief field inspr. and hydraulic engr. of irrigation surveys, Water Power and Reclamation Service, Dept. of the Interior, Calgary, Alta.

Transferred from the class of Junior to that of Associate Member

MOORE, Charles Melbourne, B.Sc. (Queen's Univ.), inspecting engr., Reclamation Service, Dominion Government, Calgary, Alta.

Transferred from the class of Student to that of Associate Member

HALL, John G., B.Sc. (McGill Univ.), asst. supt., Back River Power Company, Montreal, Que.

MACDONALD, John Angus, B.Sc. (N.S. Tech. Coll.), junior topog'l. engr., Geol. Survey of Canada, Ottawa, Ont.

MACKENZIE, William Langlands, B.Sc. (McGill Univ.), asst. engr., Welland Ship Canal, St. Catharines, Ont.

Transferred from the class of Student to that of Junior

ABEL, John Stewart, B.Sc. (Univ. of Man.), asst. engr., way and structures, Winnipeg Electric Railway, Winnipeg, Man.

DOIDGE, Henry George, B.Sc. (Univ. of Man.), instructor, science dept., Royal Military College, Kingston, Ont.

SPOTTON, John Greer, B.A.Sc. (Univ. of Tor.), manager, Hepburn & Spotton, Guelph, Ont.

STEWART, Malcolm Davidson, B.A.Sc. (Univ. of Tor.), engrg. dept., Price Bros. & Co. Ltd., Chicoutimi West, Que.

WELDON, Harold Stanley, B.A.Sc. (Univ. of Tor.), district manager Montreal office, Canadian Inspection and Testing Co. Ltd., Toronto.

WHITE, Hazel Marguerite, B.A. (Dalhousie Univ.), asst. plant engr., Dept. of Telephones, Saskatchewan Government, Regina, Sask.

The following Students were admitted:—

ARGUE, Harold Edward, 2111 Osler Street, Regina, Sask.

BALFOUR, Melville W., 931 Seventh Avenue North, Saskatoon, Sask.

GILLETZ, Colly, 2372 Waverly Street, Montreal, Que.

GREENBURG, Harry, 1088 St. Dominique Street, Montreal, Que.

SILLERS, Thomas George Archibald, 411 Third Avenue North, Saskatoon, Sask.

TITUS, Ernest Moulton, 512 Avenue K North, Saskatoon, Sask.

WHITE, Joseph James, 610 Lansdowne Avenue, Saskatoon, Sask.

WILSON, James Harvey, Qu'Appelle, Sask.

The following Students were admitted at the meeting of Council held on August 26th, 1924:—

BUCHANAN, Thomas Gwynne, 1983–57th Avenue West, Vancouver, B.C.

CLUFF, Harold David, Lieut., R.C.C.S., B.Sc. (Univ. of Man.), Camp Borden, Ont.

DIXON, Meredith Fred, 219 Wilson Avenue, Montreal, Que.

FERRABEE, Francis Gilbert, 731 Sherbrooke Street West, Montreal, Que.

FERGUSON, John Clifford, B.Sc. (Queen's Univ.), Queenston, Ont.

McCULLAGH, Karl G., B.Sc. (Univ. of Man.), Camp Borden, Ont.

TAMES, John Alexander, 11247–124th Street, Edmonton, Alta.

WRIGHT, James Frederick Church, 665 Langside Street, Winnipeg, Man.

ANNOUNCEMENT OF MEETINGS

Further information may be secured from the secretaries of the various branches, whose addresses will be found under "Officers of Branches" on page 624 of *The Journal.*

NIAGARA PENINSULA BRANCH:—

Secretary-Treasurer, R. W. Downie, A.M.E.I.C.

Oct.	Trip to inspect the plant of the Horton Steel Works, Bridgeburg.
Nov. 7th.	Dinner meeting at St. Catharines, to commemorate the centenary of the Welland canal. Speaker E. W. Beatty, K.C., president, Canadian Pacific Railway Company. Presentation of branch charter by President Surveyer, M.E.I.C.
Dec. 11th.	Dinner meeting, Niagara Falls. Northern Ontario night. Speaker, The Hon. Chas. McCrea, minister of mines, Ontario.

SASKATCHEWAN BRANCH:—

Secretary-Treasurer, J. W. D. Farrell, A.M.E.I.C.

Oct. 9th.	Address by Colonel Boyden of the Portland Cement Association.
	Meeting at which Major Geo. A. Walkem, M.E.I.C., will present the Branch charter, date to be announced later.

WINNIPEG BRANCH:—

Secretary-Treasurer, P. Burke-Gaffney, A.M.E.I.C.

Oct. 2nd.	Smoking Concert (Jointly with Association of Professional Engineers.) It is expected that the presentation of the branch charter, by Vice-President, Major Geo. A. Walkem, M.E.I.C., will take place at this meeting.
Oct. 16th.	Address on "Design and Operation of Flour Mills", by Theodore Kipp, Jr.E.I.C.
Nov. 6th.	Address on "City Financing", by H. C. Thomson.
Nov. 20th. Dec. 4th.	Prize Papers. Engineering students, University of Manitoba.
Dec. 18th.	Address on "Modern Combustion Engineering", by A. J. T. Taylor.

Memorandum re World Power Conference and Subsequent Visit to France and Switzerland

By Frederick B. Brown, M.E.I.C.

Arrived in London on June 25th, where the following few days were spent in preparation for the World Power Conference which opened at the Palace of Industry, Wembley, on June 29th, where H.R.H. the Prince of Wales made an inaugural address. For the following two weeks, until the 12th of July, morning and afternoon sessions were held at Wembley, some times as many as three meetings proceeding at the same time in different halls. Several hundred representatives from forty-one countries attended the sessions where the keenest interest was displayed in the papers and their discussions. About 425 papers were presented on all phases of power resources, their production, development and utilization in the various countries of the world. The official programme gives the details of the subdivisions, with the authors and the titles of the papers. The papers present a very complete review of the present power situation and will undoubtedly form a most valuable contribution to the literature on the subject. It was impossible to follow all the sessions, but I gave close attention to those subjects of more particular interest to me. The speakers were handicapped in discussing the papers because many of these were not received until after the Conference had begun, and therefore most of the speakers gave brief outlines of the contents of their papers although some very good discussion was developed on several occasions. I took part in the discussion several times, and on one occasion was honoured by being asked to preside over one of the sessions of the Conference. This was on July 9th, when the subject of Internal Combustion Engines was presented in Hall No. 2, at which time there were present between 75 and 100 representatives, and 23 papers were discussed by representatives from 9 different countries. This meeting was typical of the others, and all were very interesting. One of the principal benefits of the Conference was the opportunity of meeting the engineers from the other countries and getting to know them personally, and exchanging views with them and learning something of their problems, and the economic conditions in the various parts of the world. The principal object of the Conference was undoubtedly to bring together the men who are responsible for the development and utilization of power resources and to consider how power matters can be handled scientifically and industrially, taking into consideration international and national limitations, with the ultimate object of providing a central and permanent clearing house of power information. The objects of the Conference I believe were attained, and the importance of the meeting will doubtless be very great.

With regard to the Canadian papers and their presentation, I may safely say that they were second to none, both in subject matter and form. Very high compliments were paid to the Canadian authors, and it was very evident that Canada is looked to as one of the leaders in hydro-electric power development, if not indeed the most advanced of any country.

The problems in the various countries are so widely variant that it is difficult to generalize on the subject, and reference may be had to the papers in detail to appreciate the various points raised. Some countries have few water powers, and others are abundantly endowed therewith. Some countries have very efficient fuel burning plants, and the problems of utilizing and exchanging power were discussed, and brought out the possibilities of future power stations in adjacent countries where the interchange of power and other materials may work for the benefit of both.

During the Power Conference there were certain papers which were not of direct personal interest, and it was possible to arrange for several trips in England to visit power stations and engineering works not on the official programme, as well as to see several points of interest. In this way visits were made to the shops and power plants of the London, Midland and Scottish Railway, including the very efficient steam station at Stonebridge; the Barrow-in-Furness works of Vickers, Limited, where large hydraulic turbines and diesel engines are being manufactured, as well as a great deal of ship-building, gear cutting, and other interesting work is being carried on; some of the works of the English Electric Company, Armstrong-Whitworth, a number of shops in and about London, and particularly the Palace of Engineering at Wembley Exhibition, where a really marvellous collection of exhibits of engineering interest is assembled under one roof, and which would require several volumes to describe.

At the conclusion of the World Power Conference, a party of thirty engineers, representing nine countries, joined the specially conducted tour to France, Switzerland and Italy, where a great many powe plants were inspected and a number of very enjoyable visits were made, and where also we met the leading engineers in various parts of these countries. The following summary of the itinerary give an idea of the ground covered and the plants seen.

Monday, July 14th.

Left London by train for Dover, crossing to Calais, and arrived at Lille in the evening, and inspected local electrical works and distribution system.

Tuesday, July 15th.

Left Lille in early morning and drove to Croix-Wasquehal, and inspected the steam power station there. This plant was designed for 5,000 kilowatts, and has grown to a capacity of 56,000 kilowatts, beyond the efficient capacity of the local water supply for condensing purposes. Interesting powdered coal burning apparatus side by side with chain grate stokers and hand firing, permitting comparison of methods in the same station. Continued by auto car to Roubaix, and from there to Comines, where the new steam power station of 85,000 kilowatts capacity was inspected. This is entirely equipped for burning pulverized fuel and is being extended for a much larger capacity, the ultimate capacity of which may probably be 250,000 or 300,000 kilowatts. The turbine units in this plant are of 25,000 to 30,000 kilowatts capacity each. Returned to Lille at night.

Wednesday, July 16th.

Left Lille by train 7.24, arriving at Aulnoye at 8.54, and from there went to Erquelines in Belgium. After the local system was inspected, which included a very interesting open air substation and transmission lines at 45,000 volts, left for Jeumont in France where the State Installations were inspected, after which took train for Paris, arriving there in the evening. That evening the French Minister of Public Works tendered a banquet to the Canadian Delegation and the visiting engineers at Union Inter-Allied, following which the party left by night train for Lyons, arriving there in time for breakfast.

Thursday, July 17th.

In the morning went to Ivry-Port where the laboratory of Cie Electro-Céramique was inspected and where tests were made at 1,000,000 volts on insulators manufactured by this company. In the afternoon, motor trip to Gennevilliers where the large steam power station, 200,000 kilowatts present capacity, was inspected. These units are 40,000 kilowatts each. Very interesting data obtained from Colonel Mercier, chief engineer, regarding efficiencies and selling methods, load and so forth.

Friday, July 18th.

Left Lyons in early morning and inspected the Thury system of direct current transmission, 100,000 volts at Vaulx-en-Velin. This is 100,000 volts system distributing direct current near Lyons, and fed from a number of hydro-electric power plants in Savoie province at Bellegarde, Chambery and other places. In the afternoon took train from Lyons to Valence, and thence by automobile to Beaumont-Monteux, where the power station on the Lower Isere was inspected. This is a low head plant of 28,000 kilowatts, very similar in general design to the La Gabelle, but on a smaller scale. The system of transmission lines at 120,000 volts, and the outdoor transformer stations were very interesting. Returned to Lyons by automobile at night.

Saturday, July 19th.

Left Lyons at 7 a.m., arriving at Bellegarde near the Swiss border. At Bellegarde we inspected three power plants in the gorge which send their power to Lyons, some of them dating back to the earliest days of power development, but recently re-modelled. Also inspected the site of a very large proposed development at this point where difficult hydraulic conditions have to be met. Thence by auto through a wonderful country in sight of Mont Blanc to Chancy Pougny. This is a hydro-electric station of about 45,000 kilowatts capacity, under a 25-foot head, also very similar in design to La Gabelle. It is an international river between France and Switzerland, one end of the dam being in each country. Some of the hydraulic features at this installation are quite intricate and the workmanship is excellent. After inspecting this plant we drove by auto to Val de Fier where a very neat hydro-electric power plant under 200-foot head is installed. The dam is situated in a narrow rocky gorge, and it was necessary to excavate 130 feet below the bed of the stream to obtain foundations for the dam which has a total height of 250 feet, but is very short. The water is led in a tunnel to a power plant downstream, with the forebay forming the surge tank above the station, which has a capacity of about 15,000 kilowatts. We left Val de Fier in the evening, arriving at Chambery late at night.

Editorial note: — Mr. Frederick B. Brown was asked to give an account of his trip to the World Power Conference, which is published herewith. Mr. Gale's account, which was also sent in by request, covered the trip to Norway and Sweden, while Mr. Brown's touches on the points of interest witnessed by those who took the trip to Switzerland and Italy.

Sunday, July 20th.

Left Chambery 7.10 a.m., and arrived at Bourg St. Maurice on the upper Isere, where there is a high head plant of 25,000 kilowatts, and a transmission system of 120,000 volts at Viclaire. Arrived at Chambery in the late afternoon and inspected the power plant nearby. This is of comparatively small capacity but beautifully designed.

Monday, July 21st.

Further inspection of plants near Chambery, thence to Aix-les-Bains, and after a hot sulphur bath in the famous establishment, left for Culoz and Geneva, arriving at Geneva in the evening.

Tuesday, July 22nd.

Some of the party left Geneva for Chevres, where a 20,000 horse power hydro-electric station constructed 30 years ago is still in efficient service. I went with the other portion of the party to see the arch dam at Broc. This dam is recently completed, forming an artificial lake with three rivers feeding into it. The dam is 150 feet high and about 400 feet long on the crest, and is one of the most interesting pieces of construction in Europe. Full description of the design is contained in the French and Swiss technical press, including two very good papers on temperature measurements and expansion measurements in the dam. It was completed about four years ago, and the plant operates under a head of approximately 100 metres, or 330 feet. It has a capacity of about 20,000 kilowatts fed through two steel penstocks and a long tunnel. After seeing this plant we visited the ancient Chateau of Gruyere, and later in the day the picturesque town of Romont, thence to Berne by train, arriving there in the late evening.

Wednesday, July 23rd.

Left Berne by motor car in the early morning and visited the hydro-electric station at Muhleberg. This plant was completed in 1921-1922, and has a head of 60 feet and a capacity of about 70,000 horse power and utilizes an artificial storage above the dam amounting to about 350,000,000 cubic-metres. The plant is beautifully designed and has a very fine outdoor transformer station. The generation is at 15,000 volts, and there are in the station some large frequency changing sets for railway use.

Other members of the party left Berne for Zurich where the works of Sulzer Brothers at Winterthur, and the works of Brown, Boveri & Company at Baden were inspected, after which the electric station at Olten-Goesgen was inspected. This plant is 59,000 kilowatts and is interesting because it has four different transmission voltages leaving it.

Thursday, July 24th.

Left Berne at eight o'clock in the morning, and arrived at Interlaken, where the Monophase Electric Traction system at 15,000 volts was inspected. We also visited the railroad shops at Spiez, and an interesting power plant nearby under 230 feet head, and having a capacity of 24,000 kilowatts. In this plant a very fine example of the pitting of the turbine runners was seen and four runners of different materials were inspected showing the effects of material on pitting, and also the effect of change in the draft head. This plant also has three different methods of exciting the generators, which is most unusual. Returned to Interlaken late at night.

Friday, July 25th.

Left Interlaken at 8 o'clock in the morning and climbed the Jungfraujoch by rack railway, some grades being as high as 25 per cent, and the tunnel work being extremely interesting. After descending the mountain we inspected the Burglauenen power station built 20 years ago, with a head of 550 feet, and which serves all the electric railroads in the district with a capacity of 5,000 horse-power. We left Lutschental after inspecting the power station, and reached Interlaken in the late evening.

Saturday, July 26th.

Left Interlaken in the early morning, arriving at Lucerne at noon, where the entire Swiss delegation of Power Delegates to London met us, and, with the Minister of Public Works, and the Director of Hydraulic Service, and the leading consulting engineers of Switzerland, tendered us a delightful luncheon at the Schweizerhof hotel overlooking the lake. In the afternoon some of the party took an excursion on the lake, but I, with some others, motored to Zurich, and went through the works of Escher-Wyss Company, arriving back in Lucerne by motor car in time to catch the train.

Sunday, July 27th.

Part of the party left Lucerne in the morning, and visited Amsteg works, Wassen, Goeschenen, Chiasso, and thence into Italy to Milan. The other members of the party visited the very interesting high head plant at Ritom, which takes the waters of Lake Ritom and utilizes them under a head of 828 metres. Some exceptionally interesting tunnel work and pipe line work was observed at Ritom, especially in connection with repairs made to the tunnel after failure of the rock strata. Some of the features of the Pelton wheel installation are very interesting. The four generators have a combined capacity of about 36,000 kilowatts, and are 15,000 volts, single phase, 16-⅔ cycles, 333 r.p.m. The station is designed for two more similar units. A very complete description of the works at Ritom can be found in the Swiss technical press in German.

Monday, July 28th, to Wednesday, July 31st.

Party in Venice sight-seeing and visiting hydro-electric stations at Piave, Santa Croce. The Fadalto station is 88,000 kilowatts, 105 metres head, the Nove station is 55,000 kilowatts, 99 metres head; San Floriano station 4,400 kilowatts, 14 metres head, and at Castelletto 5,200 kilowatts, 62 metres head.

Friday, August 1st, and Saturday, August 2nd.

In Venice and Milan and Stresa, where the works of the Ovesca were inspected, and the hydro-electric stations at Rovesca, 38,000 kilowatts, and at Pallanzeno, 36,000 kilowatts, were inspected.

Sunday, August 3rd.

The party left Stresa for Domodossola, where five high head installations were visited — Goglio 25,000 kilowatts, 525 metres head; Verampio 28,000 kilowatts, 570 metres head; Valdo 30,000 kilowatts, 775 metres; Rivasco 10,000 kilowatts, 346 metres; Crego 21,000 kilowatts, 490 metres. These stations are all of the Imprese Elettriche Conti.

Monday, August 4th.

The party returned to Paris and London.

As my steamer sailed from Cherbourg just before the close of the Tour, I left the party a day or two before the close and returned to Paris and Cherbourg in time to catch the Empress of France for home, spending a pleasant day or two in Paris en route.

Franklin Institute Centenary

On September 17th, 18th and 19th, 1924, the Centenary Celebration of the founding of The Franklin Institute and the inauguration exercises of the Bartol Research Foundation were held in Philadelphia.

Professor Elihu Thomson, Ph.D., Sc.D., was chairman of the Honorary Committee of the Centenary Celebration while the executive committee was presided over by President Wm. C. L. Eglin, Sc.D., of the Franklin Institute.

The morning of Wednesday the seventeenth was given over to addresses of welcome by the Honorable W. Freeland Kendrick, Mayor of Philadelphia, President Wm. C. L. Eglin of the Franklin Institute and Professor Elihu Thomson, the afternoon being devoted to sectional meetings. Addresses were given by distinguished men of science from different parts of the world, a number of whom were British Scientists who had attended the Toronto meeting of the British Association.

The event is unique in the history of scientific organizations in America and attracted considerable attention in the scientific world.

The Institute was represented by Professor W. S. Pardoe, B.A.Sc., C.E., M.E.I.C., of the University of Pennsylvania. The secretary of the Franklin Institute is Doctor R. B. Owens, M.E.I.C.

Prospectors' Map of Northern Manitoba

A map intended for the use of prospectors in the mineral belt north of The Pas, Manitoba, has been prepared by W. T. Thompson, M.E.I.C., and to those interested in this district this map should prove of great assistance.

Trade Publications

The G & W Electric Specialty Company Inc., has issued a pocket size booklet entitled, G & W Potheads Protection for Cable Ends, which is intended for the construction man on installations. This booklet will be sent to readers of *The Journal* upon application to the company.

The Marconi Wireless Telegraph Company, Limited, has issued two interesting booklets; the first entitled "The Marconi Beam System for Long-distance Communications", and the other, a reprint of a paper read before the Royal Society of Arts by Senator Guglielmo Marconi, on the "Results obtained over very Long Distances by Short Wave Directional Wireless Telegraph more generally referred to as the Beam System".

BRANCH NEWS

Victoria Branch

E. P. Girdwood, M.E.I.C., Secretary-Treasurer.

Good progress is being made with the Dominion Drydock, Esquimalt, V.I., and it is planned that the branch will visit the work in the near future.

At the last regular meeting, May 30th, it was requested to have a discussion at our next regular meeting on October 1st, the subject chosen was "British Columbia Dams". E. Davis, M.E.I.C., chief engineer, Water Rights Branch, and E. G. Marriott, A.M.E.I.C., of the Water Rights Branch were chosen as leaders. All members are expected to take part in this discussion.

Word has just come to hand that the branch charter will be presented by Geo. A. Walkem, M.E.I.C., vice-president of zone "A" at an early date.

E. A. Cleveland, M.E.I.C., comptroller of water rights, has consented to address the branch on the World Power Conference, and a discussion will follow.

Farewell Luncheon to H. M. Bigwood, A.M.E.I.C.

There was a good attendance of the Victoria Branch at the farewell luncheon held in honour of H. M. Bigwood, A.M.E.I.C. E. E. Brydone-Jack, M.E.I.C., made the presentation and expressed the regret that Mr. Bigwood was leaving the city. Chief Engineer Patrick Philip, M.E.I.C., also spoke of the great regret of his fellow engineers at Mr. Bigwood's departure.

Ottawa Branch

F. C. C. Lynch, A.M.E.I.C., Secretary-Treasurer.

Luncheon in Honour of Major Stuart McLaren

Declaring that he would attempt a second around-the-world aeroplane trip if only to vindicate the enthusiastic reception he had received from Canadians, Major Stuart McLaren addressed some three hundred local members of *The Institute* and their friends at a special luncheon, given in honour of the British fliers, in the Chateau Laurier, Thursday September 4th.

In the unavoidable absence of Premier Mackenzie King, the Hon. Charles Stewart expressed the Canadian Government's unqualified admiration of the intrepid exploit and sympathy at the hard luck which prevented success.

Major McLaren gave some interesting details of the trip and narrow escapes from death encountered. The nearness to which the party had approached success in their flight was realized when Major McLaren told that had they landed at almost any other point than at the island outside which they met disaster, repairs would have been possible.

Brown Coals and Lignites of British Empire

The Engineering Institute of Canada united with the society of Chemical Industry to hear a splendid address on the brown coals and lignites of the British Empire by Professor William A. Bone, F.R.S., in the Victoria Memorial Museum on Thursday night September 4th. Dr. A. McIntyre, chairman of the Society of Chemical Industry, presided.

Dr. Bone, who is professor of chemical technology in the Imperial College of Science and Technology, London, England, is one of the world's greatest authorities on coals and his remarks with reference to Australian and Canadian lignites were listened to with special eagerness. He is in Canada in connection with the visit of the British Association for the Advancement of Science.

In the course of a very profound address he drew attention to the unusually favourable opportunity for scientific research in coal as presented in the western Canadian coal fields where every grade of coal was represented in order. He was favourable impressed with the advantages of development of power from lignites at the pit mouth, and referred particularly to the work being done along these lines in Australia in the Marwell field in connection with which the speaker had done considerable work. The Australian government was going ahead with power installation in this field where the brown coal could be delivered to the surface at 50 cents per ton and by a specially designed boiler in which the waste gases were used to dry the coal it was anticipated that Australia would shortly have the cheapest commercial power anywhere obtainable. Such power could be economically delivered to Melbourne and other centres.

Professor W. A. Bone has isolated what he thinks is the chemical compound, or family of chemical compounds, which gives to coal its coking properties. By a process of selection and extraction, he has shown that, unless a substance of a certain type is present, the coal will not coke. The material in question appears as a brown powder composed mainly of carbon, when it is in its purest state. Other elements in its constitution are oxygen, hydrogen and nitrogen. It was previously thought that the amount of volatile material held in the coal determined its value for coke-making, but this is incorrect. The practical matter must be present or coking will not take place.

"When the constituent is present in sufficient proportions, the coal melts and intumesces before it decomposes," Professor Bone explained. "This means that it will make satisfactorily coke." The all-important constituent appears in greater proportion as the coal ages. This explains why the mysterious substance is not present in Alberta lignites.

Niagara Peninsula Branch

R. Hogg, Jr.E.I.C., Branch News Editor.

Peterborough Branch visits Niagara Falls

On August 10th and 11th, about twenty-five members of the Peterborough Branch paid a visit to Niagara Falls. They inspected the plant of The Niagara Falls Power Company, on the American side, on Sunday, and on Monday they viewed the Queenston-Chippawa power development, departing for Peterborough on Monday afternoon.

Visit of London Branch

On August 23rd and 24th, the branch had the pleasure of entertaining twenty-five members of the London Branch, who arrived in St. Catharines by motor at noon on Saturday. After a luncheon in the city, they motored, in company with several local members who acted as guides, to see the new Welland ship canal, which is being rushed to completion as fast as substantial grants of money will permit.

In the evening this branch entertained their guests to dinner on the verandah of the Pavilion, Lakeside Park, Port Dalhousie. The spot was a particularly happy choice. Within a few feet of the tables passed to and fro the grainboats that use the present canal, while into the lake on whose shores the Pavilion is situated, the sun was sinking in a profusion of color, gilding the crest of the Niagara Escarpment which was visible all the way to Hamilton. Our guests remarked on the beauty of the scene. After dinner, E. G. Cameron, A.M.E.I.C., assistant chief engineer of the Welland ship canal, sketched the history of canal building in this district from the turning of the sod for the first Welland canal, in 1824, to the present time.

E. V. Buchanan, M.E.I.C., chairman of the London Branch, expressed thanks for the way in which they were being received. He told how the members of his branch, having decided to do some visiting to other branches, chose the Niagara Peninsula for their first trip because, from write-ups in *The Journal*, and other sources, (We suspect Mr. Near, city engineer for London, was the 'Other Sources' referred to), they felt that the members of this branch spent a lot of time enjoying themselves and entertaining one another. He extended a hearty invitation to his hosts to pay a visit to the London Branch in the near future. London was about eight hundred feet higher above sea level than was St. Catharines. He held out as an inducement the fact that from this superior height a better view of Mars could be obtained by those who wished to give that planet a closer scrutiny.

C. Hellmuth, M.P.P. from Waterloo, was encountered during the afternoon, button-holed and brought to dinner. He spoke, among other things, about the Professional Engineers Act of Ontario. From its introduction, he had supported this act, and fought against its mutilation, feeling that engineers as a body were as much entitled to recognition by parliament as were lawyers or doctors. He advised the society to accept the act in its present form as a beginning, which will lead eventually to fuller recognition.

On Sunday morning the London members were taken charge of by members from Niagara Falls and escorted over the Queenston-Chippawa power development. This branch hopes that, as they climbed the eight hundred feet towards London and Mars on Sunday afternoon, they carried with them pleasant memories, as they did the best wishes of this district.

Members are Guests at Clam-Bake

Another of those delightful functions, which causes the eyes of Londoners and others to turn in envy to the Niagara Peninsula, took place Saturday, September 13th, when David Dick Jr., was host to the membership at a 'clam-bake' given at his summer cottage at Reib's Bay, on the shores of lake Erie. Anyone who has had the supreme pleasure of being a guest of Davy Dick, either at his annual 'St. Andrew's Nicht' or his 'Clam-Bake', will appreciate how hard it would be for the writer to describe this affair in detail. A burlesque soft-ball game was played on the shore, a true description of which would belong rather to the pages of Alice in Wonderland than to those of a staid engineering journal. A brass band supplied music during the afternoon, finally leading the hundred or more guests in Indian fyle along the sands for some distance and then back to the tables which were heaped high with clams and other toothsome viands.

When, at the end of the day, the mover of a vote of thanks to the host, speaking from amongst the debris on a table top, suggested that Davy Dick should be offered to the government to act as entertainer-in-chief to the Prince of Wales, he was cheered to the echo. All insisted, however, that this offer, made for the honour of Canada, should be in the nature of a short term loan. We in this district could not spare Davy for long. An oasis is too valuable these days. Thus did we 'come to the end of a Perfect Day'.

Calgary Branch

G. P. F. Boese, A.M.E.I.C., Secretary-Treasurer.

W. St. J. Miller, A.M.E.I.C., Branch Editor.

Arrangements were carried out under ideal conditions for a visit of the branch by automobile to the experimental farm station of the Canadian Pacific Railway Company (western section), at Strathmore on August 23rd. Great credit is due to Superintendent R. S. Stockton, M.E.I.C., and his staff, together with their ladies, for the splendid entertainment provided for some fifty of our members. After the stock and the station in general were inspected during the afternoon golf and tennis were indulged in. In the evening an excellent display of viands was set before us in the veterans' memorial hall, which was followed by a musical program, G. H. Patrick, A.M.E.I.C., giving some of his best vocal selections. Mrs. Boese's ability as an accompanist was highly commented on by those present. In a short speech Mr. Stockton referred to the advantages of the farm in the midst of such an immense farming community of some 900 settlers on an area of approximately 200,000 acres of irrigable land with 360 miles of canals and some 2,000 miles of distributaries. He stated that the requirements of the farmer were fulfilled by supplying him with an irrigating head of 2 c.f.s., on the basis of irrigating five acres per day to a depth of about nine inches. B. L. Thorne, M.E.I.C., proposed a vote of thanks in suitable terms which was wittily seconded by P. Turner Bone, M.E.I.C. The members returned very favourably impressed with all they saw on the farm and the entertainment extended to them.

During the recent convention of irrigationists in Calgary a very apt remark of Mr. Stockton regarding the proper use of water on the land was, "We must eventually come to support the theory of using the water for maximum returns per acre-foot of water rather than for maximum returns per acre of land irrigated".

British Scientists Welcomed by Branch

Calgary was fortunate in having the opportunity of welcoming the British Scientists on their homeward journey. Although these men paid but a flying visit of only a few hours duration the branch was instrumental in materially assisting in the arrangements for their reception and entertainment. A four-page pamphlet was specially printed for the occasion as a token of welcome for the visiting members from the local branch of the E.I.C. A list of the principal places of engineering interest in the city was given, and summarized paragraphs under the headings of irrigation, current-meter rating station, water powers, coal, and natural gas were included. These were distributed for perusal at Banff and were evidently much appreciated by the members of the association.

Flow of Water on Artificially Constructed Surfaces

On August 28th the branch entertained F. C. Scobie, as guest at a luncheon, when some fifty members were present and A. L. Ford, M.E.I.C., acted as chairman. Following the luncheon at which Mayor Webster, and Commissoner Graves were also present, Mr. Scobie gave a most interesting and instructive discourse on his specialized subject, namely, flow of water on artificially constructed surfaces. He reminded his hearers that the U.S. Reclamation Service was now the U.S. Bureau of Reclamation under the Department of Agriculture, and his particular branch was the Research Bureau.

The speaker described the early works of the Romans when culverts and conduits were constructed of lead and stone and increased volume was attained by increasing the area instead of the grade. Then he jumped a stride to Chezy's well known velocity formula $c\sqrt{rs}$ with c as a non-variable constant at first which was later developed by Kutter and Ganguillet. Kutter's value for the coefficient of roughness "n" was not below 0.014 but after use this figure has invariably proved to be 0.012. For wooden flumes Kutter gave 0.009 under ideal conditions, but the speaker advocated the use of 0.015 to 0.014. Then the efficiency of steel flumes was referred to, and the credit of origination of the flume was given to one Pat McGuiness, a blacksmith. Flumes permitted a velocity of 4 or 5 c.f.s. Wherewith chute flumes permitted a very high velocity, sometimes 28 to even 38 c.f.s. To gauge the velocity at such speeds coloring matter was introduced in the water. He remarked that considerable air was taken down a chute at such high velocities, sometimes as much as 30 per cent air.

Steel pipes were mostly used for power purposes, and he was satisfied that butt joints are less efficient than cylindrical joints, chiefly on account of interference of rivet heads. Anyway he considered that steel was not up to concrete for pipes. Referring to concrete pipes he stated that there were ten to fifteen thousand miles of such pipes in California alone, being used exclusively in the orange groves. He cited the extraordinary area of Los Angeles city, it being some 70,000 acres. This was necessary on account of the peculiar municipal water legislation and the area included much of the orange grove country. Mr. Scobie referred to the possibility of constructing a perfect aqueduct, such as the Victoria aqueduct which was cast in moulds *in situ*. Then he mentioned the bad effect of shoulders at the joints of concrete pipes which in some cases he had found as much as two or three inches high and even five inches in places in the Catskill aqueduct. He laid particular stress on the kind of concrete used, as this was of very great importance. A reasonably strong mix was essential. The use of the cement gun had produced a remarkably firm and dense concrete which would be difficult to improve upon. Density of concrete is important if excessive seepage is to be avoided.

Passing on to wood stave pipes, he said they were first introduced in Denver. In Vermont there were three lines of thirteen feet in diameter. In Montana we will shortly be able to see a fifteen-foot diameter wood-stave pipe. He gave the life of red fir as eighteen to twenty years, and Douglas fir as eight to ten years. He mentioned many rock tunnels built large enough to accommodate the steam shovel in boring. Calculations should be made with the proper desired sections using 0.035 as the value of "n". Excess area due to overbreak can be discounted and will take care of storm or flood conditions.

In announcing the question period Mr. Ford remarked that he understood Mr. Scobie was here to secure first hand information concerning field conditions and was not, on this trip at any rate, so much concerned with laboratory research work. He asked the speaker if he was preparing anything for general publication. Mr. Scobie replied that his investigations would be published in government bulletin form, but he had no intention of introducing, or attempting to introduce any new formulae as he thought there were too many on the market already.

He announced the publication shortly of a U.S. bulletin on steel pipes. He also mentioned that a sand blast on steel pipes had been profitably employed for cleaning them out, also that a coat of two inches of cement had given increased carrying capacity in some cases.

R. S. Stockton, M.E.I.C., proposed a very hearty vote of thanks to the speaker, which was seconded by G. H. Whyte, A.M.E.I.C., while the Mayor stated that if he as a non-technical man had enjoyed the talk so thoroughly, he could only wonder how much the engineers present had enjoyed it also.

Saskatchewan Branch

J. W. D. Farrell, A.M.E.I.C., Secretary-Treasurer.

Summer Meeting and Visit of British Scientists

The annual summer meeting of the branch was held in Saskatoon on the occasion of the visit by the British scientists. The meeting was well attended and the event was made thoroughly enjoyable by the kindness and hospitality of the Saskatoon members. At the opening meeting held at the university at 10.30 a.m., Professor Mackenzie outlined the programme for the day, which of course was closely related to the activities of the visiting British scientists. The chairman briefly described the British Association for the Advancement of Science and said that the party visiting Saskatoon comprised about three hundred and forty of the world's leading scientists. The members of the branch would hear Sir Charles Parsons and Dr. Howe that afternoon and would have opportunities for meeting others of the party during the afternoon and evening. The meeting was then adjourned until 3 p.m., in the afternoon, members being free to follow individual pursuits in the meantime.

At 2.15 p.m. many members of the branch with the newly-arrived Scientists and the assembled towns people witnessed the ceremony of the opening of the new chemistry building at the University. Following this, the building was thrown open for inspection by the public. The completeness of the accommodation and the equipment was the subject of much favourable comment.

At 3 o'clock about forty members of the branch with their friends and members of the British Association assembled in the new chemistry building for the adjourned meeting. Professor Mackenzie in a few introductory remarks welcomed the members of the British Association and thanked Sir Charles Parsons and Dean Howe for coming to address the meeting.

British Association for the Advancement of Science

Dr. Howe being called on first, said the British Association came to Canada to learn as well as to impart knowledge and in engineering had found much to learn. Since landing at Quebec they had seen many triumphs of engineering which were conquering the forces of nature by methods undreamed of years ago. They had seen one of the greatest rivers, the largest grain elevator, the longest bridge, the greatest water fall, the biggest pulp mill, the largest hydro-electric development, the widest streets and the most rapidly developing cities. In short, Canada was a land of superlatives but her claims were justified.

Dr. Howe referred kindly to the hospitality received and said that the meetings of the British Association might be described as being for the "cultivation of intense hospitality". As engineers we take pride in the advance of science and engineering. The development of Canada depended on the advance of engineering.

Dean Howe then spoke on the wide field of the British Association for the Advancement of Science. The association is divided into a number of sections, each dealing with a particular subject such as physics, chemistry, geology, aeronautics, etc. So also the field of engineering had now become very wide. No one man was now known as the Engineer having a knowledge of all branches, the field was too wide. The growth of engineering had given rise to difficulties in connection with engineering courses, difficulties of increasing specialization and increasing syllabuses. Dean Howe thought there was a danger in too early specialization. It is not known what a student will ultimately do, it often happens that the electrical trained man goes to the mechanical field. A graduate's need was for a good thorough grounding, to enable him to tackle any problem; this was more desirable than a highly specialized graduate and especially more desirable in Canada.

The advance of transmission, said Dr. Howe, was one of the greatest advances made, including the transmission of power, of men and materials and of intelligence. Dr. Howe said that he spent much of his spare time on radio, that the development of radio was to him a romance. The inception of radio was due to Professor James Clarke Maxwell and his researches into the nature of wave transmission through the ether and the discovery that light was a form of electro magnetic energy. Maxwell's ideas were realized and further developed by Hertz, a German physicist and finally given practical application by Marconi. Since then progress has been rapid; across Channel transmission was soon followed by transmission across the Athantic. At one time the problem arose as to whether the waves would travel around the curvature of the earth. The mathematicians said no, but Marconi found that they would and did, the waves being reflected from the upper atmosphere. To-day messages are received at the Antipodes. In the earlier work waves of long wave length were employed. Then short waves were used at night and found to travel enormous distances. The use of short waves permitted the practical use of reflectors and directional sending by the proper arrangement of aerials. Dr. Howe suggested the use of a revolving reflector which would always point around the dark portion of the earth.

Address by Sir Charles Parsons

Professor Mackenzie then introduced Sir Charles Parsons, paying tribute to his abilities as an inventor, a scientist and a director of industrial corporations.

Sir Charles said that he had been much impressed by the natural resources and engineering accomplishments mentioned by Dr. Howe. The new chemistry building had greatly impressed him as an indication of our confidence in the future. England, said Sir Charles, was not industrially of much importance until she began to develop her coal resources. Cheap power from coal gave her textile industries their start. The exhibition of 1851 was, in Sir Charles' opinion, a blow to British industry, in that it showed other nations the secret of her progress and prosperity.

He was impressed with the extent of Canadian water power development. From his own investigations Sir Charles had found that it cost approximately double the money to put down mines and develop power from coal that it cost to develop water power. Future movements of population would be influenced by the location of cheap power. Present power developments made living and progress possible here in this country where only a few years ago the only inhabitants were Indians.

Sir Charles then related various steps in the development of the steam turbine. The idea of the water turbine which was supposed to give 80 per cent efficiency was largely followed. By means of diagrams sketched on the black board the speaker showed how the velocity was kept down by staging the pressure drop through short steps. First experiments were encouraging and lead to other developments such as curving the blades and increasing the ratio of expansion by use of partial vacuum. Recent endeavors have been to further increase the ratio of expansion. The turbine has an advantage over the reciprocating engine in being able to expand steam to a lower degree.

The speaker related incidents of the skepticism and distrust connected with the early uses of the steam turbine such as the lighting of the town of Cambridge. Developments in mechanical gearing added to the usefulness of the turbine for such purposes as collieries and slow cargo ships. Using steam at 2,000 pounds pressure and 750° F. superheat a steam turbine will deliver one-third the energy of the coal consumed, which is a better efficiency than that of the best diesel engine. In large installations the turbine has a decided advantage in efficiency over the internal combustion engine.

Sir Charles then spoke briefly of the mercury vapour boiler illustrating his description with diagrams. He did not see much prospect for its general use and pointed out the danger from the very poisonous mercury fumes.

At the conclusion Colonel Garner spoke appreciatively, voicing the gratitude of the branch to the distinguished speakers and complimenting Professor Mackenzie on having arranged so enjoyable and profitable a meeting.

At Professor Mackenzie's request Dean Howe introduced the following members of the British Association who had attended our meeting:

Professor Andrew Robertson of Bristol,
Mr. J. S. Wilson of London,
Mr. Parsons of the Staff of "Engineering", London.

Following the meeting tea was served on Dean Rutherford's lawn, to which the branch members were invited and here had further opportunities to meet members of the British Association.

At 6.30 p.m. the members of the branch were invited to dinner at the King George hotel, given by the city of Saskatoon in honour of the visiting scientists.

In the evening many members attended the open meeting of the British Association when Professor Slossons of Washington gave a very interesting popular lecture on photo chemistry. During the day, through the kindness of Saskatoon members, various points of engineering interest were visited, such as the telephone exchange, the filtration plant and the power house, the visit to the latter being joined by Sir Charles Parsons.

EMPLOYMENT BUREAU

Situations Wanted

A.M.E.I.C., at present employed as sales engineer in connection with metal building products of well known concern, desires change to larger field of responsibility where his varied experience in structural steel and concrete engineering as chief draughtsman, designing engineer, inspector, etc., would be of value. Apply box No. 152-W.

Civil Engineer

Graduate, A.M.E.I.C., desires executive or engineering position. Ten years varied experience, railroad location and construction, highways, municipal engineering, design and construction of hydro-electric plants, and engineer for contractors. Apply box No. 153-W.

Mechanical and Electrical

Graduate Mechanical and Electrical Engineer with 18 years experience including 7 years as Asst. Supt. Punjab Irrigation Constructional Workshops, wants executive position. Location immaterial. Apply box 154-W.

Civil Engineer

Civil engineer, M.E.I.C., twenty-five years experience in railway and harbour construction, and contracting and operating superintendent of department of large industry, wishes engagement in executive capacity. Is good organizer. Apply box No. 155-W.

Situation Vacant

Secretary of the Geological Survey

A Secretary for the Geological Survey (Male), Department of Mines, Ottawa, at an initial salary of $2,220 per annum, which will be increased upon recommendation for efficient service at the rate of $120 per annum until a maximum of $2,700 has been reached.

Duties. — Under direction, to have charge of the Secretary's office of the Geological Survey; to handle all ordinary correspondence of the Geological Survey; to check amounts and requisitions, and to assist in the preparation of estimates and other business statements and reports; to receive and arrange for the examination or treatment of mineral and other specimens; to assist in the selection and appointment of student assistants and other seasonal employees; to receive callers and to conduct interview on behalf of the Director; in the absence of the Director to take charge of the Director's office; and to perform other related work as required.

Qualifications. — Education equivalent to graduation from a University of recognized standing, preferably with specialization in geological science; three years of experience in office work; one year of which preferably shall have been in the Department of Mines, or on work of a similar character; good knowledge of office practice; tact, good judgment and address. While definite age limit has not been fixed, age may be a determining factor in making a selection.

Application forms properly filled in must be filed in the office of the Civil Service Commission, Ottawa, *not later than October 9th, 1924.*

CORRESPONDENCE

Critical Speeds

With Special Reference to Main Shafts of Hydraulic Turbines.

The Editor,
The Engineering Journal,

Lachine, Que.
Sept. 8th, 1924

Dear Sir:—

In the course of my work during the past year or so, I have had to give considerable attention to the study of critical speeds, I decided eventually to try and develop some rapid, as well as fairly accurate, method for their determination and hope that the following analysis, the fruit of my labours, may be of interest to others in the profession.

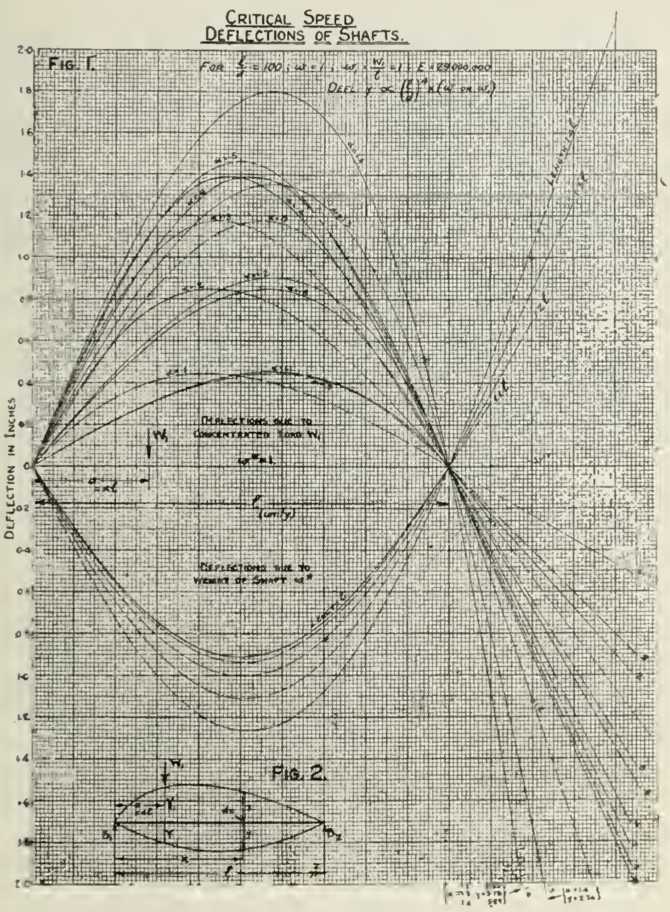
In the design of the main shafts in hydraulic turbine installations, it is frequently necessary to determine the critical speed. In the case of horizontal double-runner units especially, where the distance between bearings is relatively great, the critical speed is sometimes the deciding factor in the design.

The general theory has been investigated quite thoroughly in the past and discussions may be found in all standard text books, but owing to the difficulty in applying the theoretical formulæ to actual cases, various empirical approximations have been developed. The writer has found, in checking several special cases, that the approximations in general use do not always agree closely with the theoretical values obtained by actual integration, the degree of error depending on the nature of the loading. With a view to simplifying the present laborious methods and, at the same time checking up on these empirical formulæ, he has prepared a set of charts for determining the theoretical critical speeds.

A brief explanation of the method of obtaining these charts may be of interest. Taking the general formula for critical speed

$$n^2 = \frac{g}{4\pi^2}\,\frac{\int wydx}{\int wy^2dx}$$

where n = revolutions per second; g = acceleration due to gravity; w = unit loading; y = deflection of shaft at load wdx. We may reduce



Figures Nos. 1 and 2.—Critical Speed—Deflections of Shafts.

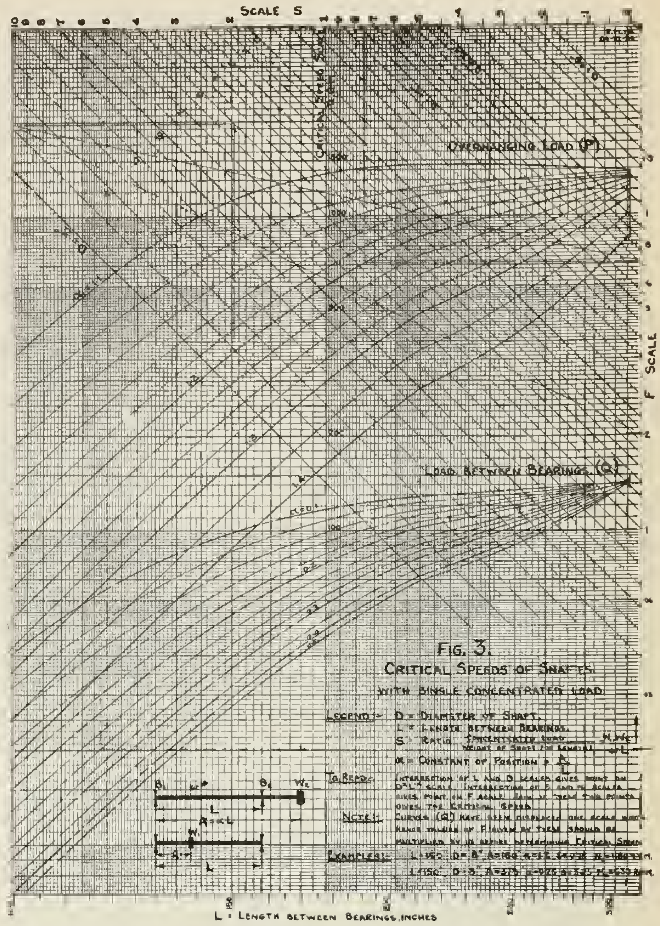


Figure No. 3.—Critical Speeds of Shafts with Single Concentrated Load.

this to the form $N_c = 187.7\sqrt{\frac{\int wydx}{\int wy^2dx}}$ = critical speed in r.p.m.

Here deflections y are in inches. To simplify the work of calculation for deflections, the diagram shown in figure No. 1 was developed which shows the form of the elastic curve for circular shafts. One set of curves gives deflections due to the weight of the shaft only and the other set gives deflections due to the concentrated load only. As will be noted, these deflections are for a unit ratio $\frac{l}{d} = 100$ and for unit weight of shaft $w = 1$ pound per inch length and concentrated load $w_1 = \frac{W_1}{l} = 1$ pound. To reduce deflections for any particular case, the values given here should be varied as $\left(\frac{l}{d}\right)^4 \times \frac{w \text{ or } w_1}{100^4}$

In the case of overhanging loads it is assumed that the overhanging weights act upward. The results given by this assumption will correspond to the condition in which the vibration of the overhanging section of the shaft differs in phase by 180° with that of the main shaft.

It may be mentioned here that some advise the consideration of all overhanging loads as being equivalent to similar loads placed at points on the opposite side of the bearing, but equidistant from it. By comparison of the deflection curves for concentrated loads we see that this is a safe assumption only for cases in which the loads are close to the bearing but as the overhang increases there is a corresponding divergence of the two elastic curves.

Consider the case of a single span with single concentrated load and with no overhang. In figure No. 2 let the curve above the horizontal line denote the elastic curve due to the concentrated load $W_1 = w_1 l$ only, and that below the horizontal line due to the weight of the shaft itself $W = wl$. Let Y_1 and Y denote the deflections at the load W_1 and y_1 and y the deflections at a point distant x from B_1. Then the general formula becomes $N_c = 187.7\sqrt{\frac{\int_0^l w\,(y+y_1)\,dx + W_1\,(Y+Y_1)}{\int_0^l w\,(y+y_1)^2dx + W_1\,(Y+Y_1)^2}}$

Now if we let the ordinates in the deflection chart figure No. 1 be P_1 and P at the concentrated load, and p_1 and p at any point $x = zl$ we have the relations,—

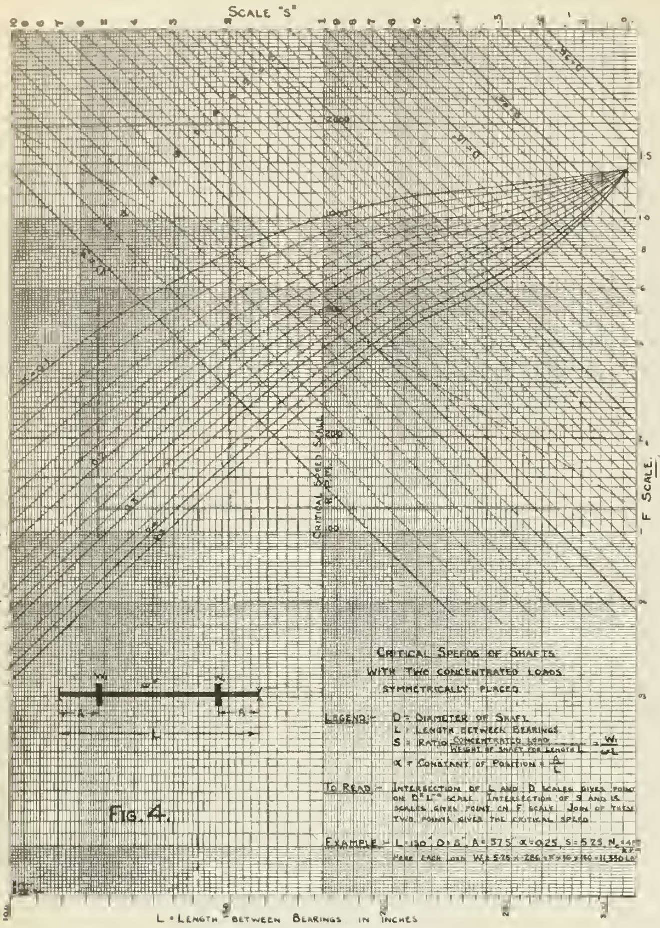


Figure No. 4.—Critical Speeds of Shafts with Two Concentrated Loads Symmetrically Placed.

$$Y = P \times \left\{\frac{l}{100d}\right\}^4 w; \quad Y_1 = P_1 \times \left\{\frac{l}{100d}\right\}^4 w_1.$$

Similarly for y_1 and y, and we get,—

$$N_c = \left[\frac{100d}{l}\right]^2 \times 187.7 \sqrt{\frac{w^2 \int_0^1 p dz + ww_1 \int_0^1 p_1 dz + w_1(wP + w_1P_1)}{w\int_0^1 (wp + w_1p_1)^2 dz + w_1(wP + w_1P_1)^2}}$$

Here we see that $\int_0^1 pdz$ is the area traced out by the ordinate p based on a distance between bearings B_1B_2 = unity. Similarly $\int_0^1 p^2dz$ is half the moment of this area about the horizontal axis. In fact, all the expressions under the radical except w and w_1 are functions of $\propto$ and may be computed and tabulated for different values of $\propto$ from the standard deflection curves in figure No. 1. Let us denote these expressions by the following symbols:—

$\int_0^1 pdz = A$; $\int_0^1 p_1dz = A_1$; $\int_0^1 p^2dz = M$; $\int_0^1 p_1^2dz = M_1$; $\int_0^1 pp_1dz = N$.

We may now simplify our equation to the form,—

$$N_c = \frac{187.7 \times 10^4 d^2}{l^2\sqrt{w}} \sqrt{\frac{A + (A_1 + P)S + P_1S^2}{M + (2N + P^2)S + (M_1 + 2PP_1)S^2 + P_1{}^2S^3}}$$

in which $S = \dfrac{w_1}{w} = \dfrac{\text{concentrated load } W_1}{\text{shaft weight } B_1B_2}$

Here the expression under the radical is seen to be a function of the variables S and $\propto$, and by denoting it by the symbol F and putting $w = .286\,\dfrac{\pi d^2}{4}$ we may reduce to,—

$$N_c^2 = 15.685 \times 10^{12}\frac{d^2}{l^4}F = K\frac{d^2}{l^4}F$$

For the purpose of constructing the diagram (figure No. 3) we may simplify this by taking logs and transforming to the determinant form,—

$$\begin{vmatrix} 2 & \log N_c - 3 & 1 \\ 1 & \log F & 1 \\ 3 & \log\dfrac{kd^2}{l^4 \times 10^6} & 1 \end{vmatrix} = 0$$

which will give us three equidistant parallel logarithmic scales as a basis for our alignment chart; namely, the central scale for N_c, the binary scale F (determined by the intersection of the $\propto$ curves with the scale S) and the binary scale $\dfrac{d^2}{l^4}$

In the case of overhanging beams the development is similar but it should be noted that the areas and moments obtained from figure No. 1 must be treated absolutely and not algebraically in order to conform to the general theory.

Figure No. 4 has been plotted for two equal concentrated loads similarly placed with respect to the bearings. This is found convenient for dealing with double runner hydraulic turbine installations. A few examples are given showing the method of reading the charts.

It will be seen that the effect of end thrust and torque have not been taken into consideration but for practical purposes these are of negligible importance.

Having this convenient weapon with which to attack the theoretical critical speeds it is possible to check up on the different approximate formulæ in general use. The most common one $N_c = 187.7 \div \sqrt{\Sigma y}$; let us call approximation A.

Here Σy = sum of deflections due to the separate loadings considered as ac ing independently. We may express these deflections as follows:—

$$y_e = \frac{5}{384}\frac{wl^4}{EI} = \text{deflection due to shaft weight } B_1B_2$$

$$y_1 = \frac{\propto^2(1-\propto)^2}{3}\frac{w_1l^4}{EI} = \text{deflection due to concentrated load } W_1$$ at its point of application. For overhanging shafts we must replace y_1 by $y_2 = \dfrac{(\propto - 1)^2\propto}{3}\dfrac{w_2l^4}{EI}$ = deflection due to overhanging concentrated load $W_2 = w_2l$, and add the deflection $y_a = \dfrac{(\propto - 1)^3(17\propto + 15)}{384}\dfrac{wl^4}{EI}$ (approx.) = maximum deflection due to overhanging weight of shaft $w(a-l)$.

Another approximation is that developed by Professor Dunkerley which gives $\dfrac{1}{N_c^2} = \dfrac{1}{N_l^2} + \dfrac{1}{N_1^2}$ + etc., where N_c, N_1, etc., are the various critical speeds obtained from the different independent loadings. Let us call this approximation B. By evaluating for $N_c = 187.7\sqrt{\dfrac{\int wydx}{\int wy^2dx}}$ for each of these simple loadings we may obtain the following formulæ, in which the subscripts correspond to those used for approximation A above.

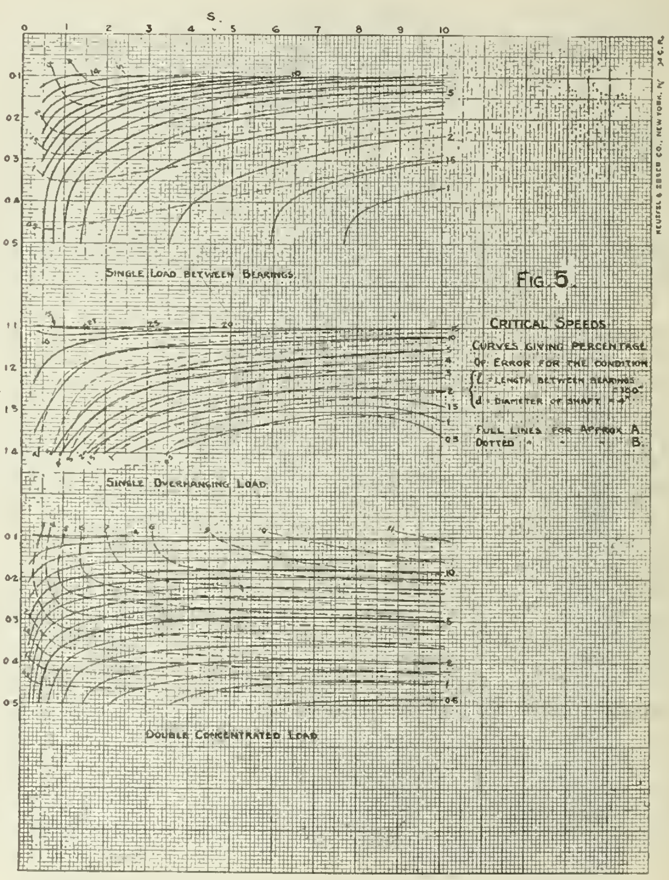


Figure No. 5.—Critical Speeds — Curves giving Percentage of Error.

$$N_l = \frac{4.68 \times 10^6 d}{l^2} \quad N_a = \frac{1.672 \times 10^6 d}{l^2(\propto -1)\sqrt{\propto^2 - 0.63\propto - 0.37}} \text{ (approximately)}$$

$$N_1 = \frac{388{,}000 d^2}{l^2 \propto (1-\propto)\sqrt{w_1}} \quad N_2 = \frac{388{,}000 d^2}{l^2(\propto -1)\sqrt{\propto w_2}}$$

These formulæ are based on $E = 29{,}000{,}000$, weight of metal 0.286 per cubic inch.

By taking particular case $d = 4''$, and $l = 100''$, the critical speeds for the two approximations and also the theoretical speed have been worked out for various values of S and $\propto$. These were compared and the ratios of the theoretical to the approximate speeds are shown in figure No. 5. Curves of percentage of error for each approximation are given.

These charts should not be taken too seriously as they are the combined results of slide rule computations and free interpolation The writer's main reason for plotting them was to obtain some rough idea of the general tendency of error of the two approximations.

In checking over some forty hydraulic turbine installations it has been found that the general run of values of S and $\propto$ are:—

(i) S = 0.3 to 8.8 average 3.13, $\propto$ = 1.1 to 1.5 " 1.33 } for overhanging runners.

(ii) S = about 1, $\propto$ = 0.3 to 0.4 } for single runner between bearings.

(iii) S = 0.2 to 0.5 average 0.36, $\propto$ = 0.15 to 0.4 " 0.23 } for two runners between bearings.

The errors given by the two approximations may be summarized as follows:—

For overhanging runners,—
- maximum errors were 17% for approx. *A*.
- maximum errors were 9% for approx. *B*.
- average errors were 4.3% for approx. *A*.
- average errors were 2.9% for approx. *B*.

For single runner between bearings,—
- average error — approx. "*A*" — 5.5%
- " "*B*" — 1%

For two runners between bearings,—
- average error — approx. "*A*" — 10.7%
- " "*B*" — 2.9%

The length between bearings was taken from centre line to centre line and in cases of proportionally long bearings the eccentricity of the loading "*A*" was obtained by adding one third the bearing length to the free overhang of the concentrated runner load from the edge of the bearing. This seems to be quite conservative.

Of course these ratios will not hold for other values of d and l. They are dependent on the relations existing between the various independent deflections or critical speeds. In general we may say that the ratios will approach unity for cases where one of the independent loads becomes of paramount importance; as for example, for the condition $S = 10$, $\propto = 1.4$, or $S = 0.25$, $\propto = 0.5$. We see that in general approximation B holds closer to the theoretical speed than approximation A. It would appear that the summation of the various maximum deflections irrespective of their relative location is not a very sound procedure and that better results are obtained if the various critical speeds for the several loads are first computed and a final speed arrived at by using some empirical formula incorporating these various speeds, of the type of approximation B.

For cases in which the shaft is of variable diameters some method must be devised of obtaining the equivalent mean diameter. Without the check of experimental data this will involve questionable assumptions, but it is believed that the following empirical method will furnish good results for ordinary cases in practice.

Considering the loadings independently we see that the critical speed for the shaft weight alone varies as the diameter while the speed based on concentrated loads varies as the square of the diameter. For a plain shaft it would therefore seem reasonable to assume that average diameter $d_1 = \Sigma ld \div l;\Sigma$ while considering the concentrated load only, we would have $d_2 = \sqrt{\frac{\Sigma ld^2}{\Sigma l}}$ The correct average under actual load conditions would be intermediate between these two values, being closer to the one or the other according to the relative importance of each loading. There is usually very little difference between these average diameters d_1 and d_2 and probably a simple method of arriving at the required diameter, and one which will be accurate enough for all practical purposes, would be to ascertain the maximum deflections y_1 and y_2 due to the two loadings, (see figure No. 1), and use the empirical formula $D = \frac{y_1 d_1 + y_2 d_2}{y_1 + y_2}$

From experimental data obtained by Dunkerley, Stodola and others, the theoretical values have been checked and agree closely with observed critical speeds for simple cases. Stodola's experiments were made at higher speeds and we may expect them to show the greatest difference. Stodola found that the ratio of theoretical to observed speed varied from 1.06 to 1.16. He found that this ratio was greater for heavier shafts and argued that this was due mostly to light foundations and consequent synthetic vibrations. It would seem advisable to assume a working ratio of say 1.15 per cent for hydraulic turbine shafts, that is to say, shafts should be designed for a critical speed of 15 per cent in excess of the computed runaway speed. This latter speed can in general be arrived at very closely from reliable experimental data on test models and, in some cases, from actual tests on recent installations.

Yours very truly,
F. M. Wood, A.M.E.I.C.,
Hydraulic Dept.
Dominion Engineering Works Ltd.

Repairing Bridge with Electric Arc

The Editor,
The Engineering Journal,
Dear Sir,—

An operation of interest to the engineering profession in general and structural engineers in particular has recently been completed in the reinforcing and building up, of bridge members eaten away by extensive corrosion. The case in point being a bridge in Pittsburgh over the Allegheny river connecting Herrs island with the North Shore, a 240-foot through truss, pin and link span, built about thirty-one years ago. The floor of the bridge was carried on timber stringers supported on cross timbers bolted to the web of floor beams.

While the upper portions of the structure are still in good state of preservation, the parts rendered inaccessible to paint and kept constantly moist by the proximity of the timber were so greatly reduced in section as to be perforated, and in many places almost severed. The webs of the floor beams and bottom of vertical posts suffered particularly, being reduced from 3/8 of an inch to 1/32 of an inch over a large area.

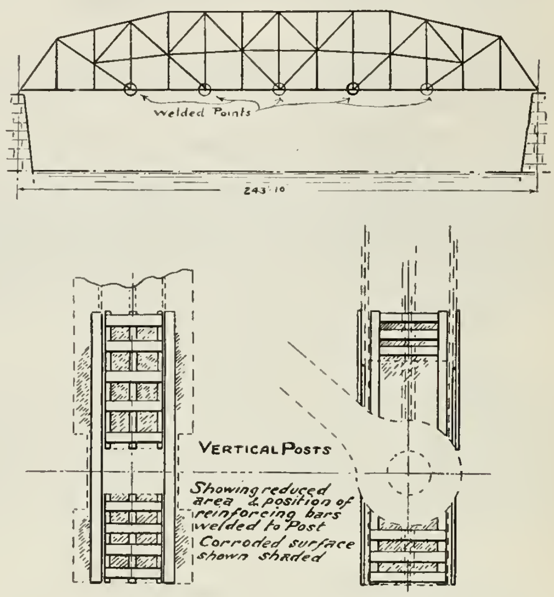


Diagram showing the Points of Welding Operations.

It was decided to renew the entire floor by cutting away the floorbeams and sidewalk brackets from their connection to the vertical posts. This operation presented no very unusual difficulties. The strengthening of columns, however, was a more serious problem. These were compression members built of Z-shaped bars and web plate, and directly above and below the pin bearing plates, were perforated and reduced in section over sixty per cent. There was also tensile stress, below the pin owing to reversal of stress in diagonals of truss.

The difficulty was overcome, both economically and efficiently, by welding, using the electric arc metallic process, and the method adopted by the engineers in charge, was to weld strips of steel, one inch by one-half of an inch extending from the bottom of the column to a point well beyond the corroded portion. After the surface of the original metal had been thoroughly cleaned by use of the acetylene torch, scrapers, and wire brushes, the bars were welded into position vertically, and tied together at close intervals with crossbars of the same section. After each point was completed, the strength of the weld was tested by the bars being subjected to a number of blows with an eight pound maul. Results of physical tests showed practically no deterioration of the original metal when welded by this process.

The reinforcing of the columns was carried out by the Pittsburgh Welding Corporation,* using a General Electric 200-ampere motor generator set, the work being performed under the supervision of the engineering department of the city of Pittsburgh.

It appears to the writer that this method of reinforcing structural members reduced by corrosion at certain points offers great possibilities as an alternative for removing the entire member. A case in point being the bottom of viaduct columns which are particularly susceptible to rust if drainage is neglected. In such cases one operator and a unit generating its own power could perform the work of an erection crew.

To the best of the writer's knowledge this is a new departure in structural engineering and opens up an extensive field.

Yours very truly,

E. H. PACY, A.M.E.I.C.

*Mr. Pacy is President of the Pittsburgh Welding Corporation.

OTHER SOCIETIES NEWS

Toronto Engineering Alumni Re-Union

The Engineering Alumni Association of the University of Toronto will hold its fifth re-union at Toronto on November seventh, eighth and ninth, 1924. The programme as recently announced will be as follows:—

Friday, November seventh,—
- Mid-day — Class Luncheons.
- Afternoon — Meeting old friends and general visiting.
- Evening — Dinner Dance, King Edward Hotel.

Saturday, November eighth,—
- Morning — Business meeting at University.
- Afternoon — Queen's-Varsity Football Match.
- Evening — School Dinner, King Edward Hotel.

Sunday, November ninth,—
- Morning — School Service, Convocation Hall.

More complete information will be made available to graduates in the early part of the present month.

Alberta Professional Engineers' Year Book

The Association of Professional Engineers of Alberta has issued a year book containing the professional engineers' act, the by-laws of the association, and a list of members of the association. The report of the fourth annual general meeting has also been issued which includes an address given on that occasion by E. A. Wheatley, A.M.E.I.C., registrar of the Association of Professional Engineers of British Columbia.

The Technical Association of the Pulp and Paper Industry

The fall meeting of the Technical Association of the Pulp and Paper Industry will be held at the hotel Statler, Buffalo, on October 14th and 15th, 1924. Following the business session the subsequent ones will be devoted to the discussion of such problems as vocational education and training, paper drying operation tests, paper testing and relative humidity conditions, revision of the standard method of testing pulp for strength, prevention of waste in the mill effluent and stream pollution.

Commissioner of the Superior Court

In order to be of greater service to the members, both residing in Montreal, and members who are passing through the city, the secretary of *The Institute* applied for and was granted a commissionership in the Superior Court, authority being granted in a document which reads in part as follows:

> "Know ye, that we, the Honourable Louis Coderre, one of the Justices of His Majesty's Superior Court, for the Province of Quebec, acting in the District of Montreal, by virtue of the powers vested in us by Articles 25 and 26a of the Code of Civil Procedure of the Province of Quebec, confiding in the integrity and ability of you the said Fraser Sanderson Keith, do constitute and appoint you a commissioner under the said law to make and receive in the said District of Montreal, all such Affidavit as any person is willing and desirous to make, in or concerning any cause, matter or thing depending, or to be depending, or in any wise concerning any of the Proceedings to be had in the said Superior Court; and also to receive affidavits to be used in any and every district in the Province of Quebec, in the Court of King's Bench, or in the Superior Court or Circuit Court, or other Court of record."

Members are requested to avail themselves of any advantage this may mean to them.

Recent Additions to the Library

Transactions, Proceedings, etc.

Presented by the Societies.
Year Book of the Western Society of Engineers, 1924.
Proceedings of The Institution of Mechanical Engineers, January to May, 1924. Volume 1.

Reports, etc.

Presented by Board of Water Supply of the City of New York.
Eighteenth Annual Report of the Board of Water Supply of the City of New York, January 1st, 1924.

Presented by The State of New York, U.S.A.
Report of the New York State Bridge and Tunnel Commission to the Governor and Legislature of the State of New York, 1924.

Presented by Department of Mines, Geological Survey, Canada.
Summary Report, 1923, Part A.
Coquihalla Area, British Columbia, Memoir 139.

Presented by Arctic Publications Committee.
Report of the Canadian Arctic Expedition, 1913-18.

Technical Books.

Presented by Lockwood Trade Journal Co. Inc., New York, U.S.A.
Classification and Definitions of Papers. Reprinted from The Paper Trade Journal.

A Course in Industrial Metallography

Under the auspices of the Dept. of Metallurgy at McGill University an extension course in Metallography will be given as in previous years, by Harold J. Roast, F.C.S., F.C.I.C., and Charles F. Pascoe, F.C.I.C. The course consists of fifteen periods, held on Monday nights at the Chemistry and Mining building, McGill University, commencing on Monday November 3rd, at 8.00 p.m. Application should be made to Dr. Alfred Stansfield, M.E.I.C., Department of Metallurgy, McGill University. The fee for the course is $15.00, payable to the bursar.

In as much as only twelve members can be accommodated at one time students will be enrolled in order of their applications. No previous knowledge is assumed, and the course is essentially practical from first to last. If any students from a previous year desire to continue their work provision will be made for an advanced course if sufficient members are obtained.

Under the auspices of the Department of Metallurgy, McGill University, a new extension course is being given in "Practical Metallurgical Chemical Analysis", by Harold J. Roast.

This course consists of fifteen periods, and will be held on Monday evenings at the Chemistry and Mining building McGill University, from 8.00 p.m. to 10.00 p.m. commencing Monday evening October 6th next. The fees are twenty dollars.

The course covers analysis of brasses, bronzes, white metals, steel and iron, and the ordinary ores and slags in these connections. Only fast and commercially accurate practical methods are taught. Instruction will be given in the installation of a works laboratory, sampling of various works products, and the usual routine of the works chemist.

As the number of students is limited to six, members will be admitted in order of their applications. Anyone desiring to enroll should make application to Dr. Alfred Stansfield, M.E.I.C., Dept. of Metallurgy, McGill University.

The largest construction work in the vicinity of St. John, N.B., at present, is the erection of the new seven storey Admiral Beatty hotel on which the foundation work is now completed and forms in place for the first storey. This hotel when completed will be one of the chain of united hotels. The general contractors for the hotel are E. G. M. Cape and Company, Montreal.

Actual construction on the pump-house at the new government drydock, at Skinners Cove, B.C., will be commenced shortly according to a report of announcement by J. P. Forde, M.E.I.C., district engineer of the Dominion public works department, who has recently made a tour of the western coast with K. M. Cameron, M.E.I.C., chief engineer, Dominion public works, Ottawa, Ontario. It is expected that tenders for the construction of the three drydock gates will be called shortly. All the latest modern equipment will be installed within the four walls of the pump-house and will provide for the pumping of the drydock in four and a half hours. There will be three main pumps with a capacity of 60,000 gallons a minute, while two auxiliary pumps will speed up the work at the rate of 9,000 gallons a minute.

Preliminary Notice

of Applications for Admission and for Transfer

September 19th, 1924.

The By-laws now provide that the Council of the Institute shall approve, classify and elect candidates to membership and transfer from one grade of membership to a higher.

It is also provided that there shall be issued to all corporate members a list of the new applicants for admission and for transfer, containing a concise statement of the record of each applicant and the names of his references.

In order that the Council may determine justly the eligibility of each candidate, every member is asked to read carefully the list submitted herewith and to report promptly to the Secretary any facts which may affect the classification and election of any of the candidates. In cases where the professional career of an applicant is known to any member, such member is specially invited to make a definite recommendation as to the proper classification of the candidate.*

If to your knowledge facts exist which are derogatory to the personal reputation of any applicant, should be promptly communicated.

Communications relating to applicants are considered by the Council as strictly confidential.

The Council will consider the applications herein described in October, 1924.

FRASER S. KEITH, Secretary.

*The professional requirements are as follows:—

Member shall be at least thirty-five years of age, and shall have been engaged in some branch of engineering for at least twelve years, which period may include apprenticeship or pupilage in a qualified engineer's office, or a term of instruction in a school of engineering recognized by the council. The term of twelve years may, at the discretion of the council, be reduced to ten years in the case of a candidate for election who has graduated from a school of engineering recognized by the council. In every case the candidate shall have held a position in which he had responsible charge for at least five years as an engineer qualified to design, direct or report on engineering projects. The occupancy of a chair as a professor in a faculty of applied science or engineering, after the candidate has attained the age of thirty years, shall be considered as responsible charge.

An Associate Member shall be at least twenty-seven years of age, and shall have been engaged in some branch of engineering for at least six years, which period may include apprenticeship or pupilage in a qualified engineer's office or a term of instruction in a school of engineering recognized by the council. In every case a candidate for election shall have held a position of professional responsibility, in charge of work as principal or assistant, for at least two years. The occupancy of a chair as an assistant professor or associate professor in a faculty of applied science of engineering, after the candidate has attained the age of twenty-seven years, shall be considered as professional responsibility.

Every candidate who has not graduated from a school of engineering recognized by the council, shall be required to pass an examination before a board of examiners appointed by the council. The candidate shall be examined on the theory and practice of engineering with special reference to the branch of engineering in which he has been engaged. This examination may be waived at the discretion of the council if the candidate has held a position of professional responsibility for five or more years.

A Junior shall be at least twenty-one years of age, and shall have been engaged in some branch of engineering for at least four years. This period may be reduced to one year, at the discretion of the council, if the candidate for election has graduated from a school of engineering recognized by the council. He shall not remain in the class of Junior after he has attained the age of thirty-three years.

Every candidate who has not graduated from a school of engineering recognized by the council, or has not passed the examinations of the first year in such a course, shall be required to pass an examination in the following subjects: geography, history (that of Canada in particular), arithmetic, geometry, euclid (books I, IV and VI), trigonometry, algebra up to and including quadratic equations.

A Student shall be at least seventeen years of age, and shall present a certificate of having passed successfully an examination equivalent to the final examination of a high school or the matriculation of an arts or science course. He shall either be pursuing a course of instruction in a school of engineering recognized by the council, in which case he shall not remain in the class of student for more than two years after graduation; or he shall be receiving a practical training in the profession, in which case he shall pass an examination equal to that prescribed for admission to the grade of Junior in the foregoing section and he shall not remain in the class of Student after he has attained the age of twenty-seven years.

An Affiliate shall be one who is not an engineer by profession but whose pursuits, scientific attainments or practical experience, qualify him to co-operate with engineers in the advancement of professional knowledge.

The fact that candidates give the names of certain members as references does not necessarily mean that their applications are endorsed by such members.

FOR ADMISSION

ANDERSON—WILLIAM, of Calgary, Alta. Born at Glasgow, Scotland, Jan. 11th, 1889; Educ., 1905-11, evening classes, Glasgow Royal Technical College, and private tuition; 1907-19, with the General Electric Company, England—5 years apprenticeship, and 7½ years in various responsible capacities—in charge of office at Hanover Street, Edinburgh, and then transferred to engrg. dept., Glasgow, as manager and responsible for carrying out contracts with shipbldg. and industrial concerns for G.E.C.; 1919, appointed manager at Glasgow for Wood & Bairns, Limited, electrical engrs.; Oct. 1920, joined the Northern Electric Co. Ltd., at Montreal, as asst. specialist in power apparatus divn., and in 1921 transferred to Calgary as power apparatus specialist. Since Sept. 1921 in charge of power apparatus divn. of the comp ny in Calgary, and responsible for estimating and carrying out all contracts on electric power apparatus.

References: R. S. Trowsdale, R. Mackay, H. J. McEwen, L. A. B. Hutton, J. H. Ross, F. J. Robertson, I. P. Macnab, G. H. Thompson.

BONUS—WILLIAM HAROLD, of 160 Howland Avenue, Toronto, Ont. Born at Bailieboro, Ont., July 16th, 1891; Educ., B.A.Sc. Univ. of Toronto, 1915; During vacations: 1911-12, in shops of Can. Gen. Elec. Co., Pete borough; 1912, DeLaval Dairy Supply; 1914, carried through contract for wiring houses; 1915, shell inspection, Canadian Inspection Co., Sarnia and London; Nov. 1915 to date, asst. supt. of bldgs. and grounds, University of Toronto, Toronto, Ont.

References: A. D. LePan, T. R. Loudon, P. Gillespie, C. R. Young, H. E. T. Haultain, R. W. Angus.

DAWSON—GERALD STEWART, of Calgary, Alta. Born at Winnipeg. Man., Jan. 4th, 1900. Educ., B.Sc. Univ. of Alberta, 1924; three summer seasons on location and constrn. C. P. R. irrigation works, earthwork, concrete and timber.

References: A. S. Dawson, P. J. Jennings, F. K. Beach, R. S. Stockton, G. P. F. Boese, S. G. Porter.

DOYE—MARIUS, of Bagotville, Que. Born at Hornu, Belgium, July 12th, 1888; Educ., Mech. engr., Ecole de St. Ghislain, Mons, Belgium, 1910; 1910-14, with Etablissements Paul Kestner, Lille, France. Specializing in evaporating problems and supervising and starting new installations; 1914-19, war service. Belgium War Cross, 1916. Artillery Officer, 1917. Wounded 1918; 1920, with J. G. White Engrg. Corpn., as res. engr. for constrn. of wharf built for Chicoutimi Port Co., at Port Alfred; On completion of work, Nov. 1920, entered with the Bay Sulphite Co. Ltd., as engr., chief of the engrg. dept.; At present chief of engrg. plant and asst. gen. supt., Port Alfred Pulp and Paper Corporation, Port Alfred, Que.

References: R. O. Sweezey, E. Lavoie, J. F. Grenon, H. B. Pelletier, G. E. LaMothe.

HENDERSON—JOHN ALEXANDER, of Vernon, B.C. Born at Lisbellaw, North Ireland, Nov. 29th, 1881; Educ., B.A., 1904, B.A.I., 1905, Trinity College, Dublin Univ.; 1906, pupil to James Barton, M. Inst. C.E., Dundalk, Scotland; 1907 (Jan.-Nov.), asst. to res. engr., Strabane & Letterkenny Rly., during constrn.; 1907-09, junior asst. engr., Lagos Rly., northern extension, survey and location on Northern Nigeria, and after leave in 1909, resumed work as asst. engr.—open lines, mtce. and capital works, resigned 1912 owing to ill-health; 1912-14, C.P.R. constrn., Weyburn Westerly branch, chiefly as res. engr.; 1916-19, overseas. Royal Engrs., and 273rd Rly. Constrn. Coy. With Salonika Forces. Retired rank, Major, R.E.; At present, sole official, Oyama Irrigation District.

References: G. A. Walkem, J. G. Reid, A. H. Legge, T. C. Macnabb, J. C. Brown, A. E. Rowbotham, J. C. MacDonald, C. N. Shanly.

LEA—HARRY WINDSOR, of 3561 Park Avenue, Montreal, Que. Born at Victoria, P.E.I., Nov. 2nd, 1898; Educ., 2 years, Prince of Wales College, Charlottetown, P.E.I. 2 years, science course, McGill Univ.; 1916-19, short courses in civil and mech. engrg. in connection with training for Can. Seige Artillery and for pilot in R.A.F.; 1920, asst. engr. on constrn. of Kipawa townsite for the Riordon Co.; 1921, asst. engr. constrn. Chippewa development, for H.E.P.C.; 1922 (4 mos.), with R.S. and W.S. Lea, consltg. engrs., Montreal; 1922 (8 mos), inspr. on street and sidewalk constrn., road dept., City of Montreal; 1923 to date, asst. engr. on constrn. of streets, sidewalks and sewers, Dept. of Technical Service, City of Montreal.

References: A. K. Grimmer, R. L. Hearn, G. R. MacLeod, J. E. Blanchard, J. H. McLaren, R. S. Lea, W. S. Lea.

MORTON—GUY H., of Calgary, Alta. Born at Ancaster, Ont. March 31st, 1885; Educ., B.A.Sc. Univ. of Toronto. 1910; 2 years in Canadian Westinghouse Factory; 8 years, sales engr., Canadian Westinghouse Co.; 5 years, sales engr., Electrical Engineers, Limited, Calgary, at present manager and principal owner.

References: R. M. Dingwall, J. J. Hanna, R. Mackay, B. L. Thorne, R. S. Trowsdale, A. Ingraham.

FOR TRANSFER FROM CLASS OF ASSOCIATE MEMBER TO THAT OF MEMBER

INGRAHAM—HARRY ALEXANDER, of Calgary, Alta. Born at Minneapolis, Minn., Aug. 26th, 1886; 1904-07, engrg., Univ. of Minnesota. Winters 1915-16 and 1916-17, night classes Univ. of Minnesota, reinforced concrete; 1907-10, dftsman., detailing mill bldgs. and machinery, and 1910-12, constrn. foreman, mill bldgs., Wellford Mfg. Co., Minneapolis, Minn., 1912-14, asst. engr. with same firm designing and reinforced concrete bldgs., and 1914-17, design and constrn. of reinforced concrete mill bldgs. and grain elevators; 1917 to date, in charge of reinforced concrete de ign and constrn. for H. Ingraham, Calgary, also consulting engr. on other bldgs.

References: W. Pearce, R. S. Trowsdale, A. S. Chapman, J. H. Walshaw, A. Ingraham.

FOR TRANSFER FROM CLASS OF JUNIOR TO HIGHER GRADE

BADGLEY—LEONARD AMEY, of Long Branch, Ont. Born at Canfield, Ont., Sept. 28th, 1889; Educ., B.A.Sc. (Honours), Univ. of Toronto, 1911; 1911-13, recorder and instr'man., geol. survey, New Brunswick and Quebec; 1912-14, instructor in surveying and drawing, Univ. of Toronto; 1914, in charge of topog'l. survey for city of Toronto in connection with town planning; 1915-16, inspr. and chief inspr., Canadian Inspection Co. & Imperial Munition Board at Ingersoll and Peterborough; 1917, inspr. and chief inspr. for the French Purchasing Commission through the Pittsburgh Testing Lab. on Munitions, artillery trucks and cable at Hamilton; 1918, Flight Cadet and 2nd Lieut., R.A.F.; 1918-19, in charge of survey, topog'l. mapping for town planning, city of Hamilton; 1919 to date, plan examiner and structural engr., city architect's dept., City of Toronto.

References: P. Gillespie, J. S. Galbraith, J. H. Curzon, P. M. Thompson, J. R. Burgess, G. Rankin, W. Gore.

BRINKMAN—FRANCIS LESLIE, of 307 Union Bank Building, Ottawa, Ont. Born at St. Thomas, Ont., August 28th, 1893; Educ., B.Sc. (Honours), Queen's Univ., 1917; Summer work: 1910, rodman, Mich. Central R.R., Windsor, Ont.; 1911-13, rodman and instr'man., City of St. Thomas, Ont.; 1914, hydro-electric radial surveys; 1915, asst. engr., Public Works of Canada, Fort William, Ont.; 1916, surveys, Mich. Central R.R., Jackson, Mich.; 1917-19, Lieut., Can. Engrs., C.E.F.; 1919 (June-Oct.), asst. city engr., Sarnia, Ont.; 1919-20, asst. to res. engr., Dept. Public Highways Ontario, Brockville; 1920-24, res. engr., Montreal road, Dept. Public Highways Ontario; Feb. 1924 to date, supt. and partner of firm, C.O. Wood, contracting engr., Ottawa, Ont.

References: R. C. Muir, S. J. Chapleau, C. O. Wood, H. B. R. Craig, A. K. Hay, A. Ferguson, N. B. MacRostie, T. S. Scott.

CRYSLER—ROY ALAN, of 50 Snowden Avenue, Toronto, Ont. Born at Toronto, May 1st, 1896; Educ., B.A.Sc. Univ. of Toronto, 1920; 1912-13, dftsman., Smith, Kerry & Chace, Toronto; 1914 (summer), instr'man., Speight & Van Nostrand, Toronto; 1915 (summer), instr'man, James, Loudon & Hertzberg, Toronto; 1916-19, overseas with Can. Engrs. and 2nd Lieut. R.A.F.; 1919 (summer), res. engr. at Orillia for James Loudon & Hertzberg, Toronto, on roads and sewer constrn.; 1920 (May-June), asst. engr., Prov. Board of Health of Ontario; 1920 (July-Sept.), engr. and surveyor, Town Planning Commission, Niagara Falls; 1920-22, engr. with H.E.-P.C. of Ontario at Niagara Falls; April 1922 to date, engr., city architect's dept., reinforced concrete branch, Toronto.

References: P. M. Thompson, G. Rankin, A. C. D Blanchard, E. A. James, P. Gillespie, T. R. Loudon.

EDMONDS—CHARLES WILLIAM of Toronto, Ont. Born at Simcoe, Ont., Feb. 24th, 1894; Educ., B.A.Sc. Univ. of Toronto, 1919; 1912-13 (summers), municipal work; 1914 (summer), rodman, dftsman. on irrigation work; 1918 (summer), instr'man in charge of rly. location survey party; 1919-20, dftsman., asst. designer and res. engr. on hydro-electric power work, with Messrs. C. H. & P. H. Mitchell, Toronto; 1920-21, designer, hydraulic dept., Spanish River Pulp & Paper Co. Ltd., Sault Ste Marie, Ont.; April 1921 to date, asst. engr., sewer section, dept. of works, City of Toronto.

References: G. H. Kohl, H. R. Carscallen, J. H. Curzon, J. A. Knight, F. S. Rutherford, J. H. Irvine.

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Engineering Index

This Index is prepared by the American Society of Mechanical Engineers.

In this department will be published from month to month the titles of current engineering papers with the authors and source and a brief extract of the more important. It is designed to give the members of The Institute a survey of all important articles relating to every branch of engineering profession.

A

AIR COMPRESSORS

LUBRICATION OF. Air Compressor Lubrication. So. Engr., vol. 41, no. 5, July 1924, pp. 44-46, 3 figs. Gives factors of correct lubrication, correct oils for common practice, and methods of application.

AIRPLANES

MONOPLANES. Monoplane Theory, N. K. Bose. Lond., Edinburgh & Dublin Philosophical Mag. & Jl. of Sci., vol. 48, no. 283, July 1924, pp. 113-125, 1 fig. Discusses theory of circulation of liquid around airplane equal and opposite to that of vortex formed, and reduces it to mathematical basis.

PRESSURE DISTRIBUTION ON WINGS. Pressure Distribution Over the Wings of an M B-3 Airplane in Flight, F. H. Norton. Nat. Advisory Committee for Aeronautics, report no. 193, 1924, 17 pp., 15 figs. Investigation carried out to determine distribution of load over wings of high-speed airplane under all conditions of flight and pressure distribution, during level flight, over portions of wings in slipstream and, during violent maneuvers, over entire wing surface; results obtained.

SLIPSTRAEM VELOCITY. Investigation of Slipstream Velocity, J. W. Crowley, Jr. Nat. Advisory Committee for Aeronautics, report no. 194, 1924, 7 pp., 9 figs. Results of experiments to investigate velocity of air in slipstream in horizontal and climbing flight to determine form of expression giving slipstream in terms of air speed of airplane.

WINGS. Elements of the Wing Section Theory and of the Wing Theory, M. M. Munk. Nat. Advisory Committee for Aeronautics, report no. 191, 1924, 25 pp., 4 figs. Results of theory of wings and of wing sections which are of immediate practical value; results proven and demonstrated by use of simple conceptions of "kinetic energy" and "momentum."

WOOD MEMBERS, STRESSES IN. Stresses in Wood Members Subjected to Combined Column and Beam Action, J. A. Newlin and G. W. Trayer. Nat. Advisory Committee for Aeronautics, report no. 188, 1924, 13 pp., 9 figs. Results of tests to determine properties of wing beams of standard and proposed sections, conducted by Forest Products Laboratory and financed by Army and Navy.

AIRSHIPS

NAVIGATION. The Airship's Position (Le Point en Aéronef), L. Garin. Arts et Métiers, vol. 77, no. 44, May 1924, pp. 161-170, 5 figs. Discusses navigation charts, gives a number of curves, and develops formulas for determining position.

ALLOYS

ALUMINUM. *See Aluminum Alloys.*

BRASS. *See Brass.*

CORRODED, COATINGS FORMED ON. Coatings Formed on Corroded Metals and Alloys, G. M. Enos and R. J. Anderson. Am. Inst. Min. and Met. Engrs.— Trans., Advance paper No. 1358-N, July 1924, 9 pp., 16 figs. As coating formed affects corrosion rate, duplicate samples of eight non-ferrous alloys were placed in flowing mine water. Alloys tested were as cast or as rolled, and machined or polished. Describes tests and gives corrosion losses and appearance of samples at end of test.

CORROSION-RESISTANT. Corrosion-Resistant Alloys—Past, Present and Future—With Suggestions as to Future Trend, P. A. E. Armstrong. Am. Soc. for Testing Matls., Preprint of paper presented at meeting June 24-27, 1924, No. 19b, 15 pp.

Symposium on Corrosion-Resistant, Heat-Resistant and Electrical-Resistance Alloys. Am. Soc. for Testing Matls., Preprint of paper presented at meeting June 24-27, 1924, No. 19a, 4 pp. Contains tabulation on supplementary pages of manufacturers' data on composition and properties of the alloys.

FUSIBLE. Properties of Fusible Alloys, N. F. Budgen. Chem. & Industry, vol. 43, no. 27, July 4, 1924, pp. 200T-203T, 2 figs. Discusses properties of lead, bismuth, tin, cadmium, and mercury, used for fusible plugs in automatic fire-extinguisher systems, also manufacture of small statuary, etc.

IRON. *See Iron Alloys.*

ALUMINUM

WELDING. Gas Welding of Aluminum, S. W. Miller. Can. Machy., vol. 32, no. 6, Aug. 7, 1924, pp. 33-34 and 50. Discusses porosity in weld, brittle, character of flame, preheating casting, manipulation of welding rod, and welding sheet aluminum. Abstract of paper read before N. Y. sec. Am. Welding Soc.

ALUMINUM ALLOYS

ALUMINUM-COPPER-MAGNESIUM, CASTING AND HEAT TREATMENT. Casting and Heat Treatment of Some Aluminum-Copper-Magnesium Alloys, S. Daniels and J. B. Johnson. Am. Inst. Min. & Met. Engrs.—Trans., Advance paper No. 1350-N, July 1924, 22 pp., 6 figs. Deals with portion of work of Material Section, Engineering Division, Air Service, U. S. A., on casting and extended heat treatment of alloys of duralumin type (copper 2.5-5.0 per cent, magnesium 0.0-1.0 per cent, silicon 0.2-1.0 per cent, iron 0.3-1.5 per cent, manganese 0.0 to 1.0 per cent, chromium, etc.). This range of compositions includes an alloy recently placed on market in cast form and designated as Lynite 195.

PROPERTIES. Light Alloys of Aluminum, W. Rosenhain and S. L. Archbutt. Metal Industry (Lond.), vol. 25, nos. 1 and 2, July 4 and 11, 1924, pp. 3-7, and 27-30 and 44, 14 figs. Specific tenacity; are hardening; casting alloys and wrought alloys in general use; properties of chief alloys; heat treatment; application. Paper read before Empire Min. & Met. Congress.

ARCHES

MULTIPLE. The Design of a Multiple-Arch System and Permissible Simplifications, A. C. Janni. Am. Soc. Civil Engrs. Proc., vol. 50, no. 6, Aug. 1924, pp. 755-794, 21 figs. Discusses permissible simplification or shortening of strictly theoretic method of designing multiple-arch system, arches of which cannot be considered as having fixed ends.

ASPHALT

STATUS OF. The Status of Asphalt. Lubrication, vol. 10, no. 6, June 1924, pp. 61-66. Discusses Economic value, determination of quality, refining and uses of asphalt.

AUTOMOBILE FUELS

CONSUMPTION AND DILUTION. Consumption and Dilution of Automobile Engine Oils. Lubrication, vol. 10, no. 6, June 1924, pp. 66-72, 13 figs. Description of dynamometer apparatus and test routine; discusses dilution, lubricating system, oil viscosity requirements, value of road tests, and oil consumption.

PRODUCER GAS. Producer Gas for Road Transport, Motor Transport (Lond.), vol. 38, no. 1002, May 12, 1924, p. 580, 1 fig. Details of gas-producer plant; question of cost; results of recent French trials with charcoal as fuel.

SHAFTS, STIFFNESS OF. Calculating the Stiffness of Shafts, F. A. W. Livermore. Automobile Engr., vol. 14, no. 191, July 1924, p. 197. Gives simplified formula.

AZIMUTH

DETERMINATION. The Measurement of True Azimuths, E. M. Douglas. Military Engr., vol. 16, no. 87, May-June 1924, pp. 197-199, 3 figs. Discusses variation and uncertainty of compass bearings; advantages of recording true bearings; Polaris and Solar observations for azimuth and instruments used.

B

BAUXITE

OCCURRENCE AND SUPPLY. Occurrence and Supply of Bauxite, E. C. Eckel. Cement, Mill & Quarry, vol. 24, no. 12, June 20, 1924, pp. 23-25. A hydrated oxide of aluminum. Composition and impurities of bauxite; use as a cement material.

BEARINGS, BALL

STAINLESS-STEEL. Carrying Capacity of Ball Bearings Made of Stainless Steel, A. Hultgren. Am. Soc. for Testing Matls., Preprint of paper presented at meeting June 24-27, 1924, No. 19g, 7 pp. Brief summary of series of tests of stainless steel as a ball-bearing material conducted during past six years in Gothenburg Laboratory of Aktiebolaget Svenska Kullagerfabriken; stainless steels from an American, a British and a Swedish source were used.

BEARINGS, ROLLER

TAPER. Taper Roller Bearings. Automobile Engr., vol. 14, no. 191, July 1924, pp. 196-197, 10 figs. New type with rollers guided from race.

BLASTING

LIQUID OXYGEN. Liquid-Oxygen Explosives in Epoch-Making Blast, F. W. O'Neil. Compressed Air Mag., vol. 29, no. 7, July 1924, pp. 913-916, 8 figs. 4,500 tons of rock lifted in Pennsylvania quarry with less than 800 lb. of new explosive.

BOILER FEEDWATER

TREATMENT. Feed Water Treatment. Eng. & Boiler House Rev., vols. 37, and 38, nos. 8, 9 and 1, Mar., Apr. and July 1924, pp. 281-282, 323-324, 5-7, 1 fig. Notes on recent papers read before Instn. Mech. Engrs. Boiler feedwater and scaling; present-day practice with lime-soda process; zeolite process.

The Prevention of Scale Formation by Boiler Water Conditioning, R. E. Hall, C. Fischer and G. W. Smith. Iron and Steel Engr., vol. 1, no. 6, June 1924, pp. 312-327, 18 figs. Discusses conditioning of boiler water based on sulphate concentration and pressure of boiler water, removal of precipitated sludge and suspended insoluble matter, prevention of droplets (moisture) entrained in steam.

BOILER FIRING

PULVERIZED FUEL. Pulverized Fuel for Boilers, W. M. Selvey. Colliery Guardian, vol. 128, no. 3316, July 18, 1924, pp. 157-158. Discusses fuel, preparation, burners, absorption of heat, and application to British conditions. Abstract of paper read before World Power Conference.

BOILER FURNACES

AIR PREHEATERS. Experiments on a Cylindrical Steam Boiler with and without Preheated Air, W. H. Owen. Inst. Mar. Engrs.-Trans., vol. 36, June 1924, pp. 1-37, 12 figs. Discusses preheating air of combustion; describes new form of preheater extracting 65 to 70 per cent of heat in waste gases, and tests made.
The Ljungström Air Preheater, B. G. Brolinson. Iron and Steel Engr., vol. I, no. 6, June 1924, pp. 351-358 and (discussion) 358-360, 22 figs. Discusses application of this preheater based on principle of carrying heat continually in mechanical way from flue gases to incoming air, apparatus being self-contained, compact in design, simple in operation and permiting of ready application. Paper read before Assn. Iron and Steel Elec. Engrs., Fuel Saving Conference.
The Preheating of Combustion Air, J. B. Bullock. So. African Inst. Elec. Engrs.—Trans., vol. 15, part 5, May 1924, pp. 388-396. 4 figs. Describes latest system of recovering and putting to beneficial use maximum amount of heat available in coal as fired to boiler or furnace, and gives some account of results obtainable with system and of their bearing on present boiler practice.

BOILER ROOMS

CONTROL. Measurement of Input and Output in Boiler Rooms, J. M. Spitzglass. Iron and Steel Engr., vol. I, no. 6, June 1924, pp. 299-309 and (discussion) 309-311, 11 figs. Shows how material quantities can be measured accurately and conveniently in steel-plant boiler rooms, including practical application of measuring flow of fluids and of coal; determination of constants.

BOILERS

BAFFLES. Designing Boiler Baffles, A. W. Patterson, Jr. Combustion, vol. 11, no. 2, Aug. 1924, pp. 122-124, 7 figs. Some problems brought about by incorrect baffle design, and methods by which conditions in particular plants were remedied.
CORROSION. Corrosion in Steam Boiler Plant, G. E. Swett. Pac. Mar. Rev., vol. 21, no. 7, July 1924, p. 383, 1 fig. Describes apparatus known as Hickman air separator, an automatic method of eliminating chief cause of depreciation in steam-generating equipment.
ELECTRICALLY HEATED. Electric Boilers (Les chaudières électriques), P. Bergeon. Revue Universelle des Mines, vol. 67, no. 4, Feb. 15, 1924, pp. 241-248. Discusses resistance boilers, induction boilers, and electrode boilers; comparison of cost of steam in electric and other boilers; application of electric boilers.
FIELD, INEFFICIENT HANDLING OF. Inefficient Handling of Field Boilers Source of Waste and Expense, F. G. D. Muller. Nat. Petroleum News, vol. 16, no. 29, July 16, 1924, pp. 77-79, 4 figs. Discusses improving efficiency of boilers, preheating feedwater, driller's ear attuned to exhaust, water filter for field boilers, and uses for old boilers.
LOCOMOTIVES. *See Locomotive Boilers:*
SEAMS, BRITTLENESS AND CRACKS IN. Brittleness and Cracks in Seams of Steam Boilers, H. Kriegsheim. Power Plant Eng., vol. 28, no. 15, Aug. 1, 1924, pp. 792-795, 6 figs. Causes and prevention of so-called caustic embrittlement.
STANDARDIZATION. Sixteen Years of Boiler Standardization, J. A. Stevens. Power, vol. 60, no. 6, Aug. 5, 1924, pp. 217-218. Details of work of Boiler Code Committee.
WASTE-HEAT. Utilizing Waste Heat, K. W. Heinrich. Pac. Mar. Rev., vol. 21, no. 7, July 1924, pp. 376-377, 3 figs. Describes fire-tube steam or hot-water generator especially adapted for reclaiming heat from exhaust gases of Diesel engines, developed by Davis Eng. Corp. Possibilities of application.
Waste-Heat Boilers and Vertical Retort Installations. Gas Jl., vol. 167, no. 3,190, July 2, 1924, pp. 106-122, 20 figs. Twelfth report of Research Sub-Committee of Gas Investigation Committee. Investigation conducted on water-tube waste-heat boilers attached to installations of Woodall-Duckham continuous vertical retorts at Windsor Street works of Birmingham Gas Dept. See also Gas Wld., vol. 80, no. 2,084, June 28, 1924, pp. 633-647, 5 figs.

BONUS SYSTEMS

MAINTENANCE OF. Maintenance of a Standard Time and Bonus System. C. W. Setter. Soc. Indus. Engrs. Bul., vol. 6, nos. 7-8, July-Aug. 1924, pp. 10-14. Details as practised at works of Republic Metalware Co., Buffalo, N. Y.

BRAKES

POWER. The Commission's Report on Power Brakes. Ry. Rev., vol. 75, no. 7, Aug. 16, 1924, pp. 251-257. Mandatory conclusions enunciated by Interstate Commerce Commission as result of its extended investigation of power brakes and appliances.

BRASS

ALPHA-BETA, HEAT TREATMENT OF. Experiments on the Heat Treatment of Alpha-Beta Brass, O. W. Ellis and D. A. Schemnitz. Am. Inst. Min. & Met. Engrs. —Trans., Advance paper No. 1348-N, July 1924, 11 pp., 2 figs. Details of experiments carried out mainly with view of determining whether precipitation of soft particles within a supersaturated solid solution would not enhance its hardness. Effect of reheating quenched alpha-beta brass on its micro structure; results of reheating quenched alpha-beta brass at 100 deg., 200 deg. and 300 deg. cent.; aging at room temperature.
FOUNDRY MIXTURES, NICKEL ADDITIONS TO. The Advantage of Nickel Additions to Brass Foundry Mixtures, W. M. Corse. Metal Industry (Lond.), vol. 25, no. 3, July 18, 1924, pp. 79-80. Discusses advantages of nickel additions and gives typical examples of benefit derived. Lecture before Metropolitan Brass-founders' Assn., New York.

BRIDGES

RAILWAY. Long Girder Spans for Reinforced Concrete Bridge. Ry. Rev., vol. 75, no. 6, Aug. 9, 1924, pp. 202-205, 6 figs. Pennsylvania Ry. uses spans of unusual length for new structures which replaces steel bridge at Becks Run, Pa., Monongahela River.
SYDNEY, AUSTRALIA. The Competitive Designs for the Sydney Harbour Bridge. Engineering, vol. 118, no. 3056, July 25, 1924, pp. 129-132, 18 figs. Discussion of the different designs submitted for construction of Sydney Harbor Bridge. Proposals are of five general types, viz., arch, cantilever-arch, cantilever, suspension and cantilever-suspension.

BRIDGES, CONCRETE

ARCH. Big Four Cutoff Involves Monumental Bridge. Ry. Age, vol. 77. no. 3, July 19, 1924, pp. 99-103, 8 figs. Cleveland, Cincinnati, Chicago and St. Louis constructing 13.7 miles of grade revision and double track work on its Indianapolis-Cleveland line which embraces a seven-mile relocation involving some very heavy and spectacular construction of which most important feature is a reinforced-concrete arch viaduct at Sidney, Ohio. Details of construction of bridge.
Hill to Hill Bridge, Bethlehem, Pa. Ry. Rev., vol. 75, no. 3, July 19, 1924, pp. 77-84, 13 figs. Long viaduct relpaces wooden bridge over Lehigh River and eliminates 8 grade crossings. Bridge is of high level or viaduct type; except for 2 through truss spans and 8 through girder spans, entire structure is of reinforced concrete design.

BRIDGES, LIFT

BASCULE. Bascule Bridge and Viaduct at Coleraine. Ry. Engr., vol. 45, no. 535, Aug. 1924, pp. 265-271, 10 figs. Engineering details and drawings of 11-span viaduct recently completed on L.M. & S.R. (Northern Counties Committee), Ireland. One section of this structure includes first Strauss underhung counterweight Bascule Bridge in British Isles, erected over River Bann to replace old viaduct.

BUILDING CONSTRUCTION

FIREPROOF. Analysis of Cost of Types of Fireproof Construction, A. F. Klein. West. Soc. of Engrs.—Jl., vol. 29, no. 7, July 1924, pp. 290-300, 10 figs. Gives unit costs of different methods of fireproof construction of 3 types of buildings; analyzes 4 types of construction for 16-story hotel, 3 for light manufacturing building, and 3 for heavy warehouse.
Comparison of Types of Fireproof Construction, C. L. Post. West. Soc. of Engrs.—Jl., vol. 29, no. 7, July 1924, pp. 278-289, 11 figs. Compares types of fireproof construction covering foundations, columns and floor construction, hollow clay tile arches, reinforced-concrete joist construction, flat-slab construct on, etc., recognizing fact that no universal rules can be laid down.

BUSES

TROLLEY. The Scope of the Trolley Bus, C. O. Silvers. Motor Transport (Lond.), vol. 39, no. 1010, July 7, 1924, pp. 13-14, 2 figs. Its advantages and disadvantages; traffic and mechanical requirements.
See also Motor Buses.

C

CABLEWAYS

PORTABLE. "Artex" Portable Ropeway. Indus. Mgt. (Lond.), vol. 11 (new series) no. 12, June 1924, pp. 325-326, 2 figs. Discusses Artex system built on mono-cableway system of transportation, including rope coupling by means of which endless-rope track can be shortened or lengthened for altering scope and position of conveyor.

CANALS

HYDRAULIC NOTCH. Calculation of Hydraulic Notch for Channel Control, H. B. Muckleston. Eng. News-Rec., vol. 93, no. 6, Aug. 7, 1924, pp. 232-233. Method employed in designing channel construction to maintain constant energy gradient at change of canal grade.
LOCK GATES. New Type of Canal Lock Gate Developed in Sweden, L. Lawski. Eng. News-Rec., vol. 93, no. 4, July 24, 1924, pp. 135-136, 3 figs. Describes floating sector type canal gate developed to meet peculiar conditions which exist in Sodertalje Canal, at Sodertalje, near Stockholm, a tidal canal where difference in head is small. Filling water admitted around gates.

CAR HOUSES

DESIGN. Fort Wayne Builds Modern Carhouse. Elec. Ry. Jl., vol. 64, no. 6, Aug. 9, 1924, pp. 191-194, 7 figs. Details of design and construction of car house of Indiana Service Corp., giving facilities for inspection repairs and storage.

CAR LIGHTING

MAINTENANCE METHODS. Light, Not Lamps, Determines Economy of Car Lighting, E. E. Dorting. Elec. Ry. Jl., vol. 64, no. 3, July 19, 1924, pp. 80-82, 2 figs. Analysis shows light to be thing purchased in car lighting; old lamps should be discarded; lamps and power for lighting cars cost Interborough Rapid Transit Co. $125,964 per yr.

CARS

AIR-COMPRESSOR. Mobile, Self-Contained Compressor Car for Railroad Service. C. S. Kulp. Compressed Air Mag., vol. 29, no. 8, Aug. 1924, p. 955, 3 figs. Details of compressor car outfit consisting of two type POV-2 compressors directly connected to 50 hp. engine, single-cylinder horizontal type operating on 4-stroke cycle.

CARS, REFRIGERATOR

FRENCH. Refrigerator Cars on the French System (Les wagons frigorifiques), M. A. Sigmann. Revue Générale des Chemins de Fer, vol. 43, no. 6, June 1924, pp. 399-417, 9 figs. Development of refrigerator cars; design and construction of isothermic cars of Orleans Railway; transportation of fruit, meat, milk, etc.

CAST IRON

FORMULAS. Cast Iron Formulae. Metal Industry (Lond.), vol. 25, no. 2, July 11, 1924, pp. 35-37, 3 figs. Use of formulas which purport to give relative proportions of the various constituents, particularly silicon-carbon relations. Criticizes specific formulas which have been proposed. Tenor of author's conclusions seems to be that all such formulas are more dangerous than useful.
POROSITY. Porosity in Cast Iron, A. Marks. Foundry Trade Jl., vol. 30, no. 412, July 10, 1924, pp. 25-27, 8 figs. Also Metal Industry (Lond.), vol. 25, no. 3, July 18, 1924, pp. 61-62. Discusse graphite, shrinkage, gas, and dirt porosity and concludes that there is no single cause or cure of porosity in castings. Each case has to be dealt with on first principles and molding, feeding, chilling and metal all attended to.
SHRINKAGE. Shrinkage. Metal Industry (Lond.), vol. 25, no. 3, July 18, 1924, pp. 83-86, 3 figs. Discusses chief phenomena and causes of shrinkage in cast iron. Deals at some length with classic work of Keep.
The Influence of Various Elements on the Shrinkage of Cast Iron and Steel, I. Jaederstroem. Testing, vol. 1, no. 4, Apr. 1924, pp. 290-307, 16 figs. Shows influence on shrinkage exerted by carbon, silicon, manganese, phosphorus, sulphur, nickel and chromium, determined by varying percentage of one element at a time.
SOLIDIFICATION AND COOLING, CHEMICAL EQUILIBRIA DURING. Chemical Equilibria During Solidification and Cooling of White Cast Iron, H. A. Schwartz and Anna N. Hird. Am. Inst. Min. & Met. Engrs.—Trans., Advance paper No. 1356-S, July 1924, 4 pp. By analyzing cementite separated electrolytically from white cast iron of known composition and history, distribution of silicon between austenite and cementite during and after freezing has been followed. Results constitute a contribution to our knowledge of equilibria in ternary system iron-carbon-silicon. Information also obtained regarding distribution of manganese, silicon, and phosphorus, when only relatively small amounts of each are present.

CASTINGS

STRUCTURE OF. Surface Structure Versus Inner Structure of Metals, V. N. Krivobok and O. E. Romig. Am. Soc. for Steel Treating—Trans., vol. 6, no. 1, July 1924, pp. 66-76, 11 figs. Discusses structures which appear on surface of cast metals and their relation to inner crystalline organization of metal; variety of surface structures and danger of erroneous conclusions based on them solely.

CEMENT

MAGNESIUM OXYCHLORIDE. What is Good Magnesium Oxychloride Cement? H. L. Olin and B. H. Peterson. Chem. and Met. Eng., vol. 31, no. 7, Aug. 18, 1924, pp. 266-267. Effects of adding free lime and calcium carbonate studied and causes of weakening of cement in case of former investigated.

STORAGE. Effect of Storage of Cement, D. A. Abrams. Lewis Inst., Structural Matls. Research Lab.—Bul. no. 6, Apr. 1924, 33 pp. 12 figs. Results of tests with three different lots of portland cement stored up to five years show that increase in strength of concrete in approximately proportional to logarithm of age, also appreciable loss in strength due to storage in small lots. Deterioration is due to absorption of atmospheric moisture which causes partial hydration, etc.

CEMENT, PORTLAND

PUZZOLANA. Effect of Puzzolana on Cements (L'influence des pouzzolanes sur les ciments), O. Raulin. Génie Civil, vol. 85, no. 2, July 12, 1924, pp. 37-39. Discusses special portland cements and their properties; class puzzolana including volcanic slag, trass, blast furnace slag, etc., and their properties.

CENTRAL STATIONS

CHICAGO. ILL. Calumet and Crawford Ave. Stations of the Commonwealth Edison Co., Chicago, Ill., W. F. Sims. Iron & Steel Engr., vol. 1, no. 7, July 1924, pp. 382-386, 5 figs. General layout, coal-handling equipment, boiler plant, feed-water system, switchhouse, connection with other stations.
OPERATING-COSTS ANALYSIS. How to Analyze the Operating Costs in a Municipal System, G. F. Drewry. Elec. News, vol. 33, nos. 13 and 14, July 1 and 15, 1924, pp. 54-55 and 55-56. Advantages of cost analysis; cost of power can be definitely distributed; power factor must be taken into account.
PARSONS LINE. Some Opinions on the "Parsons Line". Power Engr., vol. 19, no. 220, July 1924, pp. 251-253, 4 figs. Number of expressions by station engineers regarding value of this method of checking operating results.
PRACTICE. General Review of Current Practice, P. Junkersfeld and G. A. Orrok. Combustion, vol. 11, no. 2, Aug. 1924, pp. 125-129, 3 figs. Current practice in power-plant field reviewed with particular reference to central stations. Compact chart indicating equipment in 22 of the most modern plants in United States. Paper presented at World Power Conference in London, July 1924.
PULVERIZED-COAL BURNING. Thiers Central Station Fired with Pulverized Coal (Station centrale de Thiers chauffée au charbon pulvérisé), M. L. Champy. Annales des Mines; vol. 5, no. 5, May 1924, pp. 291-317, 3 figs. Storing, drying, and conveying of pulverized coal; combustion chamber, boilers, turbo-alternators, switching facilities and tests made; plant was particularly constructed to use a fuel which was otherwise useless because it was too fine.
REMODELING. Modern Equipment Reduces Cost of Power. Power, vol. 60, no. 6, Aug. 5, 1924, pp. 210-211, 2 figs. Steam equipment of Abbeville, La., municipal light plant replaced by Diesels; cost of generating current reduced; water works served by motor-driven centrifugal pumps and air lift.

CHAINS

SILENT, MANUFACTURE OF. The Story of Morse Chain, C. G. Priebe. Am. Mach., vol. 60, nos. 20, 22, 24 and 26, and vol. 61, nos. 2 and 4, May 15, 29, June 12, 26, July 10 and 24, 1924, pp. 737-740, 811-814, 887-889, 959-962, 69-71 and 145-148, 50 figs. May 15: Development of chain and its manufacture; growth of Morse Chain Co.; layout of units of plant. May 29: How sprocket wheels are made. June 12: Drawing operations; forming pin stock; carbonizing; presswork in pins. June 26: How links are stamped out and hardened. July 10: How chain is assembled, riveted, inspected and packed for shipment. July 24: Typical applications of silent chain for power transmission.

CHIMNEYS

DRAFT CALCULATIONS. Theory of Draft (Théorie du tirage), N. Peters. L'Association des Ingénieurs sortis des Ecoles spéciales de Gand—Annales, vol. 14 (Series 5), 1924, pp. 129-140. Formulas for calculating dimensions of stacks, heat losses, etc.
SIZE DETERMINATION. How to Determine the Proper Size of Chimney, T. S. Clark. Power, vol. 60, no. 5, July 29, 1924, pp. 175-179, 1 fig. Explains in a practical manner necessary elements for determining proper size of chimney for a given installation. Includes typical examples.

CHROME STEEL

PROPERTIES. Chromium—Its Uses and Its Alloys, W. M. Mitchell. Forging—Stamping—Heat Treating, vol. 10, no. 8, Aug. 1924, pp. 303-306, 13 figs. Chromium in steel lessens thermal conductivity; property is of importance when heat treating large forgings.

CHROME-NICKEL STEEL

CARBIDES. The Carbides in Nickel Chromium Steels, J. H. Andrew and H. Hyman. West of Scotland Iron & Steel Inst.—Jl., vol. 31, parts 6 and 7, Mar.-Apr. 1923-1924, pp. 116-123, 10 figs. Discusses analysis of carbides in samples water quenched from 770 deg. Cent., and tempered at 650 deg. Cent. for 3 hr., and water quenched from 1,200 deg. Cent. and tempered at 650 deg. Cent. for 3 hr.
NON-RUSTING. Non-Rusting Chromium-Nickel Steels, B. Strauss. Am. Soc. for Testing Matls., Preprint of paper presented at meeting June 24-27, 1924, No 19e, 10 pp., 5 figs. Valuable properties of chromium as an alloy with iron and steel, and experiments which led to development of two chromium-nickel steels in Physical Research Laboratory of Messrs. Krupp, Germany; results of corrosion tests, physical and metallographic properties, properties under elevated temperatures, and applications of these steels.

CIRCUIT BREAKERS

HIGH-VOLTAGE. High-Voltage Circuit Breakers, J. S. Jenks. Am. Inst. Elec Engrs.—Jl., vol. 43, no. 8, Aug. 1924, pp. 715-718. Discusses question from operators point of view, gives experiences with West Penn system.

CITY PLANNING

SUPER-HIGHWAY PLAN. Greater Detroit's Proposed Super-Highway Plan. Eng. Wld., vol. 25, no. 2, Aug. 1924, pp. 59-61, 1 fig. Discusses congestion problem and more surface lines needed. See also Eng. and Contracting (Roads and Streets), vol. 62, no. 2, Aug. 6, 1924, pp. 283-287, 1 fig.

CLUTCHES

DESIGN. Considerations in Clutch Design, A. Clegg. Machy. (Lond.), vol. 24, no. 614, July 3, 1924, pp. 436-438, 5 figs. Conical clutches.
Plate and Coil Clutches, A. Clegg. Machy. (N. Y.) vol. 30, no. 12, Aug. 1924, pp. 953-955, 6 figs. Notes on design. Describes different types.

COAL

CARBONIZATION. Practical Coal Carbonization, F. W. Sperr, Jr. Universal Engr., vol. 40, no. 2, Aug. 1924, pp. 31-37, 4 figs. Discusses high temperature and low temperature carbonization with special reference to American conditions, yields and values of by-products. Abstract of paper read at meeting of Phila. Local Sec., A. S. M. E.
GASIFICATION. The Regenerative Coal Gasification System at Aylesbury, A. G. Lane. Gas Jl., vol. 167, no. 3190, July 2, 1924, pp. 149-153, 3 figs. Coal is transformed into gas in single operation, leaving only ash liquor and tar as residuals, and renders large proportion of energy of coal available and saleable as town's gas. See also Gas Wld., vol. 80, no. 2084, June 28, 1924, pp. 664-675, 3 figs.

COAL DUST

EXPLOSION PREVENTION. Spreading Stone Dust with Compressed Air to Prevent Coal-Dust Explosions, C. Moran. Compressed Air Mag., vol. 29, no. 7, July 1924, pp. 917-918, 5 figs. Discusses testing of coal dust for explosion properties and application of stone dust distribution and stone dust shelving to prevent or arrest coal dust explosions.

COAL HANDLING

PLANTS. Coal-Handling System, J. A. Beck. Combustion, vol. 11, no. 2, Aug. 1924, pp. 120-121, 3 figs. Description of apparatus installed at plant of Kansas Gas & Elec. Co. at Strauss, Kan., and of method of operation.

COKE

GASIFICATION. The Gasification of Coke in Steam, with Special Reference to Rates of Gasification and the Composition of the Gas, S. Pexton and J. W. Cobb. Gas Jl., vol. 167, no. 3190, July 2, 1924, pp. 161-169, 7 figs. Investigates composition of gas and amount of undecomposed steam as varying with temperature, velocity of gas stream and nature of coke used. See also Gas Wld., vol. 80, no. 2084, June 28, 1924, pp. 675-678.

COMPRESSED AIR

FOUNDRY EQUIPMENT. Pneumatic Apparatus Speed Up Performance in the Foundry, S. G. Roberts. Compressed Air Mag., vol. 29, no. 7, July 1924, pp. 933-936, 13 figs. Discusses pneumatic equipment of Malleable Iron Fittings Co., Branford, Conn., including air operated riddles, knock-out vibrators, jet cleaners and sprayers, etc.

CONCRETE

ADMIXTURES IN. Recommended Admixtures in Concrete, D. A. Abrams. Contract Rec., vol. 38, no. 33, Aug. 13, 1924, pp. 814-815. Results of investigations to determine effects of calcium chloride and other compounds on compressive strength of concrete.
AGGREGATES. Analysis of Grading Curve for Concrete Aggregates, L. I. Hewes. Eng. News-Rec., vol. 93, no. 6, Aug. 7, 1924, pp. 222-226, 2 figs. Mathematical study of size gradation of sand and stone to co-ordinate various measures of grading such as fineness modulus, surface area and density ratio.
FRICTION TESTS. Friction Tests of Concrete on Various Subbases, A. T. Goldbeck. Public Roads, vol. 5, no. 5, July 1924, pp. 19-20 and 23, 1 fig. Discusses determination of frictional resistance a step toward rational design of concrete pavement, description of specimens and method of tests and frictional resistance lowered by wet subbase.
MIXING. Concrete Methods on the C.C.C. and St. L. Ry., J. B. Hunley. Eng. & Contracting (Bldgs.), vol. 61, nos. 3 and 4, Mar. 26 and Apr. 23, 1924, pp. 681-691 and 871-879, 5 figs. Old and new practices, with especial reference to proportioning. Notes on designing concrete mixtures. Paper read at Am. Concrete Inst. convention, Feb. 25-28, 1924.
MOIST SANDS. The Bulking of Moist Sands, A. A. Levison. Public Roads, vol. 5, no. 5, July 1924, pp. 21-23, 5 figs. Effect of phenomenon on strength and yield of concrete.

CONCRETE CONSTRUCTION REINFORCED

BULKHEADS. Reducing the Cost of Concrete Bulkheads, T. Aston. Concrete, vol. 25, no. 1, July 1924, pp. 28-30, 5 figs. Develops hollow stepped-down concrete wall for use as bulkhead for wharves, retaining walls, and the like. Shows step wall system, as applied to dam walls, gives cheaper construction than standard types of dam walls.

CONDENSERS, STEAM

SURFACE. Surface Condensers and Auxiliaries, J. P. Likiak. So. Engr., vol. 41, no. 5, July 1924, pp. 51-55, 11 figs. Size limit, arrangement of passes, method of tube packing and methods of cleaning tubes.

CONDUITS

CONCRETE. Concrete Conduit Gaining Favor. Cement & Eng. News, vol. 36, no. 7, July 1924, pp. 33-34 and 40, 4 figs. Electrical engineers find "stone" product has many advantages over other materials in underground wiring systems.
ELECTRICAL CONCRETE-PIPE. Concrete Pipe Electrical Conduits. Concrete, vol. 25, no. 1, July 1924, pp. 32-34, 4 figs. Gives method of installation, essential qualities of duct material, comparison of various materials, advantages of using concrete conduit and extensive use of concrete conduit.

CONVERTERS

ROTARY. The Generating Effect in Rotary Converters on Short Circuit, F. Hoeberli. Brown Boveri Rev., vol. 11, no. 1, Jan. 1924, pp. 3-12, 12 figs. Details of short circuit test of rotary converters for direct-current traction at 1600 volt, and their favorable behavior.

CONVEYORS

FACTORY. Increasing Production by Power Conveyors. Machy. (Lond.), vol. 24, no. 618, July 31, 1924, pp. 558-561, 5 figs. Conveyor installations that have proved their economy in plant manufacturing small parts.

COPPER DEPOSITS

CANADA. Copper Deposits of Arctic Canada, G. M. Douglas. Eng. & Min. Jl.—Press, vol. 118, no. 3, July 19, 1924, pp. 85-89, 5 figs. Discusses British Government explorations, great extent of mineralized area, copper in three forms, deposits at Bathurst inlet, possibilities of high-grade ore and transportation problem.

CORROSION

ELECTROLYTIC. The Electrolytic Theory of Corrosion, W. D. Bancroft. Physical Chem.—Jl., vol. 28 no. 8, Aug. 1924, pp. 785-871. Reviews electrolytic theory and criticizes some conclusions based on it.

COST ACCOUNTING

FUNCTION OF, MEASURING. Evaluating the Cost Department. Mech. Eng., vol. 46, no. 8, Aug. 1924, pp. 477-479. Varying views of cost accountants, engineers, and others on possibility of measuring cost-accounting function.

COSTS

MACHINE SHOP, ESTIMATING. How to Estimate Machine Shop Costs, A. A. Dowd. Am. Machinist, vol. 61, no. 6, Aug. 7, 1924, pp. 227-230, 3 figs. Estimates of machining time on spline-milling operations; practical examples of keyway and slot cutting; gear milling and hobbing estimates.

COUNTERBORES

MANUFACTURE OF. Manufacturing Interchangeable Counterbores. Machy. (N. Y.), vol. 30, no. 12, Aug. 1924, pp. 943-947, 15 figs. Unusual operations and fixtures employed by Gairing Tool Co., Inc., Detroit, Mich., in making counterbores and holders.

CRANES

CRAWLER. Crawler Crane Built for First Time in Canada, H. P. Armson. Can. Machy., vol. 32, no. 3, July 17, 1924, pp. 19-21 and 42, 3 figs. Designed and built by J. T. Hepburn, Ltd., Toronto, for service in civic yards.

TRAVELING. A Special Running Shed Crane Equipment on the Pennsylvania Railway. Ry. Gaz., vol. 41, no. 2, July 11, 1924, p. 43, 3 figs. Particulars of ten-ton electric overhead traveling crane, operating on circular track and having all wheels of same diameter, at Columbus, O., enginehouse of Penna. Ry.

CRANKSHAFTS

EXPLOSION-ENGINE, RESONANCE OF. Experimental Demonstration and Exact Measurement of Resonance of Crankshafts of Explosion Engines; Rôle of Flywheel; Favorable Effects of Elastic Coupling (Démonstration expérimentale et mesure précise des phénomènes de résonance propre des arbres manivelles des moteurs à explosion; rôle du volant; influence favorable d'un accouplement élastique), A. Blondel and H. Harle. Académie des Sciences—Comptes Rendus des Séances, vol. 178, no. 18, Apr. 28, 1924, pp. 1442-1452, 4 figs. Results of experiments to measure resonance in crankshafts at various speeds and comparison of results with theory.

CURVES

HYPERBOLIC. Plotting Hyperbolic Transformation Curves (Note sur le tracé des courbes hyperboliques de transformation, dans le diagramme). Arts et Métiers, vol. 77, no. 44, May 1924, pp. 170-173, 3 figs. Discusses Brauer's curve showing volume and absolute pressure of gas varying in geometric progression; plotting of hyperbolic curves by means of logarithmic auxiliary curve.

D

DAMS

BARRAGE. Wilson Dam at Muscle Shoals, World's Greatest Hydraulic Development, Development, H. L. Cooper. Universal Engr., vol. 40, no. 2, Aug. 1924, pp. 21-26, 8 figs. At Tennessee River for production of electric power and improvement of navigation; details of power house equipment, 30,000 h.p. turbines, 25,000 kva. generators, 60 cycle, three-phase 12,000 volt 100 r.p.m. etc. See also Nat. Engr. vol. 28, no. 8, Aug. 1924, pp. 388-391, 3 figs.

CONCRETE. Concrete Work at Wilson Dam, Muscle Shoals, R. P. Brown. Eng. and Contracting (Water Works), vol. 62, no. 1, July 9, 1924, pp. 61-66, 6 figs. Construction features of largest concrete project in world. Paper read before Annual Convention of Nat. Lime Assn.

MULTIPLE ARCH. Multiple Arch Barrage Dams and Their Security (Les barrages à voûtes multiples et la sécurité), E. Baticle. Génie Civil, vol. 85, no. 2, July 12, 1924, pp. 36-37. Criticises continued confidence in multiple arch dams after Gleno failure and shows that dams do not give security theoretically that might be expected of them.

DIES

DRAWING. Designing Drawing Dies. Machy, (Lond.), vol. 24, nos. 611 and 614. June 12 and July 3. 1924, pp. 341-344 and 422-426, 14 figs. Radii over which metal can be drawn, type of equipment used, operation of drawing die, design of first-operation die, die for final drawing operation, design of blank holders, computing blank diameter of shells of unusual shapes, determining number of operations required, combination die for blanking and drawing, troubles encountered in drawing light-gage metal, etc.

DIESEL ENGINES

CENTRAL-STATION. Diesel Engines Turn Tables on Central Station. Oil Engine Power, vol. 2, no. 7, July 1924, pp. 366-370, 6 figs. Atlantic Wire Co., Branford, Conn. changed power source from steam plant to Diesel-engine drive; costs chargeable are considerably less per kw-hr. than purchased current cost; two six-cylinder Lombard Diesel engines rated to develop 180 h. h.p. each and direct connected to two Westinghouse 3-phase 200 kva. alternators and 10-kw. direct-connected exciters.

HEAVY-OIL BURNING. Burning Heavy Fuel Oil in Diesel Engines, R. Hildebrand. Power House, vol. 17, no. 14, July 20, 1924, pp. 26 and 39, 1 fig. Satisfactory results were obtained with small three-cylinder, single-acting, four-stroke vertical engine developing 200 h.hp. at 257 r.p.m.

REPLACES WATER POWER. Municipality Replaces Water-Power with Oil Engines. Oil Engine Power, vol. 2, no. 7, July 1924, pp. 379-380 and 385, 3 figs. When city of Marshall, Mich., began to grow so fast that all available water flow was used up in attempt to keep pace with increasing power demands, electric current was purchased outside at moderate rates. Subsequent steep rises in cost of purchased power made city turn to oil-engine power, and Diesels since installed have netted big operating gains.

SCAVENGING BLOWERS FOR. Centrifugal Scavenging Blowers for Two-Cycle Marine Diesel Engines, E. Klingelfuss. Brown Boveri Rev., vol. 11, no. 4, Apr. 1924; pp. 67-80, 28 figs. Details of design and construction of centrifugal scavenging blowers, their advantages, and prime-movers for them; arrangement on board ship; operation in conjunction with Diesel engines.

DIRECTION FINDING

UNILATERAL. A New Unilateral Radiogoniometer (Un nouveau radiogoniomètre avec levée du dute), E. Bellini. L'Onde Electrique, vol. 3, no. 29, May 1924, pp. 233-253, 19 figs. Describes a new device for direction finding.

DOCKS

FLOATING. Reinforced Concrete Dolphins for 60,000-Ton Floating Dock at Southampton. Concrete and Constructional Eng., vol. 19, no. 7, July 1924, pp. 450-454, 1 fig. To provide docking facilities for ships of Majestic type and larger (56,557 tons).

DRAINAGE

DRAINAGE AND RAINFALL, E. V. WILLARD. Nat. Reclamation Mag., vol. 3, no. 2, Feb. 1924, pp. 24-25 and 34-35. Records show that wet cycles alternate with dry cycles and drainage has no effect on rainfall.

DITCHES. Method of Reconstructing Old Open Drainage Ditches, J. L. Parsons. Eng. and Contracting (Water Works), vol. 62, no. 1, July 9, 1924, pp. 77-79, 1 fig. Discusses reconstruction work much of which consists of cleaning out and deepening old ditches.

Open Ditches Replaced by Tile. Nat. Reclamation Mag., vol. 3, no. 3, Mar. 1924, pp. 44-45 and 55, 7 figs. Discussion at Congress in St. Louis shows value of tile replacement for ditches.

SILT DEPOSITS. Handling Silt in Settling Basins, R. M. Towl. Eng. and Contracting (Water Works), vol. 62, no. 2, Aug. 13, 1924, pp. 341-344, 3 figs. Describes how silting problems are being met and results in hall creek settling basin.

DRILLING MACHINES

HEAVY-DUTY, POSSIBILITIES OF. Possibilities of Heavy-duty Drilling, H. L. Tigges. Machy. (N. Y.), vol. 30, no. 12, Aug. 1924, pp. 950-952, 5 figs. Points out possibilities of vertical heavy-duty drilling machine by presenting examples of work done in automobile plants. By term "heavy-duty drilling machine", is meant a machine with a box column.

E

EARTHQUAKES

JAPAN. Six Lessons from the Japan Earthquake, R. F. Moss. Mich. Architect & Engr., vol. 6, no. 2, Feb. 1924, pp. 18-22, 1 fig. Gives six important lessons and recommendations for future construction.

EDUCATION, ENGINEERING

POWER-PLANT ENGINEERING. Training Engineers for Alberta's Power Plants, R. M. Dingwall. Power House, vol. 17, no. 14, July 20, 1924, pp. 19-20 and 40-41, 3 figs. Provincial Inst. of Technology & Art, Calgary, Alberta gives complete course in mechanical engineering consisting of two terms of 8 mos. each; students devote 50 per cent of their time to practical work.

EDUCATION, INDUSTRIAL

CHARACTER AND EXTENT. Education and Training for the Industries. Mech. Eng., vol. 46, no. 8, Aug. 1924, pp. 482-483. Investigation into character and extent of such training. Making industry attractive to high-school and college students. Labor as a means of social salvation.

ELECTRIC CIRCUITS

THEORY. A Generalization of Reciprocal Theorem, J. R. Carson. Bell System Technical Jl., vol. 3, no. 3, July 1924, pp. 393-399. Generalization of Raleigh's theorem as to periodic electromotive force in circuit A giving rise to same current in B as would be excited in A if electro motive force operated in B.

ELECTRIC CONDUCTORS

JOINTS. The Contact Resistance of Large Conductors, A. R. Enger. Elec. Jl., vol. 21, no. 7, July 1924, pp. 316-318, 6 figs. Shows from experiments that voltage across contact will vary inversely with pressure, and that resistance between contacts depends only on total pressure with which they are forced together.

ELECTRIC DISTRIBUTION SYSTEMS

OPERATION. The Continuity and Regularity of Operation of Large Electric Systems, G. Semenza. Engineering, vol. 118, no. 3055, July 18, 1924, p. 112. Shows that improvement of service is an advantage both for consumer and producer, but perhaps more for producer. Causes of bad service.

ELECTRIC FURNACES

INDUCTION. A Six-Ton Induction Furnace Installation, M. Unger. Gen. Elec. Rev., vol. 27, no. 8, Aug. 1924, pp. 498-503, 12 figs. Details of new General Electric Co. three-ton furnace and its auxiliaries, yielding high-grade melt of extreme uniformity.

MELTING WITH. Melts in Twin Electric Furnaces, A. W. Bryant. Iron Trade Rev., vol. 75, no. 4, July 24, 1924, pp. 226-228, 4 figs. At plant of Kelley & Jones Co., Greensburg, Pa., who manufacture a line of plumbing and valve fittings in gray iron, steel and malleable iron, two acid-lined units, 1½ tons capacity each, mounted on turntable 180 deg. apart and having single set of electrodes, provide small batches of hot metal at short-even intervals.

ELECTRIC GENERATORS, A.C.

PARALLEL OPERATION. Parallel Operation of Direct-Connected Auxiliary Generators, H. B. Seeley. Elec. Jl., vol. 21, no. 8, Aug. 1924, pp. 387-390, 6 figs. Discusses operating shaft-driven auxiliary generators in parallel with other sources of auxiliary power, with parallel operation with main bus through transformers, parallel operation with turbine-driven house unit, parallel operation of two-shaft generators.

SHORT CIRCUITS. Short Circuits of Alternating-Current Generators, C. M. Laffoon. Am. Inst. Elec. Engrs.—Jl., vol. 43, no. 8, Aug. 1924, pp. 736-743, 17 figs. Presents physical conception and simple non-mathematical analysis of short-circuit phenomena of alternating-current generators. Formulas are developed for maximum instantaneous values of armature and field short-circuit currents delivered by both single and polyphase generators.

ELECTRIC GENERATORS, D.C.

LOW VOLTAGE. Stability of Direct-Current Generators, C. Fynn. Elec. Jl., vol. 21, no. 7, July 1924, pp. 304-308, 6 figs. Discusses d.c. generators separately excited and self-excited gives no-load and full load saturation curves, d.c. generators used as exciters for a.c. generators.

ELECTRIC LOCOMOTIVES

DEVELOPMENT. The Development of the Electric Locomotive, F. H. Shepard. Ry. Elec. Engr., vol. 15, no. 7, July 1924, pp. 225-236, 1 fig. World-wide summary of present-day practice as regards heavy electric traction.

ELECTRIC MACHINERY

IRON LOSSES. Surface Iron Losses with Reference to Laminated Materials, T. Spooner and I. F. Kinnard. Am. Inst. Elec. Engrs.—Jl., vol. 43, no. 8, Aug. 1924, pp. 723, 729, 7 figs. Details of tests with experimental salient pole machine and experimental three-phase induction motor, showing that approximately surface losses of air-gap induction, as 1.5 power of tooth frequency, from second to first power of 2 with increase of 2, and as first power of slot pitch.

VIBRATION ABSORBERS. Vibration Absorbers for Large Single-Phase Machines, C. R. Soderberg. Elec. Jl., vol. 21, no. 8, Aug. 1924, pp. 383-387, 8 figs. Discusses elimination of excessive vibrations or of condition of resonance by means of spring-mounted stators, elastic properties of foundations, etc.

ELECTRIC MOTORS

SYNCHRONOUS INDUCTION. The Synchronous Induction Motor, H. Cotton. World Power, vol. 2, nos. 6, and 7, June and July 1924, pp. 329-337 and 45-50, 14 figs. General theory and operation of synchronous induction motors, conditions of slip, equation of slip motion and its solution for special cases.

ELECTRIC MOTORS, A.C.

INDUCTION. Change-Speed Induction Motors, C. W. Kincaid. Elec. Jl., vol. 21, no. 8, Aug. 1924, pp. 357-363, 20 figs. Discusses modifications to obtain speed changes, separate stator windings for each speed desired; three-phase, series-star low speed, parallel-star high speed combinations.

Induction Motors on Unbalanced Circuits, A. M. Dudley. Elec., Jl., vol. 21, no. 7, July 1924, pp. 339-343, 3 figs. Discusses Vector methods of analysis of unsymmetrical systems.

A New Self-Excited Synchronous Induction Motor, V. A. Fynn. Am. Inst. Elec. Engrs.—Jl., vol. 43, no. 8, Aug. 1924, pp. 744-748, 7 figs. Comparison of synchronous and asynchronous motors, combination of advantages of both in Danielson synchronous induction motor, self-excited, synchronous induction motor, and gives details of new type of synchronous induction motor giving satisfactory solution of difficulties.

INDUCTION, SPEED REGULATION. The Speed Regulation of Induction Motors by Three-Phase Commutator Motors Connected in Cascade, W. Seiz. Brown Boveri Rev., vol. 11, no. 7, July 1924, pp. 139-142, 3 figs. Details of Brown Boveri-Scherbius and rotating-field cascade systems for speed regulation of induction motors.

SYNCHRONOUS. The Control of Synchronous Motors, H. D. James and J. H. Graybill. Elec. Jl., vol. 21, no. 7, July 1924, pp. 335-339, 4 figs. Discusses field frequency method and time element method of control and both combined.

ELECTRIC MOTORS, D.C.

RECONNECTING. Reconnecting Direct-Current Machines. Change in Speed, A. C. Roe. Power, vol. 60, no. 6, Aug. 5, 1924, pp. 212-215, 5 figs. Three problems worked out showing how to figure winding for change in speed of shunt, compound and series motor.

SPEED REGULATOR. Speed Regulator for Single Motor Drive, J.-H. Ashbaugh. Elec. Jl., vol. 21, no. 8, Aug. 1924, pp. 390-393, 7 figs. Details of speed regulator insuring accuracy and ease of operation which can be used on installations where armature voltage control is impossible and speed regulation must be obtained solely by motor field control.

ELECTRIC TRANSMISSION LINES

CONSTRUCTION IN ROUGH COUNTRY. Line Construction in Rough Country, J. D. Roberts. Elec. Light & Power, vol. 2, no. 7, July 1924, pp. 15-16, 41-45 and 69, 31 figs. Describes type of towers, tower foundations, erection of towers, stringing of conductors and right of way.

DIRECT-CURRENT. High Voltage Electricity Transmission, J. S. and W. E. Highfield. Engineer, vol. 136, no. 3576, July 11, 1924, p. 54, 4 figs. Advqntages of direct-current transmission from point of view of lines and cables. Abstract of paper read at World Power Conference.

LIGHTNING. Lightning and Other Transients on Transmission Lines, F. W. Peek, Jr. Am. Inst. Elec. Engrs.,—Jl., vol. 43, no. 8, Aug. 1924, pp. 697-709, 13 figs. Coordinates researches and observations on lightning with view of determining various types and order of magnitude of predatory voltages to which transmission lines are subject.

OVERHEAD. Comparative Costs of Tower Line, H. S. Brubaker. Elec. Light & Power, vol. 2, no. 8, Aug. 1924, pp. 19-21, 41-46 and 58, 28 figs. Details of construction by three different methods: piece by piece method; towers built prone and later up-end them into place; replacing concrete anchor by grillage type anchor; and their application in construction of Penn Power Co.

WOODEN POLES FOR LONG SPANS. Wooden Pole Towers for Long-Span Construction, K. B. Ayers. Elec. Wld., vol. 83, no. 3, July 19, 1924, pp. 114-115, 3 figs. Details of installation of two spans more than 3,000 ft. long. How installation was made. Steel wires used.

ELECTRIC WELDING, ARC

SAFETY PRECAUTIONS. Using the Arc with Safety, D. H. Devoe. Welding Engr., vol. 9, no. 7, July 1924, pp. 28-29. Methods of protecting eyes and bodies of electric arc welding operators; safeguarding apparatus.

SYSTEMS. Electrical System of Welding, C. N. O. Dutton. So. African Inst. Elec. Engrs.—Trans., vol. 15, part 4, Apr. 1924, pp. 364-374, 18 figs. Gives short description illustrating their advantages for metals to be welded or treated by Bernados system, metallic arc system, spot and butt welding and metallic tipping on depositing by electric arc.

EMPLOYEES, TRAINING OF

FOREMEN. A Successful Experiment in Industrial Education, D. J. Roach. Chem. & Met. Eng., vol. 31, no. 7, Aug. 18, 1924, pp. 272-273. How one large company is training its foremen and operating bosses in economics, mathematics, and technology of its industry.

ENGINEERING

HUMAN FACTOR IN. The Human Factor in Engineering, S. C. Godfrey. Military Engr., vol. 16, no. 87, May-June 1924, pp. 180-183, 1 fig. Discusses "human engineering" or treatment of human tools with as much consideration as materials; including workers' councils, etc.

EVAPORATORS

CHEMICAL PLANTS. Heating an Evaporator with the Exhaust from Condensing Engines, F. H. Nickle. Chem. & Met. Eng., vol. 31, no. 6, Aug. 11, 1924, pp. 226-228, 3 figs. Device designed to act as condenser for multi-expansion engines and evaporator for chemical plant service at same time.

STEAM-JACKETED, HEAT TRANSFER IN. Heat Transfer in Steam-Jacketed Evaporators, H. L. Olin, M. H. Dowell and C. M. Tovnbee. Chem. & Met. Eng., vol. 31, no. 3, July 21, 1924, pp. 116-119, 3 figs. Determining overall transmission and film coefficients as well as operating efficiencies on plant equipment over a wide range of industrial conditions. Paper read before Am. Inst. Chem. Engrs.

EXHAUST STEAM

COST CALCULATION. How Shall We Calculate the Cost of Exhaust Steam? T. Fuwa. Chem. & Met. Eng., vol. 31, no. 4, July 28, 1924, p. 150. Comparison of four possible bases of evaluating exhaust steam and a discussion of advantages of each.

F

FANS

INSTALLATION. Auxiliary Equipment for Blast and Ventilating Fans, D. L. Hubbard. Mech. Wld., vol. 76, no. 1961, Aug. 1, 1924, pp. 70-72, 6 figs. Discusses proper foundations and supports, absorption of vibrations, preferably by means of cork slab; fan and motor noises; fan drives by steam engine and turbine; push-button control.

MINE. Principles of the Design of Mine Fans. Colliery Engr., vol. 1, nos. 4 and 5, June and July 1924, pp. 163-166 and 231-233, 11 figs. Study of fans suited to British colliery conditions. Principal features and functions of exhaustive ventilator, the typical kind of ventilator employed in British mines.

FEEDWATER HEATERS

LOCOMOTIVE. Analysis of Feed Water Heating Devices, E. P. Gangewere. Ry. Mech. Engr., vol. 98, no. 7, July 1924, p. 409. Feedwater heaters with pumps take more heat from exhaust than exhaust-steam injector type.

FIRE PROTECTION

SPRINKLERS. How the Fire Chief Regards Automatic Sprinklers, I. G. Hoagland. Fire & Water Eng., vol. 76, no. 6, Aug. 6, 1924, pp. 253-254 and 278-279. Replies to questionnaire asking for facts as to use chiefs make of this device; opinion as to its usefulness.

FLOORS

LOADS. Strain of Swaying Crowds on Balcony Measured at Iowa. Eng. News-Rec., vol. 93, no. 6, Aug. 7, 1924, p. 231. Stress measurements in floor show effect more than doubled by jumping of excited, cheering students.

FLOW OF STEAM

RESISTANCE OF PIPE BENDS TO. How to Figure the Resistance of Pipe Bends to the Flow of Steam, C. H. Day. Heat & Vent. Mag., vol. 21, no. 7, July 1924, pp. 51-52, 3 figs. Data on four assumed conditions, using standard ells, long-radius ells, minimum radius bends and bends with radius of ten pipe diameters.

FLUE-GAS ANALYSIS

SCIENTIFIC METHODS. Scientific Flue Gas Analysis, D. Brownlie. Eng. & Boiler House Rev., vol. 38, no. 1, July 1924, pp. 3-5, 2 figs. Gives essential facts regarding true scientific methods necessary for flue-gas analysis.

FORGING

SAFETY CODE. Tentative Safety Code of Forging. Forging—Stamping—Heat Treating, vol. 10, no. 8, Aug. 1924, pp. 282-285. Tentative draft formulated under joint sponsorship of Nat. Safety Council and Am. Drop Forging Inst. Reprinted from Nat. Safety News, June 1924.

FOUNDRIES

ECONOMY IN. Economy in Foundry Practice, E. H. Browne. Foundry Trade. Jl., vol. 30, no. 412, July 10, 1924, pp. 38-40. Discusses monotony in foundry practice, case of patternmaker, management, layout of foundry, equipment, care of plant, provision of molding tools, design, patterns, molding and melting.

POWER-GAS CONSUMPTION MEASUREMENT. The Measurement of Power Gas, F. J. Taylor. Foundry Trade Jl., vol. 29, no. 390, Feb. 7, 1924, pp. 105-109, 9 figs. Measurement of amount of gas used for motive power in foundries. Discusses determination of volume passing through gas main by: (1) Estimation in case of engines, (2) pitot tubes, (3) orifices, (4) venturi tubes, and (5) electroflow meter.

FREQUENCY CHANGERS

SET. A 35,000 KW Synchronous Frequency Changer Set, M. W. Smith. Elec. Jl., vol. 21, no. 7, July 1924, pp. 343-346, 4 figs. Describes set of Brooklyn Edison Co. consisting of 35,000 k.w. 11,400 volt, 3-phase, 25-cycle synchronous generator and 47,500 h.p., 3-phase, 60-cycle, 13,800 volt synchronous motor. See Also Am. Inst. Elec. Engrs.—Jl., vol. 43, no. 8, Aug. 1924, p. 709, 1 fig.

FUELS

See Oil Fuel; Peat; Pulverized Coal.

FURNACES

HEAT TRANSFER CAUSED BY RADIATION OF GASES. Heat Transfer in Furnaces as Caused by Radiation of Gases. Fuels & Furnaces, vol. 2, no. 7, July 1924, pp. 675-678, 2 figs. Equations presented which more or less upset modern theory of heat transfer and reestablish truth of older theories.

RECUPERATOR. The Chapman-Stein Recuperator. W. C. Buell, Jr. Iron & Steel Engr., vol. 1, no. 6, June 1924, pp. 327-332 and (discussion) 333-339, 12 figs. Describes number of installations in use of this type, which is said to have best succeeded in eliminating two main troubles, leakage and breakage.

G

GALVANIZING

WIRE. Galvanizing (Étude sur la Galvanisation), A. Knepper. Usine, vol. 33, no. 24, June 14, 1924, pp. 19-23, 2 figs. Discusses thickness of zinc coat for hot galvanizing and exposure to weather; hot galvanizing and interior use; electro lytic galvanizing and exposure to weather; and electrolytic galvanizing for interior use; Develops formulas for calculation.

GAS ENGINES

STEEL WORKS. The Gas Engine in the Steel Industry, A. C. Danks. Mech. Eng., vol. 46, no. 8, Aug. 1924, pp. 450-460 and (discussion) 460-462 and 501, 22 figs. First 4-cycle installation; methods of governing; effect of entering temperatures of gas and air; piston troubles and design; operating costs; engine tests, etc.

GAS

INDUSTRIAL. New Methods of Producing Gas for Industrial Operations, R. Maclaurin. Ceramic Soc.—Trans., vol. 23, part 2, 1923-1924, pp. 121-144, 5 figs. Discusses chemical reactions in making gas; (1) heating bituminous coal to above 400 deg. C. in absence of oxygen; (2) reaction of air with heated carbon, Siemens producer gas; (3) steam contacting with highly heated carbon, water gas reaction, and their combinations.

GAS MANUFACTURE

HORIZONTAL RETORTS. Description of a New Horizontal Setting. Gas Jl., vol. 167, no. 3191, July 9, 1924, pp. 257-258, 1 fig. Describes plant of Robert Dempster & Son, Ltd., Elland, England; features make it unusually flexible and capable of meeting future contingencies in event of more widespread use of smokeless fuel.

GAS PRODUCERS

LARGE-SCALE POWER GENERATION, APPLICATION TO. The Gas Producer as Applied to Large-Scale Power Generation, A. H. Lymn. Iron & Coal Trades Rev., vol. 109, no. 2941, July 11, 1924, pp. 58-59. Describes various methods of applying gas-producer plants to generation of power on large scale and shows economies of different systems as compared with each other and with most modern direct-fired steam practice. Abstract of paper read before World Power Conference.

PRESSURE. Control of Pressure Gas Producers, W. P. Chandler, Jr. Iron & Steel Engr., vol. 1, no. 6, June 1924, pp. 289-293 and (discussion) 293-299, 4 figs. For metallurgical furnaces in steel mills; discusses main factors influencing producer operation and means for obtaining greatest return for given sizes of gas producer and from coal charged.

GEARS

FRICTION. Fieux System of Friction Gearing and Its Application to Railway Motor Cars as Automatic Gearing [Le conjoncteur-disjoncteur à friction (Système Fieux), son application aux véhicules automoteurs comme embrayage automatique], J. Fieux. Société d'Encouragement pour l'Industrie Nationale—Bul., vol. 136, no. 3, Mar. 1924, pp. 279-287, 8 fig. Properties and action of Fieux make-and-break friction gear, and examples of application to railway motor cars.

Transmission by Means of Friction Wheels (Les transmissions par galets de friction). Génie Civil, vol. 84, no. 23, June 7, 1924, pp. 549-551, 6 figs. Use of friction wheels and disks; transmission efficiency; coefficient of friction; etc.

GOLD

PRODUCTION, CANADA. Canada as a Gold Producer, L. D. Huntoon. Min. & Metallurgy, vol. 5, no. 211, July 1924, pp. 315-322, 8 figs. World's gold production. Analysis of Canada's gold production. Railroad building keeping up with prospectors.

GRINDING

MACHINE-TOOL PARTS. Grinding Operations Expedite Manufacture of Machine Tools, W. E. Groene. Abrasive Industry, vol. 5, no. 8, Aug. 1924, pp. 189-192, 6 figs. Describes grinding operations carried on at plant of R. K. LeBlond Machine Tool Co., Cincinnati.

GRINDING MACHINES

INTERNAL AND EXTERNAL. Internal and External Grinding Machines. Machy. (Lond.), vol. 24, no. 617, July 24, 1924, pp. 521-526, 8 figs. Designed by Holroyd & Co., Ltd., Milnrow, for grinding large steel tubes.

GYROSCOPES

THEORY. Some Properties of Spherical Curves, with Applications to the Gyroscope, O. D. Kellogg. Am. Mathematical Soc.—Trans., vol. 25, no. 4, Oct. 1923, pp. 501-524, 2 figs. Discusses certain intrinsic properties of spherical curves and applies results to theory of gyroscope; gives further results and formulas in connection with gyroscope problems.

H

HARDNESS

ALUMINUM BRONZE, HEAT-TREATED. Notes on the Hardness of Heat-Treated Aluminum Bronze, G. F. Comstock. Am. Inst. Min. & Met. Engrs.—Trans., Advance paper No. 1357-N, July 1924, 9 pp., 4 figs. Results of scleroscope and Brinell tests on specimens of cast 10 per cent aluminum bronze, quenched and reheated at various low temperatures.

GRAY IRON, BRINELL TEST. The Value of the Brinell Hardness Test to the Gray-Iron Foundry, I. Jaederstroem. Testing, vol. 1, no. 4, Apr. 1924, pp. 286-289, 2 figs. Results of researches. Main reason for great popularity of Brinell test in investigation of steel is fact that it not only indicates resistance of material to penetration of another, harder body, but that hardness values thus obtained permit also definite conclusions on tensile strength of steel under investigation.

HEATING

BUILDINGS. The Calculation of Thermal Requirements in Buildings by Means of a Graphic Chart, J. N. Victor. Am. Architect, vol. 126, no. 2450, July 16, 1924, pp. 69-71. Chart is adapted to designing of steam, vapor, vacuum and hot-water systems which employ direct, indirect or coil radiation and for all temperature differences.

HIGHWAYS

SPECIFICATIONS. Preparation of Highway Specifications, A. S. Macmillan. Can. Engr., vol. 47, no. 3, July 15, 1924, pp. 152-154. Discusses features from contractors viewpoint contained in paper presented at annual convention of Can. Good Roads Assn.; respecting contractor's interests; position of engineer.

HYDRAULIC PRESSES

RAM SPEED. Ram Speed of Hydraulic Presses, H. S. Cattermole. Mech. Wld., vol. 76, no. 1959, July 18, 1924, p. 37. Discusses required ram speed for given operation, shows relation between press and pump and press and accumulator, and makes calculations.

HYDRAULIC TURBINES

ACCEPTANCE TEST. Proposal for Uniform Rules for Testing Water-Power Plants, G. Sundby. Engineering, vol. 118, no. 3056, July 25, 1924, pp. 145-147. Discusses diversity in specifications and guarantee tests, and various factors to be considered in formulation of standard tests. Abstract of paper read before World Power Conference.

PELTON WHEELS. Pelton Wheels Working at Variable Heads (Au sujet des turbines Pelton travaillant sous une hauteur de chute variable), M. deSparre. Académie des Sciences—Comptes rendus des Séances, vol. 178, no. 24, June 10, 1924, pp. 1942-1948. Mathematical determination of head H_0 serving as basis for calculation, so as to make variation of efficiency minimum when head varies between minimum H_1 and maximum H_2.

REACTION. The Hydraulic Reaction Turbine, H. B. Taylor. Engineering, vol. 118, no. 3054, July 11, 1924, pp. 71-73. Discusses recent improvements including, (1) incorporation of turbine as integral part in power-house construction, (2) division of casing into number of radial sections separated by planes containing turbine axis, (3) adoption of propeller-type turbine of extremely high specific speed, (4) transformation of draft tube, etc. Abstract of paper read before World Power Conference.

HYDRO-ELECTRIC DEVELOPMENTS

FRANCE. Putting Through a Great Hydro-Electric Project in France. Compressed Air Mag., vol. 29, no. 7, July 1924, pp. 919-922, 13 figs. Details of work in Ossau Valley, Pyrenees, for supplying power for electrification of Midi Ry., including reservoir and tunnel work, power-house construction, and equipment.

NEWFOUNDLAND. Hydro-Electric Power Development in Newfoundland. Engineering, vol. 118, no. 3056, July 25, 1924, pp. 125-127, 15 figs. partly on supp. plates. Particulars of hydro-electric scheme being carried out in Humber River district of Newfoundland, where continuous output of 100,000 h.hp. will be utilized in paper mills of Newfoundland Power & Paper Co., Ltd., and for lighting and heating new township of Corner Brook. Work is being carried out by W. G. Armstrong, Whitworth & Co., Ltd., Lond., who are also manufacturing turbines which will be installed at the site.

HYDRO-ELECTRIC PLANTS

ALABAMA. Hydroelectric Practises and Equipment of the South, O. G. Thurlow and J. A. Sirnit. Am. Inst. Elec. Engrs.—Jl., vol. 43, no. 8, Aug. 1924, pp. 719-723, 8 figs. Discusses hydraulic power resources of South, design of Alabama Power Co.'s plants, Southern superpower system and advantages of linking up systems.

CANADA. Building Canada's Hydro-Electric Power Units, H. P. Armson. Can. Machy., vol. 32, no. 31, July 31, 1924, pp. 19-22, 5 figs. Outline of water-power development in Dominion, with details of construction features of plant on Isle Maligne and shop methods used in building some units at Canadian Allis-Chalmers Co.'s, Davenport plant in Toronto.

ICE TROUBLES. Ice Troubles in Norwegian Water-Power Plants, A. Ruths. Engineering, vol. 118, no. 3054, July 11, 1924, pp. 73-74. Details of power-house troubles due to frazil ice and drift ice and their elimination. Abstract of paper read before World Power Conference.

I

ICE PLANTS

FREEZING TANKS. Ice Freezing Tank Design, C. Wilkie. Ice & Refrigeration, vol. 67, no. 1, July 1924, pp. 50-55, 13 figs. Points out ways whereby installation of freezing tanks can be safeguarded against errors; influence of harvesting equipment. Paper read before meeting of Chicago subordinate N. A. P. R. E. and Chicago Sec. A. S. R. E.

OIL-ENGINE-DRIVEN. Economy from Oil Engine Power at the Coal Pit's Mouth. Oil Engine Power, vol. 2, no. 7, July 1924, pp. 363-365, 5 figs. Operating at mouth of coal mine and driving Marion County Coal Co.'s, Centralia, Ill., own machinery, three oil engines have been able to produce substantial savings over and above cost of coal-generated power in production of ice and refrigeration

IMPACT TESTING

ROUNDED BARS. Experiments on the Duration of Impacts, Mainly of Bars with Rounded Ends, in Elucidation of the Elastic Theory, J. E. P. Wagstaff. Lond., Edinburgh & Dublin Philosophical Mag. & Jl. of Sci., vol. 48, no. 283, July 1924, pp. 147-158, 2 figs. Discusses duration of collision of two perfectly elastic bars and its form of mathematical relation.

INDUSTRIAL MANAGEMENT

BONUS SYSTEMS. *See Bonus Systems.*

BUDGETING. Elements of Budget Control, D. J. Hutchinson. Pit & Quarry, vol. 8, no. 10, July 1924, pp. 75-78. Procedure in establishing budget system.

RATE SETTING. Rate Fixing in Engineering Works. Machy. (Lond.), vol. 24, no. 617, July 24, 1924, pp. 516-518, 2 figs. Payment by results and rate-fixing methods; share of production responsibilities by management and labor.

INDUSTRIAL RELATIONS

LABOUR MANAGEMENT. What We Think of Industrial Democracy After 7 Years, W. P. Hapgood. Factory, vol. 33, no. 2, Aug. 1924, pp. 187-189 and 286-290, 2 figs. Experiences of factory council in working its way up through usual worries about wages and hours of work into constructive effort toward bringing business to higher level of efficiency.

INLAND WATERWAYS

RAILWAYS. Waterway and Railway Equivalents, W. M. Black. Am. Soc. Civil Engrs.—Proc., vol. 50, no. 6, Aug. 1924, pp. 837-851. Discusses considerations that should guide establishment of new waterway lines of transportation, replacing destructive competition by co-operation.

INSULATORS, ELECTRIC

SUSPENSION. The Development of a Suspension-Type Insulator, H. B. Smith. Am. Inst. Elec. Engrs.—Jl., vol. 43, no. 8, Aug. 1924, pp. 689-696, 27 figs. Outlines conditions under which suspension-type insulator has been developed experimentally for long distance transmission conditions of 110,000- and 220,000-volt power lines.

INTERNAL-COMBUSTION ENGINES

AIR SUPPLY. A Note on the Air Supply for Large Motor Ships, P. T. Brown. Inst. Mar. Engrs.—Trans., vol. 36, July 1924, pp. 101-140, 11 figs. Discusses air requirements of Diesel machinery for injecting and pulverizing fuel, and for maneuvring engines and other purposes; Lloyd's rules; air compressors and their size.

IRON ALLOYS

CHROMIUM-IRON. Some Engineering Applications of High-Chromium-Iron Alloys, C. E. MacQuigg. Am. Soc. for Testing Matls., Preprint of paper presented at meeting June 24-27, 1924, No. 19j, 10 pp., 6 figs. Uses and limitations of an alloy with about 25 to 30 per cent of chromium and fractions of one per cent of silicon and manganese, remainder largely iron; carbon varies from about 0.1 to 3 per cent, depending on properties desired.

IRON-CARBON. A Laboratory Method for the Preparation of Small Steel Bars Differing Only in Carbon Content and the Effect of Changes in Carbide Concentration on the Specific Resistance, E. D. Campbell and G. W. Whitney. Am. Soc. for Steel Treating—Trans., vol. 6, no. 1, July 1924, pp. 33-50. Results of laboratory tests by means of which small steel bars varying only in carbon content may be prepared; also specific resistance measurements on these bars when annealed and when hardened by quenching in oil or in water.

IRON CASTINGS

CLEANING. Cleaning Iron Castings Hydraulically. Mech. Wld., vol. 75, no. 1955, June 20, 1924, pp. 389-390. Describes new method of cleaning castings, successfully experimented with at Erie, Pa., foundry of Gen. Elec. Co.; results in considerable saving of labor and time and eliminates dust. Abstract of paper read by C. B. Lockhart before Pittsburgh Foundrymen's Assn.

IRON AND STEEL

CORROSION. The Submerged Corrosion of Iron, W. G. Whitman and R. P. Russell. Chem. & Industry, vol. 43, nos. 26 and 27, June 27, July 4, 1924, pp. 193T-196T and 197T-199T, 4 figs. Discusses corrosion under natural water and solutions of alkali and non-oxidizing acids and its explanation along electro-chemical lines.

EFFECT OF TEMPERATURE ON. Effect of Temperature on Metals. Power Plant Eng., vol. 28, no. 15, Aug. 1, 1924, pp. 801-803, 3 figs. Review of data on irons and steels. Presented before joint meeting of A.S.M.E. end A.S.T.M.

IRRIGATION

U.S.A. The Movement of Water in Irrigated Soils, C. S. Schofield. Agricultural Research—Jl., vol. 27, no. 9, Mar. 1, 1924, pp. 617-696, 16 figs. Discusses certain aspects of alkali problem in relation to irrigation farming which as a whole relates to soluble salts in soil solution.

L

LABOUR

HOURS OF WORK. Effect of Changes in Hours of Work on Output. Monthly Labour Rev., vol. 19, no. 1, July 1924, pp. 120-124. Discusses 8-hr. day entirely from economic standpoint and analyzes existing data on relation between hours of work and production, showing complexity of problem.

LABORATORIES

NATIONAL PHYSICAL LABORATORY, ENGLAND. The National Physical Laboratory. Engineering, vol. 117, no. 3052, and vol. 118, nos. 3053 and 3055, June 27, July 4 and 18, 1924, pp. 823-824, 5-6 and 100-101, 1 fig. Review of work done by the Laboratory during 1923, including work of engineering and aerodynamics departments, work on metallurgy, physics, electrical standards and measurements, wireless, electrotechnics, cables, and photometry.

LATHES

INSPECTION OF PARTS. The Inspection System in a Lathe Building Plant, H. S. Riggs. Machy. (Lond.), vol. 24, no. 616, July 17, 1924, pp. 481-486, 12 figs. Checking accuracy of lathe parts, assembled units and completed machines of Lodge & Shipley Machine Tool Co.

LIGHTING

STREET. Recent Advance in Street Lighting Methods, S. B. Hood. Elec. Light & Power, vol. 2, no. 8, Aug. 1924, pp. 13-15 and 58, 5 figs. Details of application at Minneapolis of low-voltage multiple supply in preference to more commonly used high-voltage series systems.

LIME

HYDRATED. Hydrated Lime in Concrete. Contract Rec. & Eng. Rev., vol. 38, no. 30, July 23, 1924, pp. 743-745, 1 fig. Experimental investigations confirm practical experience that lime in mix facilitates handling and placing of concrete.

LIMESTONE

BUILDING REQUIREMENTS. Building Stone Requirements. Stone, vol. 45, no. 6, June 1924, pp. 349-351, 2 figs. Report of Committee on Building Requirements for Indiana Limestone includes code sections covering all classes of building stone customarily used, thus constituting recommended code of practical value.

LIQUIDS

EVAPORATION. The Rate of Evaporation of Liquids in a Current of Air, T. B. Hine. Physical Rev., vol. 24, no. 1, July 1924, pp. 79-91, 1 fig. Results of experiments show that rate of evaporation is linear function of wind velocity.

HEAT OF EVAPORATION. Apparatus for the Determination of the Heat of Evaporation of Liquids of High Boiling Points, J. H. Awbery and E. Griffiths. Physical Soc. of Lond.—Proc., vol. 36, part 4, June 15, 1924, pp. 303-312, 2 figs. Discusses two new forms of apparatus and their relative merits; tested by determining with them heats of evaporation of alcohol, water, and aniline.

LOCOMOTIVE BOILERS

FIREBOXES. Four-Sheet Fireboxes for Mallet Locomotives. Ry. Rev., vol. 75, no. 5, Aug. 2, 1924, pp. 161-165, 9 figs. Describes firebox construction on Norfolk & Western Ry.; Seven-sheet firebox construction reduced to four by use of unusually large boiler plates.

REPAIRING. Side Lights on Boiler Work at Glenwood Shops. Boiler Maker, vol. 24, no. 7, July 1924, pp. 191-194, 10 figs. Special shop made equipment aids in repairing many different classes of locomotives coming to Glenwood shops, Baltimore & Ohio Ry.

LOCOMOTIVES

DEVELOPMENT. The Steam Locomotive; Engineering and Business Considerations, W. H. Winterrowd. Can. Ry. & Mar. Wld., no. 317, July 1924, pp. 322-325, 3 figs. Discusses development steam locomotive has undergone during past 20 years and lines along which future development may be expected.

ELECTRIC. *See Electric Locomotives.*

LONG RUNS. Extension of Locomotive Runs, F. E. Russel. Ry. Mech. Engr., vol. 98, no. 8, Aug. 1924, pp. 464-467. Discusses advantages of long runs and mechanical difficulties encountered. Abstract of paper read before Pac. Ry. Club.

OIL-ELECTRIC. Oil-Electric Locomotive Comes to New York. Compressed Air Mag., vol. 29, no. 7, July 1924, pp. 923-925, 6 figs. Details of new locomotive with 200-kw. generator directly connected to 300-hp. oil engine for switching service of N. Y. Central; uses low-cost fuel oil.

POWER AND EFFICIENCY IMPROVEMENTS. Power and Efficiency Improvements in Steam Locomotives, G. M. Basford. Engrs. & Eng., vol. 41, nos. 3 and 6, Mar. and June 1924, pp. 61-64 and (discussion) 64-69 and 159-162, 4 figs. Paper read at Conference on Economy in the Use of Fuel, held at Engrs. Club of Phila., Jan. 15, 1924.

STEAM AND ELECTRIC, COMPARISON OF. Steam and Electric Locomotives Compared. Ry. Gaz., vol. 41, no. 3, July 18, 1924, p. 90. Electric-locomotive traction enables large horsepower to be obtained from locomotives of reasonable length and with low axle loads.

TANK Four-Cylinder "Baltic" Tank Engine—London Midland & Scottish Railway. Ry. Gaz., vol. 41, no. 3, July 18, 1924, pp. 82-83, 3 figs. 4-6-4 type four-cylinder tank engine built at Horwich works of London Midland & Scottish Ry. for use in dealing with heavy suburban traffic over severely graded lines, also for hauling express residential trains within radius of about 50 miles.

VALVE GEARS. Development of the Lentz Poppet Valve Gear, A. Niklitchek. Ry. Mech. Engr., vol. 98, no. 7, July 1924, pp. 407-409, 4 figs. Discusses reduction of valve-gear maintenance costs and lubricant and water consumption on Austrian locomotives.

LUBRICATING OILS

CYLINDER. Oils for Valve and Cylinder Lubrication, A. J. Dixon. So. Engr., vol. 41, no. 5, July 1924, pp. 60-61. Why some cylinders take polish and others do not. Selection of cylinder oils.

PURIFICATION. Purification of Marine Turbine and Diesel Engine Lubricating Oils. Am. Mar. Engr., vol. 19, no. 7, July 1924, pp. 11-13, 4 figs. In marine turbines and Diesel engines it is almost universal practice to reuse lubricating oil by means of circulation system; discusses batch and continuous system of purification.

STORAGE AND HANDLING. Oil Storage and Handling Practice. Elec. Ry. Jl., vol. 64, no. 3, July 19, 1924, pp. 77-79, 6 figs. Information obtained from 57 electric railways shows that careful storage of lubricants eliminates waste, prevents contamination, minimizes fire hazard, and facilitates keeping of records; increased use of buses by railways makes necessary storage of gasoline in quantity.

TURBINES. Characteristics of Efficient Turbine Oil, A. F. Brewer. Elec. Light & Power, vol. 2, no. 8, Aug. 1924, pp. 16-18 and 38, 2 figs. Discusses properties of oil, including viscosity, cooling, ability, tendency to evaporate, fluid friction developed, demulsibility, water content, tendency to decompose, foaming and content, carbon content, sulphur and acids.

LUBRICATION

THEORY OF. Some Notes on the Theory of Lubrication with Particular Application to the Michell Thrust and Journal Bearings, J. Ward. Inst. Mar. Engrs.—Trans., vol. 36, July 1924, pp. 141-185, 24 figs. Discusses dry, rolling, greasy and viscous friction; perfect lubrication; Michell viscometer; lubrication of parallel surfaces, inclined surfaces; flow of oil; pressure distribution; bearings, etc.

M

MACHINE SHOPS

FIRE-DEPARTMENT. Efficiency in the Fire Department Machine Shop, J. C. Moran. Fire & Water Eng., vol. 76, no. 3, July 16, 1924, pp. 107-108, 112, 135-136, 7 figs. Methods which make Hartford shop model; personnel and equipment; importance of good location for building. Abstract of paper read before New England Assn. Fire Chiefs.

REPAIRS HANDLING. A Simple and Economical Method of Handling Repairs, F. H. Colvin. Am. Mach., vol. 61, no. 5, July 31, 1924, pp. 189-190, 3 figs. Plan, worked out by Gould & Eberhardt, Newark, N.J., which cuts out much of the paper work and overhead expense in repair work.

MACHINE TOOLS

UNIVERSAL METAL-CUTTING MACHINE. A Combination Type of Metal-Cutting Machine. Machy. (Lond.), vol. 24, no. 617, July 24, 1924, pp. 513-515, 7 figs. Universal machine especially adapted for reproducing various designs from enlarged patterns or drawings, either by punching, profiling, routing, milling or engraving.

MACHINERY

ALTITUDE, INFLUENCE OF. Influence Exerted by Altitude on Apparatus, K. Lubowsky. Elec. Wld., vol. 84, no. 3, July 19, 1924, pp. 109-110. Influence of altitude on calculations connected with all apparatus which generates, distributes or consumes energy. Correction factors for various types of apparatus; influence on heating; outputs and ratings; table for any height.

MACHINING METHODS

ECCENTRICS, TURNING OF. Tools and Fixtures for Turning Eccentrics, F. H. Mayoh. Machy. (N. Y.), vol. 30, no. 12, Aug. 1924, pp. 976-979, 11 figs. Points out methods to be used in machining eccentric parts under different conditions.

MAGNETISM

ANALYSIS. The Elements of Magnetic Analysis, E. H. Crapper. Engineering, vol. 117, nos. 3041, 3045, 3047, 3051 and 3052, Apr. 11, May 9, 23, June 20 27, 1924, pp. 452-454, 601-602, 660-662, 786-788 and 816-817, 21 figs. Points out that no complete system of magnetic analysis has yet been evolved and put into practice; magnetic constants of magnet which require consideration are divided into two groups, according as they refer (1) to nature of material used, and (2) to working qualities or properties of magneto-magents, these constants are obtained directly by experiment, or derived from experimental results obtained.

MATERIALS HANDLING

CONCRETE BUILDING UNITS, MANUFACTURE. Economical Handling of Raw Materials in Building Unit Manufacture. Concrete, vol. 25, no. 1, July 1924, pp. 13-18, 6 figs. Summary of methods in common use in excavating and handling sand and gravel, according to conditions to be met.

MEASUREMENTS

LENGTH. Industrial Length Measurement, Standards of Measurement and Systems of Tolerances (La mesure industrielle des longueurs, Etalons de mesures et systèmes à tolérances), H. Stroh. Génie Civil, vol. 84, nos. 25 and 26, June 21 and 28, 1924, pp. 594-597, 615-617, 12 figs. Discusses length measurement in connection with production of good quantities and of interchangeable parts, establishing standards; mechanical precision and systems of tolerances; discusses symmetrical and asymmetrical tolerances, admissible wear of tolerances; standards for length measurement.

METALLOGRAPHY

LEHIGH UNIVERSITY. Metallography at Lehigh University, H. B. Pulsifer. Forging—Stamping—Heat Treating, vol. 10, no. 7, July 1924, pp. 276-278, 7 figs. Leading engineering colleges are coming to recognize metallography as most important of the aspects commonly assembled under metallurgy.

METALS

DEFORMATION. Torsional Tests of Metals, Elastic and Permanent Deformation (Les essais de torsion des métaux,déformations élastiques et déformations permanentes), J. Seigle and F. Cretin. Génie Civil, vol. 84, nos. 23 and 24, June 7 and 14, 1924, pp. 545-549 and 565-568, 19 figs. Describes apparatus used; studies angles of torsion, torsion curves for elastic and permanent deformation, elastic limit of torsion, etc.

DIFFUSION IN SOLID STATE AND PLASTICITY. The Trend in the Science of Metals, Z. Jeffries. Am. Inst. Min. & Met. Engrs.—Trans., Advance paper No. 1337-N, May 1924, 23 pp., 23 figs. Discusses diffusion in solid state and plasticity of metals.

MACHINING QUALITIES. A Method for Determining the Resistance of Metals to Drilling and Its Application to the Investigation of the Machineability of Metals, A. Kessner. Testing, vol. 1, no. 4, Apr. 1924, pp. 270-285, 11 figs. Describes drilling testing machine; some investigations carried out by means of Kessner machinability testing machine; standard comparison metals for drilling tests.

MELTING. Fluxes and Slags in Metal Melting, Metal Industry (Lond.), vol. 25, no. 5, Aug. 1, 1924, pp. 101-102. Report of chief points in joint discussion of following contributions to recent symposium on slags and fluxes held by Faraday Soc. and Inst. Metals; General Introduction, Oxidizing Fluxes in Milling Non-Ferrous Metals; Slags from Lead, Copper and other Blast Furnaces, Use of Slags in Brass Melting; Slags in Melting Silver Alloys; and Sulphurizing and Desulphurizing by Basic Slags and Fluzes.

NON-METALLIC INCLUSIONS IN. A Note on Non-Metallic Inclusions in Metals, with Special Reference to Aluminium, A. G. Lobley. Foundry Trade Jl., vol. 30, no. 412, July 10, 1924, p. 34. Discusses cryolite present in aluminum, nitrogen, carbon and aluminum; states that electric remelting is not harmful. Abstract of paper read at symposium on Slags and Fluxes, arranged by Faraday Soc., Inst. of Metals, Inst. of British Foundrymen and Non-Ferrous Research Assn.

TESTING. Bending Tests with Rotating Bars (Essais de flexion avec rotation du barreau pour de fortes valeurs de la flèche de flexion), M. Cretin and M. Siegle. Revue de Métallurgie, vol. 21, no. 6, June 1924, pp. 358-367, 24 figs. Discusses principle of fatigue test by rotary bending; bending tests beyond elastic deformation.

The Jannin Method for Testing Metals as to Wear, and Its Application to Testing Antrifriction Metals (Étude de la méthode de M. L. Jannin pour l'essai des métaux à l'usure et de son application à l'essai des métaux antifriction), M. P. Nicolau. Revue de Métallurgie, vol. 21, no. 6, June 1924, pp. 347-355, 1 fig. Shows that by this method resistance to wear of antifriction metals cannot be determined, and that application of this method is limited to rapid determination of friction conditions.

MICROMETERS

CARE OF. Proper Care Essential to Micrometer Accuracy. Can. Machy., vol. 32, no. 4, July 24, 1924, pp. 25-26, 6 figs. Hints on use and care of measuring instruments.

MICROSCOPES

ILLUMINATORS FOR. Vertical Illuminator for Microscopes. Engineering, vol. 118, no. 3053, July 4, 1924, p. 30, 3 figs. Describes vertical illuminator recently introduced by R. & J. Beck, Ltd., London, in which reflector can be moved along two lines at right angles and can also be tilted about both these axes. It is thus possible to adjust position and angle of reflector as required.

METALLURGICAL. The Microscope as an Aid in Metallurgy, F. E. Lee. Can. Inst. Min. & Metallurgy, Bul., no. 147, July 1924, pp. 505-510, 8 figs. Application of microscope in problems arising from various operations of Tadanac Reduction Works.

Ore Problems and the Microscope, W. L. Uglow. Can. Inst. Min. & Metallurgy-Bul., no. 147, July 1924, pp. 495-504. Application of microscope in discovery, development, concentration and reduction of metallic ores; types of microscopes.

MOTOR BUSES

GREAT BRITAIN. Municipal Bus Working in Detail. Motor Transport (Lond.), vol. 39, no. 1012, July 21, 1924, pp. 73-77, 3 figs. How organization and record keeping of Reading omnibuses insure efficiency.

Six-Wheel. Unit Accessibility Features Six-Wheel Bus. Motor Transport (Phila.), vol. 30, no. 8, July 10, 1924, pp. 298-300, 4 figs. Particulars of first motor-bus model of Six-Wheel Co., Phila.; easy riding qualities, durability and easy servicing outstanding features in design; units quickly detached; steel body construction simplifies repair work.

MINES

Development. Reducing the Cost of Prospecting Isolated Mining Properties, F. A. McLean. Can. Inst. Min. & Metallurgy, no. 148, Aug. 1924, pp. 531-538, 2 figs. Discusses development of promising claims, selection of compressed air plant, type of drive, tunneling, drifting, etc.

MOTORS, A.C.

Induction. Winding and Connecting Small Single-Phase Motors, C. A. M. Weber. Elec. Jl., vol. 21, no. 8, Aug. 1924, pp. 377-382, 29 figs. Discusses single-phase a.c. with split phase primaries and squirrel-cage rotors, and with single-phase primaries and wound rotors; methods of winding primaries, slot insulation, etc.

MOTOR-TRUCK TRANSPORTATION

Development. The Position of the Motor Truck in Transportation, T. R. Dahl. Power Wagon, vol. 33, no. 236, July 1924, pp. 15-19, 2 figs. Discusses economics of trucking, savings in marketing, handling local freight, etc. Abstract of paper read before World Motor Transport Congress.

MOTOR TRUCKS

Gas Producers for. Most Recent Application of Transportable Gas Producers (Les dernières applications des gazogènes transportables), C. Mathieu. Industrie des Tramways, Chemins de Fer et Transports Publics Automobiles, vol. 18, no. 210, June 1924, pp. 197-209, 18 figs. Review of latest types of gas producers for traction by road or rail.

Steam. Another Shaft-Driven Steam Waggon. Motor Transport (Lond.), vol. 39, no. 1010, July 7, 1924, pp. 47-49, 6 figs. Details of 6-ton truck combining best features of steam and gasoline practice, made by Mann's Patent Steam Cart and Waggon Co., Ltd.

N

NITROGEN

Fixation. Nitrogen Fixation Processes, L. F. Goodwin. Can. Chem. & Metallurgy, vol. 8, no. 7, July 1924, pp. 158-161. Gives resume of recent progress; discusses synthetic ammonia, Casale and Fauser processes.

O

OIL

Cracking. The Dubbs Process for Cracking Oil. Petroleum Times, vol. 12, no. 287, July 5, 1924, pp. 5-8, 2 figs. Principles of Dubbs process, equipment and operation, commercial results, results with heavy oils and cracking products.

Cut Oil, Electrical Dehydration of. The Electrical Dehydration of Cut Oil, F. D. Mahone. Am. Inst. Min. & Met. Engrs.—Trans., Advance paper No. 1354-P, July 1924, 5 pp. Much crude oil, as produced from well, carried varying amounts of water, which may be present as free water in globules sufficiently large to settle out, in time, if fluid is allowed to stand, or as an emulsion formed by myriads of minute water particles each surrounded and entrapped by a film of oil through which it cannot break under action of gravity alone. Such an emulsified mixture of oil and water is termed "cut oil". Describes apparatus for breaking up emulsion.

Production from Coal. The Director of Fuel Researchon Oil and Coke Production from Coal, C. H. Lander. Gas Wld., vol. 81, no. 2086, July 12, 1924, pp. 8-10 (annual coal supp.). Discusses yield and quality of oil, market for coke, and ammonia yield. Extract of paper read before World Power Conference.

See also Petroleum.

OIL ENGINES

Solid-Injection. Types of Modern Power-Plant Oil Engines. Oil Engine Power, vol. 2, no. 7, July 1924, pp. 386-388, 2 figs. Bessemer Gas Engine Co., Grove City, have joined with Atlas-Imperial Engine Co., Oakland, Cal., in manufacture of airless-injection oil engines by acquiring Eastern manufacturing rights. Gives table showing how oil engine effects savings in comparison with every other type of heat prime mover.

Fuels, Specifications for. Standard Specifications for Oil Engine Fuels. Motorship, vol. 9, no. 7, July 1924, pp. 506-508, 3 figs. Compilation of replies to communication addressed by "Motorship" to representatives of marine and stationary oil-engine industry to users of engines and oil companies on possibility of recommending uniform specifications for oil-engine fuels.

OIL FUEL

Burners. The Fuel Oil Burner from Fire Chief's Standpoint, A. J. Caulfield. Fire & Water Eng., vol. 76, no. 4, July 23, 1924, pp. 157-158 and 180. Discusses hazards of chimney defects; accepted and unaccepted types of burners; some suggestions for better maintenance of burners. Abstract of paper read before New England Assn. Fire Chiefs.

OSCILLOGRAPHS

Cathode-Ray. Wave Form Examination with the Cathode Ray Oscillograph, N. V Kipping. Elec. Communication, vol. 3 no. 1 July 1924, pp. 69-75, 7 figs. Discusses development of Cathode Ray Oscillograph from older vibrating types; production of satisfactory time scale; methods of frequency comparison, etc.

OXY-ACETYLENE WELDING

Manganese Steel. Welding of Manganese Steel, S. W. Miller. Acetylene Jl., vol. 26, no. 2, Aug. 1924, pp. 65-71, 14 figs. Preliminary report of Gas Welding Committee of Am. Bur. Welding. Discusses what happens during welding of manganese steel, how actual operation may be best conducted and what structural results of welding are in both base metal and weld.

Medium High-Carbon Steel. Autogenous Welding. Ry. & Locomotive Eng., vol. 37, no. 7, July 1924, pp. 202-204, 4 figs. Investigation on steel of axles and wheels that fall under classification of medium high-carbon steel; rolled-steel wheels, couplers, low-carbon steel, wrought iron, cast iron, cast-iron wheels non-ferrous metal and torch cutting.

Monel Metal. The Autogenous Welding of Monel Metal by the Oxy-Acetylene Process. Machy. (Lond.), vol. 24, no. 617, July 24, 1924, pp. 528-530, 12 figs. Discusses properties of monel metal, pressure of blow-pipe, oxy-acetylene welding of rods, bars, sheets, plates and castings, and gives examples.

Non-Ferrous Metals. Oxy-acetylene Welding of Non-Ferrous Metals, A. S. Kinsey. Am. Welding Soc.-Jl., vol. 3, no. 6, June 1924, pp. 27-51, 8 figs. Describes oxy-acetylene welding of copper, brass, bronze, aluminum, monel metal, nickel and lead. Bibliography.

Pressure Vessels. An Investigation of Welded Pressure Vessels. Am. Welding Soc., bul. no. 5, June 1924, 152 pp. 120 figs. Report of Pressure Vessel Committee of Am. Bur. of Welding covering recommendations to A.S.M.E. Boiler Code Committee, comments on construction, design, hydrostatic hammer test, welding wire, tests of welded specimens, marking and stamping, etc.

Railway Shops. Report on Autogenous and Electric Welding. Ry. Rev., vol. 75, no. 4, July 26, 1924, pp. 125-133, 23 figs. Gives results of investigations with reference to building up flat spots on steel and steel-tired wheels, building up of worn collars at journal ends of axles, and welding of fractures in couplers; recommendations affecting gas and electric welding limits and regulations of report for 1919. Paper presented before annual convention of Am. Ry. Assn., Div. V. Mechanical.

Torch Uses. Variety of Torch Uses, C. W. Geiger. Welding Engr., vol. 9, no. 7, July 1924, pp. 22-25, 11 figs. Largest industrial firms on Pacific Coast use torch in many different and profitable ways.

OXYGEN

Metallurgical Use. Some Applications of Oxygen to Ferrous Metallurgy, F. W. Davis. Iron & Steel Engr., vol. 1, no. 6, June 1924, pp. 339-346 and (discussion) 346-351, 2 figs. Discusses application of oxygenated air in metallurgic presses, especially iron blast furnaces and ferroalloys, and results to be expected from its use.

P

PAINTS

Red Lead. Some Observations on Red Lead as a Paint Pigment, E. F. Hickson and H. R. Snoke. Paint Manufacturers' Assn. of U. S., Sci. Sec., circular no. 207, July 1924, pp. 47-60, 6 figs. Discusses flow test used in conjunction with brush test for determining painting qualities of red lead. Paper read before Sec. of Paint & Varnish Chemistry at meeting of Am. Chem. Soc.

PAPER INDUSTRY

Water Power. Water Power in Pulp and Paper Industry in Canada. Eng. Wld., vol. 25, no. 2, Aug. 1924, pp. 69-72, 1 fig. Low cost power essential to industry; general conditions in each province; construction activities; future power requirements of industry.

PAPER MANUFACTURE

Liming of Blowpits. What Causes Liming of Blowpits? Paper, vol. 34, no. 14, July 24, 1924, pp. 605-610. Investigation of liming of blowpits in sulphite mills reveals various causes, but cold air is chief factor.

Rag-Cooking Methods. European Rag Cooking Methods, R. Sansone. Paper, vol. 34, no. 13, July 17, 1924, pp. 557-559, 2 figs. Account of various forms and types of boilers used in European paper mills where rags and reeds are cooked for pulp. Translated from Papeterie, pp. 246-253, 1924.

Sizing. Colloid Studies in Rosin, R. Lorenz, Paper Trade Jl., vol. 78, nos. 23, 24, 25 and 26, and vol. 79, no. 1, June 5, 12, 19, 26 and July 3, 1924, pp. 61-66. 47-52, 43-45, 52-54 and 51-55, 13 figs. Colophony and its use; preparation of pure raw material; dispersoid analysis: surface tension and internal friction; chemical equilibrium in sizing beater; flocculation phenomena of rosin sizing; action of aluminum hydrates in sizing and electrostatic sizing theory. Translated from Papier-Fabrikant, 1923.

Vacuum Drying. Drying Paper in a Vacuum, T. J. Keenan. Paper, vol. 34, no. 16, Aug. 7, 1924, pp. 699-701, 2 figs. Describes operation of Minton vacuum paper machine drier at So. Norwalk, Conn. (Norwalk Co.), paper being dried in 28 in. vacuum.

PAPER MILLS

Cutless Bearings for. Cutless Bearings for Paper Mills, C. F. Sherwood. Paper, vol. 34, no. 13, July 17, 1924, pp. 565-567. Application of rubber cutless bearings as substitute for ordinary bearings on wet end of Fourdrinier machine.

Electric Boilers and Digesters. Electric Boilers and Digesters, R. Sansone. Paper, vol. 34, no. 13, July 17, 1924, pp. 561-562, 2 figs. Electrically operated apparatus urged for use in pulp and paper mills for steam generation and direct heating of liquors.

Oil-Fuel Burning. Fuel Oil Burning at Paper Mill, A. Fette. So. Engr., vol. 41, no. 5, July 1924, pp. 35-41, 22 figs. Details of installation of plant of Charles Boldt Paper Mills Co., New Iberia, La., which was designed for burning coal or fuel oil.

PATENTS

Law. Inventors and Patentees, J. R. Langley. Elec. Jl., vol. 21, no. 7, July 1924, pp. 326-330. Discusses U. S. law and patent office practice, covering issue of patents, conception of inventions and reduction to practice, preservation of evidence, interferences, etc.

PATTERNS

Foundry. Rapping and Drawing Patterns, B. Shaw and J. Edgar. Mech. Wld., vol. 76, no. 1960, July 25, 1924, pp. 54-55, 5 figs. Discusses difference for repetition work and for jobbing work, lifting straps and how to fit them.

PAVEMENTS

"Black Base" Construction. "Black Base" Construction in Mercer County, N. J., H. F. Harris. Good Roads, vol. 67, no. 1, July 1924, pp. 12-14, 3 figs. Gives method followed in constructing foundation, and topping "black base" with regular standard sheet asphat pavement 1½ in. thick, Up to present time "black base" work has shown no cracks and is to all intents and purposes in every respect equal to standard practice in constructing sheet asphalt with rigid base.

PAVEMENTS, CONCRETE

Impacts. Impact on Concrete Pavements. Pub. Works, vol. 55, no. 7, July 1924, pp. 221-223, 3 figs. Tests made by Bur. Pub. Roads using specially devised machine, and conclusions drawn from them.

Weighing Aggregates for. Weighing Concrete Aggregates for Highway Pavements, R. W. Crum. Eng. Wld., vol. 25, no. 2, Aug. 1924, pp. 89-91, 6 figs. Iowa Highway Commission has adopted actual weighing of aggregates on road pavement construction; quality in modern highway pavements in highly desirable and any economical method of attaining high degree of quality should be adopted; investment in hard surface pavements should be safeguarded by best methods of construction; materials used should not be abused by careless treatment.

PEAT

Production. The Utilization of Peat for Power Production, G. K. Fletcher. World Power, vol. 2, no. 7, July 1924, pp. 19-22. Discusses difficulties arising from moisture content, cost, and advantages of peat production.

PETROLEUM

Evaporation Loss. Evaporation Loss of Petroleum Theories and Their Application, J. H. Wiggins. Am. Inst. Min. & Met., Engrs.—Trans., Advance paper No. 1353-P. July 1924, 8 pp. Pictures economic phase of evaporation losses and actual evaporative conditions in handling and storing crude and gasoline in United States; discusses some of the theories of physics involved in evaporation loss; and describes application of these theories to handling oil and gas on producing properties.

PHOTOMETERS

MICRO. A Registering Micro-Photometer for Accurate Measurements, M. Siegbahn. Lond., Edinburgh & Dublin Philosophical Mag. & Jl. of Sci., vol. 48, no. 283, July 1924, pp. 217-224, 5figs. Describes new registering microphotometer, very convenient in use, enabling measurements of line-distances with precision of 0.002 mm.

PIPE

CEMENT LINING. Prolonging the Life of Pipe by Cement Lining, R. J. Newsom. Fire & Water Eng., vol. 76, no. 6, Aug. 6, 1924, pp. 255-256 and 280-281. How this type of lining lengthens age of pipe and increases delivery of water; fallacy of oversizing; lining of large pipe. Abstract of paper read before Am. Water Works Assn.

CORROSION. Remedies for Subaqueous Corrosion of Pipe, C. W. Foulk. Fire & Water Eng., vol. 76, no. 6, Aug. 6, 1924, pp. 259-260 and 277. Discusses phenomena of corrosion; effect of dissolved oxygen on iron; protective coating deposited by water; formation of acid water. Abstract of paper read before Ohio conference on Water Purification at Columbus, O.

THREADING. Pipe Threading in Oil Field Service, F. D. Bostaph. Oil Trade Jl., vol. 15, no. 7, July 1924, pp. 40-44. Investigation shows that greater percentage of trouble develops when long threaded pieces and couplings are being screwed together in field than when shorter couplings and threads were used. Concludes that threading chasers as in use in all threading machines at present time do not reproduce pitch of their own threads on pipe in all cases.

PIPE, CAST IRON

BRONZE WELDING IN. Bronze Welding Cast Iron Pipe in Chicago. Acetylene Jl., vol. 26, no. 2, Aug. 1924, pp. 78-80, 9 figs. Peoples Gas Light & Coke Co. are laying 6-in cast-iron bronze-welded gas line in Nordica Ave.; welding is accomplished by fusing tobin bronze to cast-iron pipe in band completely around joint.

SPUN. "Spun" Iron Pipes. Roy. Engrs. Jl., vol. 38, no. 2, June 1924, pp. 249-251, 1 fig. Details of preparing chromium-steel mold revolvable at high speed pouring from sector-shape ladle containing exact quantity of metal for one pipe, etc.

PIPE LINES

FRICTION OF. Pipe Friction. Mech. Wld., vol. 76, no. 1958, July 11, 1924, pp. 21-22, 2 figs. Discusses available formulas for calculating frictional resistance in pipe lines for water, applicable mainly to power-plant work.

WELDING. Report on Welding of Pipe, G. O. Carter. Am. Welding Soc.—Jl., vol. 3, no. 7, July 1924, pp. 13-19. Discusses welding applied to very extensive pipe lines, large and small plants and installations, including long oil and gas pipe, etc., organization of welding crews, cost of welding, etc.

PIPE, WOOD-STAVE

CONSTRUCTION. Wood Stave Pipe Lines and Penstocks, J. B. Holdcroft. Can. Engr., vol. 47, no. 3, July 15, 1924, pp. 149-151, 5 figs. Consideration involved in design of wood stave pipe employed for hydraulic power installations; Douglas fir used in manufacture; settling dimensions of staves; design of tongues, bands and cradles.

POLES, CONCRETE

CAST. Making and Erecting Concrete Poles, L. R. Brown. Elec. Ry. Jl., vol. 64, no. 5, Aug. 2, 1924, pp. 159-161, 6 figs. Casting is done in horizontal steel forms with reinforcing rods wired to cast-iron rings and suspended in place; portable derrick is used for erection.

POWER

EARTH'S INTERNAL HEAT, UTILIZATION OF. Power from the Earth's Heat, T. T. Read. Mech. Eng., vol. 46, no. 8, Aug. 1924, pp. 446-449, 8 figs. Discusses increase of earth's temperature toward its center. Gives résumé of published material about actual installations at favorable places on earth's surface, and plans proposed by well-known engineers for further development.

NEW ENGLAND REQUIREMENTS. Power Requirements and Source of Supply of New England, C. T. Main, H. I. Harriman and D. C. Jackson. Boston Soc. Civil Engrs.—Jl., vol. 11, no. 5, May 1924, pp. 193-227. Report of Committee of Associated Industries of Mass., covering kinds and amount of present power, cost, available new sources, probable demand for power from new sources, probable cost of supplying it, coal prices, fuel oil for power, Diesel engine; with summary and general conclusions.

WORLD POWER CONFERENCE. The First World Power Conference. World Power, vol. 2, no. 7, July 1924, pp. 7-18. Detailed program and list of papers, June 30 to July 12, 1924.

The Significance of the First World Power Conference. World Power, vol. 2, no. 7, July 1924, pp. 1-6. Discusses object, focusing information on policy of main countries in development of power resources; evolution of international power policy; natural power resources.

POWER PLANTS

BRITISH EMPIRE EXHIBITION. The First World Power Conference at Wembley. Power House, vol. 17, no. 15, Aug. 5, 1924, pp. 21-33, 3 figs. Complete report of deliberations of engineers from every part of globe at British Empire Exhibition and description of power plant in operation at Wembley.

EQUIPMENT PURCHASING. Purchasing Power Plant Equipment. Power Plant Eng., vol. 28, no. 15, Aug. 1, 1924, pp. 795-796. Specifications must be complete and definite. Bids must be brought to a comparative basis analysis.

POWER TRANSMISSION

ELECTRIC, NORWAY-DENMARK. Transmission of Electric Power From Norway to Denmark, A. R. Angelo. Engineering, vol. 118, no. 3055, July 18, 1924, p. 114. In 1921 three commissions were appointed, one by Danish, one by Norwegian, and one by Swedish State, with object of investigating question of transmission of electric power from Norway to Denmark. Main points of report submitted in 1923 by a Joint Committee elected by these commissions for investigation of technical and financial aspects of the matter. Paper, abridged, contributed to World Power Conference.

WAVE. Wave-Power Transmission, E. A. Barclay-Smith. Lond., Edinburgh & Dublin Philosophical Mag. & Jl. of Sci., vol. 48, no. 283, July 1924, pp. 97-109, 9 figs. Discusses phenomena occurring in wave-power transmission through liquids in Constantinesco system.

PROFIT SHARING

FRANCE. Profit-Sharing and Recent French Legislation, P. Pic. Int. Labour Rev., vol. 10, no. 1, July 1924; pp. 1-29. Discusses act passed by French Parliament in 1922 for joint stock companies with profit-sharing schemes, and reluctance in its application.

PUBLIC UTILITIES

CUSTOMERS' SERVICES, INSTALLATION OF. Installating Customers' Services. Elec. Wld., vol. 83, no. 3, July 19, 1924, pp. 1 6-118. Analysis, which refers to methods followed in different parts of United States, indicating tendencies which should be of interest to every electric light and power company throught country.

PULLEYS

CONE. The Calculation of Cone-Pulley Diameters, H. E. Merritt. Mech. Wld., vol. 76, no. 1961, Aug. 1, 1924, pp. 66-67. Details of calculation for crossed belts and its application to open belts by means of correction determined to high degree of accuracy by simple slide-rule calculation.

PULVERIZED COAL

FIRING. Experience with Coal Dust and Combustion of Pulverized Coal (Les expériences sur les poussières de houille et la combustion du charbon pulvérisé), J. A. deGrey. Revue Universelle des Mines, vol. 2 (series 7), no. 5, June 1, 1924, pp. 276-283, 2 figs. Discusses principles of burner construction, combustion chamber, use of low-grade fuels and mixtures.

Pulverized-Coal Firing in a Billet Reheating Furnace, (Le chauffage au charbon pulvérisé d'un four poussant à billettes). Génie Civil, vol. 84, no. 26, June 28, 1924, pp. 621-623, 3 figs. Details of reconstructing furnace for reheating billets before rolling which were formerly fired with half-gas, difficulties met with and advantages of new system.

PLANTS. Self Contained Pulverized Coal Unit, C. H. Tupholme. Power Plant Eng., vol. 28, no. 15, Aug. 1, 1924, pp. 800-801, 2 figs. Describes British development which crushes, separates, dries and delivers pulverized coal to furnace. Requires no auxiliary plant except means for rotating its spindle and provision of a supply of raw coal to hopper; low first cost and compactness; permits low-grade fuels to be burned economically.

PUMPING STATIONS

DIESEL-DRIVEN. Large Paris Pumping Plants are Diesel-Driven. Oil Engine Power, vol. 2, no. 7, July 1924, pp. 388-390, 3 figs. Gives illustrations and account of one of large oil-engined pumping plants of Paris, fitted with two 4-cylinder, 4-cycle engines belt-connected to Rateau double-suction centrifugal pumps.

PUMPS

AIR-LIFT. Experimental Study of Air Lift Pumps and Application of Results to Design, C. N. Ward and L. H. Kessler. Univ. of Wis.—Bul., vol. 9, no. 4, serial no. 1265, 1924, 166 pp. 60 figs. Results of experiments as to footpieces show that conditions of eduction pipe, where energy of air is expended in producing motion of water, are factors determining success or failure.

TESTING. The Comparison of Pump Tests with Special Reference to Low Head Pumps, E. F. Delery. Louisiana Eng. Soc.—Proc., vol. 10, no. 2, Apr. 1924, pp. 98-107. Lays stress on capacity and spouting velocity as related to lift in selecting or designing pumps; gives practical examples of determining efficiency.

VACUUM. Determining the Type of Vacuum Pump for Given Air Removal Conditions, C. M. Reed. Power, vol. 60, no. 2, July 8, 1924, pp. 52-54, 4 figs. Discusses rotative dry-vacuum pump and steam-jet pumps, and gives charts for simplified calculation of relative volumes and weights of dry air in air-steam mixtures.

PUMPS, CENTRIFUGAL

LUBRICATION. Oil System Specially Designed for Municipal Pumping Plant, H. R. Cady. Power, vol. 60, no. 6, Aug. 5, 1924, pp. 203-205, 3 figs. Tells why continuity of service is highly important and how low renewal cost is obtained. Gravity tank provides 15-min. supply without pump, and indicating devices check operation.

PUNCHES

DIES AND, STANDARD SETS. Standard Punch and Die Sets, S. Diamant. Am. Mach., vol. 61, no. 5, July 31, 1924, pp. 199-201, 3 figs. Various types and advantages. Time and original cost saved by standard equipment. Abstract of paper for Metropolitan Sec. A.S.M.E., Apr. 15, 1924.

PYROMETRY

THERMOELECTRIC. The Principles of Applications of Thermoelectric Pyrometry, L. B. Hancy. Australasian Inst. Min. & Met.—Proc., no. 52, Dec. 31, 1923, pp. 185-206, 7 figs. Discusses developments, thermo-couples, cold end of couples, protection and repairs of couples; methods of standardization of couples and instruments, etc.

R

RADIATORS

AMMONIA, CAST-IRON, HEAT TRANSFER IN. Heat Transfer in Cast-Iron Radiator Sections for Ammonia, H. J. Macintyre. Ice & Refrigeration, vol. 67, no. 1, July 1924, pp. 42-43, 4 figs. Results of tests showing that cast iron may be made suitable for use on low-pressure side of ammonia cycle. Paper presented at west. meeting, Am. Soc. Refrig. Engrs.

SIZES, CALCULATION OF. A Speedy and Accurate Method of Figuring Radiator Sizes, P. R. Babcock. Heat. & Vent. Mag., vol. 21, no. 7, July 1924, pp. 53-54, 2 figs. Gives formulas and methods.

RADIOTELEGRAPHY

SHORT WAVE. Results Obtained Over Very Long Distances by Short Wave Directional Wireless Telegraphy, More Generally Referred to as the Beam System, G. Marconi. Roy. Soc. of Arts—Jl., vol. 72, no. 3740, July 25, 1924, pp. 607-617 and (discussion) 617-621, 8 figs. Reviews developments, neglect of short waves; many problems can only be solved by short wave directional system, reflectors used in this system, successful tests a carried out between Poldhu and Argentine.

RAILS

CORRUGATION. How Rail Corrugation Has Been Eliminated in Pittsburgh, I. E. Church. Elec. Ry. Jl., vol. 64, no. 3, July 19, 1924, pp. 83-85. Results of investigations made of circumstances under which in past corrugation developed and track structure was designed to prevent its recurrence.

LIFE OF. Securing the Maximum Life of Rail in Track, B. M. Cheney. Eng. & Contracting (Railways), vol. 62, no. 1, July 16, 1924, pp. 129-133. Average age of rail varied from 5.6 to 13.6 yr.; gives factors that determine length of service.

TREATED AND UNTREATED. Mill Treatment Doubles the Life of Rail. Elec. Ry. Jl., vol. 64, no. 4, July 26, 1924, pp. 123-125, 1 fig. Service tests made by Boston Elevated Ry. show wear on Sandberg sorbitic rail to be only about one-half that on untreated rail in same track; cost of treated rail is slightly higher.

RAILWAY ELECTRIFICATION

BRITISH EMPIRE EXHIBITION. First World Power Conference. Ry. Gaz., vol. 41, no. 4, July 25, 1924, pp. 121-124, 2 figs. Abstracts of papers on electrification of railways read at British Empire Exhibition. Electric Traction in Italy, F. Tajani; Electrification of Railways in Norway, H. J. Schreiner; Power problems of Sweden Railways, I. Ofverholm.

FRANCE. Electrification of Suburban Lines to the West of Paris (L'électrification des lignes de la banlieue Ouest de Paris). Industrie des Tramways, Chemins de Fer, et Transports Publics Automobiles, vol. 18, no. 210, June 1924, pp. 184-190, 12 figs. Details of electrification of state railways; permanent way, rolling stock, electric equipment.

SWITZERLAND. Present Status of Railway Electrification of the Federal Swiss Railroad (L'État actuel de l'électrification des Chemins de fer fédéraux suisses. Génie Civil, vol. 84, no. 26, June 28, 1924, pp. 609-614, 7 figs. Also Elec. Ry. & Tramway Jl., vol. 50, no. 1242, June 13, 1924, pp. 273-277, 6 figs. Progress in electrification; working current, single-phase 15,000-volt, 16 2-3 periods, generated in hydro-electric power stations; 525 out of 2900 km., are now electrified.

RAILWAY MOTOR CARS

FRANCE. Traction on Rail Tracks by Means of Liquid Fuel Engines (La Traction sur voie ferrée par moteurs à combustibles liquides), E. Brillié. Société d'Encouragement pour l'Industrie Nationale—Bul., vol. 136 no. 3, Mar. 1924, pp. 217-278, 145 figs. Describes construction of Diesel engines, etc., types of transmission and their efficiency; gives illustrations and details of large number of engines for locomotives, railway motor cars, locotractors, etc.

GASOLINE. Petrol Rail Car Development. Tramway & Ry. Wld., vol. 55, no. 30, June 19, 1924, pp. 290-293, 8 figs. Describes Brill model no. 55 gasoline rail car; overall length 43 ft. 5 in., width over posts 8 ft. 4 in., height from rail to top of roof 10 ft. 5 in., passenger compartment seats 46, engine is four-cylinder, four-cycle, heavy-duty type, developing 41.8 hp. at 800 r.p.m.

IMPROVEMENTS. Improvements in Motor Car Design, H. Dubath. Elec. Ry. Jl., vol. 64, no. 7, Aug. 16, 1924, pp. 251-253. Trends in design of electric-railway rolling stock considered from standpoints of first cost and maintenance; bodies, running gear, ball and roller bearings, brakes and other parts discussed. Abstract of paper read before Union Internationale de Tramways, de Chemins de fer d'Intérêt local et de Transports Publics Automobiles.

RAILWAY OPERATION

TRAIN LOADS, MAXIMUM. Maximum Train Loads. Ry. Rev., vol. 75, no. 6, Aug. 9, 1924, pp. 205-209. Report of committee for purpose of establishing quick and practicable method of adjusting tonnage ratings for various locomotives under different conditions of grade and alignment.

RAILWAY REPAIR SHOPS

TURBO-GENERATOR REPAIRS. Headlight Maintenance on the Nickel Plate, H. A. Leatherman. Ry. Elec. Engr., vol. 15, no. 7, July 1924, pp. 217-218, 5 figs. Describes methods of repairing all turbo-generator work for two divisions of average length done at Stony Island shops of New York, Chicago & St. Louis, Ry.

RAILWAY SHOPS

DELIVERY OF MATERIAL. Store Delivery of Material to Users at Shops, J. E. Peery. Ry. Rev., vol. 75, no. 5, Aug. 2, 1924, pp. 155-159, 5 figs. Results obtained on Southern Pacific system indicate possibilities of substantial savings through this service.

LAYOUT. Some Questions in Modern Shop Design, E. Wanamaker. Ry. Mech. Engr., vol. 98, no. 8, Aug. 1924, pp. 486-488. Flexibility of arrangement with view to probable future expansion is important consideration.

SCRAP RECLAMATION. The Disposition of Discarded Material, H. C. Stevens. Ry. Rev., vol. 75 no. 3, July 19, 1924, pp. 87-91, 17 figs. Discusses possibilities in reclamation of various items of scrap, by installation of modern labor-saving devices, together with possible savings, if importance of conservation and reclamation is recognized and conceded by placing work under supervision of aggressive, studious, mechanical man with proper material knowledge. Gives some methods employed by Wabash Ry.

RAILWAY SIGNALING

DOUBLE-WIRE. The Double-Wire Working of Points and Signals. Ry. Engr., vol. 45, no. 535, Aug. 1924, pp. 283-285, 6 figs. Shows how first cost of signaling and of its subsequent maintenance may be reduced; points and signals are easier to move; signals are compensated when "on" and when "off", and they are definitely restored instead of going "on" by gravity; insures that signals do not stick "off".

RAILWAY TIES

FORECASTING REQUIREMENTS FOR. How a Road Can Forecast Its Tie Requirements, E. Stimson. Wood Preserving News, vol. 2, no. 7, July 1924, pp. 109-112. Average life for untreated ties is 9 1-3 yr. and 16 yr. for treated ties. Tables estimating crosstie requirements of B. & O. for 1922 and 1923 and cross-tie renewal experience and projection for B. & O.

The Dhilwan Creosoting Plant, H. L. Woodhouse. Roy. Engrs. Jl., vol. 38, no. 2, June 1924, pp. 205-210. Discusses creosoting and creosoting plant of Northwestern Ry. of India, methods, costs, fire protection, etc.

RAILWAY TRACK

STRESSES IN. Track Stresses, C. T. Ripley. Ry. & Locomotive Eng., vol., vol. 37, no. 7, July 1924, pp. 208-210, 2 figs. Series of stremmatograph tests made on large electric locomotives. First series of tests made on and near horseshoe curve in New Mexico on tangent track and 6-deg. and 10-deg. curves, showed that some high stresses were obtained under these locomotives, especially on 10-deg. curves.

TRANSFER TABLES. 35-Ton Electric "Surface Traverser". Engineer, vol. 138, no. 3577, July 18, 1924, pp. 84-85, 2 figs. Describes transfer table constructed by S. H. Heywood & Co., Ltd., Reddish, Eng., for Bengal-Nagpur Ry. Co's workshops at Khargpur, for transferring rolling stock on parallel tracks.

REAMERS

TAPER MACHINE. Taper Machine Reamers, F. Cooke. Machy. (Lond.), vol. 24, no. 615, July 10, 1924, pp. 449-452, 5 figs. Motion of a reamer; positive value; natural and negative value teeth; stability from spiral teeth.

REFRACTORIES

RESEARCH COMMITTEE REPORT. Refractories for Gas-Retorts, with Special Reference to Silica, W. Emery. Gas Jl., vol. 167, no. 3191, July 9, 1924, pp 3-16, 24 figs. (supp.). Gives list of claims for and against silica materials, and discusses each item. As result of works experience, writer suggests that it is possible to produce fire-bricks which have zero volume changes when worked at moderately high temperature. Give notes on micro-structure of retorts by A. Scott.

Report of Refractory Materials Joint Research Committee. Gas. Jl., vol. 167, no. 3191, July 9, 1924, pp. 17-36 and (discussion) 36-38 (supp.), contains abstracts of following papers; Storage of Silica Refractories, W. J. Rees; Relation Between Ordinary Refractoriness. Under-Load Refractoriness, and Composition, Physical anp Chemical, of Refractory Material, A. J. Dale, 11 figs; Refractoriness Under Load, J. W. Mellor, 2 figs.; Sedimentation as a Means of Purifying Clay, S. R. Hind; Effect of Repeated Burning on Structure and Properties of Lime-Bonded Silica Bricks, W. Hugill and W. J. Rees, 10 figs.; Some Causes of Variation in Sizes of Refractories Bricks and Block, J. W. Mellor, 3 figs.; Thermal Conductivity and Some Other Properties of Two Commercial, Heat-Insulating Bricks Used in Kiln Construction, A. T. Green, 5 figs.; Influence of Texture on Transmission of Heat Through Firebricks, A. T. Green, 12 figs.

REFRIGERANTS

METHYL CHLORIDE. A Heat Chart for Methyl Chloride, T. M. Gunn. Refrig. Wld., vol. 59, no. 7, July 1924, pp. 15-18. Advantages and properties of methyl chloride and explanation of chart; with diagram more common problems of refrigeration may be worked out almost without calculation.

THERMODYNAMICS. Comparison of Thermodynamic Characteristics of Various Refrigerating Fluids, W. H. Carrier and R. W. Waterfill. Refrig. Eng., vol. 10, no. 12, June 1924, pp. 415-424, 12 figs. Comparison and analysis of refrigerating cycles of various fluids using ideal Carnot cycle as standard, also their adaptability for positive or centrifugal compression. Paper read before Am. Soc. Refrigerating Engrs.

REFRIGERATING MACHINES

COMPRESSION. Recent Improvements in Refrigerating Apparatus, F. Ophuls and G. A. Horne. Refrig. Eng., vol. 2, no. 1, July 1924, pp. 1-13, 8 figs. Deals with that part of ammonia-compression refrigerating system in which ammonia is transferred to compressor, from then to condenser, then to receiver and finally liquid is returned to expansion, pressure-reducing or liquid regulating valves of system. Paper read before Fourth Int. Congress of Refrigeration.

EVAPORATED-WATER. Refrigeration with Evaporated Water. Nautical Gaz., vol. 107, no. 3, July 19, 1924, p. 76 (tech. sec.), 3 figs. Details of new Westinghouse-Leblanc apparatus which does not require chemicals.

REFRIGERATING PLANTS

AMMONIA TABLES, USE OF. Using the Ammonia Tables, J. E. Starr. Power, vol. 60, no. 3, July 15, 1924, pp. 91-92. Gives tables showing properties of saturated and superheated ammonia—saturated-ammonia table containing also gage pressure—and explains their use.

RESEARCH PLANTS. Refrigeration for Research Work, S. R. Winters. Ice & Refrigeration, vol. 67, no. 1, July 1924, pp. 14-15, 2 figs. Describes experimental refrigerating plant at Bur. Animal Industry of U. S. Dept. Agriculture, Washington, D. C.; considerations of temperatures required; description of equipment; improvement of foods due to research work.

ROADS

MAINTENANCE COST. Keeping Maintenance Cost as an Aid to Highway Development, H. L. Washburn. Good Roads, vol. 67, no. 1, July 1924, pp. 3-5, 6 figs. How Harris City., Texas, has reduced its expenditures for road maintenance through installation of cost accounting system.

SURFACES. Tractive Resistance and Related Characteristics of Roadway Surfaces, T. R. Agg. Iowa State College of Agriculture & Mechanic Arts, vol. 22, no. 36, Feb. 6, 1924, 62 pp., 33 figs. Discusses tractive resistance of self-propelled vehicles, especially interaction of tire and road surface; measuring of rolling resistance and its variations, relation between type of tire and rolling resistance, fuel consumption, etc.

ROADS, CONCRETE

CRACKING. Checking of Concrete Road Surfaces, G. A. Macdonald. Can. Engr., vol. 47, no. 7, Aug. 12, 1924, pp. 235-239, 10 figs. Investigations into cause of cracking of concrete roads; details of experiments and conclusions drawn from results; suggested procedure to prevent cracking; concrete should be kept moist and covered with tarpaulins.

INSPECTION OF. Some Essential Points on the Inspection of Concrete Highways, H. S. Mattimore. Good Roads, vol. 67, no. 1, July 1924, pp. 1-2 and 14, 4 figs. In order to give unbiased opinion in judging service value of any type of road surfacing, complete investigation or analysis of design and methods of construction are necessary. Discusses sub-grade condition and reinforcing concrete road slabs.

ROAD CONSTRUCTION

REFINED TAR. Refined Tar in Highway Construction, J. S. Crandell. Can. Engr., vol. 47, no. 3, July 15, 1924, pp. 161-163, 3 figs. Subgrade must be carefully drained and prepared; laying wearing course; method of applying tarvia and finishing surface; Paper read at annual convention of Good Roads Assn., St. Andrews, N. B.

ROLLING MILLS

BLOOMING MILL. Mechanical and Electrical Analyses of 40 Inch Blooming Mill Screwdown, F. D. Egan. Iron & Steel Engr., vol. 1, no. 7, July 1924, pp. 371-379, 42 figs. Electrification of 40-in. blooming mill of Lackawanna plant of Bethlehem Steel Co., replacing all steam and hydraulic drives.

HOT-STRIP. A New 20-16 in. Hot Strip Mill, N. Jones and G. P. Wilson. Am. Inst. Elec. Engrs.—Jl., vol. 43, no. 8, Aug. 1924, pp. 710-715, 9 figs. Details of new plant of West Leechburg Steel Co., Pa. designed for thin strips, including outdoor substation equipment, with motors, speed regulations, etc.

ROLLS

ALLOY-STEEL. Producing Hardened and Ground Rolls, J. R. Adams. Abrasive Industry, vol. 5, no. 7, July 1924, pp. 168-170, 6 figs. Discusses rolls of composition C 0.70 to 1.25, Mn 0.20 to 0.40, Si 0.15 to 0.30, Cr. 1.50 to 2.50 per cent, their production in electric furnace, hardening of surfaces, grinding, and microscopic and scleroscopic and other tests.

CASTING. Vertical Pouring of Rolling-Mill Rolls (La coulée en chute appliquée aux cylindres de laminoirs). Fonderie Moderne, vol. 18, June 1924, pp. 143-146, 5 figs. Used in place of bottom casting, in metal mold, with hottest part at top.

ROOFS

SAWTOOTH CONSTRUCTION. A Modern Type of Saw-Tooth Roof Construction. Am. Architect, vol. 126, no. 2449, July 2, 1924, pp. 25-29, 12 figs. Two sets of trusses are used, transverse and longitudinal. Illustrated by examples designed by Ballinger Co., Phila., Pa.

S

SCREWS

WHITWORTH. Whitworth Screws, M. H. Sabine, Machy. (Lond.), vol. 24, no. 618, July 31, 1924, pp. 562-565, 1 fig. Details of dimensions, efficiency and other data in tabular form.

WOOD. Production Data in Manufacturing Wood Screws, W. Richards. Can. Machy., vol. 31, no. 27, July 3, 1924, pp. 25 and 43, 3 figs. Description of manufacture of steel wood screws and production data for every operation. All operations performed automatically. Machines of each class arranged in batteries to facilitate work.

SEWAGE DISPOSAL

ACTIVATED SLUDGE, DEWATERING. Experience in Dewatering Activated Sludge, L. Pearse. Mun. & County Eng., vol. 67, no. 1, July 1924, pp. 18-21. Discusses difficulties of dewatering, properly conditioning of sludge, comparison of press types, filering, filtering with aid of additional pressure, vacuum filters, centrifuge, flotation, secondary removal of water, filter cloths and cost data. Paper read before Int. conference, Sanitary Eng., Land, July 7, 1924.

CHICAGO. The Sewage Disposal Problem of Chicago, L. Pearse. Eng. & Contracting (Water Works), vol. 62, no. 1, July 9, 1924, pp. 74-76. Discusses sewage treatment in Chicago. Review of developments and projects under way. Paper read before Ill. Soc. Engrs.

SLUDGE DIGESTION. Sludge Disposal by the Digestion Process, J. Watson. Eng. & Contracting (Water Works), vol. 62, no. 1, July 9, 1924, pp. 85-87. Discusses experiences at Birmingham, Eng. Paper read before Conference of British Assn. Mgrs. of Sewage Disposal Works.

Pensauken Sludge Digestion Plant, N. C. Wittwer. Pub. Works, vol. 55, no. 7, July 1924, pp. 213-216, 4 figs. Sewage treatment plant involving separate sludge digestion and mechanical sludge scrapers built jointly by two communities consists of three-compartment clarification tank preceded by bar screens, sludge digestion tank, pumping station and sludge drying beds.

SHAPERS

NEW TYPE. New 10-inch Stroke Shaping Machine. Machy. (Lond.), vol. 24, no. 615, July 10, 1924, p. 463, 3 figs. Describes machine recently constructed by Ormerods' Tool Co., Ltd., Hebden Bridge, for use in Doncaster Technical College workshop, embodying some rather unusual features introduced with specific object of increasing educational value of machine, and including in a traversing-head machine certain features usually associated with pillar type.

SPRINGS

COIL. Coil Spring Calculations. Machy. (Lond.), vol. 24, no. 618, July 31, 1924, pp. 566-567, 3 figs. Discusses calculation of springs for measuring instruments for valves used in internal-combustion engines; gives chart for design of coil springs of circular-section wire.

FAILURES. Causes of Spring Failures, J. W. Rockefeller. Machy. (N.Y.), vol. 30, no. 12, Aug. 1924, pp. 965-966, 3 figs. Fatigue as a cause of failure; designing a spring to lift a dead weight; failure due to faulty material.

STEAM

HIGH-PRESSURE. Extra-High Pressure Steam. Power Engr., vol. 19, no. 220, July 1924, pp. 247-250 4 figs. Study of technology and economics of new development in power plant practice, abstracted from Münzinger's recent book.

RESEARCH. Steam Research Promises Much for Power-Plant Engineers, P. W. Swain. Power, vol. 60, no. 6, Aug. 5, 1924, pp. 200-203. By Bur. of Standards, M. I. T., and Harvard for constructing and extending steam tables.

STEAM POWER PLANTS

HIGH PRESSURES AND SUPERHEATS. High Pressures and High Superheats, W. G. Noack. Brown Boveri Rev., vol. 11, nos. 2 and 3, Feb. and Mar. 1924, pp. 23-30 and 54-63, 22 figs. Their evolution and application in steam power plants. Possible improvement of efficiency of ideal steam engine by increasing initial pressure and temperature; regenerative feedwater heating with steam bled from intermediate stages of turbine; turbines for high pressures and superheats; governing; steam generators and accessories for high pressures.

STEAM TURBINES

AUXILIARIES, MOTOR DRIVES FOR. Motor Drives for Turbine Auxiliaries, H. W. Smith. Power Plant Eng., vol. 28, no. 15, Aug. 1, 1924, pp. 807-810, 5 figs. Modern practice in application and control of motors for auxiliary drives.

CHARACTERISTICS CURVES. Characteristic Curves of Steam Turbines, J. Y. Dahlstrand. Power Plant Eng., vol. 28, no. 15, Aug. 1, 1924, pp. 797-799, 7 figs. Understanding of fundamentals and factory test curves will enable one to figure effects of changed operating conditions.

DISKS, AXIAL-VIBRATION PREVENTION. The Protection of Steam-Turbine Disks from Axial Vibration. Power, vol. 60, no. 3, July 15, 1924, pp. 94-99, 13 figs. Abstract of paper by W. Campbell presented at spring meeting of A.S.M.E., Cleveland, O., May 26-29, 1924, giving details of investigation made by Gen. Elec. Co. to account for turbine-wheel failures of a peculiar and erratic nature, which could not be explained on basis of stress alone. Essential cause was found to be fatigue resulting from disk vibration whose period corresponded closely to turbine operating speed.

MARINE. *See Marine Steam Turbines.*

STEEL

AUTOMOBILE. Stainless Steel for Automobiles. Automobile Engr., vol. 14, no. 191, July 1924, pp. 201-202, 1 fig. Discusses properties, heat treatment, advantages and disadvantages of stainless steel.

CHROME. *See Chrome Steel.*

CHROME-NICKEL. *See Chrome-Nickel Steel.*

COLD-ROLLED STRIP. Production of Cold Rolled Strip Steel, M. Farmer. Forging—Stamping—Heat Treating, vol. 10, no. 8, Aug. 1924, pp. 295-297. Discusses casting temperatures, segregation of elements, rolling of ingots and billets, high-speed rolling of billets and cold-rolling operations. Paper presented at Am. Soc. for Steel Treating.

COLD-WORKED, CRYSTAL DEFORMATION IN. Crystal Deformation in Cold-Worked Steel, H. H. Lester. Army Ordnance, vol. 5, no. 25, July-Aug. 1924, pp. 455-458, 44 figs. Preliminary study of behavior of atoms within iron crystal as it occurs in steel when metal is stressed up to and beyond elastic limit and up to and beyond yield point.

PLATES, CORROSION-RESISTANCE TESTS. Tests Steel Plates of Leviathan, G. B. Waterhouse. Iron Trade Rev., vol. 75, no. 4, July 24, 1924, pp. 29-230, 8 figs. Chemical and physical tests made by author on samples of original German plates and English plates which had been installed in 1919 fail to show clearly why German steel resisted corrosion more successfully during 10 years of service than other steel in 5 years. Copper present and banded structure may explain resistance.

IRON ALLOYS. *See Iron Alloys.*

PRESSED. Redevelopment in Pressed Steel Practice, M. R. Innes. Forging—Stamping—Heat Treating, vol. 10, no. 7, July 1924, pp. 262-264, 6 figs. Pressed metal has many advantages over other methods of production, but common sense must prevent detrimental effect caused by making wild claims.

TESTS. What is Steel, A. Sauveur. Am. Inst. Min. & Met. Engrs.—Trans., Advance paper No. 1338-S, May 1924, 22 pp., 15 figs. Results of experiments conducted in Metallurgical Laboratory of Harvard University, in which twisting and tensile stresses were applied to iron and steel bars heated at middle to predetermined temperatures, temperature falling gradually toward both ends of bars.

STEEL CASTINGS

CLEANING. Cleaning Steel Castings Economically. Abrasive Industry, vol. 5, no. 8, Aug. 1924, pp. 198-200, 6 figs. Describes cleaning-room operations, consisting of sandblasting, tumbling, removing gates and risers, grinding, chipping, polishing, and inspecting, of Ohio, Steel Foundry Co., Springfield, O.

DESIGN. Designing Steel Castings, E. R. Young Machy. (Lond.), vol. 24, nos. 616 and 617, July 17 and 24, 1924, pp. 501-503 and 538-540, 8 figs. Discusses pattern design, shrinkage, rib design, size and shape of castings,finish allowances, problems encountered.

VALVES. Valve Castings Made in Steel, P. Dwyer. Foundry, vol. 52, no. 15, Aug. 1, 1924, pp. 579-583 and 605, 8 figs. Various component parts of valves for most every purpose beyond capacity of cast iron are poured from steel melted in electric furnace.

STEEL, HEAT TREATMENT OF

CAST STEEL. Heat-Treatment of Steel with Special Reference to Production, J. W. Urquhart. Machy. (Lond.), vol. 24, no. 616, July 17, 1924, pp. 497-499. Discusses steel castings, their heat treatment, annealing and its effects, correct furnace design, cracked castings.

PROBLEMS IN. Problems of the Heat Treater as Influenced by the Pre-Natal History of the Material, P. E. McKinney. Am. Soc. for Steel Treating—Trans., vol. 6, no. 1, July 1924, pp. 51-65, 14 figs. Discusses melting and refining processes and suggests (1) classification of material based on character of service for which intended, without regard to composition, (2) establishment of recommended practices for production of ingot material, similar to heat treatment, (3) development of methods for testing which will detect inherent defects.

STEEL WORKS

CALCUTTA, INDIA. Blast Furnace Plant at Asansol, India. Iron Age, vol. 114, no. 5, July 31, 1924, pp. 254-256, 5 figs. See also Iron Trade Rev., vol. 75, no. 5, July 31, 1924, pp. 294-296, 4 figs. Two stacks with coke plant and auxiliaries of development of Indian Iron & Steel Co., near Calcutta.

STREET RAILWAYS

CARS, ONE-MAN. A New Idea in One-Man Operation. Elec. Traction, vol. 20, no. 7, July 1924, pp. 293-295, 3 figs. Washington Ry. & Elec. Co. develops automatic step treadle for rear exit operation to gain stamp of public approval for one-man car.

TROLLEY BUS, MOTOR BUS, AND. The Operation of Tramways, Trolley Omnibuses and Motor Omnibuses. Tramway & Ry. Wld., vol. 55, no. 30, June 19, 1924, pp. 307-308. Gives experience, and advantages and disadvantages of each system in Birmingham.

STRUCTURES

EFFECT OF WIND ON. Modern Ideas on Wind Force and Roof Truss Design, A. Tomlinson. Commonwealth Engr., vol. 11, no. 10, May 1, 1924, pp. 398-401, 1 fig. Discusses ordinary theory of wind pressure on roof, modern theory of wind pressure and result of investigations. Abstract of paper read before Instn. Engrs., Australia.

SUBSTATIONS

AUTOMATIC. The Application of Automatic Control to Mine Substations, C. E. H. vonSothen. Am. Inst. Elec. Engrs.—Jl., vol. 43, no. 8, Aug. 1924, pp. 729-735, 8 figs. Brief outline of method of operation and protection provided for both synchronous converter and synchronous motor-generator equipments.

DISTANCE CONTROL. Remote Control for Sub-Stations, C. J. Sargeant and T. N. Riley. Electrician, vol. 93, no. 2,407, July 4, 1924, pp. 12-13, 4 figs. Details of use of supervisory telephone systems for control of substations from central stations.

OUTDOOR. New Types of Outdoor Substations, C. D. Gray and MM. Samuels. Elec. Wld., vol. 84, nos. 5 and 6, Aug. 2 and 9, 1924, pp. 208-210, 263-267 10 figs. Structural details; use of motor-operated disconnecting switches; description of new type of "disconnect"; lighting and control features; specific installation details for modern step-in and step-down outdoor substations; security safety and economy without decreasing reliability.

SULPHUR

PRODUCTION AND USE. Production and Use of Refined Sulphur, C. A. Newhall. Chem. & Met. Eng., vol. 31, no. 4, July 28, 1924, pp. 144-149, 10 figs. Discussion of technology of manufacturing refined sulphur and of advantages and methods of commercial utilization. From paper read before Am. Inst. Chem. Engrs. July 1924.

SUPERPOWER

FUEL ECONOMY THROUGH. Fuel Economy Through Interconnection, N. G. Reinicker. Engrs. & Engr., vol. 41, no. 4, Apr. 1924, pp. 97-99. Paper read at conference on Economy in the Use of Fuel, held at Engrs. Club of Phila., Jan. 15, 1924.

NORTHEAST UNITED STATES, SURVEY OF. Northeast Superpower Studies Completed. Power, vol. 60, no. 5, July 29, 1924, pp. 179-182, 6 figs. Also Eng. Wld., vol. 25, no. 2, Aug. 1924, pp. 77-79, 1 fig. Abstract of report covering present and future power requirements of the ten northeastern states and part of Ohio, Virginia and West Virginia, with special reference to cost of delivering hydroelectric power. Report indicates growth in use of electrical power for industrial and other purposes; recommends extension of interconnection between different systems, construction of large steam plants strategically located, and development of large hydro-electric projects. See also Engineers' Committee Report on Northeastern Super-Power, Eng. News-Rec., vol. 93, no. 5, July 31, 1924, pp. 186-188, 3 figs., giving comparative costs of power through combination of different sources.

T

TELEPHONE LINES

INDUCTIVE INTERFERENCE. Telegraphy and Telephony. Sci. Abstracts, vol. 27, part 6, June 25, 1924, pp. 317-328. Details of investigation by Swedish Telegraph Administration into interference by singlephase railway power lines with special reference to Stockholm-Göteborg electrification, telephone lines to be moved 200 m. from power line.

TESTING. Electrical Tests and Their Applications in the Maintenance of Telephone Transmission, W. H. Harden. Bell System Technical Jl., vol. 3, no. 3, July 1924, pp. 353-392, 32 figs. Details of more important electric testing methods and their application in maintaining transmission efficiency, including d. c. and a.c. methods.

TELEPHONY

CABLE DISTRIBUTION. Economical Cable Plant, E. K. Goss. Telephone Engr., vol. 28, no. 7, July 1924, pp. 17-18. Some engineering features involved in laying out economical system of cable distribution for small and moderate sized exchanges; methods of relief and multipling.

DEVELOPMENTS. Developments in Manual Operation, J. P. Boylan. Telephony, vol. 87, no. 3, July 19, 1924, pp. 21-23, 2 figs. Recent improvements in manual switchboard practice; straightforward trunking system developed for Rochester Co.; innovations of new board. Paper presented at convention of New York Up-State Assn.

TEMPERATURE CONTROL

METHODS. Accurate Temperature Control System S. R. Winters. Ice & Refrigeration, vol. 67, no. 1, July 1924, pp. 10-13, 4 figs. Methods employed at Bur. of Animal Industry, U. S. Dept. Agriculture for maintaining temperatures with accuracy of 0.1 deg. cent.; refrigerating equipment and control system.

TESTING MACHINES

TENSILE-STRENGTH. Calibration of Tensile Strength Testing Machines by Means of Test Bars (Tarage des machines de traction au moyen d'éprouvettes), M. P. Nicolau. Revue de Métallurgie, vol. 21, no. 6, June 1924, pp. 342-346. Describes new method and shows its advantages compared with older methods.

TOOLS

STORAGE. A Practical System of Tool Storage and Control, F. A. Pope. Factory, vol. 33, no. 2, Aug. 1924, pp. 208-211, 8 figs. Shows, how centralized storage, flexible shelving, mechanical handling equipment and systematic grouping of tools have in one shop given clean-cut but economical control over tools.

TRACTORS

CORPS. The New Corps Tractor. Army Ordnance, vol. 5, no. 25, July-Aug. 1924, pp. 443-445, 5 figs. Experimental corps tractor delivered to Aberdeen Proving Ground for test was designed and built to meet requirements of Caliber Board; tracklaying vehicle, using conventional type of track; gives general specifications.

Roadless Transport. Motor Transport (Lond.), vol. 38, no. 1002, May 12, 1924, pp. 586-589, 9 figs. Details of Pavesi, Holt, Kegresse, and other tractors capable of travelling over very rough ground.

TRAFFIC

Congestion Relief. City Planning and Traffic Congestion. Elec. Traction, vol. 20, no. 7, July 1924, pp. 303-307. Discusses relation which building construction and street layout bear to problem of traffic congestion; economic causes and cures for modern bedlam in city streets.

TRANSFORMERS

Single and Three-Phase. Characteristics and Shop Testing of Single-and Three-Phase Power Transformers, J. W. Rogers. Mech. Wld., vol. 75, nos. 1946, 1951 and 1954, and vol. 76, no. 1957, Apr. 18, May 23, June 13 and July 4, 1924, pp. 242-243, 324-325, 370-372 and 8-9, 11 figs. General description of tests for copper loss and impedance, core loss, magnetic leakage, ratio and polarity, regulation, efficiency, ratio of core to copper losses, rating and temperature rise, insulation, and methods of calculating the various characteristics of a transformer from data obtained in shops.

Static, Mechanical Forces in. Mechanical Forces in Power Transformers. Power, vol. 60, no. 5, July 29, 1924, pp. 166-167, 11 figs. Elementary explanation of how mechanical forces are set up in static transformers due to short-circuits or faulty switching, that have resulted in failure of windings.

Unbalanced Load. The Current Conditions in Transformers Working on Unbalanced Load, F. Grieb. Brown Boveri Rev., vol. 11, no. 1, Jan. 1924, pp. 15-19, 8 figs. Discusses compensation of unbalanced loading of secondary of 3-phase transformers on primary side.

TUBES

Seamless Steel. Manufacture of Seamless Steel Tubing, W. C. Chancellor. Engrs.' Soc. West. Pa.— Proc., vol. 40, no. 6, July 1924, pp. 217-248, 36 figs. Details of rotary piercing process as distinct from cupping process and hydraulic piercing of solid slugs, and equipment used at Ellwood City Works of Nat. Tube Co.

TUNNELING

Pit River, California. Tunneling in Volcanic Formations on Pit River Project. Eng. News-Rec., vol. 93, no. 5, July 31, 1924, pp. 168-171, 8 figs. Particulars of tunneling work in Pit River No. 3 tunnel now under construction by Pacific Gas & Elec. Co. in northern California. Wall plate drifts and top center headings used as rock varies from friable tuff to hard lava; air shovel with ½-cu. yd. bucket is preferred mucking method; bonus system increases progress.

V

VARNISHES

Properties. Varnish Studies, W. T. Pearce. Indus. & Eng. Chem., vol. 16, no. 7, July 1924, pp. 681-684, 2 figs. Studies tabular data obtained from tests to ascertain value of laboratory tests and chemical analyses in determining durability of varnishes.

Tung-Oil. The Alkali Increase Test for Tung Oil Varnishes, H. A. Gradner and C. P. Holdt. Paint Manufacturers' Assn. of U. S., Sci. Sec., circular no. 206, June 1924, pp. 25-34. Discusses application of alkali increase test to commercial varnishes, and accuracy of these tests.

VENTILATION

Buildings. Ventilating Buildings on the Economizer Plan, T. N. Thomson. Plumbers Trade Jl., vol. 77, no. 2, July 15, 1924, pp. 140-144, 3 figs. Study of new method of ventilating buildings both winter and summer, using heat economics to cut down cost of ventilation.

W

WASTE HEAT

Recovery. On the Recovery of Waste Heat from Open-Hearth Furnaces by the Use of Waste Heat Boilers, T. B. Mackenzie. West of Scotland Iron & Steel Inst.—Jl., vol. 31, parts 6 and 7, Mar.-Apr. 1923-1924, pp. 90-109. Discusses heat losses in open-hearth furnaces, application of waste-heat boilers, experience in operating, savings from waste-heat boilers; discussion; bibliography.

Utilization. The Reciprocal Utilization of Waste Energy, B. M. Gerbel. Engineering, vol. 118, no. 3054, July 11, 1924, pp. 75-76. Discusses coöperation of different plants for purpose of utmost joint utilization or their fuel, besides combination between works of different power and steam requirements. Abstract of paper read before World Power Conference.

WATER FILTRATION

Standard of Clarity. Sensitive Detection of Suspended Matter and a Proposed Standard of Clarity in Filtered Water, J. R. Baylis. Am. Water Works Assn. Jl., vol. 11, no. 4, July 1924, pp. 824-832, 2 figs. Discusses determination of turbidity of filtered water, new turbidimeter, determining suspended matter in filtered water and proposed standards.

WATER GAS

Plant Operation. Rochester's Water Gas Plant Has a Checkerless Carburetter, W. N. Whitney. Gas Age-Rec., vol. 54, no. 3, July 19, 1924, pp. 75-79, 13 figs. Details of construction and equipment features of new water gas plant of Rochester Gas & Elec. Corp.

WATER POWER

Norway. The White Coal of Norway. Electrician, vol. 93, no. 2407, July 4, 1924, pp. 8-11, 6 figs. Surveys Norway's water power, relation of state to its utilization, and gives details of power stations.

Sweden. Sweden's Water Power. Electrician, vol. 93, no. 2408, July 11, 1924, pp. 39-42, 4 figs. Deals with general electricity supply in Sweden and steps which have been taken by State to control and employ large amount of power that is available; describes various hydro-electric stations owned and operated by state and gives general power situation.

WATER SUPPLY

California. The Use of Balancing Reservoirs in Water Distributing Systems, J. E. Phillips. Am. Water Works Assn.—Jl., vol. 11, no. 4, July 1924, pp. 793-796. Discusses advantage of balancing reservoirs or kickback tanks used to meet peak load requirements.

Cost System. A Cost System for Water Works in Large Towns and Small Cities, E. E. Peacock. Am. Water Works Assn.—Jl., vol. 11, no. 4, July 1924, pp. 797-807. Details of classification and subdivisions of unit cost system, covering collection, purification and distribution.

Water Hardness. The Relation of Hardness in Water Supply to Public Health, E. S. Chase. Am. Water Works Assn.—Jl., vol. 11, no. 4, July 1924, pp. 873-880. Discusses effect of hardness of drinking water on health, using mortality statistics.

WATER TREATMENT

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Second Water Purification Works for Oklahoma City. Eng. News-Rec., vol. 93, no. 6, Aug. 7, 1924, pp. 216-219, 4 figs. Describes new combined clarification softening, double aeration and carbonization plant.

WEIRS

Semi-Circular. Semi-Circular Weirs Calibrated at Purdue University, F. W. Greve. Eng. News-Rec., vol. 93, no. 5, July 31, 1924, pp. 182-183, 2 figs. Extensive experiments dealing with curved weirs, or notches, cut in a vertical wall have been in progress for some time at hydraulic laboratory of Purdue Univ. Particulars of test made as part of project, on semi-circular openings to determine relation between head and quantity of water discharged.

WELDING

Electric. *See Electric Welding, Arc.*

Oil Refineries. Welding Practice in an Oil Refinery, C. R. Price. Am. Welding Soc.—Jl., vol. 3, no. 7, July 1924, pp. 20-30, 13 figs. Discusses application of welding to pipe, boiler and tank work, structural iron and general repairs, and gives examples of practical work.

Oxy-Acetylene. *See Oxy-Acetylene Welding.*

Pipe. *See Pipe Lines, Welding.*

Properties of Steel in. Properties of Steel in Welding, F. C. Thompson. Welding Engr., vol. 9, no. 7, July 1924, pp. 17-20, 5 figs. Effect of heat treatment on ductility and toughness; tensile properties of deposited metals; effect of different elements. Abstract of paper read before Instn. Welding Engrs.

WIRE ROPE

Care of. The Wear and the Care of Wire Rope, W. Constable. Am. Contractor, vol. 45, no. 25, June 21, 1924, pp. 25-27, 9 figs. Explains right and wrong uses of wire rope and practices conducive to longevity are suggested. Paper read before meeting of Lake Superior Min. Inst.

Economical Application of. Wire Ropes, T. A. Taylor. Can. Min. Jl., vol. 45, no. 27, July 4, 1924, pp. 643-647, 8 figs. Principles governing economical application of steel-wire mining ropes both for winding and haulage purposes. Various types of ropes available and state of development to which each of these have been brought; reason for choice of most suitable rope under given circumstances; safety factor obtainable.

WOOD PRESERVATION

Treatment. Wood Preservation. Am. Ry. Eng. Assn.—Bul., vol. 25, no. 265, Mar. 1924, pp. 845-1066, 67 figs. Report of committee giving creosote specifications, service test records, marine piling research, preservative treatment for signal trunking and capping, creosote mixture with other oils, zinc-petroleum mixture; also report of sub-committee on marine piling investigations.

WORLD POWER CONFERENCE

Proceeding. Proceedings of the First World Power Conference. Engineering, vol. 118, nos. 3053, 3054, 3055 and 3056, July 4, 11, 18 and 25, 1924, pp. 18-20, 35-47, 77-87 and 115-124, 3 figs. Abstracts of papers presented and discussions which took place at Conference, held June 30 to July 12, 1924.

Z

ZIRCONIUM

Technology of. Technology of Zirconium and Its Compounds, F. C. Nonamaker. Chem. & Met. Eng., vol. 31, no. 4, July 28, 1924, pp. 151-155. Intimate, authoritative view of significant and in many ways unique development of an element that exhibits properties of absorbing interest to many industries.

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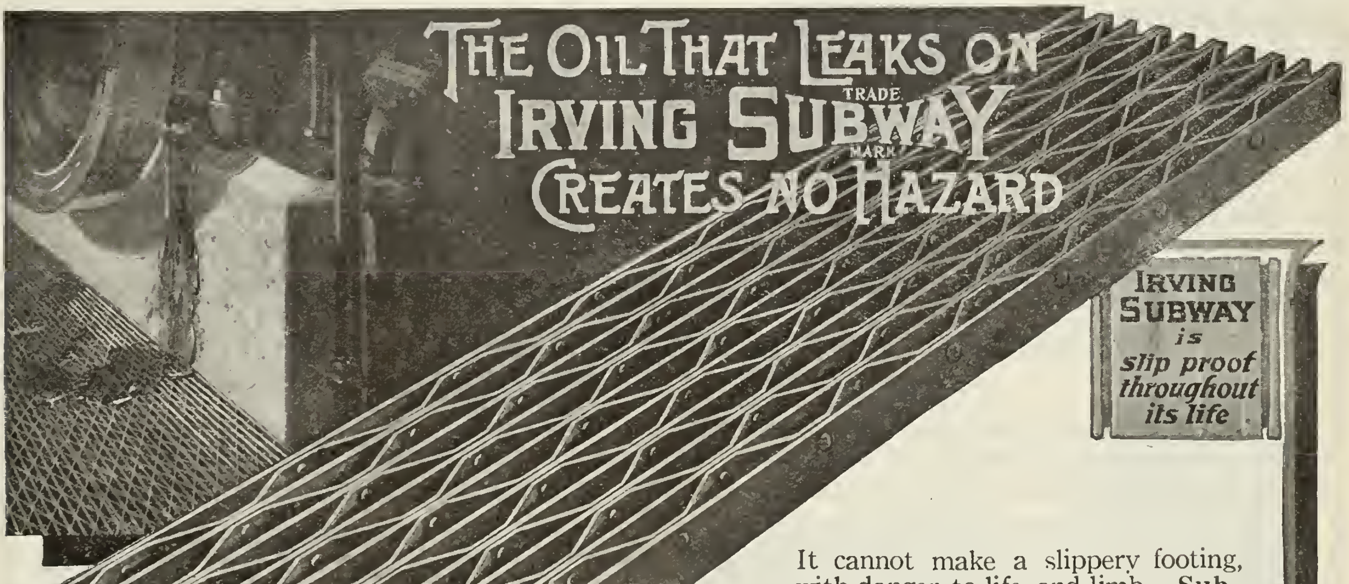

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For Alphabetical List of Advertisers see page 54

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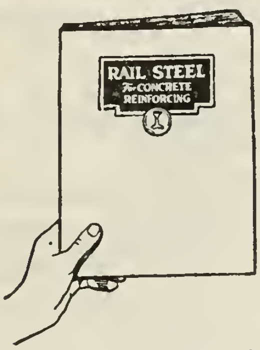

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TENDERS

SEALED Tenders addressed to the undersigned, and endorsed "Tender for Two Steel Caissons, Esquimalt, B.C." will be received at this office until *12 o'clock noon, Thursday, November 6, 1924*, for the construction of Two Steel Floating Caissons for the New Drydock at Esquimalt, B.C.

Plans and forms of contract can be seen and specification and forms of tender obtained at this Department, at the offices of the District Engineers, Post Office Building, Victoria, B.C.; Post Office Building, New Westminster, B.C.; Equity Building, Toronto, Ont.; Postal Station "H", Montreal, Que.; Post Office Building, Quebec, Que., and Custom House Building, St. John, N.B., and at the Post Offices, Vancouver, B.C., and Esquimalt, B.C.

Tenders will not be considered unless made on printed forms supplied by the Department and in accordance with conditions contained therein.

Each tender must be accompanied by an accepted cheque on a chartered bank, payable to the order of the Minister of Public Works, equal to 5 per cent of the amount of the tender. Bonds of the Dominion of Canada or bonds of the Canadian National Railway Company will also be accepted as security, or bonds and cheque if required to make up an odd amount.

NOTE.—Blue prints can be obtained at this Department by depositing an accepted cheque for the sum of $50.00, payable to the order of the Minister of Public Works, which will be returned if the intending bidder submit a regular bid.

By order,
S. E. O'BRIEN,
Secretary

Department of Public Works,
Ottawa, September 20, 1924.

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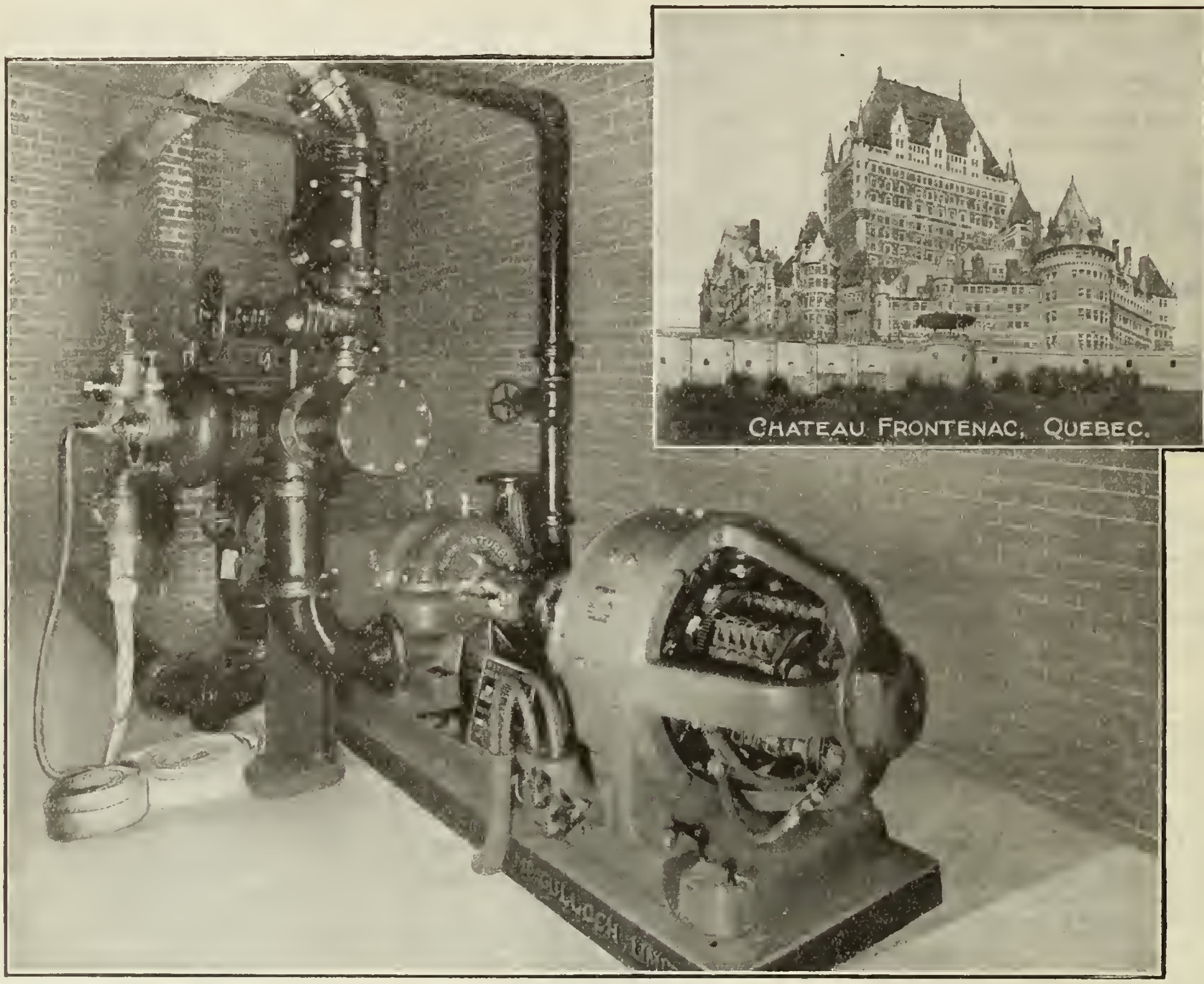

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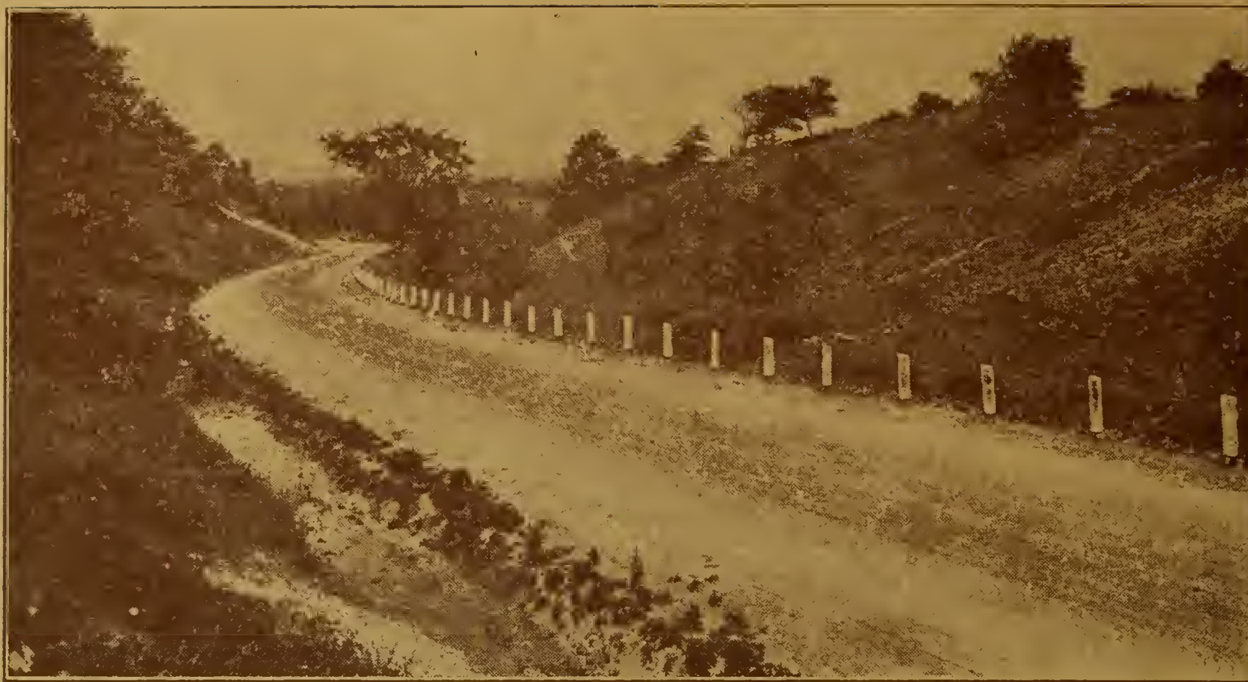

THE

ENGINEERING JOURNAL

THE JOURNAL OF THE ENGINEERING INSTITUTE OF CANADA

"TO FACILITATE THE ACQUIREMENT AND INTERCHANGE OF PROFESSIONAL KNOWLEDGE AMONG ITS MEMBERS, TO PROMOTE THEIR PROFESSIONAL INTERESTS, TO ENCOURAGE ORIGINAL RESEARCH, TO DEVELOP AND MAINTAIN HIGH STANDARDS IN THE ENGINEERING PROFESSION AND TO ENHANCE THE USEFULNESS OF THE PROFESSION TO THE PUBLIC"

THE ENGINEERING INSTITUTE OF CANADA FOUNDED 1887

NOVEMBER 1924

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AT 176 MANSFIELD STREET, MONTREAL

Vol. VII   No. 11

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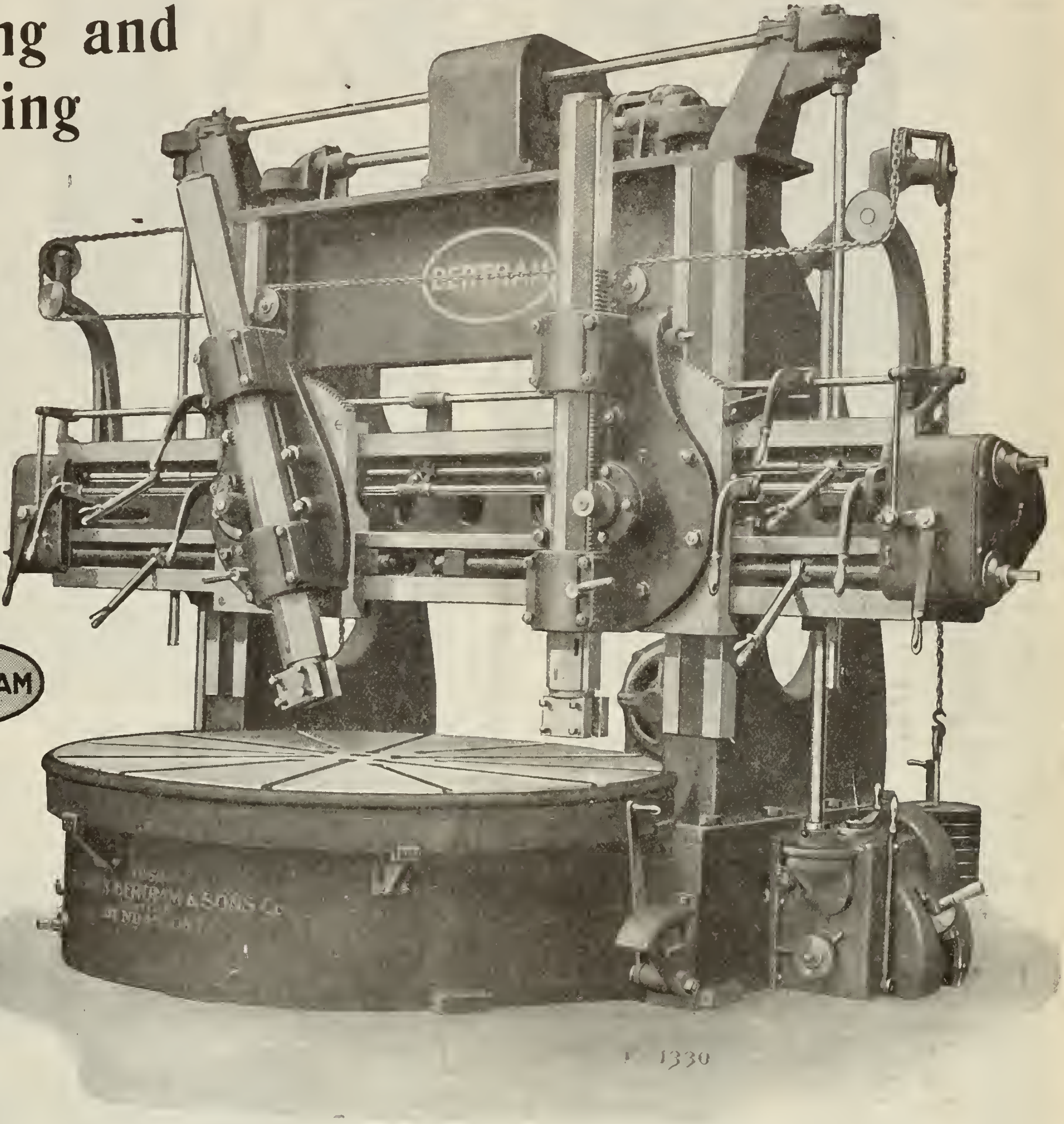

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ALTHOUGH many generations have come, lived upon and vanished from Canadian soil since this Dominion became a British possession, it is only a short hundred years ago that the first steps were taken to make Canada a great commercial Power within the Empire. This significant act was the transference of leases of mines and minerals of Nova Scotia from the Duke of York to the General Mining Association.

It took place in 1825. Immediately, operations were commenced upon a comprehensive and systematic scale, the Association expending £300,000 between 1825 and 1846 in opening mines and developing the coal industry. Coal production was increased from 21,000 tons in 1828 to 294,000 tons in 1858.

This was the first step towards a great commercial Canada. But it was not enough. Canada had a great destiny. And even so early as 1858 men of broad vision foresaw the vast possibilities of Nova Scotian coal and mineral development which should bring about a revolution in the standing of the Dominion of Canada.

In 1882 there came into being the Nova Scotia Steel Company, forerunner of the greatest commercial organization in Canada—The British Empire Steel Corporation.

The British Steel Empire Corporation gathered into one mighty system the many individual companies engaged in coal and iron ore production, steel manufacture, ship-building, shipping and allied activities. Development was accelerated to a pace commensurate with the needs of the country. Cost of production and operation was reduced to the minimum. The country prospered exceedingly.

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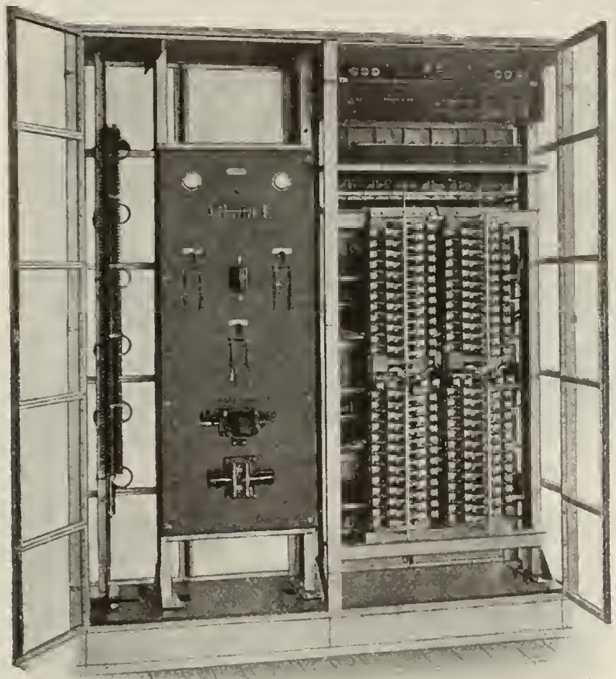

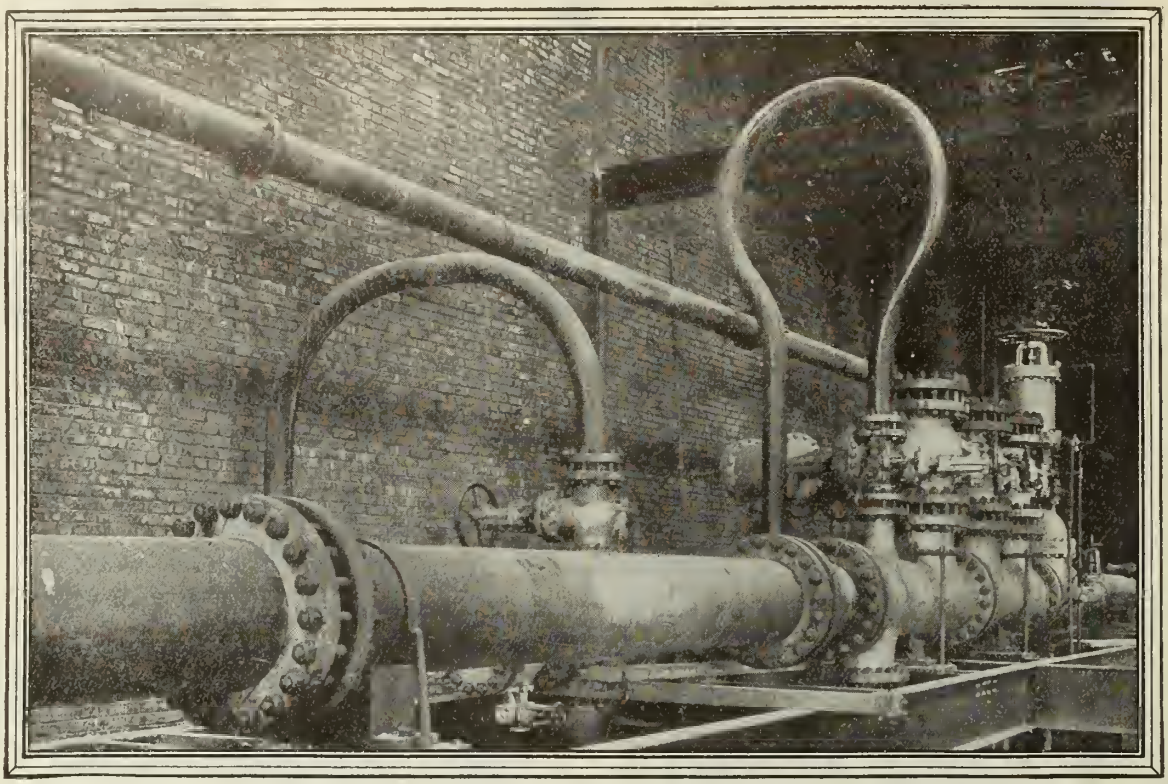

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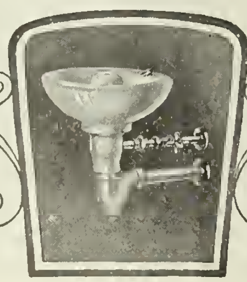

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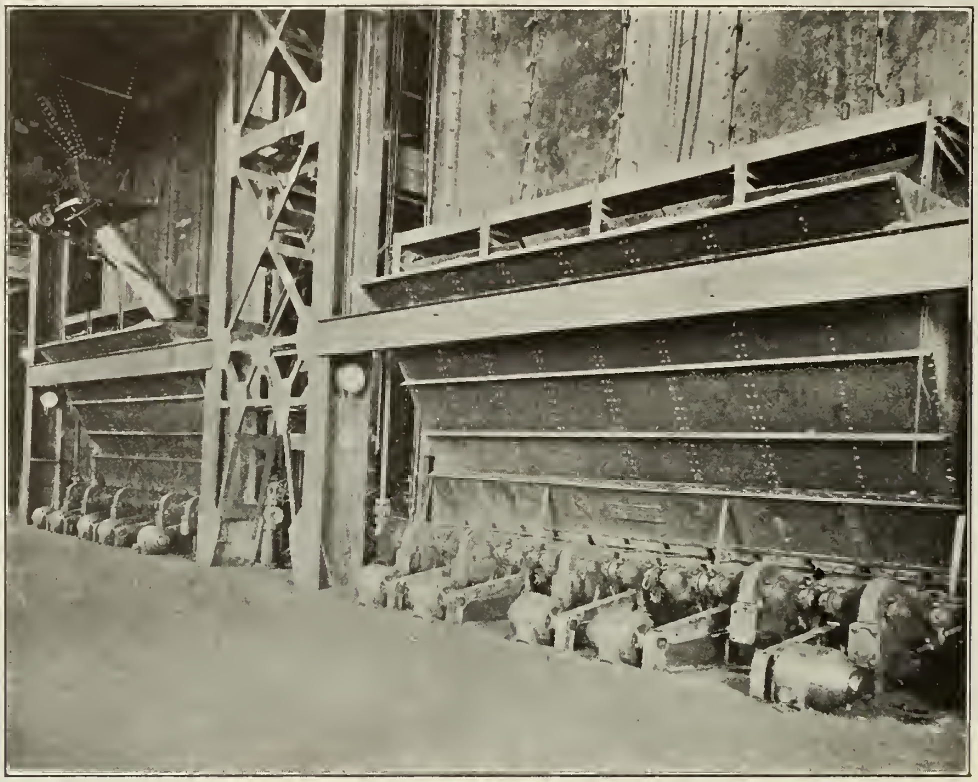

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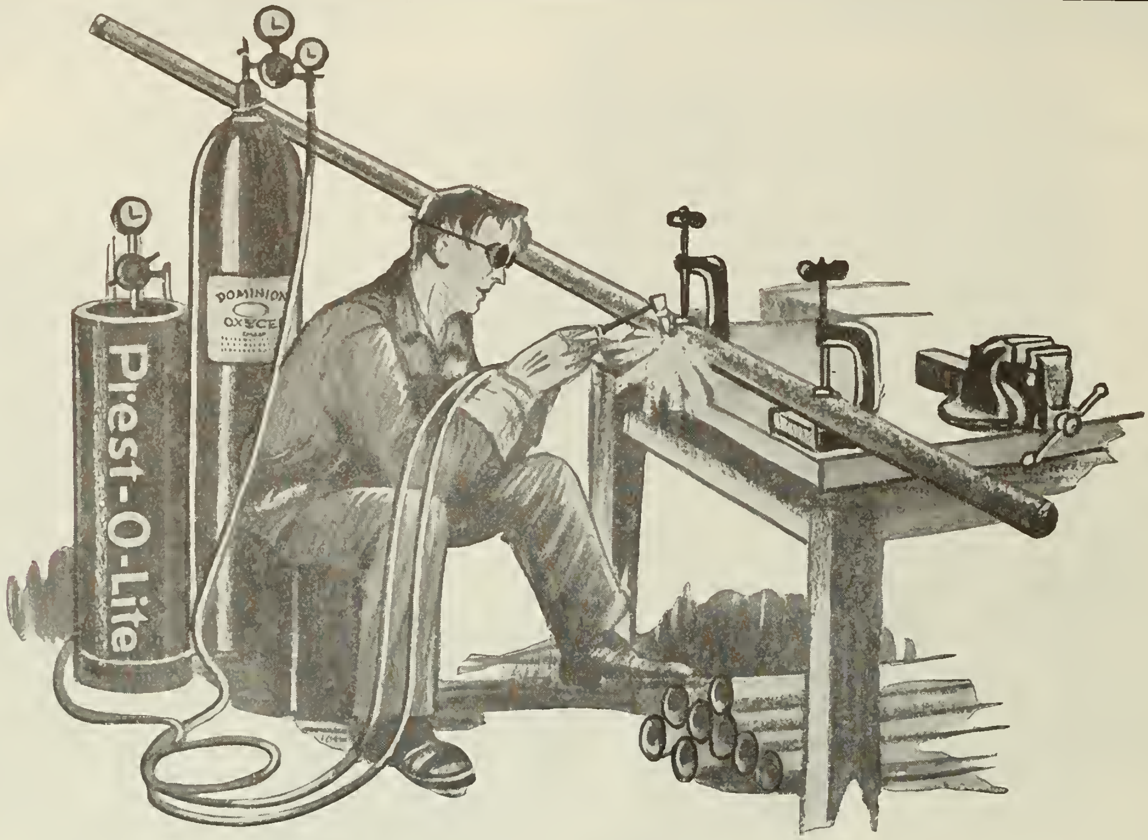
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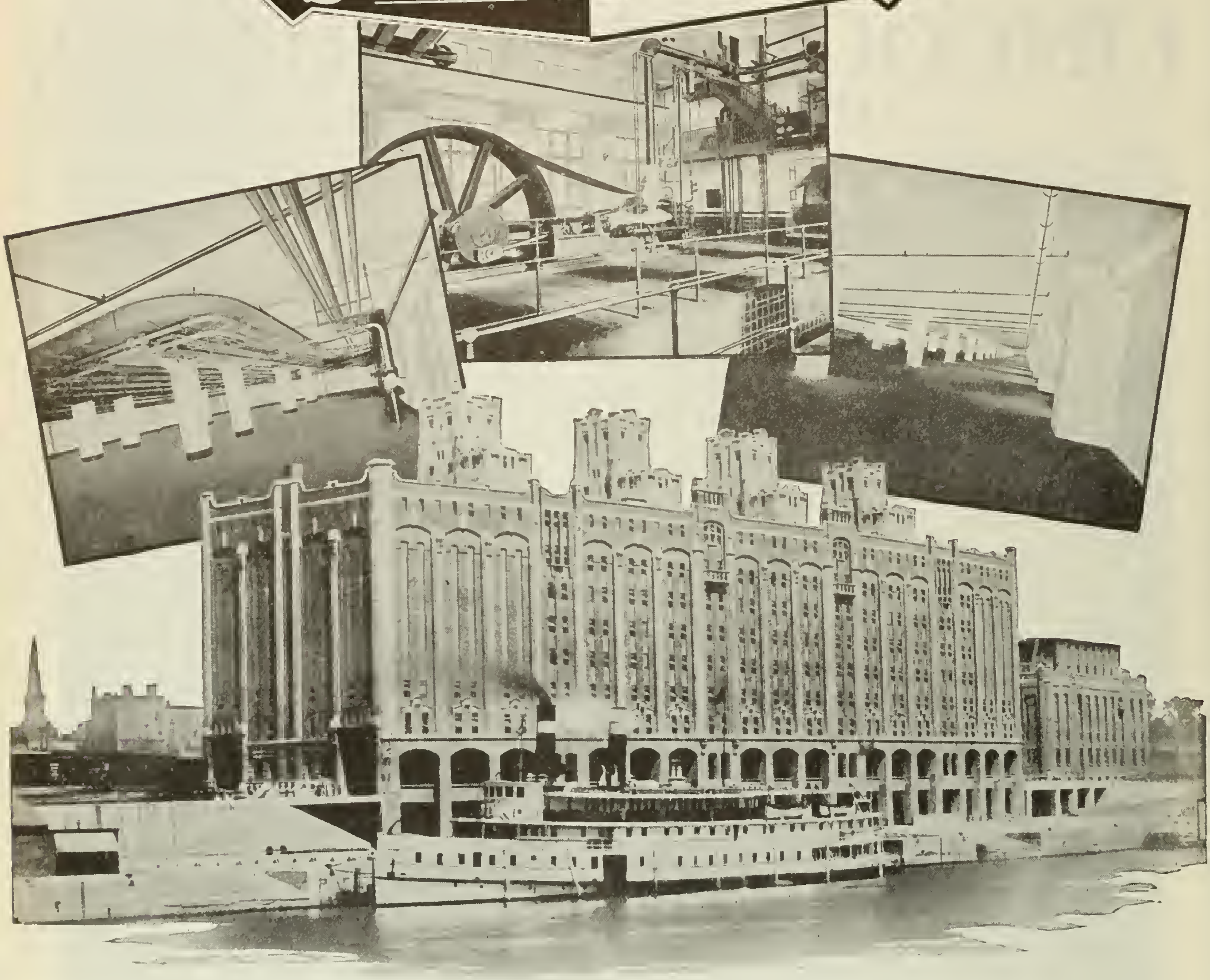

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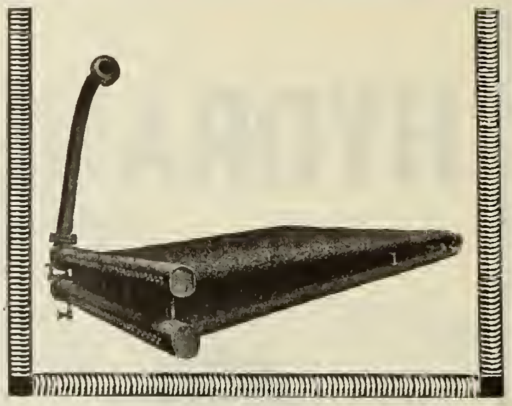

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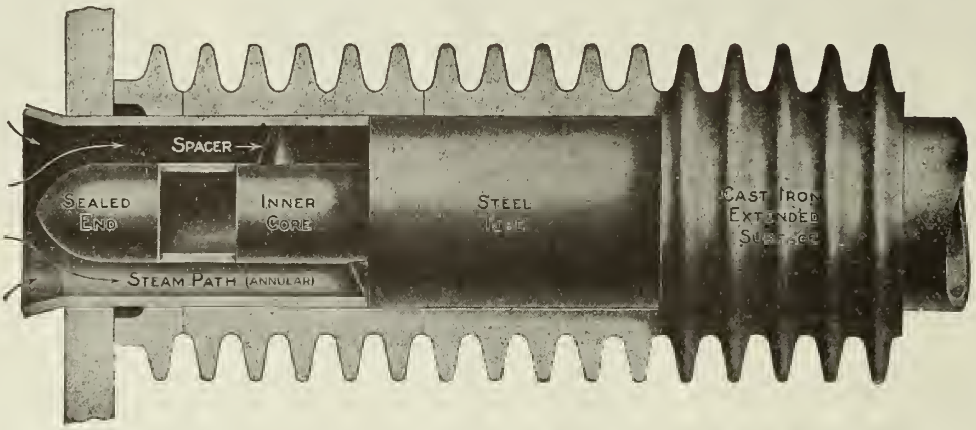

A short uncovered portion at each end of the tube permits the ends to be inserted and expanded into the connecting headers

Note the Inner Core Tube with Spacer Pieces

This holds the Inner Tube Central and provides an Annular Space through which the steam Flows. By this means the heat reaches every part of the flowing steam by travelling a shorter distance than if it had to reach the centre of the Tube. This cut also shows the Cast Iron Spools or Extended Surface which protects the Outer Surface of the Steel Tube from the corroding effect of the Gases of Combustion and from burning tubes during starting or stand by periods.

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In Marine installations there are two distinct Types of Superheaters. 1st The Waste Heat Type which comprises a bank of Foster Elements—as shown in cut—placed in the Path of the Hot Gases after they leave the boiler and are on the way to the stack. Waste Heat only is used in these Superheaters and with 70° of Superheat we find a saving of over 10% in fuel is obtained. 2nd The Flue Type which comprises a bank of bare tubes which are inserted in large tubes in Scotch Marine Boilers. This Type is similar to Locomotive Type. With 200°F. Superheat the Flue Type gives a saving in fuel of about 14%. In Locomotive practice fuel savings of 25% are obtained regularly. Further examples of Actual Savings-Horizontal Return Tubular Boiler—207° Superheat—Fuel Saving 22% to 25%. Scotch Marine Boiler, Tug Service, Superheat 50° Fuel Saving 14¾%, 85° Savings of 20½%.

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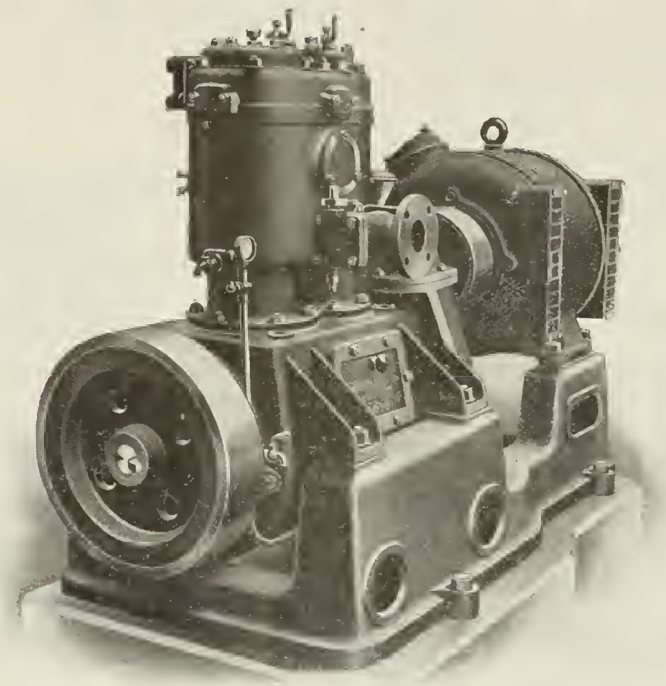

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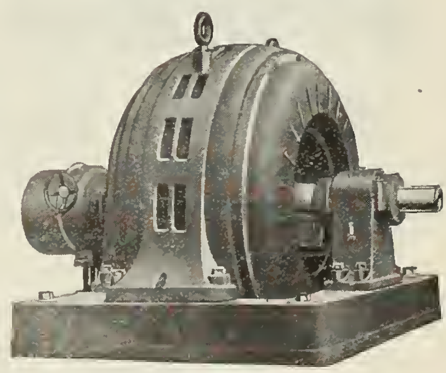

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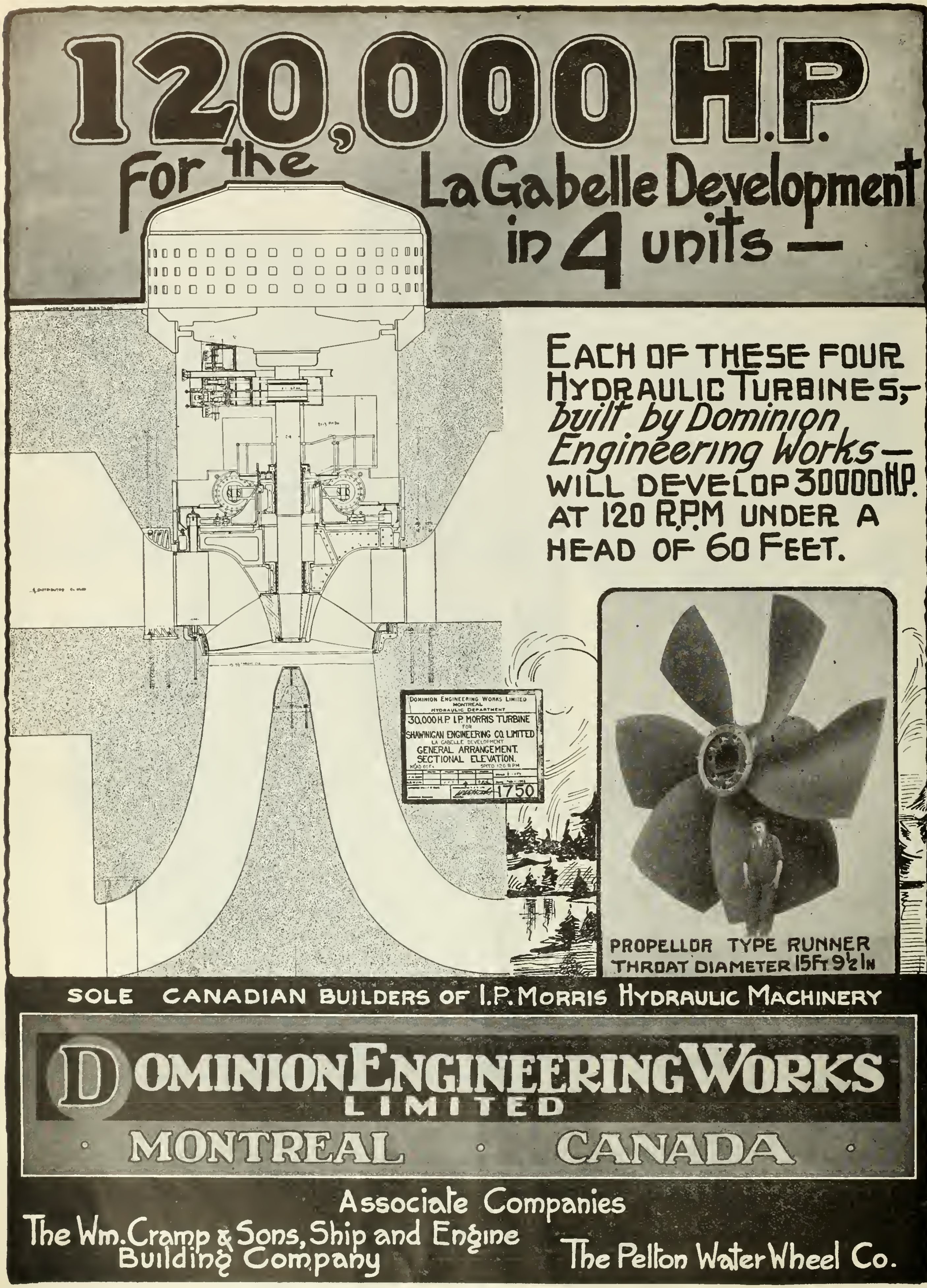
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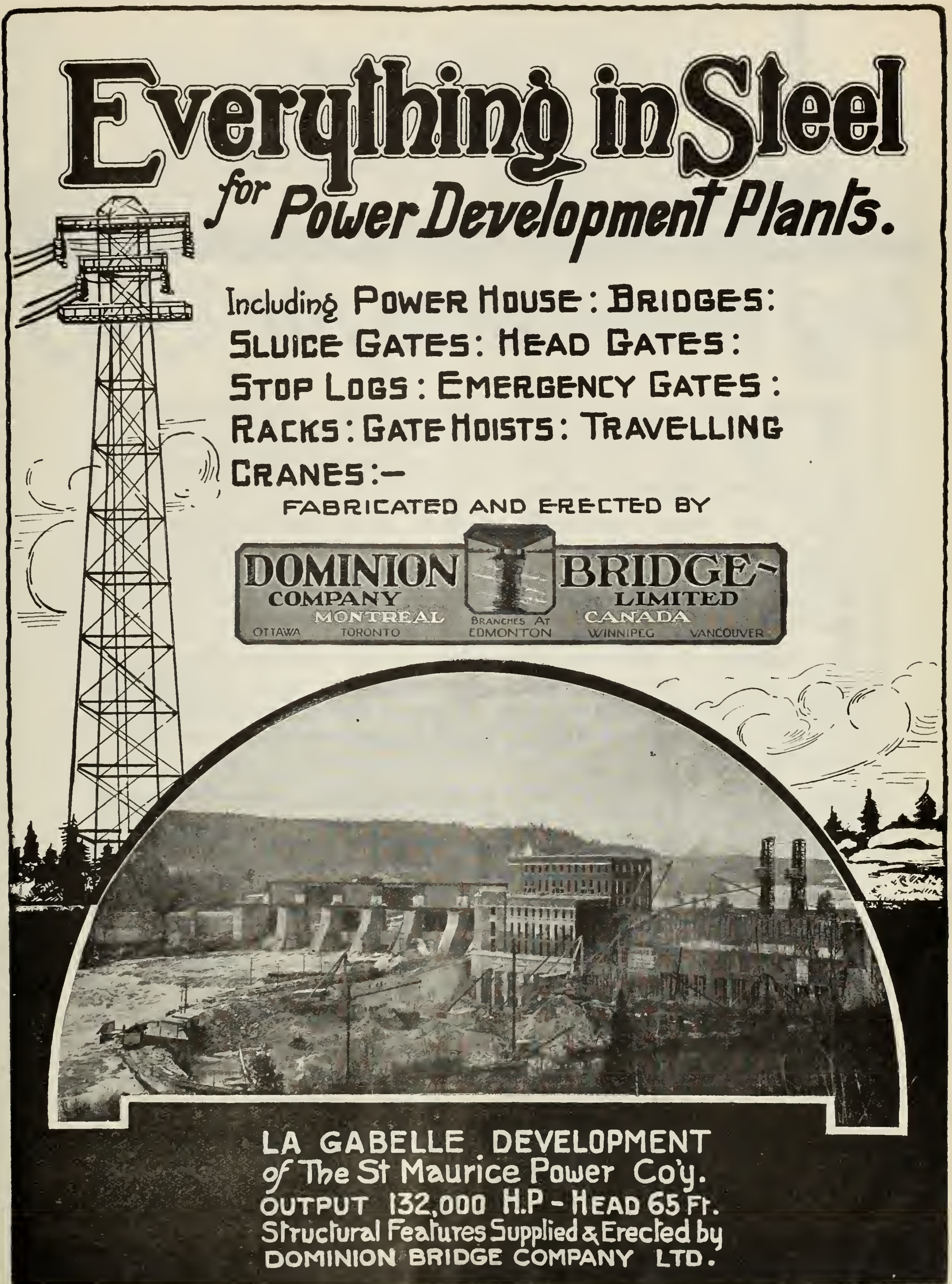
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Concrete in Sea Water

The Results of Tests of Specimens of Concrete placed in St. John Harbour

A. G. Tapley, A.M.E.I.C.,
Assistant Engineer, Department of Public Works, Canada, St. John, N. B.

Paper read before the St. John Branch, The Engineering Institute of Canada, April 17th, 1924.

During the summer of 1922, W. G. Chace, M.E.I.C., was instrumental in having a length of concrete pipe forwarded to St. John, N.B., for testing purposes, from the Lock Joint Pipe Company, East Orange, N. J. The dimensions of this pipe are, length 10 feet 2½ inches, outside diameter, 1 foot 3⅛ inches, and inside diameter, 12 inches. The pipe was made by their centrifugal process, and does not contain any reinforcement.

There was a skin on the inside surface of the pipe, one-eighth of an inch in thickness. This skin showed numerous small cracks throughout, which were only discernible by the application of water. The outside surface of the pipe showed a close dense mixture, with sand showing on the surface, and with no voids, excepting small air-holes about the size of a pinhead. This pipe was immersed at half-tide elevation, on the wall at the head of Slip No. 2, at West St. John, N. B., on December 4th, 1922.

Details of Test Specimens received from Ottawa

During August 1922, eighteen concrete cylinders, 6 inches by 12 inches, were received from the laboratory for testing materials, Department of Public Works, Ottawa. Details of these are given in the following extracts from letters received from E. Viens, A.M.E.I.C., director of the laboratory.

*"The series of specimens are completed and have been allowed to mature in water in the laboratory for over two months.

"Six different series were made comprising the following mixes:—

Series 1. 1–6 mix.
" 1A. 1–6 mix plus 7.5 per cent diatomaceous earth of the weight of the cement.
" 2. 1–8 mix.
" 2A. 1–8 mix plus 7.5 per cent diatomaceous earth of the weight of the cement.
" 3. 1–10 mix.
" 3A. 1–10 mix plus 7.5 per cent diatomaceous earth of the weight of the cement.

"Identical series of specimens to the above will be sent to the Pacific sea water and to the western alkali soils. We are keeping specimens of each series in water, under laboratory conditions, the object being to have the specimens that will stand the test sent back to this laboratory in a year or two, or more years, as it may be warranted by the durability of the specimens, and test every specimen for crushing strength against the specimens kept in the laboratory".

*"We shipped to you yesterday, six boxes of concrete specimens to be placed in sea water under your care. The boxes contained three specimens each and the specimens are labeled on lead tags inserted into the concrete. The reading of these labels is as follows:—

	Series	Month	Date	Year
Box No. 1 cylinders.....	1	2	22	1922
Box No. 2 cylinders.....	1A	2	23	1922
Box No. 3 cylinders.....	2	3	20	1922
Box No. 4 cylinders.....	2B	3	22	1922
Box No. 5 cylinders....:	3	4	4	1922
Box No. 6 cylinders.....	3C	4	5	1922

Memorandum Re Concrete Specimens Shipped on August 10th, 1922

**"In table No. 1 are given some of the characteristics of the aggregates, the sieve analysis of the crushed limestone, of the sand, and also of the combination of crushed stone and sand used in the specimens.

*Letter dated July 6th, 1922, from E. Viens, A.M.E.I.C., director of laboratory for testing materials, Ottawa, to A. Gray, M.E.I.C., engineer-in-charge, St. John, N.B.

*Letter dated August 11th, 1922, from E. Viens, A.M.E.I.C., to A. Gray, M.E.I.C

**Memorandum enclosed with letter dated August 24th, 1922, from E. Viens, A.M.E.I.C., to A. Gray, M.E.I.C.

Table No. 1.—Characteristics of Aggregate and Sieve Analysis.

	Crushed Limestone	Ottawa River Sand	Proportions 1 part sand 2 parts limestone
Specific gravity.......	2.70	2.68	2.69
Weight per cubic foot..	122.00	100.00	118.00
Voids per cent........	27.70	40.00	30.00
Per cent passing sieve			
1.50 in.	100.00	......	100.00
1.00 in.	74.80	......	83.20
.75 in.	65.40	......	77.00
.50 in.	36.10	......	57.40
.25 in.	10.00	100.00	40.00
No. 10	.80	99.00	34.10
No. 20	.50	92.00	31.40
No. 30	......	55.00	19.00
No. 40	......	30.50	10.00
No. 50	......	25.50	8.50
No. 80	......	6.00	2.00
No. 100	......	2.30	1.00
No. 200	......	.50	.20

"The limestone used is of good quality, but the sand is inferior, having a tensile strength of only 66 per cent of standard sand. The weakness of this sand is apparently due to a film of organic matter surrounding the grain, for when washed in a warm solution of sodium hydroxide, it gives a higher tensile strength than standard sand.

"You will notice the low weight (118 pounds) per cubic foot, and also the high percentage of voids (30 per cent) of the combination of the aggregate used in the specimens. That was done intentionally; the purpose being to obtain a more or less porous concrete that would permit the alkaline solutions to permeate it and thereby enable us to note the difference of endurance between the neat concrete and the concrete containing the admixture of diatomaceous earth.

"Table No. 2 gives the mix and the percentage of water used in each series. The diatomaceous earth is in addition to the other materials:

Table No. 2.—The Mix and Percentage of Water Used.

Series	Mix by weight Cement	Aggregate	Diatomaceous earth in per cent of weight of cement	Per cent water used
1	1	6	none	8.50
1A	1	6	7.5	9.00
2	1	8	none	8.34
2B	1	8	7.5	8.84
3	1	10	none	7.75
3C	1	10	7.5	8.25

"Eighteen samples of each series were made, and three of each series were sent to the following points and individuals:—

A. Gray, M.E.I.C., engineer-in-charge, P.W.D., St. John Harbour, St. John, N.B.

J. E. St. Laurent, M.E.I.C., district engineer, P.W.D., Winnipeg, Man.

A. Griffin, superintendent of operation and maintenance, Dept. of Natural Resources, Can. Pac. Railway, Brooks, Alberta.

Professor G. M. Williams, A.M.E.I.C., University of Saskatchewan, Saskatoon, Sask.

E. Brydone-Jack, M.E.I.C., supervising engineer, P.W.D., Victoria, B. C.

"Three samples of each series are being kept here under laboratory conditions to be tested for compressive strength at some future time.

"As stated before, the intention of the test is purely to find whether an admixture of diatomaceous earth to concrete has any beneficial effect for alkali soils and sea water concrete works. The length of time the test should last will have to be judged by the individual parties to whom the specimens have been sent, after inspecting them at different intervals.

"It is also the wish of the department to have all of the specimens that will not completely disintegrate during the test shipped back so that a photograph and the compressive strength may be taken."

There were three specimens of each mix, and one of each was placed about low water, half-tide, and high water, on the wall at the head of Slip No. 2, at West St. John. They were immersed on December 4th, 1922.

Notes on 1923 Specimens

One year ago, during a visit to St. John, of Colonel H. C. Boyden, of the Portland Cement Association, the test specimens at West St. John were visited and Colonel Boyden expressed a wish that Professor Duff A. Abrams, M.E.I.C., of the Structural Materials Research Laboratory, Lewis Institute, Chicago, might have an opportunity to consider our problem. The writer agreed to forward to Professor Abrams samples of the sand and gravel taken from the sea beach in the vicinity of Negro point, and did so. A reply was received from Professor Abrams, a copy of which follows:—

*"We have received the samples of sand and gravel which you forwarded to us as mentioned in your letter of May 25th. These samples are identified by our Lot No. 6767 and 6768.

"Attached are two copies of our report on these samples. The sand is somewhat fine for best results and would be improved by the addition of a coarse sand which contained a large proportion of particles ranging in size from No. 16 to No. 4 sieve. A coarse, well-graded concrete sand gives a fineness modulus of 2.75 to 3.25.

"However, we believe this sand can be used with good results if the following precautions are observed:—

(1) Reduce quantity of sand used to a minimum which will produce a workable concrete.
(2) Slight increase in quantity of cement as compared with the quantity required for a well-graded sand.
(3) In any case, the quantity of mixing water should be the minimum which will give a plastic concrete.

"With the gravel available, and the somewhat richer mix usually employed in sea water concrete, an aggregate mixture in the proportions of about 28 per cent sand and 62 per cent gravel, by volume, will give a workable mix. In a 1-1.3-3.3 mix, (about 1 cement to 3.9 total mixed aggregate), about 1.8 barrel of cement per cubic yard of concrete would be required.

"The above-mentioned mixtures contain a little less cement than the 1-1½-3 mixture used in your tests which you have under way.

"The ill effects of the fineness of the sand can be partially overcome by reducing the quantity of sand to a minimum as suggested above. We shall be very glad indeed to know the results of test, which you may carry out with the mixtures suggested above. We believe it would also be of interest if concrete mixtures using the same quantity of cement were made up with a graduated series of sand contents — for example, 22 per cent, 25 per cent, 28 per cent, 33 per cent, 40 per cent, etc., of the total aggregate."

Tests of Concrete Aggregates

From — St. John, N.B., Canada.
Sent by — A. Gray, M.E.I.C., engineer of Public Works.
Sand and gravel from sea beach; samples identified as follows:— Sand, — Our Lot No. 6767. Gravel, — Our Lot No. 6768.

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*Letter dated July 25th, 1923, from Prof. D. A. Abrams, M.E.I.C., to A. Gray, M.E.I.C.

Table No. 3.—Sieve Analysis

Number or size of sieve	Size of square opening. Inches	Amount coarser than each sieve per cent by weight Lot No. 6767	Lot No. 6768
100	.0058	100	100
50	.0117	83	100
30	.0232	33	100
16	.0469	8	100
8	.093	1	100
4	.185	0	100
3/8 inch	.37	–	87
3/4 inch	.75	–	37
1½ inch	1.5	–	0
	Fineness modulus*	2.25	7.24

*Sum of per cent in sieve analysis, divided by 100.

Table No. 4.—Miscellaneous Tests

	Lot No. 6767	6768
Unit weight — lb. per cu. ft.	104.0	112.0
Organic impurities, by colorimetric test	Trace	—
Silt, — per cent by weight	0.4	—

Discussion of Tests.

The sieve analysis shows that this sand is too fine for best results if used in concrete in the *ordinary* proportions. The particles range in size from the No. 100 to the No. 16 sieve.

The coarse aggregate is well-graded from the No. 4 sieve to 1½ in. and is composed of hard, *durable* particles.

The silt content of the sand was low; the colorimetric test for organic impurities showed only a trace of organic material.

Correct (Sgd.) R. D. ROBERTSON.
Approved (Sgd.) D. A. ABRAMS.
Professor in Charge of Laboratory.

Additional Test Specimens Prepared

As a result of this letter, additional test specimens, Nos. *A3* to *A7*, inclusive, were made during October 1923, details of which are given in table No. 11. All of these specimens were, approximately, six feet long by twelve inches by fourteen inches, containing about one-quarter of a cubic yard. Two cylinders, six inches by twelve inches, were made for each specimen. One cylinder has been placed with the specimen, and the other was stored in the air.

In these specimens, the cement content was maintained at 1.8 barrels per cubic yard of concrete, while the aggregates were made of from 22 per cent to 40 per cent of sand, and 78 per cent to 60 per cent of gravel. Sand and gravel were taken from the sea beach in the vicinity of Negro point. Both sand and gravel were thoroughly dried before using by being placed on sheets of galvanized iron, under which fires were built. Analysis of this material is contained in Professor Abrams' letter. Water used in the mixing was fresh water taken from the city mains.

These specimens were all hand-mixed. First the sand and gravel were thoroughly mixed together, then the cement was added, and the whole mixed again; then the water was added, and the mixture was again turned as it received the water. Specimens were all mixed in one batch. Forms were removed in about one week, when the specimens were ponded or totally immersed for one month before being finally placed in position at or near the mid-tide elevation on the end wall of Slip No. 2 at West St. John.

In addition to the foregoing, four other specimens were cast and numbered *T1* to *T4*, inclusive. These were of the same size as the other specimens. Two cylinders, six inches by twelve inches, were made for each specimen. One cylinder has been placed with the specimen, and the other was stored in the air.

The sand and gravel were similar to that used in the 1923 "*A*" specimens, being dried in the same way, and the mixing water was fresh, being taken from city mains. Specimens *T1* and *T3* are of the proportions of 1-1-2 proportioned in the usual way with the cement content being at the rate of 1.8 barrels per cubic yard of concrete.

A-1 March 4, 1922. A-1 April 12, 1924. A-2 March 4, 1922. A-2 April 12, 1924.

Figure No. 1,—Concrete Test Blocks A—1 and A—2.

T1 received an admixture of plasterer's cattle hair, but there was no hair in *T3*. *T2* was proportioned 1-2-1, i.e., one of cement, two of sand, and one of gravel; 1.8 barrels of cement was used to the cubic yard of concrete. *T2* also received an admixture of plasterer's cattle hair. *T2* is a good deal of a curiosity specimen, as the writer was curious to see just how double the amount of sand would compare with the other specimens. The hair was added to the specimens to see if it would assist their density *T4* is of the proportions of 1-1-2, but was proportioned by weight instead of by volume. This gave it about one-seventh more cement content.

In all of the *T* specimens, the aggregates were thoroughly mixed together; the cement and water were thoroughly mixed together; and the two mixtures were then thoroughly mixed with each other. Specimens were hand-mixed in one batch. Forms were removed in about one week, and specimens were then ponded for one month before being placed in position at or about mid-tide elevation on the end wall of Slip No. 2.

Table No. 11 gives more detailed information concerning all the foregoing specimens.

Information concerning the condition of the specimens and cylinders, upon removal of moulds, has been kept. It will only be necessary to mention here that they were all in first class condition, with the exception of numerous small air voids on the faces.

We also treated two of the 1920 specimens which were badly disintegrated with a 1 to 3 mortar mixture containing 10 per cent by weight of the cement of "Rockwall" plaster, applied with a cement gun. One of these specimens was reinforced with wire, but the other had no reinforcing. These were also immersed at mid-tide elevation, on the end wall of Slip No. 2, at West St. John.

NOTE: — All of the 1923 specimens were placed in the middle cage of the frames which held the 1920 specimens, replacing 1920 specimens which had totally failed. A plan of these frames accompanied the 1921 report.

G. N. Hatfield, A.M.E.I.C., road engineer for the city of St. John, made two specimens. One specimen was of asphaltic concrete, weighing 557 pounds. In size it measured 3.65 feet by 1.2 foot by 0.97 foot. The other specimen was of sheet asphalt, weighing 562½ pounds. In size it measured 4.22 feet by 1.3 foot by 0.97 foot. Following is a copy of letter from Mr. Hatfield, giving details of the specimens. They were also immersed at mid-tide elevation on the end wall of Slip No. 2, at West St. John, N. B., on November 26th, 1923.

*"Concerning the sample blocks of asphalt submitted to you for test purposes, might say that the asphalt used is known by the trade name of "Beacon", and is a distilate of Mexican crude oil. This was fluxed or cut back with Mexican asphaltic oil obtained at the McAvity plant, East St. John, the resultant hardness of the asphaltic cement was about 80 degrees by the standard needle, which is the penetration of a No. 2 needle under 100 grams weight for 5 seconds at 77 degrees fahrenheit.

"The sample with the heavy I-bolt was constructed of equal parts of crushed trap rock ranging from 1¼ inch down to ¼ inch, and beach sand, all of which was heated to 300 degrees F., to which was added the asphalt cement at 225 degrees F., in the proportion of 85 pounds of asphalt to 9 cubic feet of mixed stone and sand, all of which were mixed in a mechanical steam jacketed mixer. One face of this block was painted with hot asphalt, the other three sides are as they came out of the form. The composition of this block is known as asphaltic concrete.

*Letter dated November 27th, 1923, from G. N. Hatfield, A.M.E.I.C., to A. G. Tapley, A.M.E.I.C.

B-1 March 4, 1922. B-1 April 12, 1924. B-11 March 4, 1922. B-11 April 12, 1924.

Figure No. 2,—Concrete Test Blocks B—1 and B—11.

T-1 Jan. 14, 1924. T-2 Jan. 14, 1924

Figure No. 3,—Concrete Test Blocks T—1 and T—2.

Jan. 14, 1924. April 12, 1924.

Figure No. 4,—Asphaltic Concrete and Sheet Asphalt Test Blocks.

"The other sample is composed of materials known as that used in sheet asphalt, and is constructed of sand and asphaltic cement about 110 pounds of asphalt to 9 cubic feet of sand; the method of mixing, etc., applies to both samples."

We also immersed a block of granite at the same place and elevation. This block weighs 586 pounds and measures 4.65 feet by 1.15 foot by 0.74 foot. This was immersed on November 16th, 1923.

Water Analysis

Samples of the water were taken from the harbour at Slip No. 2, West St. John, and also from the centre of the basin at Courtenay bay. They were taken at high water, half-ebb, low water, and half-flood in each case. They were forwarded to the laboratory at Ottawa for analysis, a copy of which follows:—

Table No. 5.—*Analysis of Eight Samples of Sea Water from St.John Harbour, Submitted November 2nd, 1923

Samples from Slip No. 2 West St. John: No. 1, high water; No. 2, half-ebb; No. 3, low water, No. 4, half flow.

Sample from centre of basin, Courtenay bay: No. 5, high water, spring tide; No. 6, half-ebb, neap tide; No. 7, low water, spring tide; No. 8, half flow, neap tide.

Parts per 1000	Sample Numbers 1	2	3	4	5	6	7	8
Sodium Chloride	22.654	20.197	23.770	21.175	20.161	19.742	21.750	20.517
Magnesium Bromide	0.336	0.299	0.352	0.314	0.299	0.293	0.322	0.304
Magnesium Chloride	2.944	2.624	3.087	2.752	2.620	2.565	2.824	2.664
Potassium Sulphate	1.247	1.112	1.309	1.166	1.110	1.087	1.198	1.130
Magnesium Sulphate	0.704	0.630	0.744	0.658	0.628	0.615	0.681	0.643
Calcium Sulphate	1.387	1.234	1.449	1.297	1.232	1.207	1.326	1.249
Total	29.272	26.096	30.711	27.362	26.050	25.509	28.101	26.507
Total solids determined by evaporation	29.276	26.100	30.716	27.364	26.054	25.512	28.106	26.512

*From letter dated February 7th, 1924, from E. Viens, A.M.E.I.C., to A. G. Tapley, A.M.E.I.C.

You will notice that there is not much difference between the totals obtained by the addition of the salts by analysis and that by direct evaporation of the water. This small difference is within the experimental error, which shows that the contamination of the water is negligible. You will also notice that there is considerable difference in the salinity of the water at different stages of the tide, but we cannot arrive at any conclusion for this variation. However, this may mean more to you than it does to us.

The analysis shows that in both places the water is more saline at low water, and also that it is more saline at West St. John than at Courtenay bay. One familiar with the locality would look for the reverse in both cases.

Compression Tests

The 6-inch by 12-inch cylinders for the 1923 specimens, also those of *A2*, *B5*, *B7*, *B11* and *B13* of the 1921 specimens, were forwarded to the laboratory at Ottawa, and were broken for compression during March 1924. A copy of results obtained, and also compression tests made on August 14th, 1922, which concern several of the same specimens, viz., *A2*, *B5*, *B7*, *B11*, and *B13*, is given below. Attention may be drawn to the very material increase in strength in these specimens between August 1922 and March 1924.

Table No. 6.—Compression Test on 16 Concrete Cylinders, 6" x 12", shipped to Ottawa February 1st, 1922.

The specimens after having been capped and kept under water for six months were tested for their compressive strength. The results are tabulated below:

Specimens	Date made	Date of test	Compressive Strength Lbs. per sq. in
A-1	Sept. 27, 1921	Aug. 14, 1922	3957
A-2	"	"	3169
B-3	"	"	1030
B-2	Sept. 28, 1921	"	1008
B-6	"	"	2438
B-9	"	"	No strength, fell apart.
B-4	Sept. 29, 1921	"	2437
B-7	"	"	2418
B-8	"	"	3013
B-5	Sept. 30, 1921	"	2657
B-10	"	"	2558
B-11	"	"	2858
B-12	Oct. 5, 1921	"	1776
B-13	"	"	1661
B-14	"	"	1266
B-15	Oct. 21, 1921	"	2044

Table No. 7.— *Tests of Fourteen Cylindrical Concrete Specimens in connection with Sea Water Test, submitted February 27th, 1924

The above specimens not having parallel faces were capped with a rich cement mortar, and cured in water for eight days, and then tested for their compressive strength. The results obtained are tabulated below:—

Specimen	Tag marks	Comp. strength lbs. sq. in.	Remarks
A-2	1-1.8-2.6 Abrams	4254	All of these specimens appeared to be dense and had remained dry after being in water for eight days.
A-3	C1-S22-G78	4312	
A-4	C1-S25-G75	4415	
A-5	C1-S28-G72	4496	
A-6	C1-S33-G67	4376	
A-7	C1-S40-G60	5059	
B-5	B.Chl.Cem. 1-1.8-2.6	2990	Strong odor of lime and damp throughout.
B-7	N.R.Ochre Cem. 1-1.8-2.6	3461	Dry.
B-11	C.Ochre Cem. 1-1.8-2.6	3878	Dry.
B-13	Pa.Al.Cem. 1-1.8-2.6	3943	Peculiar odor and damp throughout.
T-1	1-1-2	3735	Foreign matter in specimen.
T-2	1-2-1	1675	Too much fine material, damp throughout.
T-3	1-1-2	3283	Good, somewhat damp.
T-4	1-1-2	5448	Very dense and dry.

A study of the results of March 1924, is very interesting, all of the *A* specimens running over 4,200 pounds to the square inch, that of *A7* reaching 5,059 pounds per square inch, and all remaining dry after being immersed for eight days.

Of the *B* specimens, *B7* and *B11* stand out prominently, as they remained dry after 8 days' immersion, and reached a crushing strength of 3,461 and 3,878 pounds respectively.

Of the *T* specimens, *T4* is the most remarkable, as after 8 days' immersion it remained very dense and dry, and reached the compressive strength of 5,448 pounds per square inch, being the greatest reached by any of the specimens.

Table No. 10 gives the present physical condition of specimens *A2*, *B5*, *B7*, *B11* and *B13*, as well as other specimens. The present physical condition of the 1923 specimens remains the same as when immersed.

Table No. 8.— Analysis of the Cement used in 1923 Specimens

Date — Oct. 4, 1923. Brand — Canada Cement.
Engr. — A. Gray. Work — Concrete in sea-water test specimens, St. John Harbour, N.B.

Physical Tests

Sample No.	Car No.	Tensile Strength lbs. per sq. inch 1 to 3	Age at test
1	Bought from stock	340	7 days
2	from local retailer.	331	7 days

Setting Initial	Setting Final	Fineness per cent passing No. 200 sieve	Soundness test Pats	Normal consistency
1 h. 50 m.	4 h. 30 m.	80.86	O.K.	10.20

Chemical Analysis.

Insoluble residue	0.42	Sulphur anhydride	1.85
Magnesia	3.35	Loss on ignition	1.64

The above results meet with the requirements of the Standard Specification for Portland Cement of the Canadian Engineering Standards Association.

I find that "Canada" Portland cement averages in weight 86 pounds per bag. U. S. Cement weighs 94 pounds per bag. It would be well to bear this in mind when making use of U. S. tables or formulas in designing work.

*Letter dated March 24th, 1924, from E. Viens, A.M.E.I.C., to A. Gray, M.E.I.C.

Perhaps it would be the better plan to consider the specimens in groups as follows:—

1920 specimens	Group *A*
1921 specimens	" *B*
Cylinders from Ottawa laboratory	" *C*
1923 specimens	" *D*
Special (specimens treated with cement gun, asphaltic concrete, etc.)	" *E*

The specimens in group *A* have been immersed through four winters. The greater number of them have proved total failures. A few are standing up fairly well, but mostly show signs of disintegration so that it is merely a question of time until they also fail. The outstanding specimen is *P35*, a 1-3-5 dry mixture. This specimen at present is in fair condition, but shows slight disintegration on bottom corners.

These blocks were all pre-cast, being air-cured for periods varying from one week to two months. Several of these specimens, immersed at the high water stage, are in good condition, but the same mixtures placed at lower stages of the tidal range have proved failures, so that we may consider all of this group as having failed, or being on the way to failure. Their disintegration has been rapid, but we must not lose sight of the severe conditions they were called upon to combat. These conditions apply to all specimens.

Group *B* specimens have been immersed through three winters. These specimens were mainly cast in place and covered by the following tide. The majority of them contained admixtures. *A1* and *A2*, which did not contain admixtures, are going at the top.

The outstanding specimens of this group are *B1* and *B11*. These specimens show no change since being immersed. *B1* was made by the Lock Joint Pipe Company. It was precast, and air-cured for three months, and contained an admixture of puddled clay. *B11* contained about 10 per cent of powdered red metallic oxide,

With reinforcing. Without reinforcing.
Figure No. 5,—Gunite Test Blocks.

Table No. 9—Test Specimens Concrete in Sea Water, Group A

No. specimen	Proportions	Kind of mixture	Tidal elevation centre of block	Immersed in 1920	Condition April 20 1921	Condition March 6, 1922	Condition March 24, 1923	Condition March 31, 1924
P 1	1-1½-3	Med.	10.9	Sept. 27	Cracking around gravel voids at top	Slightly disintegrated	Seriously disintegrated	Gone completely
P 2	"	Dry	18.3	"	Bottom of block going for one foot up	" "	Bottom going badly	" "
P 3	"	Med.	25.0	"	Good condition, no change	Good	No change	
P 4	1-2-4	Wet	10.9	Sept. 29	Bottom and edges going slightly	Slightly disintegrated	Seriously disintegrated	Seriously disintegrated on bottom and top
P 5	"	"	18.3	"	" " " " "	" "	" "	Gone completely
P 6	"	"	25.0	"	Good condition, no change	" "	Going slightly on bottom	Gone badly on bottom
P 7	1-3-5	"	10.9	Sept. 30	Bottom and edges going slightly	Seriously "	Gone completely	Gone completely
P 8	"	Med.	18.3	"	" " " " "	" "	" "	" "
P 9	"	"	25.0	"	Good condition, no change	Slightly "	Seriously disintegrated	Gone badly on bottom
P 10	1-1½-3	"	10.9	Oct. 6	" "	Excellent	Fair, going slightly on edges	Outer surface (skin) going on corners
P 11	"	"	18.3	"	" "	"	Going slightly on bottom	" " " lower corners
P 12	"	"	25.0	"	" "	"	Excellent	Excellent.
P 13	1-2-4	Wet	10.9	Oct. 8	" "	"	Fair, going on edges	Outer surface (skin) going on corners and [top
P 14	"	Med.	18.3	"	" "	"	Excellent	Going slightly on one corner
P 15	"	"	25.0	"	" "	"	"	" " bottom corners
P 16	1-3-5	Wet	10.9	Dec. 13	Going slightly on top edges	Seriously disintegrated	Seriously disintegrated	Gone completely
P 17	"	"	18.3	" 14	Good condition, no change	" "	" "	" "
P 18	"	"	25.0	" 14	" "	Slightly "	Going on bottom	Going on bottom and corners
P 19	1-2-4	"	10.9	" 17	" "	" "	Fair, going on bottom edges and top	Badly gone on bottom, top and corners
P 20	"	Med.	18.3	" 17	" "	Excellent	Good, going slightly	Going on back seriously
P 21	"	"	25.0	" 17	" "	"	Excellent	Excellent
P 22	"	Dry	10.9	" 18	" "	Good	Fair, going slightly on corners	Going seriously back and top
P 23	"	"	18.3	" 21	" "	"	Good	Gone completely
P 24	"	"	25.0	" 21	" "	Slightly disintegrated	Going on bottom	Going on bottom
P 25	"	"	10.9	" 18	Going slightly on top edges	Seriously disintegrated	Seriously disintegrated	Gone completely
P 26	"	"	18.3	" 21	" " edges	" "	" "	Going seriously on bottom and corners
P 27	"	"	25.0	" 21	Good condition, no change	Good	Excellent	Going on bottom corners
P 28	1-3-5	"	10.9	" 7	Going slightly on edges	Seriously disintegrated	Seriously disintegrated	Seriously disintegrated
P 29	"	"	18.3	" 7	" "	" "	" "	Gone completely
P 30	"	"	25.0	" 7	Good condition, no change	" "	" "	" "
P 31	1-2-4	"	10.9	" 7	Going slightly on top edges and bottom	Slightly "	Fair, going on edges	Seriously disintegrated
P 32	"	"	18.3	" 8	" " " " "	" "	" "	Gone completely
P 33	"	"	25.0	" 8	Going slightly on bottom edges	" "	Going on bottom	Going on bottom
P 34	1-3-5	"	10.9	" 17	Good condition, no change	Good	Good, going slightly	Going seriously on bottom and back
P 35	"	"	18.3	" 18	" "	"	Excellent	Going very slightly on bottom corners
P 36	"	Med.	25.0	" 20	" "	"	"	
				1921				
P 37	1-1½-3	"	19.3	Feb. 11	Washed overboard from platform			
P 38	1-2-4	"	19.3	"	Good condition, no change	Washed overboard from platform		
				1920				
S 1	1-1½-3	Med.	10.9	Oct. 5	Expansion on corners slight	Slightly disintegrated	Seriously disintegrated	Gone completely
S 2	"	"	18.3	"	Bottom going slightly, otherwise good	" "	Fair, going on bottom	Slight disintegration on bottom
S 3	"	"	25.0	"	Good condition, no change	" "	Going on bottom	Gone completely
S 4	1-2-4	Wet	10.9	"	Gone badly bottom, edges, sides and top	Seriously "	Gone completely	" "
S 5	"	"	18.3	"	Gone badly on top edges and lower corners	" "	Seriously disintegrated	" "
S 6	"	Med.	25.0	"	Good condition, no change	Slightly "	Going on bottom	" "
S 7	1-3-5	Wet	10.9	Oct. 6	Bad on top showing crack 1½ feet long at top	Seriously "	Seriously disintegrated	" "
S 8	"	Med.	18.3	"	Fair condition	Fair condition	" "	" "
S 9	"	"	25.0	"	Good condition, no change	Seriously disintegrated	" "	Seriously disintegrated
S 10	1-1½-3	"	10.9	Oct. 8	" "	Excellent	Fair, slightly disintegrated	Fair, slightly disintegrated
S 11	"	"	18.3	"	" "	"	" "	" "
S 12	"	"	25.0	"	" "	"	Excellent	Excellent
S 13	1-2-4	"	10.9	Dec. 13	Going on top cracking 6" down from top	Seriously disintegrated	Gone completely	Gone completely
S 14	"	Wet	18.3	"	Very bad condition, going all over	Gone completely	" "	" "
S 15	"	Med.	25.0	"	Going slightly on bottom	Seriously disintegrated	" "	" "
S 16	1-3-5	"	10.9	Dec. 17	Going slightly on bottom, top and edges	" "	" "	" "
S 17	"	"	18.3	"	Going slightly on corners and top edges	" "	" "	" "
S 18	"	"	25.0	"	Bad on lower corners	" "	" "	" "
S 19	1-2-4	"	10.9	Dec. 20	Going slightly on top edges	Slightly "	Seriously disintegrated	" "
S 20	"	"	18.3	"	Going slightly on edges and faces	Seriously "	" "	" "
S 21	"	"	25.0	"	Good condition, no change	" "	Gone completely	" "
S 22	"	Dry	10.9	Dec. 9	Going slightly on top edges and corners	" "	" "	" "
S 23	"	"	18.3	"	Bad condition, no change	" "	" "	" "
S 24	"	"	25.0	"	Poor, going on bottom edges and corners	" "	" "	" "
S 25	"	"	10.9	"	Going on edges, corners and top quite badly	" "	" "	" "
S 26	"	"	18.3	"	Bad condition, going all over	" "	" "	" "
S 27	"	"	25.0	"	Going badly on bottom edges and corners	" "	" "	" "
S 28	1-3-5	"	10.9	Dec. 7	Going on top, edges, and bottom	" "	Seriously disintegrated	" "
S 29	"	"	18.3	"	" " "	" "	" "	" "
S 30	"	"	25.3	"	Going on bottom, edges and corners	" "	" "	" "
S 31	1-2-4	"	10.9	Dec. 8	Poor, going top, edges and bottom	" "	" "	" "
S 32	"	"	18.3	"	" " " "	" "	Gone completely	" "
S 33	"	Med.	25.0	"	Poor going on bottom edges,	" "	Seriously disintegrated	" "
S 34	1-3-5	"	10.9	Dec. 18	Good condition, no change	Good	" "	" "
S 35	"	"	18.3	"	" "	"	" "	" "
S 36	"	Dry	25.0	Dec. 20	" "	Seriously disintegrated	" "	" "
				1921				
S 37	1-1½-3	Med.	19.3	Feb. 10	Bad condition, going all over	Washed overboard from platform		
S 38	1-2-4	"	19.3	"	" " "	" " " "		

NOTE. — Datum is L.W.O.S.T. Elevations above datum. Tidal range 28 feet.

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(commercial ochre), and was cast in place, and immersed by the following tide.

Many of these specimens are going at top and bottom. This may be due to sand predominating at these points, and having the cement content washed out before getting a final set. These specimens do not show the cracks on the faces, as was the case with the group *A* specimens.

The group *C* specimens all consisted of 6-inch by 12-inch cylinders, one-half of which contained an admixture of diatomaceous earth. All these blocks show wear, thus exposing their coarse aggregate. They have been immersed for two winters.

The group *D* specimens have only been immersed for one winter. Full details of them are shown in tabular form.

Of the group *E* specimens, the specimens treated with the cement-gun have only been immersed one winter. The asphaltic-concrete and sheet asphalt have only been immersed one winter.

General Remarks

It is the writer's opinion that, in northern waters, the main damage to concrete in sea water is caused by mechanical action, through freezing and otherwise, rather than chemical action. In the study of our specimens, it has been observed that during the summer months disintegration is not discernible, while in the winter months it is very rapid.

No doubt a certain amount of chemical action occurs mainly through the sulphates and carbon dioxide, but I am of the opinion that the lower temperatures of the sea water in northern latitudes has a tendency to greatly retard this action, while the warmer temperature of those latitudes where frost does not occur accelerates chemical action.

It has lately been demonstrated that if concrete be placed in a strong saline solution, and the solution then be heated to evaporation that salts will be deposited in the pores of the concrete. These salts then expand with results, to the concrete, similar to freezing action.

If we take a piece of concrete and partially immerse it in water, we shall find that the water runs up inside it to a higher level than outside; and the more hair-like the passages in the concrete, the higher the water will run. This is due to its capillarity. The rising of the water in the concrete has nothing whatever to do with the atmospheric pressure.

Even when most carefully prepared from materials of the highest grade, concrete is not of itself completely waterproof. In large masses of actual work, it is difficult to produce concrete of such close texture as to prevent undesirable seepage at all points.

When through absorption and capillarity, the pores of the concrete become saturated with water and frost receives the opportunity to act on this water, the result is very similar to that which occurs when a water pipe freezes. After each successive freezing, erosion occurs and the next freezing penetrates deeper into the concrete, until it is destroyed.

It is not only in sea water that damage occurs to concrete through freezing, as a number of structures on the Great Lakes have been so damaged, viz., at Port Arthur, Fort William, Sault Ste. Marie, and the concrete footings of the transmission towers of the Ontario Hydro-Electric Commission.

Also, some stones that are liable to be destroyed by the effects of frost on first being taken from the quarries, are no longer so after being exposed for some time to the air, having lost their quarry water through evaporation. This difference is very manifest between stone quarried in summer and that quarried in winter. It has frequently happened that stones of good quality have been entirely ruined by hard freezing immediately after being taken from the quarry; while, if they are quarried during the warm season of the year, and have an opportunity to lose their quarry water by evaporation, prior to cold weather, they withstand freezing very well.

In fact, whether it be stone, wood, or concrete, if there are pores or other shallow places, where the water is confined and held in suspension, and then subjected to hard freezing, damage will inevitably result, whether these materials be immersed in sea water or otherwise.

Table No. 10,—Test Specimens Concrete in Sea Water, Group B.

No. of Specimen	Kind of Mixture	Proportions	Tidal Elevation centre of block	Immersed 1921	Condition March 6, 1922	Condition March 24, 1923	Condition March 31, 1924
A 1	Med.	1–1.8–2.6	17.0	Sept. 27	Disintegrating slightly on edges.......	No further change..........	Top going seriously.
A 2	Dry	"	"	"	" " " bottom....	" "	One top corner going badly.
B 1	Wet	1–1.5–2.5	"	Oct. 13	" " " "	" "	No further change.
B 2	Dry	1–1.8–2.6	"	Sept. 28	" allover..............	Seriously disintegrated.......	Seriously disintegrated.
B 3	Med.	"	"	" 27	" "	Gone completely.............	
B 4	"	"	"	" 29	" slightly on bottom and top	No further change..........	Going slightly on top.
B 5	Wet	"	"	" 30	" " "	" "	" " and bottom.
B 6	Med.	"	"	" 28	" " top..........	Seriously disintegrated......	Gone completely.
B 7	"	"	"	" 29	" " bottom.......	No further change.........	Going slightly on bottom, seriously on top.
B 8	"	"	"	" 29	" " top..........	" "	Going seriously corners and top.
B 9	"	"	"	" 28	Completely gone....................	....	
B 10	"	"	"	" 30	Good.....................................	Going top and bottom.......	Going seriously corners and top.
B 11	Wet	"	"	" 30	"	Good........................	Good.
B 12	Dry	"	"	Oct. 5	Disintegrating on top................	No further change..........	Gone completely.
B 13	Wet	"	"	" 5	" slightly on bottom.....	" "	Going seriously on top corners.
B 14	Med.	"	"	" 5	" seriously on bottom....	Gone completely............	
B 15	"	"	"	" 21	" slightly on bottom.....	No further change..........	Going slightly top and bottom corners.
Lock 12"	Joint Concr	Pipe Co. ete Pipe	Ltd.	1922 Dec. 4		Pipe cracked vertically half height on opposite sides, otherwise good.	Bad cracks (longitudinally) on both sides, cracks around circumference.

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Table No. 11,—Additional Test Speciment, Group D.

No. of Specimen	Kind of Mixture	Dates, All in 1923 — Of Mixing	Forms Removed	Ponded	Immersed	Kinds of Cement Used	Proportions	No. of Batches	Weights, All in Pounds — of Water in Batches	Total of Water	Total of Cement	of Specimen	per Cubic foot	of Water per Cu. foot	Volume of Concrete in Cu. Ft.	Percentage of Water to total Weight	Percentage of Water to Cement by Weight	Conditions of Concrete After Mixing	Physical Condition After Removing Moulds	Remarks
A 3	Med	Oct 1	Oct 9	Oct 9	Nov 6	Port	Cement 1 Sand 22% Gravel 78%	1	75.44	75.44	171.79	1008	148.5	11.11	6.79	7.48	43.33	Plastic mix water just coming to top on spading. Consistency of liver.	Good. All edges, corners & faces intact. A few small air voids. Material adhered slightly to mould. Sand shows on all faces. Apparently specimen was very thoroughly mixed	Temperatures - Of Air 45° Fah. Of Water 50° Fah. Sand dry. Gravel dry. Sea beach sand and gravel. Water fresh. Hand-mixed. Inside of moulds treated with soft soap. Precast and ponded before finally immersing. Gravel ¼" to 1¼" in size
A 4	Med	Oct 1	Oct 9	Oct 9	Nov 6	Port	Cement 1 Sand 25% Gravel 75%	1	71.59	71.59	171.53	993	146.5	10.56	6.78	7.21	42.32	Good plastic mix. Consistency of liver. Water just to top on spading	Good. All edges corners & faces intact. A few small air voids. Material adhered slightly to mould. Sand shows on all faces. Apparently specimen was very thoroughly mixed	Temperatures - Of Air 48° Fah. Of Water 55° Fah. Sand dry. Gravel dry. Sea beach sand and gravel. Water fresh. Hand mixed. Inside of mould treated with soft soap. Mould filled through end. Pre-cast and ponded before finally immersing. Gravel ¼" to 1¼" in size
A5	Med	Oct 1	Oct 9	Oct 9	Nov 6	Port	Cement 1 Sand 28% Gravel 72%	1	69.87	69.87	169.0	101.7	152.2	10.46	6.68	6.87	41.34	Good plastic mix. Will barely quake not soft enough to flow. Water just to top on spading	Good. Edges corners and faces in excellent shape excepting at bottom of block where gravel voids show on one corner for a vertical height of 6 inches. These voids are ⅛" to ½" in depth. A small percentage of air voids show on all faces. Sand shows on all faces. Material adhered slightly to mould. Specimen well mixed	Temperatures - Of Air 50° Fah. Of Water 52° Fah. Sand dry - Gravel dry. Sea beach sand and gravel. Water fresh. Hand mixed. Inside of mould treated with soft soap. Mould filled through end. Pre-cast and ponded before finally immersing. Gravel ¼" to 1¼" in size
A6	Med.	Oct 2	Oct 9	Oct 9	Nov 6	Port	Cement 1 Sand 28% Gravel 67%	1	80.42	80.42	170.27	998	148.3	11.95	6.73	8.06	47.23	Good plastic mix. Consistency of batter. Slumps not soft enough to flow. Water barely to top on spading	Good. Faces edges and corners are in good condition. Faces show no voids except a small percentage of pin holes caused by air. Sand shows on all faces. Material adhered slightly to mould	Temperatures Of Air 52° Fahr. Of Water 55° Fahr. Sand dry. Gravel dry. Sea beach sand and gravel. Water fresh. Hand mixed. Inside of mould treated with soft soap. Mould filled through end. Pre-cast and ponded before finally immersing. Gravel ¼" to 1¼" in size
A7	Med	Oct 2	Oct 9	Oct 9	Nov 6	Port	Cement 1 Sand 40% Gravel 60%	1	83.33	83.33	172.80	994	145.5	12.2	6.83	8.38	48.22	Good plastic mix. Will barely quake not soft enough to flow. Water barely to top on spading	Good. Faces edges and corners are in good condition. Faces show no voids except a small percentage of air holes. Sand shows on all faces. Material adhered slightly to mould	Temperatures - Of Air 52° Fahr. Of Water 56° Fahr. Sand dry. Gravel dry. Sea beach sand and gravel. Water fresh. Hand mixed. Inside of mould treated with soft soap. Mould filled through end. Pre-cast and ponded before finnaly immersing. Gravel ¼" to 1¼" in size
T 1	Med	Oct 2	Oct 9	Oct 9	Nov 6	Port	1-1-2 by volume	1	95.45	95.45	199.55	963	145.7	14.44	6.61	9.91	47.83	Good plastic mix. Consistency of batter not soft enough to flow. Water barely to top on spading	Good. Edges corners & faces all intact and showing no serious voids. No voids except a small percentage air voids. Sand shows on all faces, runs heavy in sand at top. Material adhered slightly to mould	Temperatures Of Air 54° Fahr. Of Water 56° Fahr. Sand dry. Gravel dry. Sea beach sand and gravel. Water fresh. Hand-mixed. Inside of mould treated with soft soap. Mould filled through end. 1½ bushels of plasters cattle hair added. Sand, gravel and hair mixed together. Cement and water mixed together. The two mixtures then mixed together. Pre cast and ponded before finally immersing. Gravel ¼" to 1¼" in size
T2	Med	Oct 3	Oct 9	Oct 9	Nov 6	Port.	1-2-1 by volume	1	142.49	142.49	203.78	921	136.4	21.11	6.75	15.47	69.93	Good plastic mix. Consistency of liver. Quakes but not soft enough to flow. Too heavy in sand. Water just to top on spading. Too heavy in sand. Water just to top on spading	Good. All faces, edges and corners are intact excepting for numerous small air voids. Sand predominates on all faces. Runs heavy in sand throughout. Material adhered slightly to mould.	Temperatures Of Air 59° Fahr. - Of Water 57° Fahr. Sand dry - Gravel dry. Seabeach sand and gravel. Water fresh. Hand-mixed. Inside of mould treated with soft soap. Mould filled through end. 1½ bushels of plasters cattle hair added. Sand and gravel and hair mixed together. Cement and water mixed together. The two mixtures then mixed together. Pre-cast and ponded before finally immersing. Gravel ¼"-1¼" in size
T3	Med	Oct. 11	Oct. 16	Oct. 16	Nov 16	Port.	1-1-2 by volume	1	97.30	97.30	204.97	1009	148.6	14.33	6.79	9.64	47.47	Good plastic mix. Consistency of batter. Not soft enough to flow. Water barely to top on spading	Good. All faces, edges and corners are intact except for numerous small voids. Tar from mould shows on all faces. Material adhered slightly to mould.	Temperatures - Of Air 54° Fahr. - Of Water 55° Fahr. Sand dry - Gravel dry. Sea beach sand and gravel. Water fresh. Hand-mixed. Inside of mould treated with tar. Mould filled through end. Cement and water mixed together. Sand and gravel mixed together. The two mixtures then mixed together. Pre-cast and ponded before finally immersing. Gravel ¼"-1¼" in size
T4	Dry	Oct 22	Oct 26	Oct 26	Nov 26	Port	1-1-2 by weight Cement 236.96 lbs. Sand 236.96 lbs. Gravel 473.92 lbs.	1	74.00	74.00	236.96	970	145.6	11.11	6.66	7.63	31.23	Very stiff mix. Water not showing on top after spading	This specimen contains on faces quite a few holes about the size of a bean. There is a chip at one corner at centre of specimen about 2" long	Temperatures - Of Air 49° Fahr. - Of Water 50° Fahr. Sand dry. Gravel dry. Sea beach sand and gravel. Water fresh. Hand-mixed. Inside of mould treated with graphite. Mould filled through end. Cement and water mixed together. Sand and gravel mixed together. The two mixtures then mixed together. Used a tamper of 6"x8" billet of wood weighing 30½ lbs. Pre-cast and ponded before finally immersing. Gravel ¼" to 1¼" in size

Another point concerning concrete of which we must take cognizance is cracking. By reference to the table No. 10, showing present condition of the specimens, we find that the Lock Joint Pipe Company's 12-inch pipe is cracking badly, also that the inside skin is breaking away all over. Going back to the immersing of this specimen, we find that the pipe contains no reinforcing; that this inside skin was one-eighth inch in thickness, and showed numerous small cracks, which were only discernible by the application of water. We also find that of the specimens treated with the cement gun, the one without reinforcing is showing some small cracks in the faces. In both cases, the concrete was, originally, as dense as we can expect to make it.

In most of the 1920 specimens, the first sign of disintegration was the breaking up of the faces into numerous small cracks.

It is now generally accepted that it is not possible entirely to prevent the contraction of Portland cement concrete, due to a drop in temperature or loss of moisture. It is common knowledge that most materials expand when wetted or heated, and that they contract when cooled or dried. It is not, however, generally known that in the case of concrete, the changes in bulk are influenced to a far greater degree by moisture than by changes in temperature. Concrete, in fact, swells and shrinks when wetted or dried just the same as a piece of timber, although to a much less degree. Concrete, when thoroughly saturated, expands about as much as if its temperature had been raised 1,000 degrees Fahrenheit, and it will therefore be obvious that in order to minimize this expansion and contraction, the access of moisture to the concrete must be prevented.

There are three things which we may do to ensure the maximum of immunity from cracks in concrete construction, viz:—

(1) Use either an efficient waterproof sheathing or an integral cement waterproofing process, or both.

(2) Use only clean suitable aggregates and a cool cement, which in itself is not liable to expand or contract.

(3) Reinforce the concrete by evenly distributed steel in small sections, so placed as to take up any stress which might arise in the concrete, and thus prevent expansion and distribute the movement due to contraction.

In the disintegration of concrete in sea water, in northern latitudes, what occurs is as follows:—

The water enters the pores in the concrete causing the concrete to expand to its limit. When the exterior water recedes, the water is held in the concrete. Frost then acts on this water in the concrete, causing still further expansion. The concrete is unable to withstand this final expansion, and breaks down. In St. John harbour, as mentioned in a previous article, mid-tide specimens are completely immersed for four hours, partly immersed for two hours, and subjected to hard freezing in winter seasons for six hours out of every twelve.

Comparing the compressive strength of specimens *A2* and *B11*, we find that a 10 per cent mixture of powdered red metallic oxide, (commercial ochre), caused a loss in strength to *B11* of about 9 per cent. These specimens are made from the same cement and aggregates, of the same proportions and mixed under similar conditions. Comparing their physical condition, we find that, after being immersed for three winters, *B11* shows no change whereas *A2* is going badly at the top. Unfortunately, we have no 6-inch by 12-inch cylinders of the *B1* specimen, and therefore we are not able to compare it with the others. However, from visual observation, it has the appearance of ample strength, and compares very favourably with either of the others.

This would indicate that the use of proper admixtures, in the right proportions, is beneficial more particularly in the checking of contraction and expansion in the concrete, caused either by frost, moisture or temperature. The use of the powdered red metallic oxide was found to nicely lubricate the mix. This would permit of the use of less water, and at the same time secure a suitable workability. Workability is the controlling factor in the handling of concrete. No effect in shrinkage of the concrete has been noticed from the use of admixtures.

The increased yield of concrete containing powdered admixtures is probably sufficient to offset the cost of the admixture. There would also be a saving in labour cost and greater assurance of uniformity in the finished product. The concrete made under the old accepted methods is so lacking in uniformity as to make its poorest quality subject to rapid attack from sea water, and therefore dangerous and expensive.

As to the amount of powdered admixtures to be used, this must be determined by testing for the strength of concrete desired. Every aggregate to be used must be analyzed, by either mortar-void or sieve analysis, so that the proper amount of stone, cement, sand and water may be determined to give the desired strength with a suitable plasticity or workability.

There are a number of these powdered admixtures which have been tried out and which undoubtedly are beneficial to the concrete and greatly lengthen the period of its permanency, especially when used in sea water. Some of these admixtures are patented preparations, others are not. A few may be mentioned which we know to be good, viz., celite, kaolin, hydrated lime, powdered red metallic oxide, and puddled clay. The improvement in workability, which is effected by these admixtures in the proper proportions, is about that which should be expected from a 20 per cent increase in the cement content.

We now have immersed specimens ranging in compressive strength from 1,675 pounds per square inch to 5,448 pounds per square inch. They also include specimens with and without admixtures, pre-cast, ponded, and cast in place, these latter being immersed by the next tide after casting. As pre-casting and ponding is a very expensive proposition, it should not be adopted until cast-in-place work has been definitely proven unsuitable. We should experiment further with admixtures. While some that we have used have failed, we fully expected that they would. Had they not done so, there would be no problem to be solved.

In mass work in sea water, a concrete having a compressive strength of 3,000 pounds to the square inch should be sufficient. In cast-in-place mass work, the bottom of the concrete should not be placed at a lower elevation in the tidal range than will permit of the concrete receiving its final set before being covered by the next tide.

Regarding chemical action in concrete in sea water, we have a way of ascertaining the amount of this in St. John harbour. Berth 15 at West St. John was constructed during 1914. The gravel filling behind the concrete superstructure was placed shortly after the completion of the wall. As this gravel filling has protected the concrete from frost action, by stripping away the gravel at some point, the damage caused by chemical action could be readily ascertained.

As field tests are necessarily long time tests, it seems to me that results from freezing, thawing, expansion from moisture and temperature, chemical action, etc., could all be ascertained in the laboratory in a fraction of the time in which they may be obtained in the field.

Conclusions

Concrete should be proportioned by weight. In this way, greater uniformity may be obtained. The minimum of water necessary to obtain a plastic or workable mix should be used. The cement content should be at least 1.8 U.S. barrels, or 677 pounds of cement to the cubic yard of concrete.

Where subjected to abrasion, from floating ice, logs, etc., the concrete should be protected with a suitable sheathing. The concrete should be further protected with a waterproof sheathing, or an integral waterproofing powdered admixture.

The concrete should be reinforced with steel reinforcing in such a manner as to take care of stresses arising from expansion and contraction.

A careful analysis of all gravel, stone and sand should be made by the sieve or mortar-void method, so as to accurately determine the correct amount of each, as well as the amount of water to be used.

Cement to be used should be carefully analyzed, to determine its suitability for use.

Different methods of tamping the concrete should be investigated. The vibratory method is finding considerable favour.

The use of powdered admixtures, and cast-in-place concrete, subject to immersion in a short period after placing, should be more thoroughly investigated.

The writer is convinced that cast-in-place concrete, containing a powdered admixture and properly reinforced, may be made, which will endure for much longer periods than concrete in sea water has heretofore endured, and which will compare favourably from an economical standpoint with other construction materials. Also that concrete so made may be efficiently and economically repaired by the use of the cement-gun, when necessary.

Construction joints and sharp corners should be eliminated where at all possible. Before using, the cement should be aerated or air-slaked to cool it, and thus reduce expansion in the concrete.

Electric Steam Generators

Their Development, Efficiency and Operating Costs — How they solve the Problem of the Utilization of Surplus and Off-peak Energy.

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Paper read before the Winnipeg Branch, The Engineering Institute of Canada, April 17th, 1924.

The main object of this paper is to draw the attention of all parties interested to the commercial possibilities of the electric steam generators of the water resistance type as a means to assist hydro-electric plants in disposing of their surplus or off-peak power, daily or seasonable.

It will also review briefly the different developments brought forward from time to time in order to meet either specific requirements, various conceptions, or new applications, and to remedy the possible difficulty encountered in actual practice.

Taking into consideration the general belief that the only profitable utilization of electric energy from water power was in light, power, and in metallurgic and chemical industries, the very suggestion of creating heat by electricity was at first considered as an heresy, and it has taken quite a long time before the possibilities of practical and economical uses of electricity for heat production has been seriously discussed and accepted.

During the past few years, however, electric heating has received a great deal of attention and study, due in some countries to the scarcity of coal, and in other places to the ever increasing amount of waste energy resulting from local conditions or from seasonable surplus of water power.

Electric apparatus for the heating of water were at first almost entirely built of resistance coils enclosed in tubes which were in turn immersed in the water. Although these were not meeting adequately the requirements, only slight developments took place until the idea of building a boiler along the lines of the water rheostat had been tried out and demonstrated possible. This new idea was then worked upon in several countries at the same time until several boilers specially designed for water resistance were developed and the generation of steam by electricity successfully worked out.

Features of the Water Resistance Type of Steam Generator

The construction of a steam generator of the water resistance type is extremely simple. In its simplest form it consists only of a closed vessel with ordinary boiler connections for water supply and steam line. The electric energy is made to flow through the water in the vessel from an electrode or block of electrodes, the number, form and size of which are determined by the energy required and the voltage supplied. They are generally placed vertically as separate units or in blocks, and are removable from the top, bottom or end of the generator, as most convenient with the construction adopted.

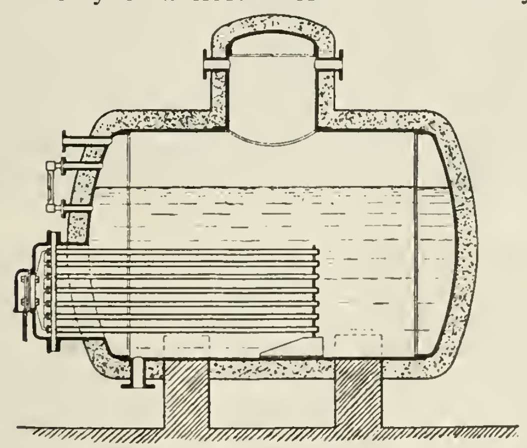

Figure No. 1.—Electric Steam Generator of the Resistance Coils Type.

The only kind of energy to be used in steam generators is alternative current at a pressure varying in general use from 100 to 6,600 volts. Owing, however, to the comparatively high resistance of some water, it has been possible in a few cases to make use of pressure as high as 20,000 volts, thereby eliminating the use of transformers, the cost of which would have been greater than the cost of the generator itself.

The resistance of water is variable in proportion of the amount of salts in solution and is lower for river water than for condensate. As the latter, however, contains always, in general use, from 20 to 40 per cent make-up water from other sources, its conductivity is found to be at a practical figure.

The resistance of water varies also in inverse proportions to its heat contents; that is to say, the resistance is decreasing as the temperature is rising; and considerable investigations and tests made with various kinds of water to determine the relations of resistance and temperature have proven that the same law applies to any kind of water.

In the course of experiments conducted this summer by the writer it has been shown conclusively that, by proper adaption of a new improvement in the construction of electric steam generators the practical maximum pressure given as 6600 volts can be safely raised much higher, as the formation of gas unavoidable at high pressure under previous conditions, has been rendered negligible by the new development even when pressure was raised step by step as high as 66,000 volts —(This last high voltage, of course, being used for experimental purposes only.)

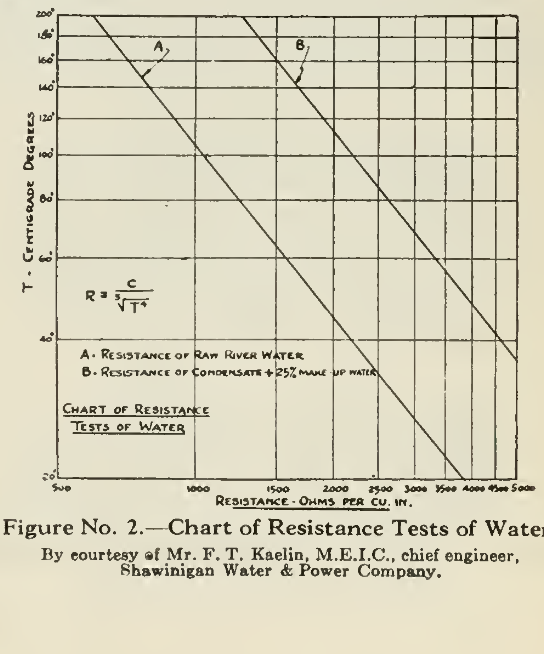

Figure No. 2.—Chart of Resistance Tests of Water.

By courtesy of Mr. F. T. Kaelin, M.E.I.C., chief engineer, Shawinigan Water & Power Company.

From these investigations a chart has been made which shows in two curves, straightened by use of logarithmic scale, the result obtained from river water (A) and from condensate water with about 25 per cent make-up water (B) the relation of resistance and temperature being expressed by the formula, $R = \frac{C}{\sqrt[5]{T\,4}}$ in which R = ohms per cubic inch, T temperature and C is a constant of 42,000 for river water and of 87,000 for condensate with 25 per cent of make-up water.

From the above explanations it can be seen that the resistance of water can very easily be controlled over a considerable range by allowing and regulating the discharge of some of the water in the generator. The purer the water and the higher the resistance the less water to be discharged in order to maintain a suitable conductivity.

A very important feature in the electric steam generator is that the generation of steam being caused by the passage of the electric current through the water, there is no heating surface, therefore none of the possible dangerous conditions affecting coal-fired boilers, such as the interruption of the feed water supply. The only effect of this in an electric steam generator is the gradual decrease in the amount of energy absorbed and the proportionate decrease in the amount of steam produced.

Development of the Electric Steam Generator

The first electric steam generator of the water resistance type of substantial size was built in Italy some twenty years ago. It was controlled by means of electrodes, which by mechanical operation, were immersed more or less in the water, thereby increasing or decreasing the active area and regulating accordingly the electric input. Owing to the difficulty of control under the above conditions, and to its limited capacity, only a small number of this type were constructed and placed in operation. Eight years after, new developments, permitting a better construction and a much easier way of control, again directed attention to the electric boilers, but, due to the war, very little was done in this direction until the last few years. During the war, however, the first really practical industrial electric steam installation was constructed for the, (Societa Italiana di Electro Chemica), Electro-Chemical Society of Italy.

Seven generators of 800 h.p., each were needed to meet the total requirements of the installation which is still amongst the largest in Europe. These generators use three-phase current at a pressure of 6,000 volts, and are made to utilize a part of the waste energy available

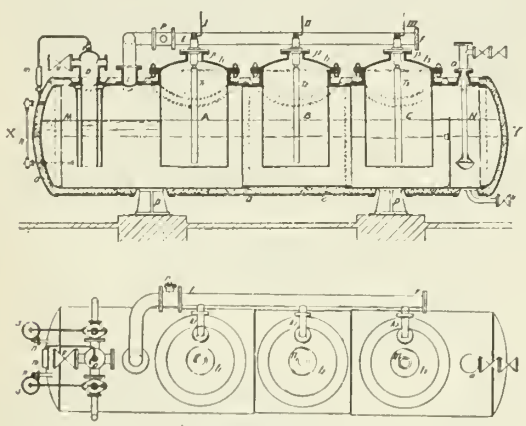

Figure No. 3.—3,500-k.w., 6,600 volts, Single Horizontal Tank Type as Manufactured in France.

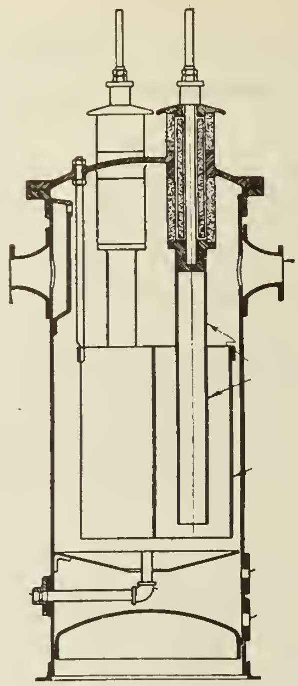

Figure No. 4.—de Kermor Single Vertical Tank Type, 3 phases.

at night from the hydro-electric plant of Naples at Pescara. This type of electric steam generator has met with favour in Italy and in Switzerland, where only relatively small installations are in demand, although the high costs of construction has somewhat retarded its development.

Its special feature, only possible on account of the limited size, is the use of a special insulator placed inside the boiler shell and partitioning it so that each electrode is partially insulated either from the metallic shell of the generator or from the other electrodes, in such a way as to lengthen the path of the current through the water and thus retain a very compact construction.

A somewhat similar type of generator is used in Sweden, but in closer keeping to the original construction of movable electrodes. According to the latest information the mechanical control of the early days has been modified to a large extent, and the depth of the electrode immersion is now regulated by means of a variable solenoid action.

In France the electric steam generator has been subjected to a total transformation and the vertical construction has been abandoned for the horizontal one for all capacities over 1,000 k.w. Under this new shape the generator has lost some of its compactness, but has gained a suppleness of operation entirely unknown in the vertical type. It is particularly noticeable in case of failure in the electric supply, when the reserve of the horizontal type can take up the load for a period of from thirty minutes to one hour without any interruption with the steam requirements.

Special Construction Requirement in America

Both the vertical and horizontal types of generator just mentioned have given very good results in their own field, but their high cost made them prohibitive, as their limitation in capacity made them impractical to meet the requirements of this country, where installations run all the way up to 50,000 k.w. Their construction had therefore to be entirely revised in order to make them suitable for the large field of operation open to them on the North American continent, so exceptionally endowed in the number and size of its water falls, the potential source of hydro-electric energy.

The first effect of this revision was to reduce from three to five times the first cost of the generator per kilowatt; the next to make a more rugged construction built to withstand any kind of treatment and to eliminate the expensive parts of replacement, thereby reducing the maintenance costs to a minimum. As a direct consequence of these improvements, there is today in operation throughout Canada and United States electric steam generators of a total capacity exceeding 250,000 k.w. The same general lines of construction have been followed in the developments of the various sizes 50 to 25,000 k.w., excepting in a new horizontal type built specially for heat accumulation and the smaller domestic sizes in which single-phase current is used.

The electrode block, in the case of single-phase generator, is made of a number of plates kept at a predetermined distance by means of porcelain bushings. In the case of generators using the three-phase element, a set of electrodes is built of three cylinders of suitable material, properly connected to the electric power lines by means of leads entering the generator shell through specially designed insulators. Each one of these cylinders is, according to the construction adopted, either partially or totally enclosed by a shield for the protection of the generator shell against any possible electric action. The same shield is sometimes made to enclose the three electrodes. It takes various shapes; it is either solid or cut with holes or longitudinal slots, and it forms, in general, the neutral point of the three-phase system.

In the vertical type of steam generator the three electrodes are placed as a complete unit in the same shell up to 2,200 volts, which has been found the largest voltage practically possible compatible with economy in costs. For any higher voltage, the horizontal construction would seem the logical solution, for it combines very commendable features and very appreciable economy in first cost. In this country, the three tank type, developed by the Shawinigan Water and Power Company, seems to have found greater favour. In this case one electrode only is placed in each tank and the three shells connected in star.

Operation and Control

The method of operation and details of control for electric steam generators may be varied in many ways to suit individual or peculiar demands of such installation. The operation may be automatic or manual, continuous or intermittent with auxiliary controls by means of

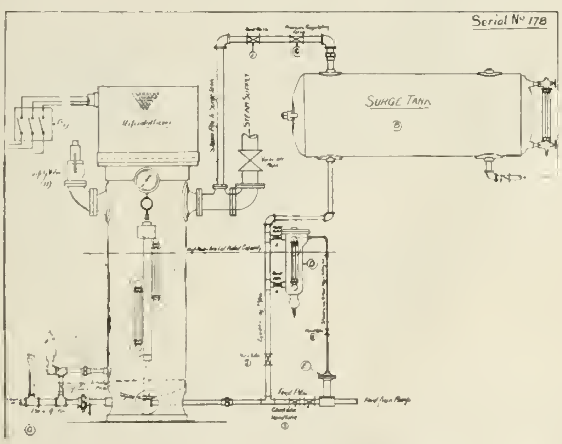

Figure No. 5.—Automatic Pressure Control by Surge Tank.

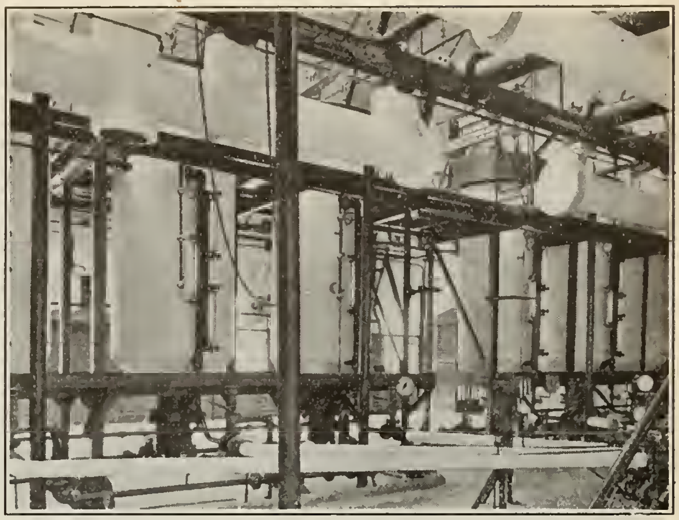

Figure No. 6.—Two 25,000-k.w., 6,600 volts, Three Tank Type Units Manufactured in Canada under de Kermor Patents.

thermostats or pressure regulators, or by means of electric relays, magnetic switches or valves, electric pump, etc.

A system of control developed about a year ago uses an electrically driven pump to regulate the depth of immersion of the electrode by controlling the speed of the motor and thereby increasing or decreasing at will the electric input of the generator. It does not, however, seem to fulfill, in actual practice, all it promised at first.

Two other systems of control seem to give a greater amount of satisfaction. The first one is entirely based on pressure and the use of a surge tank, making the operation extremely simple. At the start the steam generator is filled to a certain level. The electric circuit being closed, the water under joule effect is brought to the temperature of ebullition and steam begins to form, escaping to the system, and rising in pressure. As the pressure increases it gradually closes the pressure regulating valve on the steam line going to the surge tank, creating a slightly higher pressure in the generator and thereby causing the water level to lower.

This action has for effect to decrease in turn the electric input until an equilibrium is reached where the electric energy consumed is exactly equal to the heat required for the production of the steam demand.

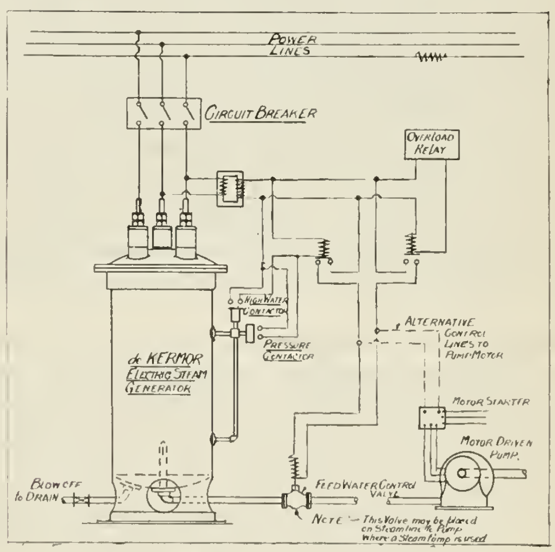

Figure No. 7.—Electric Control.

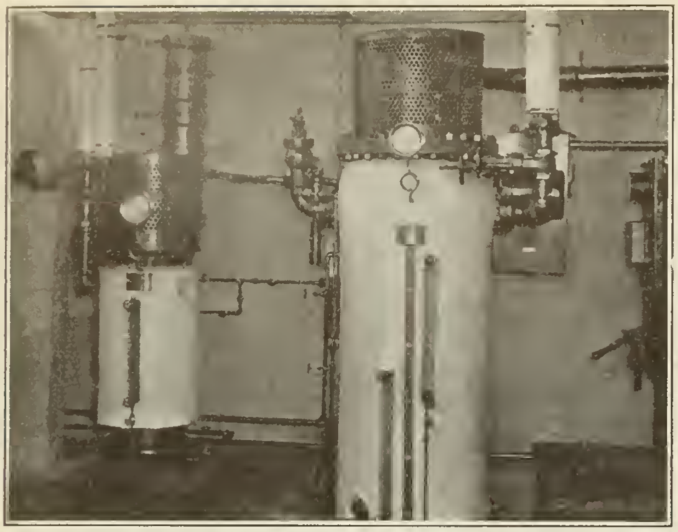

Figure No. 8.—Installations of de Kermor Electric Steam Generators for the Heating of Grace Hospital, Winnipeg.

The other control which is electric, regulates the admission of the feed water to the boiler by means of a magnetic valve or electrically driven pump. The circuit to the valve or the pump, according to the case, is opened or closed by either the water level reaching its maximum or by the pressure of steam, lowering or raising the water according to the demand for steam and acting accordingly on the electric input.

An overload attachment can also be adjusted to the control and made to meet different purposes. It can be used by a consumer of energy to insure a complete utilization of a block of power purchased on a yearly basis by directing to the generator any fraction of this energy which might at any time not be required for other purposes, and it may be used by the power distributor as an effective check against a sudden load in excess of the maximum agreed upon.

In one of the vertical types of electric steam generator, the features of the control by surge tank are incorporated in the steam generator itself. The construction consists of a double shell in which the centre one is the generating chamber with the electrode blocks. The production of steam proceeds in the usual manner until such time as the pressure rising in the system acts on the regulating valve as in the case of the surge tank, and brings about the lowering of the water level. The horizontal type is controlled in exactly the same manner, the only difference being that the generation of steam is made in a plurality of chambers instead of one, as in the previous case.

A special system of control has also been devised for the accumulation of steam produced in the electric steam generator. This control regulates the water level in the accumulation chambers, and, taking care first of the constant demand of the system, accumulates the surplus until the proper pressure is reached and the accumulation stopped.

Efficiency and Comparative Cost of Operation

The efficiency of electric steam generators, which is very high, has been found to be about 95 per cent in the smaller sizes and increases to 98 per cent in the larger size.

Figures have been obtained from users of this type of steam generator which show that in general use, one pound of coal consumed in a boiler can be replaced by electric energy averaging from 2.1 to 1.6 k.w.h., according to the degree of efficiency of the coal-fired boiler. The average found by users in Italy and Switzerland is of 1.6 k.w.h., for one pound of coal. In France the average is rising to 2 k.w.h., and in the more efficient coal plants of Canada and United States it is reaching a little higher, 2.17 k.w.h.

In the making of figures for purpose of comparison, it should not be forgotten that the first cost of a coal-fired plant is from five to ten times higher than the cost of an electric steam generator plant. In a 50,000-k.w., plant, located in eastern Canada, it was found that the first costs of $390,000 for coal-fired plant necessitated only an expenditure of $75,000 for an electrical equipment of same steam output. If, to the interest on the capital expenditure, the usual depreciation charges are added, the fixed charges are found to be $54,600 for the coal plant against $10,500 for the electric plant. To this should be added labour and repairs about eight times larger in the coal plant.

If, for the purpose of comparison, 2 k.w.h., is taken as a fair average for the energy required to replace one pound of coal, and $10 as a base price per ton of coal, net delivered in the bunkers of the power house, one sees that the equivalent electric energy should be obtained at a rate of 0.25 cent. But if one takes into account the manifold advantages of electric steam generators; great suppleness of operation, rapidity of starting and stopping without noticeable loss, easy regulation over a very wide range; and if proper allowance is made for the difference in the fixed charges, in labour, repairs, etc., a rate of at least 0.28 cent per k.w.h., would be found to be equivalent to the price of $10 per ton of coal.

It is self-evident that the figures given above cannot be applied to the computation of costs wherever intermittent service is required. In such case, as also in the case of domestic heating, electric energy at a much higher rate can be used with still very adequate economy.

Now the question is to see if the power distributors can allow practical rates and find a sufficient remuneration in this newly created demand of energy. It is a well known fact that the coefficient of daily utilization of the energy produced by hydro-electric plants rarely exceeds 70 per cent, and that very few installations have available reservoirs sufficient to hold all water in excess of their curve of consumption or that which results from temporary increases. The energy of many hours every night and of Saturdays, Sundays and other holidays also remains unused, and it is by the millions that kilowatt hours of energy thus lost can be counted.

Therefore it appears as certain that one would find in electrification of industrial and domestic boilers the

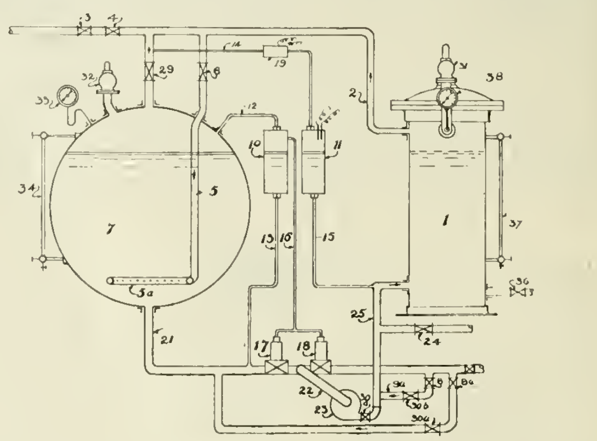

Figure No. 9.—Steam Storage Installation as made under de Kermor System of Automatic Control.

means of utilizing the greater part, if not all, of these large wastes of energy, daily or seasonable, the importance of which exceeds a quarter of the total available annually.

Thousands of steam boilers representing hundred of millions of square feet of heating surface exist throughout the North American continent, and if only a part of these boilers were electrified it would be possible to produce electrically, with no appreciable additional installation costs, the same amount of steam by using millions of kilowatt hours taken from the waste which has been spoken of. The additional receipts resulting from the sale of this energy alone would insure the very satisfactory remuneration of the additional capital and in many cases would turn an annual deficit into a profit for the hydro-electric plants.

Possible purchasers of surplus energy are everywhere. Among the first is the plant with a large installation of coal-fired boilers many times too big for summer requirements with its subsequent losses. In its case the cost of electric energy could not even be taken into consideration. Another interested party is the industrial plant developing its own water power, which generally has no reservoirs and therefore wastes the energy during the night. In the same category is the plant which purchases blocks of energy and uses the said energy only during the smaller part of the twenty-four hours each day and not at all on Sundays and holidays.

Hydro-electric Steam Storage Installations

To obtain the best possible results in such cases, hydro-electric steam storage installations have been made. The largest known to the writer is serving a cotton spinning and weaving plant in central Europe and utilizes for steam production only the energy available at night, storing the heat in tanks with a capacity of accumulation of 16,000,000 B.t.u., each, at 180 pounds pressure.

In the evening when the water turbine is free to generate electric power, the energy produced is absorbed by the electric steam generator and the resultant steam carried into the water of the storage tanks. In the morning the storage tanks filled up under high pressure are ready to deliver steam and the water turbine is reverted to the driving of the main transmission shaft in the plant. The steam consumption required by the plant is provided during the entire day by the steam taken from the storage tanks. This installation has now been in operation for years and from the records kept it is shown that the pressure in the storage tanks has been from 156 to 180 pounds after loading, and from 51 to 66 pounds after a day discharge; and the thermal efficiency of the installation, including the steam generator and the steam distribution system has been 83 per cent per cycle of 24 hours.

From all of the foregoing it can readily be understood that the power distributors are interested in allowing practical rates for this kind of service. It is beyond doubt that the existing hydro-electric plants which, after proper service to their customers, dispose further of surplus energy, have every interest to sell it. They are even interested in selling it at a rate considerably lower than the price of equivalence with coal if this reduction is necessary to encourage installation of electric steam generators. A reduction of one-tenth to one-twentieth of a cent per kilowatt hour, according to the size of the generator, would permit an amortization of all the new equipment at the end of a few months of operation. (One of the largest electric steam generator installations in the world located in Canada was paid for in this way in less than three months.)

It is not the purpose of this paper to cover also the domestic field of electric heating, which offers much larger possibilities than yet realized by the majority of power distributors, but it should be fitting to mention the technical revolutions in electricity predicted in the "Giant Power" number of the "Survey Graphic". In this number, which represents a year's work, the great possibilities in hydro-power development and in the generation of energy by burning coal at the mines are very vividly shown, and the conclusion is drawn that the day is not far off when electric heating apparatus, fed by great systems, will replace little by little the boilers now heated by coal, and the Quebec heater will be as great a curiosity as an Egyptian mummy.

Report of Institute Fuel Committee

Summary of Conclusions, Introduction, Review of Preliminary Activities.

The Fuel Committee of *The Engineering Institute of Canada* submits to Council its final report.

Section I — Summary of Conclusions

The following is a brief resumé of the findings and recommendations of your committee. The various items are dealt with at greater length in section V.

(a) Findings

1. That for the purpose of discussion of fuel problems, Canada may be divided into three regions;—the boundaries of which cannot be regarded as rigidly determined.

(*I*) Western: *From British Columbia coast to Winnipeg.*

(*II*) Central: *Ontario and approximately as far east as Montreal.*

(*III*) Eastern: *Montreal to Atlantic coast.*

2. That it is reasonoble to expect that the Eastern and Western regions of Canada can be made generally self-supporting in the matter of coal for household and power purposes.

3. That the Central region must be dependent chiefly upon the importation of American coals, except in so far as Canadian coals can penetrate into competitive areas in the extreme east and west of the region.

4. That it is unreasonable and uneconomic to expect Alberta coals to compete in the Central region with American coals under present conditions.

5. That the apparent economic substitutes for American anthracite are: metallurgical coke, British anthracites, and to a lesser degree, briquettes.

6. That the work of the Dominion Fuel Board is of the very greatest benefit to Canada and that it should be encouraged in every way.

(b) Recommendations

Your committee recommends:

1. That the governments, federal or provincial, institute an inquiry into the real cost of moving coal.

2. That each province consider the advisability of establishing, with the authority of provincial legislation standards of quality and regulations governing delivery of coal.

3. That a national fuel policy be only embarked upon after recommendations are received from the Dominion Fuel Board.

4. That Alberta operators concentrate their efforts on the production of high grade bituminous coals for power purposes in western Canada and the United States rather than on any non-economic efforts to ship their low grade coals to Ontario.

Section II — Introduction

On April 23rd, 1923, a fuel committee was appointed by the Council of *The Institute* to examine into and report to Council on the matters covered by the following terms of reference:—

"In view of the importance of the fuel problem of Canada, and believing that the profession could do much to add to its solution, a committee of *The Institute* was nominated at the meeting of Council held on April twenty-third, nineteen twenty-three, with the above personnel.*"

It is believed that the objects of this committee should be to use the information available and make a report thereon, using the collective opinions of the various members of the committee."

When constituted by Council on April 23rd, 1923, the committee had twelve members. From time to time other members have been added.

In consonance with the terms of reference above quoted, the members of the Fuel Committee laid down a policy to govern the scope of its work in the early stages, and to suggest a possible correlation with the work of the various branch fuel committees. This policy is as follows:—

"That the main fuel committee should concern itself solely with the sources, production, transportation, and distribution of fuels to the various parts of Canada as a whole."

"That the branch fuel committees should confine themselves to the economical utilization of the different fuels available in each locality, and to educational campaigns regarding proper use of heating equipment and domestic fuel, for the benefit of the householder."

It is felt also by the committee that this report should deal with the fuel situation at the present time and in the near future. It is not intended to cover the conditions which might prevail when the population of Canada has largely increased, since the distribution of population and industries, foreign relations, national policy, possible new developments in production of power and heat, and other conditions which might obtain at such times, are matters of conjecture which are not within the scope of this report to discuss.

Section III — Review of Preliminary Activities

The major portion of the work of the committee since its inception has been done by correspondence. In addition, however, a number of meetings have been held of certain members of the committee, and these will be mentioned in order.

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*The personnel of the Fuel Committee of *The Engineering Institute of Canada* all of whom are members of *The Institute.*

R. W. Angus, M. J. Butler, C. V. Corless, F. A. Combe, J. R. Donald, J. T. Farmer, F. W. Gray, A. R. Greig, B. F. C. Haanel, R. A. C. Henry, C. P. Hotchkiss, A. D. LePan, G. C. Mackenzie, C. A. Magrath, E. V. Moore, James McEvoy, G. D. Macdougall, D. H. McDougall, G. R. Pratt, C. A. Robb, R. A. Ross, J. A. Shaw, Lesslie R. Thomson, F. L. Wanklyn, R. S. L. Wilson.

In order that the work of this committee might be fully co-ordinated with that being undertaken by the Dominion Fuel Board and by the Canadian Institute of Mining and Metallurgy, a meeting was held in Montreal on Thursday, May 31st, 1923, of the members of the E.I.C., Fuel Committee to discuss with the members of the Dominion Fuel Board and with representatives of the C.I.M.M., the relationship and activities of the three bodies. Minutes of that meeting were kindly forwarded immediately to all attending by Mr. Fraser S. Keith, M.E.I.C., general secretary of *The Institute.*

On June 8th, the E.I.C., Fuel Committee issued its first circular to its own members, which was followed by another circular on July 25th. A very brief digest of these circulars follows herewith:—

(1) Requests for co-ordination of work of general fuel committee with branch fuel committees.
(2) Requests for suggestions and comments.
(3) Requests for views on one or two specific fuel points, and intimation of arrangements for holding meeting of representations of general E.I.C., fuel committee.

To these circulars replies were received and your committee made a digest of the opinions of all the members of the committee regarding the various fuel policies and problems with which the committee was confronted. This digest is of interest as it collated a wide variety of opinion held by members of the committee on many of the problems relating to the fuel situation in Canada.

Shortly afterwards your committee prepared a special brief review in draft form on the coal situation in Canada. This Coal Review was first circulated to the Montreal members of the Fuel Committee, with the suggestion that it should be criticised and discussed at a subsequent meeting in order that it might be put into shape for circularization to the whole committee. This meeting was held on October 5th, 1923, and as a result of this meeting it was decided to circulate to the general membership of the committee:—

(a) Copy of a digest of members' opinions.
(b) Copy of a Coal Review then just completed.

A brief digest of the Coal Review is as follows:—

1. *Eastern Region of Canada:* It seems to be economically feasible to supply from purely Canadian sources all the coal necessary in this region, both for household and power purposes.
2. *Western Region:* It seems to be economically feasible to supply coal or carbonized lignite briquettes for household purposes in this region from purely Canadian sources. In some of the larger centres, however, the Alberta coals cannot compete economically for power purposes with American bituminous coals.
3. *Central or acute fuel area:* (a) Ontario and the western portion of Quebec constitute the acute fuel area of Canada, which area imports roughly 13,000,000 tons of bituminous coal per year and 4,500,000 of anthracite. It may also be termed the coal consuming area of Canada.

(b) It is non-economic under present conditions to expect coal from any Canadian source to compete in this region either in the household or power fields with coals coming from the United States.

(c) That for household purposes Welsh coal, briquettes of various kinds, and coke form desirable and apparently economic substitutes for the American anthracite at present consumed.

The situation described above in paragraphs 1, 2, and 3, is presented graphically in figure No. 1, — a fuel map of Canada. The committee is enabled to present this map through the courtesy of the Dominion Fuel Board, Dr. Charles Camsell, M.E.I.C., chairman, C. P. Hotchkiss, A.M.E.I.C., secretary, and of the Natural Resources Intelligence Branch, Department of the Interior, F. C. C. Lynch, A.M.E.I.C., superintendent.

During the summer of 1923, it became apparent to the members of the Council and of the Fuel Committee that to have any unanimity of opinion in the final report, it would be necessary to hold a meeting in order that the committee's representatives from the different parts of the country interested in fuels might discuss personally the whole fuel problem. To that end the Council set aside the approximate sum of $500.00 in order to meet the travelling expenses of one or two representatives from each section of Canada. Your committee wishes to record its sense of obligation to the Council in respect to this very generous decision. It should be mentioned here that it would have been almost impossible to present an unanimous report had this action not been taken by Council.

Section IV — Proceedings of Meetings of Representatives of Whole Committee

On November 10th, there was mailed to every member of the Fuel Committee a copy of the Coal Review, a copy of the Digest of Opinions, and a letter asking for suggestions on fuel policy and for criticisms on the Coal Review.

This course of action was taken with the hope that the investigation would enable the representatives of the Fuel Committee to meet in Montreal early in 1924 in order to formulate a policy and report. After considerable discussion by correspondence, it was decided to hold this meeting on March 8th, 1924. To that end it was arranged that in addition to any of the Montreal district members who might be able to attend, to request the presence of:— Two representatives from the west, two representatives from the east, and three representatives from the general Ontario sections, — the acute fuel and coal consuming area of Canada. The date of this meeting was selected in order that the persons attending the annual meeting of the C.I.M.M., in Toronto on March 7th might be present in Montreal with the least loss of time. From November to March, therefore, the discussion of the committee on the Coal Review was collected by correspondence, and finally on March 8th the meeting took place with fifteen members or representatives present. The discussion covered five principal points:—

1. Grading and sizing of the coals and regulation of the delivery.
2. High mining costs in Alberta.
3. Transportation costs.
4. The future possibilities of Nova Scotia coals.
5. General discussion on coke.

The general findings of the committee on these and other matters are to be found in a succeeding paragraph of this report, entitled Findings and Recommendations, but it is advisable to insert here a brief summary of the discussion.

The Grading and Sizing of Coals and the Regulation of Marketing to the Consumer

(i) The question of the sizing of coals appears to be a provincial matter, and your committee feels that some national body such as the Dominion Fuel Board could with propriety urge the adoption by the provinces of uniform regulation regarding sizing.
(ii) The grading of coals is an extremely difficult matter, and your committee doubts the feasibility of introducing at the present time any Dominion wide system of grading. It appears, however, to be possible to make grading by districts. Especially is this the case in the Alberta regions; and your committee notes that a start has been made by the Alberta government in this regard. In this connection your committee believes that with proper federal action the householder could be given some protection not now enjoyed, from the present extremely unsatisfactory condition under which coal is purchased.

The Reasons for the High Mining Costs in Alberta

The reasons for the high mining costs in Alberta are the short season of production, only about five months for certain of the mines; excessively high wages; over development of the Alberta mines; mining difficulties due to geological disturbances; and the unnecessarily large number of the operating mines each with its accompanying high overhead. The opinion of Alberta representatives was that the only method of reducing this cost would be to increase the market for Alberta coal and distribute the overhead over a larger production, or to limit production to the more efficient mines.

Transportation Costs

(i) Your committee came to the conclusion in June 1923 that the government should make an absolutely impartial and independent investigation into the actual costs of moving coal over long distances in Canada and to this end a recommendation was sent by the Council to the two parliamentary fuel committees then sitting. No action on this recommendation, however, was taken by the government.

(ii) Certain members of your committee feel that the present rates are out of proportion to the real cost of moving the coal, while other members feel that though the rates are not disproportionate to cost, they should be reduced as a national measure. In this connection Mr. M. J. Butler, C.M.G., M.E.I.C., for example, presented a paper* to the Toronto Branch of *The Institute* in which he stated that under certain specified conditions with special equipment about $5.75 per ton was a fair rate for the movement of coal from Alberta to Ontario. This figure shows a very wide gap from the figure of roughly $12.00, the present tariff, or even from $9.00 the special experimental rate quoted by the Canadian National Railways.

(iii) In the whole matter of transportation, your committee would observe that a number of factors having an important bearing on the subject are not sufficiently realized. These are:—

*Copies of this paper were forwarded by the Fuel Committee to all its members.

(a) Taking for example Mr. Butler's figures, the representative of the C.N.R., on the committee states that were Mr. Butler's rates applied to the Virginian Railroad, (the coal road quoted by Mr. Butler to derive certain of his figures), there would be an operating deficit of about a million and a half instead of an operating surplus of about three and a half million.

(b) The advocates of special rates applicable to the movement of coal from Alberta to Ontario and Quebec have been basing their arguments on the assumption that these rates would be justified by reason of the fact that the railways can use during certain summer months equipment which would otherwise be lying idle. It is estimated that with the present available equipment, the railways might be in a position to handle during the summer period only possibly 250,000 tons of coal. The reason for this small amount is that, during the so-called slack season in the movement of Canadian grain to the head of the lakes, there is a heavy movement of American grain eastwards from the bay ports to Montreal. The magnitude of this latter movement has perhaps not been realized by the public but is shown quite clearly in figure No. 2 attached to this report.

(iv) Your committee cannot view with favour any doctrine that railways should move at less than cost any commodity except in times of national peril. If for national reasons it is felt by the country to be essential to develop in Ontario a market for Alberta coals, then the matter must be handled from the point of view of tariffs or bonuses, not from the point of view of penalizing the railways.

The Future Possibilities of Nova Scotia Coals

Your committee notes with satisfaction that the eastern members believe that were markets extended the Nova Scotia fields are capable of producing seven or eight million tons per annum without any large increase of capital investment. It is felt by many that a reduction

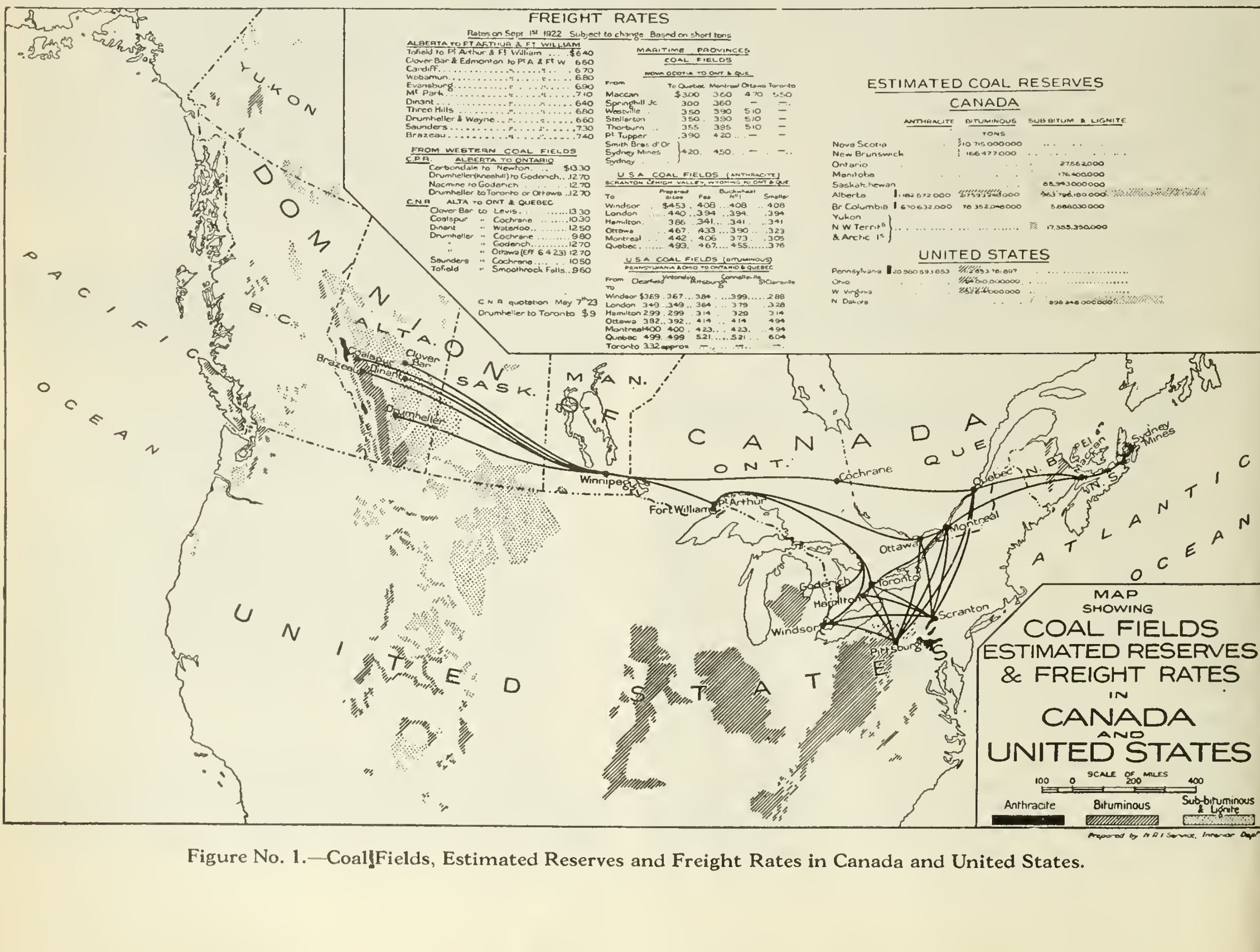

Figure No. 1.—Coal Fields, Estimated Reserves and Freight Rates in Canada and United States.

in present freight rates from Nova Scotia might be made which would permit of this extension of market. It is possible also to consider that the regions served by water shipment along the St. Lawrence and the points reached by rail from Quebec and Three Rivers, might constitute a suitable market for Nova Scotia coals. If these coals can be marketed on an economic basis, such a development is absolutely sound.

It is proper to point out that the cost of coal production in Nova Scotia since the war has been unrepresentative and temporary, and that the heavy increase since 1914 is a result of the war, arising more out of disorganization of the mining population, and interference with transportation and customary markets, than out of physical conditions or factors influencing cost of production of a permanent character, such as exhaustion of coal seams or increased difficulties of extraction.

There is still a shortage, as compared with pre-war records, of one thousand skilled miners in Nova Scotia, which is the chief cause of reduced outputs and increased cost of mining. The shortage, caused entirely by enlistments and restrictions on immigration, is being slowly overcome. As the working forces become normal producing costs will be reduced.

One other factor must be now noted, in connection with the competition of Canadian and United States bituminous coals. The bituminous coal industry in the United States is at present unbalanced and wasteful. The opening of new mines in West Virginia under extremely low production costs is accompanied by sales of coal at very low prices giving but little margin over bare expenditure for labour and material. It is alleged that this cheap coal, really selling below true cost, is embarrassing the balance of the American bituminous industry. It is therefore not unreasonable to predict that so disorganized a condition cannot be permanent and when stable economic conditions are achieved the price of American bituminous coals will advance. In this way it is fair to forecast that there will occur an improvement in general mining costs and conditions in Nova Scotia, while an increase may be expected in the cost of American bituminous coals.

General Discussion on Coke

Of all the available substitutes for imported American anthracite for household purposes, coke appears to be the most feasible at the present moment in regard to quantity production. A digest of the views of the committee appears in the Coal Review.

Section V.—Findings and Recommendations

In the opinion of many the ideal solution of the fuel problem of Canada will be reached only when Canada is self-supporting, from the point of view of supply of coal for household and power requirements. This solution is a counsel of perfection, as practically no country in the world has ever reached such a condition, with the possible exception of the United States. In other words, except in time of war, that coal will reach the consumer which in the long run is the cheapest. Your committee, therefore, in studying this question, while keeping constantly in mind the possibility of having an all Canadian fuel supply, feels that such a solution does not lie at present within the realm of the practicable.

Findings

In presenting its findings, your committee would do so under the following heads:—

I *Sources of fuel for Canada:*
  (*a*) *Eastern Region,* (*b*) *Western Region,*
  (*c*) *Central Region.*

II *Substitutes for American anthracite.*

III *Possibility of utilization of Alberta coals in Ontario, and general Alberta situation.*

IV *Miscellaneous matters.*

I.—Source of Fuel for Canada

NOTE:—See figure No. 1 showing fuel map of Canada.

(a) *Supply of Fuel to the Eastern Region of Canada.*

Coal for household and power purposes can be supplied economically to the Eastern region of Canada from purely Canadian sources. This statement is subject to one or two minor exceptions at present time due to the fact that certain American coal dealers are underselling Nova Scotian coals by small amounts in the Halifax market. This situation probably arises from the difficulty that the Nova Scotia coal operators have had with extending their markets, due to the present glut of American coal.

(b) *Supply of Fuel to the Western Region of Canada.*

Coal for household purposes in the Canadian West can be supplied economically from purely Canadian sources. These coals will come from Alberta, British Columbia and Saskatchewan. There is also the possibility of carbonized lignite briquettes from Saskatchewan supplying a portion of the demand.

In general, the coal for power requirements can also be supplied from Canadian sources. In the Eastern section, however, of the Western region, specifically Winnipeg, Alberta coals cannot compete with American bituminous coals. But the threat of the possibility of Alberta competition has had the result of reducing the price of American steam coals in Winnipeg.

(c) *Supply of Fuel to the Central Region of Canada — the Acute Fuel Area.*

Acceptable untreated coal for household purposes in the acute fuel area cannot be supplied economically from Canadian sources under present conditions.

For power purposes in all but the Eastern section of the acute fuel area it is quite hopeless to expect Canadian coals to compete with American coals.

II.—Substitutes for American Anthracite

Owing to the present impossibility, (above mentioned), of utilizing Canadian coals for household purposes in the acute fuel area, Canada in the past has been importing about four and a half million tons of American anthracite. One of the major fuel problems before Canada to-day is to discover if there are any feasible and economic substitutes for this commodity, owing to its increasing cost, decreasing quality, and a strong probability of a complete embargo by the American Government on its exportation. The following are the possible alternatives:—

(i) The development in the use for household purposes of metallurgical coke.
(ii) Importation of increasing quantities of Welsh and Scotch anthracites.
(iii) Possible development of briquetting industry using imported American anthracite fines as raw material.

III.—Possibilities of Utilizing Alberta Coal in Ontario, and General Alberta Situation

Your committee finds in connection with the whole Alberta question that owing to mining and transportation costs, it is at present unreasonable from an economic point of view to expect Alberta coals to compete in Ontario with corresponding grades of American coals. Even with a freight rate of $6.00, — admittedly far below cost, — these coals cannot compete and nothing is gained by any hesitancy in expressing this opinion formed after mature consideration.

The high mining costs are due to the lack of co-operation among Alberta operators, the very short mining season in certain of the mines, high wages of the operatives, the mining difficulties encountered, and the general over-development of the mining industry. The result of these conditions is obvious when coal costs at pitmouth in Alberta from $4.00 upwards, while coal at least as good in the American bituminous areas costs from $2.25 upwards.

Your committee also notes with satisfaction the effort recently made to effect grading and sizing of Alberta coals by means of the Alberta Coal Sales Act. This is an effort in the right direction.

IV.—Miscellaneous Matters

(I) Your committee believes that a solution of the general fuel problem of Canada will only be reached by a very careful study of the different phases of the problem, and the gradual development of a policy. In this connection your committee feels that the work of the Dominion Fuel Board is of very great importance, and wishes to touch upon this matter again under the heading of "Recommendations".

(II) A solution of the fuel problem in the acute fuel area will be forwarded by a co-ordinated policy of water power and fuel power development. As the use of water power increases coal will be released for heating purposes. In the congested centres also, central heating and steam plants will be conducive to more efficient utilization of coal both for power and heat.

(III) For off-season heating, peat offers a desirable substitute for imported coal, and your committee wishes to record its appreciation of the work accomplished at Alfred by the Peat Committee financed by the federal and Ontario governments. This is just being put upon a commercial footing.

Recommendations

1. Your committee recommends that the Council of *The Engineering Institute of Canada* memorialize the federal government to set on foot an enquiry into the actual cost of moving coal in train load lots in order to place this matter beyond the realm of half-informed controversy. Your committee would suggest that this duty might be discharged with propriety by the Railway Commission of Canada, but that its findings be not made public without including in the final figure proper allowance for overhead, depreciation and profit. Any other course of action might seriously prejudice the whole question of a long haulage movement of coal.

2. Your committee recommends to Council that the federal government be urged to take appropriate action in order that each of the provinces concerned should adopt after discussion standards of quality and regulations governing delivery of coals. Until this is done, the public in their purchasing of coal will not be protected in any way.

3. Your committee recommends that the Council place on record with the federal government its appreciation of the valuable work at present being undertaken

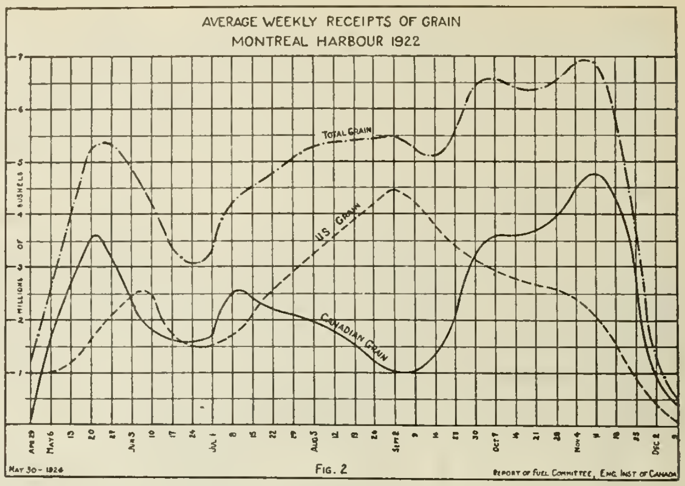

Figure No. 2.—Average Weekly Receipts of Grain, Montreal Harbour, 1922.

by the Dominion Fuel Board, that the government be urged to prosecute this work vigorously, and, further, that any so called national fuel policy should only be adopted after receiving recommendations and reports by the Dominion Fuel Board.

4. Your committee recommends that Council go on record as opposing any tendency to force the railways to haul commodities at less than cost except in times of national peril; and further recommends that, if for national reasons it be desirable to have Ontario become a market for Alberta coals, the Council urge upon the federal government the wisdom of bringing about such a result by subsidies or tariffs, rather than by imposing non-economic operation on the transportation systems.

5. Your committee recommends that the Alberta operators be urged to concentrate their efforts on the production of the high grade coals for supply to the Western region rather than on the shipment of their low grade coals to Ontario.

6. Your committee further recommends that the branch fuel committees continue their activities in connection with the solving of local difficulties in regard to fuel. This work might be of great service to the public.

7. Your committee recommends that the Canadian furnace manufacturers have their attention called in some suitable manner to the desirability of providing furnaces especially designed to burn coke and fuels other than American anthracite.

8. Your committee finally suggests very respectfully that the Council consider the possibility of appointing a standing committee on fuel and fuel policy in order that the professional engineers of this country may be able to express their united views from time to time on a matter that is so vitally important to the national welfare.

On behalf of the Fuel Committee,

F. A. Combe, M.E.I.C., *Chairman.*

Lesslie R. Thomson, M.E.I.C., *Secretary.*

Montreal, September 25th, 1924.

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THE
ENGINEERING JOURNAL

THE JOURNAL OF
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VOL. VII November 1924 No. 11

Why Engineers are Underpaid

In a letter to the *Electrical World*, T. T. Greenwood, of Boston, Massachusetts, discussing the question as to why engineers are underpaid, states,—"While there are, without doubt, a variety of reasons to account for the relatively poor pay of the average engineer, may not one of the reasons be that the average engineer is not a good salesman? In order to receive an attractive remuneration, an engineer should be a good salesman. He has but one product to sell — his services.

"Good sales ability is essential in obtaining a high price for a competitive article of utility in that the reasonableness of the high price must be clearly and convincingly set forth to the prospective customer. A most excellent article may be an entire commercial failure if its merits are not irresistably presented, and many an inferior article has received wide use through superior selling effort. A high price almost invariably necessitates sales ability of a high order; any one can make a sale if the article is satisfactory and the price is low enough.

"In selling a commercial product for a high price its value and superiority must be presented in a truthconvincing manner. In selling an engineer's service for a high price his skill and ability must be presented in the same manner.

"It is unfortunate, however, that those characteristics desirable in an able engineer are, in the main, opposed to those desirable in an able salesman. An engineer usually is, and even should be, a pessimist; the salesman an optimist. The engineer, both by nature and training, is constantly striving to improve his product. He is compelled, therefore, carefully to observe the defects in his apparatus; the good features do not need close study. The defects, however, are so magnified in his fertile imagination as often to overbalance the good points, and the apparatus, in his biased opinion, then becomes of doubtful value.

"The engineer is led by his temperament to take the same view of his own ability. When he is trying to sell his services he knows his weak points, and these, in his mind, so completely overbalance his many excellent and possibly unrealized qualities that he cannot present his case in a convincing manner; his personal defects overshadow his good points, in his mind. The salesman, on the other hand, must of necessity be constantly on the lookout for good qualities in his product; the defects are submerged. It should be so with the engineer. An able engineer's good points obviously more than overbalance his weak points, and he should train himself to assign to all points their proper values, whereby to condition himself to present his wares in a convincing manner and consequently dispose of his personal services at a satisfactory price."

Mr. Greenwood has indicated a very important phase of the situation and one which will strike most engineers as being quite pertinent.

He might have gone further and stated that engineers will continue to be underpaid as long as they, as a class, place a low value on their services. In addition to sales ability there is needed a consciousness of a higher valuation than at present exists.

There is one other very important reason why engineers are underpaid and that is that for years past there has been unemployment in the engineering profession, and it requires only one per cent of unemployment to have men bidding for the same position, and in many cases accepting lower remuneration than the position is worth.

The whole problem is wrought up in our system of education which is a problem that the engineering profession as a whole must go into, study, and solve very soon, or suffer in consequence.

The
Thirty-ninth Annual General
and
General Professional Meeting
will be held in
Montreal
Tuesday, Wednesday and Thursday,
January 27th, 28th and 29th, 1925.

On the last day a joint meeting will be held with the Association of Canadian Building and Construction Industries.

More detailed information will be given in the December Journal.

Nominations for Officers' Ballot

Regulations

The nomination of officers of *The Institute* shall be made by a nominating committee. The honorary councillors shall be *ex-officio* members of this committee. The remaining members, who shall not be officers of *The Institute*, shall be elected annually as follows: Each branch shall appoint one member, an additional member appointed by the council shall be chairman of the committee. The membership of the committee shall be announced at the annual general meeting.

Vacancies in the nominating committee, as announced at the annual general meeting, shall be filled by council from the nomination or nominations submitted by the branch in which the vacancies occur.

The nominating committee shall prepare an officers' ballot, which shall contain the names of not less than two nominees for each office to be filled, with the exception of that of president, for which only one name may be submitted.

A vice-president shall be elected by vote of the corporate members resident within the zone for which he is a candidate, an election to take place every two years in each zone, except in zone (c) where an election shall take place each year. One vice-president shall be elected from each zone, except zone (c) from which two vice-presidents shall be elected, one of whom must be resident within twenty-five miles of the headquarters of *The Institute.*

A councillor shall be elected by vote of the corporate members resident within the branch district for which he is a candidate.

The officers' ballot shall be forwarded by the nominating committee to reach headquarters not later than the fifteenth day of September, for presentation to council at a meeting to be held not later than the thirtieth day of September, and should be accompanied by a letter of acceptance of nomination from each nominee.

The council shall examine the officers' ballot submitted by the nominating committee. If the council find a nominee ineligible for the office for which he is nominated, or should the consent in writing of a nominee to appear on the officers' ballot not be furnished before the first meeting of Council in October, or should any nominee after such consent withdraw his name, such name shall be deleted, and the council shall substitute another name therefor. The words "Proposed by Nominating Committee" and "Proposed by Council" shall be printed conspicuously on the ballot, to indicate the manner of nomination of all nominees.

Not later than the seventh day of November, the secretary shall mai to each corporate member of *The Institute* the officers' ballot, as prepared by the nominating committee and the council.

Additional nominations for the officers' ballot signed by ten or more corporate members and accompanied by written acceptances of those nominated, if received by the secretary on or before the first day of December, shall be accepted by the council and shall be placed on the ballot. The words "Special Nomination" shall be printed conspicuously near such names, and the names of the members making such nominations shall be printed on some part of the ballot.

Notices shall be deemed to have been mailed to members as prescribed by the by-laws if such notices are printed in *The Journal* of *The Institute* and mailed by the dates prescribed in the by-laws.

Officers' Ballot

The following is a list of the nominees submitted by the nominating committee, and approved by council at the regular meeting held on September twenty-third, nineteen twenty-four.

President: Arthur Surveyer, M.E.I.C., Montreal.

Vice-President: *Zone a* — H. S. Carpenter, M.E.I.C., Regina; A. S. Dawson, M.E.I.C., Calgary.
Zone c — A. R. Decary, M.E.I.C., Quebec; K. B. Thornton, M.E.I.C., Montreal.

Councillors: *Victoria Branch:* F. C. Green, M.E.I.C., Victoria; G. B. Mitchell, M.E.I.C., Victoria.

Edmonton Branch: C. A. Robb, M.E.I.C., Edmonton; R. W. Ross, A.M.E.I.C., Edmonton.

Lethbridge Branch: H. W. Meech, A.M.E.I.C., Lethbridge; P. M. Sauder, M.E.I.C., Lethbridge.

Winnipeg Branch: E. V. Caton, M.E.I.C., Winnipeg; A. McGillivray, A.M.E.I.C., Winnipeg; A. A. Young, A.M.E.I.C., Winnipeg.

Lakehead Branch: H. S. Hancock, A.M.E.I.C., Fort William; H. M. Lewis, A.M.E.I.C., Port Arthur.

Sault Ste. Marie Branch: L. R. Brown, A.M.E.I.C., Sault Ste. Marie; C. H. E. Rounthwaite, A.M.E.I.C., Sault Ste. Marie.

Border Cities Branch: W. H. Baltzell, M.E.I.C., Ojibway; J. E. Porter, A.M.E.I.C., Ford.

Niagara Peninsula Branch: S. R. Frost, A.M.E.I.C., Niagara Falls; F. S. Lazier, M.E.I.C., Thorold; T. S. Scott, M.E.I.C., Niagara Falls.

London Branch: H. A. Brazier, M.E.I.C., London; H. B. R. Craig, M.E.I.C., London.

Hamilton Branch: W. F. McLaren, M.E.I.C., Hamilton; R. K. Palmer, M.E.I.C., Hamilton.

Toronto Branch: Wm. Gore, M.E.I.C., Toronto; H. K. Wicksteed, M.E.I.C., Toronto.

Kingston Branch: T. A. McGinnis, M.E.I.C., Kingston; W. P. Wilgar, M.E.I.C., Kingston.

Peterborough Branch: R. L. Dobbin, M.E.I.C., Peterborough; D. L. McLaren, A.M.E.I.C., Peterborough.

Montreal Branch: J. E. Armstrong, A.M.E.I.C., Montreal; C. B. Brown, M.E.I.C., Montreal; F. A. Combe, M.E.I.C., Montreal; J. T. Farmer, M.E.I.C., Montreal; J. H. Hunter, M.E.I.C., Montreal; O. O. Lefebvre, M.E.I.C., Montreal; G. R. MacLeod, M.E.I.C., Montreal; A. C. Tagge, M.E.I.C., Montreal.

Quebec Branch: L. C. Dupuis, A.M.E.I.C., Quebec; A. B. Normandin, A.M.E.I.C., Quebec.

Saguenay Branch: G. E. Lamothe, A.M.E.I.C., Chicoutimi; C. R. McCort, A.M.E.I.C., Kenogami.

Moncton Branch: H. J. Crudge, M.E.I.C., Moncton; C. S. G. Rogers, A.M.E.I.C., Moncton.

St. John Branch: A. R. Crookshank, M.E.I.C., St. John; G. G. Murdoch, M.E.I.C., St. John.

Halifax Branch: J. L. Allan, M.E.I.C., Dartmouth; A. R. Chambers, M.E.I.C., New Glasgow.

The branches of *The Institute* not included in the above list are provided with council representation by election under the previous by-laws.

OBITUARIES

Hon. J. L. Côté, A.M.E.I.C.

The Institute and the engineering profession as a whole have suffered the loss of one of their outstanding representatives in the public life of Canada in the death of the Hon. Jean L. Côté, A.M.E.I.C., which occurred at his native village, Les Éboulements, Que., where he had spent the last few months prior to his intended return to western Canada.

Born at Les Éboulements, Que., on May 6th, 1867, he received his early education at the Commercial Academy at Montmagny, Que., and later graduated from Ottawa University in 1890. As early as 1886, Mr. Côté made a trip to Edmonton, Alta, with a party of land surveyors in the capacity of chainman, and it was as a result of this trip that he decided to prepare himself for the profession of engineering.

During the years 1893 to 1895 he was engaged in the exploration work in Alaska, making a photo-topographical survey of the eastern part for the International

HON. J. L. CÔTÉ, A.M.E.I.C.

Boundary Commission. In 1896, he was engaged in the retraversing of the shore of lake Erie and the following year found him again in Manitoba engaged in Dominion Lands Survey work. In 1899, he went to the Yukon for the Dominion government, but later resigned his position to engage in the legal surveying of mining claims and general engineering. In 1903, Mr. Côté opened an office as land surveyor and engineer in Edmonton, Alta.

Mr. Côté's first appearance in the political arena was in 1909 when he presented himself as a candidate for election in the district of Athabasca, and was returned at the head of the poll. In 1913, and again in 1917, after the district had been divided, he was elected for Grouard, the western part of the original riding. On September 25th, 1918, Mr. Côté was appointed provincial secretary, an important position in the Cabinet which he filled with the utmost satisfaction. In him, the province of Alberta found a Canadian of whom any country might justly be proud; his training and peculiar experiences particularly fitted him for guidance in the great development which is undoubtedly at hand. His intense sincerity inspired confidence in all those with whom he came in contact. In 1923 Mr. Côté was appointed to the Senate to fill the vacancy created by the death of Senator Amédée Emmanuel Forget.

The late Mr. Côté was elected an Associate Member of *The Engineering Institute of Canada* (then The Canadian Society of Civil Engineers) on June 12th, 1909.

E. G. Deville, I.S.O., D.T.S., Hon. M.E.I.C.

By the death of Dr. E. G. Deville, I.S.O., Hon.M.E.I.C., director general of surveys, at his late residence in Ottawa, on September 21st, 1924, there passed away one who held a unique position in the engineering and scientific life of this country and more particularly in the federal service at Ottawa. He had been surveyor general of Canada since 1885 and in 1921 was promoted to the position of director general of surveys, which he held at the time of his death.

E. G. DEVILLE, I.S.O., D.T.S., Hon.M.E.I.C.

Dr. Deville was born at La Charité sur Loire, Nièvre, France, February, 1849. He was educated at the French Naval School at Brest from which he graduated in 1868. He had charge of extensive hydrographic surveys in the islands of the Pacific ocean, Peru, and elsewhere. He retired from the navy in 1874, came to Canada and soon after his arrival entered the service of the Quebec government, where he remained until 1879 as inspector of surveys and astronomer. Dr. Deville was commissioned as a Provincial Land Surveyor for the province of Quebec in 1877 and as Dominion Land and Topographical Surveyor in 1878.

In 1881, he joined the Department of the Interior as inspector of Dominion land surveys, and in that capacity had charge of the extensive field operations being carried on in western Canada. During the term of office of the late Mr. Lindsay Russell as deputy minister and surveyor general, Dr. Deville had the immediate supervision of the extensive work being carried on by the department in the preparation of western Canada for the increased immigration which soon followed. One of the outstanding tasks which he performed at that time in collaboration with the late Dr. W. F. King, later chief astronomer, was the compilation of a Manual of Surveys for the guidance of Dominion land surveyors, which is regarded by surveyors and mathematicians of the present day as a standard. When Mr. Russell retired because of ill health Dr. Deville was appointed surveyor general in March, 1885.

Dr. Deville was a charter member of the Royal Society of Canada and was for over twenty years secretary of the Scientific Section. In 1905 the University of Toronto conferred upon him the honorary degree of Doctor of Laws, while in 1916, King George V appointed him a Companion of the Imperial Service Order. In the Town Planning Association he was one of the prime movers and occupied a prominent place on the executive board of this and of the Canadian Engineering Standards Association. He was for many years honorary president and later patron of the Dominion Land Surveyors' Association. In October 1922 he was elected Honorary Member of *The Engineering Institute of Canada*, in recognition of his contributions to the advancement of science in this country. But while, as has thus been indicated, Dr. Deville earned, secured, and maintained an enviable position among the leaders in engineering and its kindred sciences, his chief claim to recognition was in connection with his chosen life work, the administration of the important branch of the public service of which for so many years he was the honoured and efficient head.

Edwin R. Gray, B.A.Sc., C.E., A.M.E.I.C.

In the death of Edwin Roy Gray, B.A.Sc., C.E., A.M.E.I.C., at his home in Hamilton, Ontario, on October tenth, *The Institute* lost a member who had made remarkable progress in his profession since graduating from the University of Toronto in 1913. The late Mr. Gray commenced his engineering career in 1904 with the Canadian Pacific Railway on the Toronto-Sudbury line. In 1906 he was instrumentman on the National Transcontinental Railway, and 1908 to 1909 instrumentman for the city of Toronto. On graduation he was appointed district engineer of the city of Toronto in charge of sewer construction, having had charge of East Toronto sewerage system, Toronto Midway sewerage system and Moore Park sewerage system. In 1915 he was appointed deputy city engineer of the city of Hamilton, and the following year made city engineer in full charge. In 1923 Mr. Gray suffered a breakdown in health which compelled him to resign the arduous duties of city engineer. As a mark of appreciation of the excellent work he did for the municipality he was made manager of the Parks Board. During the past year Mr. Gray has been confined to his home.

In 1913 Mr. Gray was married to Miss Winnifred Harrison, daughter of Doctor W. S. Harrison, former controller of Toronto, and is survived by Mrs. Gray, his parents, two sisters, one brother, one son and two daughters. The late Mr. Gray, who was in his fortieth year at the time of his death, enjoyed, to a marked degree, the high esteem of his fellows, being noted alike for his good judgment and unswerving integrity. He was greatly interested in the engineering profession, and was one of the most active members in the establishment of the Hamilton Branch of *The Institute*, in which he held office for a number of years. He was elected an Associate Member on May 18th, 1915, and was a member of the Council of *The Institute* during 1920, 1921 and 1922.

Louis Napoléon Rhéaume, M.E.I.C

Louis Napoléon Rhéaume, M.E.I.C., died at his home, 81 Daly Avenue, Ottawa, Ontario, on October 4th, 1924, following an extended illness. The late Mr. Rhéaume, has long been connected with the engineering work of the Federal government, and devoted some fifty years of his life to engineering work in the government service in connection with which he was active until four years ago when he was superannuated. Mr. Rhéaume was born in Quebec City and received his early education at the Quebec Seminary, later entering McGill University, in the course of civil engineering. He was a member of the geographical survey party which set out in 1872 to map out the proposed route of the Canadian Pacific Railway through the Rocky mountains, with which he spent three years, and of which he was the sole surviving member. The surveyed route was never used by the Canadian Pacific Railway, but is to-day followed by the Canadian National Railways. Mr. Rhéaume's work has been principally in connection with waterways improvements on the St. Lawrence river, and under his direction many of the important waterway contracts were constructed on the St. Lawrence river, including locks at Soulanges, the Long Sault and Prescott. Mr. Rhéaume has been a member of *The Institute* since its earliest days, having been elected a Member on January 20th, 1887, six months prior to the incorporation of the Canadian Society of Civil Engineers.

PERSONALS

E. A. Markham, A.M.E.I.C., has been transferred by the Poole Construction Company, from their Regina office to their Vancouver office.

Willis Chipman, M.E.I.C., and George H. Power, A.M.E.I.C., civil engineers of Toronto have announced that the partnership entered into on April 1st, 1910, has been dissolved by mutual consent effective October 1st, 1924.

C. G. J. Luck, A.M.E.I.C., has been appointed to the staff of Fraser, Brace, Limited, and is located at Kenogami, Que. Mr. Luck was formerly with the Canadian Pacific Railway Company, at Kipawa, Que.

Joseph A. P. Marion, S.E.I.C., who received his degree of B.Sc. from the University of Manitoba last spring, has accepted a position with the C. D. Howe Company, Port Arthur, Ont.

W. D. Bracken, S.E.I.C., who graduated from Queen's University in electrical engineering in 1923, is with the Canadian Niagara Power Company, Niagara Falls, Canada, as inspector doing general engineering work.

R. C. Leslie, S.E.I.C., who graduated from the University of Toronto last year, has resigned from the staff of the Dominion Bridge Company, Lachine, Que., to accept a position with the Canadian Bridge Company Limited, at Walkerville, Ont.

E. Lorne Goodall, S.E.I.C., has been appointed heating engineer with the Abitibi Power and Paper Company Limited, at Iroquois Falls, Ontario. Following graduation last year, Mr. Goodall was appointed to the staff of the Ottawa Suburban Roads Commission.

L. W. May, Jr.E.I.C., who was for a number of years with the Hydro-Electric Power Commission of Ontario, on the Queenston-Chippawa power development has joined the staff of the Pennsylvania Water and Power Company, and is located at Holtwood, Penna.

Arthur H. Blanchard, M.E.I.C., professor of highway engineering and highway transport, University of Michigan, has been appointed by Governor Alexander J. Grosbeck and Commissioner Frank F. Rogers, consulting engineer to the Michigan state highway department.

Stewart Young, A.M.E.I.C., has been appointed director of town planning under the Minister of Municipal Affairs for the Saskatchewan government. Mr. Young was formerly district engineer for the Department of Highways at North Battleford.

Julian C. Smith, M.E.I.C., vice-president and general manager of the Shawinigan Water and Power Company Limited, was elected president of the Montreal Tramways and Power Company, at the meeting of the directors held on September twenty-sixth.

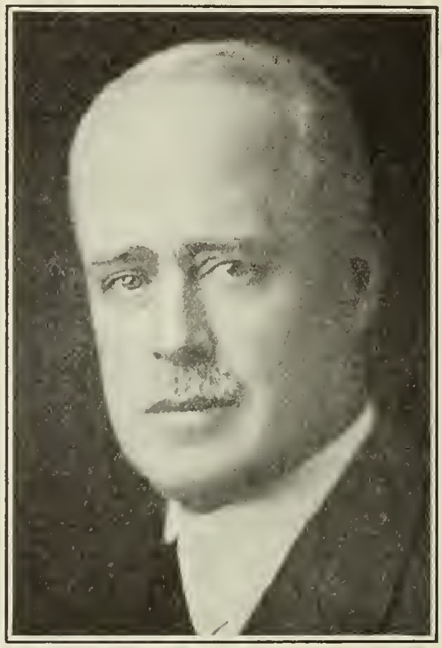
C. C. Lindsay, A.M.E.I.C., who has for the past four years been engineer and mine superintendent of the Bennett-Martin Asbestos and Chrome Mines, Limited, Thetford Mines, Quebec, has joined the staff of Price Brothers and Company, Limited, and is located at Chicoutimi, Quebec.

Irvine M. Marshall, A.M.E.I.C., has resigned as superintendent of the Yellow Pine Mining Company, Goodsprings, Nevada, to accept the position of assistant professor of mining engineering at the University of Illinois. Mr. Marshall graduated from Queen's University in 1921, with the degree of B.Sc.

H. D. Booker, A.M.E.I.C., has been appointed to the staff of the Canadian Westinghouse Company Limited, at their Halifax office. Mr. Booker was formerly located at Fort William, as service department engineer with the same company, and was later with the Nipigon Corporation Limited, Nipigon, Ontario.

Bernard H. Hughes, A.M.E.I.C., sailed from Liverpool on October fifteenth returning to Northern Nigeria, where he will be located for the next six months. Mr. Hughes has been engaged in railway construction work in Nigeria, and in a recent letter forwarded some interesting photographs of the work, of which two are reproduced elsewhere in this issue.

DR. ARTHUR SURVEYER, M.E.I.C.
President of The Institute, who received the degree of Doctor of Engineering at the centennial celebration of Rensselaer Polytechnic Institute at Troy, New York, on October 3rd, 1924.



MAJOR GEO. A. WALKEM, M.L.A., M.E.I.C.,
Vice-President of The Institute, Reeve of the Municipality of Point Grey, B.C., who has recently presented the Charters of the Institute Branches from Vancouver B.C., to Sault Ste. Marie, Ont.

H. Wyatt Johnston, S.E.I.C., has been appointed chief engineer of the Canadian Prest-Air Limited. Mr. Johnston has been engaged on the design of the plant which this company is erecting in Montreal. This is the first commercial plant of its type to be built in this country.

C. H. Scheman, A.M.E.I.C., general manager of the Horton Steel Works, Limited, Bridgeburg, Ontario, announces that his company has opened a service office in Toronto, and that his time will be divided between the establishment of this office and the Bridgeburg works, of the company.

Noel F. Harrison, A.M.E.I.C., has sailed for Ireland where he will be engaged in building activities near Dublin. During the past year, while in Winnipeg, Mr. Harrison has been employed on the preparation of plans and specifications for a new housing scheme in connection with which he has now gone to Ireland.

J. A. Bernier, A.M.E.I.C., formerly city engineer of the city of Shawinigan Falls, Que., has been appointed city manager of Grand Mere, Que. Prior to his appointment to the city of Shawinigan Falls, Mr. Bernier was with the surveys and design bureau, of the city of Montreal. Mr. Bernier is a graduate of Laval university, having received his degree of B.Sc. in civil engineering.

William C. Munro, S.E.I.C., has been appointed chemical engineer, with the Daily News Paper Corporation, North Tonawanda, New York. This company has recently been incorporated, and is erecting a soda pulp mill and a book paper mill at North Tonawanda.

Mr. Munro graduated from McGill University in 1923, and was formerly assistant engineer on the Manicouagan development, for the Ontario Power Company, Limited, Thorold, Ontario.

William Rodger, A.M.E.I.C., has been appointed chief engineer of the Acadia Sugar Refineries, Dartmouth, N.S. Mr. Rodger, who is a native of Scotland, came to this country in 1911 when he joined the staff of the Canadian Pacific Railway Company at Montreal. He was formerly machine superintendent with the Starr Manufacturing Company at Dartmouth, N.S., and in 1918 was appointed plant manager with the Halifax Ship Yards. He later joined the staff of the Dominion Coal Company, at Glace Bay, C.B., as checker and designer.

Eugene Roy, Jr. E.I.C., Appointed Assistant Engineer of Outremont, Que.

Eugene Roy, Jr.E.I.C., junior engineer of the hydraulic service, department of Lands and Forests, Quebec, has resigned to accept the appointment of assistant engineer of the city of Outremont, succeeding Emile Lacroix, A.M.E.I.C., who has recently been appointed city engineer and manager. Mr. Roy is a graduate of the Ecole Polytechnique of Montreal, of the class of '20, and has been connected with the provincial hydraulic service since that time. In the capacity of secretary-treasurer of the Quebec Branch of *The Institute*, Mr. Roy has taken an active interest in Institute affairs.

J. A. BERNIER, A.M.E.I.C.
Newly appointed city manager of Grand Mere, Que.

Patrick Philip, M.E.I.C., Appointed Deputy Minister of Public Works, B.C.

Patrick Philip, M.E.I.C., chief engineer of the department of public works of British Columbia, has been appointed deputy minister of that department. Mr. Philip will continue as chief engineer of the department, which position he has occupied since 1921, receiving his promotion from district engineer. Mr. Philip was born at Londonderry, Ireland, in 1882, and received his education from the Royal High School, Edinburgh; the Royal University, Ireland, and private tuition. His first work in Canada was with the Grand Trunk Pacific Railway, when between 1907 and 1909, he occupied various positions on location and construction work. Prior to entering the service of the provincial public works department he was for seven years assistant engineer, in the engineering department of the city of Vancouver. Mr. Philip was a councillor of ***The Institute*** in 1923 and is a past-chairman of the Victoria Branch.

PATRICK PHILIP, M.E.I.C.
Deputy Minister of Public Works of British Columbia.

Professor Robert W. Angus, M.E.I.C., Elected Vice-President of A.S.M.E.

Professor Robert W. Angus, M.E.I.C., of Toronto, has been elected vice-president of the American Society of Mechanical Engineers, for the next two years.

Prof. Angus was born in St. Thomas, Ont., on July 24th, 1873. His public and secondary school education was received in London, Ont., and in 1897 he graduated from the University of Toronto with the degree of Bachelor of Applied Science in Mechanical and Electrical Engineering.

His first practical engineering experience was obtained from E. Leonard and Sons in London and in the drafting room of the Standard Oil Company in Cleveland, Ohio. After his graduation he returned to Cleveland to work on a special gas-engine design and later he had valuable experience with the Shoenberger Steel Company, (the U.S. Steel and Wire Company), Pittsburgh.

When the separate Department of Mechanical Engineering was established at the University of Toronto, Professor Angus was appointed its first head. He was made professor in 1906, which position he still holds. His duties include the direction of all the heat-engine and hydraulic work in the university. He is entirely responsible for the design and equipment of the mechanical and hydraulic laboratories of the university.

Through extensive travel Professor Angus has kept in touch with the most advanced engineering work in America and Europe. In addition to his college duties he has a large consulting practice, particularly along the lines of expert testing and reporting on machinery and processes in connection with pumps and turbines. He carried out the research work at the basis of the design of the intake for the Chippawa-Queenston power plant at Niagara Falls. He is the author of a book, The Theory of Machines, and has contributed a number of articles to engineering journals.

A. P. Walker, M.E.I.C., honoured by Associates

A number of officials of the Canadian Pacific Railway Company, gathered in the office of the general superintendent, H. C. Grout, at Toronto, on Monday, October 20th, 1924, to mark the retirement of A. P. Walker, O.L.S., M.E.I.C., assistant district engineer, from active service with the company.

Mr. Grout in a few well chosen words, referred to Mr. Walker's long service with the company, his sterling qualities and unfailing loyalty, and uniform courtesy and kindness, to all those to whom he came in contact. Mr. Angus MacMurchy, K.C., solicitor for the company, on behalf of Mr. Walker's associates in the service presented him with an engrossed address, also a gold watch, suitably inscribed. Mr. MacMurchy in his remarks cited instances of invaluable work done by Mr. Walker in the compiling of information and preparation of plans, which assisted materially in the efforts of his department and

PROFESSOR R. W. ANGUS, M.E.I.C.

expressed the wish that Mr. Walker would continue to have good health and long be spared to enjoy his well merited pension.

In reply Mr. Walker spoke very feelingly of the kindness of those who had taken part in the proceedings, thanked them from the bottom of his heart and assured them that he would long remember their thoughtfulness and expressed the hope that all present would live and remain in the service as long as he had.

During Mr. Walker's long service he has been especially identified with the construction of the Ontario and Quebec Railway, the Ottawa and Gatineau Valley Railway and the Montreal and Western Railway, also the surveying of practically all lines of this company on the Ontario District, all of which testify to his skill and ability as engineer and surveyor.

Mr. Walker's membership in *The Institute* dates from April 19th, 1888, when he was elected an Associate Member of the Canadian Society of Civil Engineers, and was elected a Member on April 19th, 1898.

Joins Shawinigan Executive

John Bow Challies, C.E., M.E.I.C., director of water power and reclamation in the Department of the Interior, resigned his post in the government service, the early part of October to accept an important professional position with the Shawinigan Water and Power Company, Mr. Challies being the outstanding authority on water power and water power administration in the Dominion, as well as being consultant in international waterway problems.

The news of Mr. Challies' change will be read with interest by all members of the profession in Canada, as no one is better known and no one has taken a more active part in the affairs of this organization during the past decade.

In addition to graduating from Woodstock College in 1889, Mr. Challies was a member of the famous class of the School of Practical Science '03, receiving the post-graduate degree of C.E. from the University of Toronto in 1915.

JOHN BOW CHALLIES, C.E., M.E.I.C.

He joined the Topographical Surveys in 1903, where, under the tutelage of the late Doctor Deville, D.L.S., director general of Dominion surveys, he received a thorough grounding in general survey work and departmental activities. In 1909 he was chosen as technical assistant to the late R. E. Young, D.L.S., chief geographer for Canada, to organize and supervise water power administrative and investigatory work in the Department of the Interior. On the death of Mr. Young in 1911, Mr. Challies was given complete charge of all the water power work of the department.

Mr. Challies is a member of the Dominion Power Board, the Lake of the Woods Control Board, and of the recently created Dominion Fuel Board. In recent years he has occupied very responsible positions for the government in connection with both interprovincial and international waterway negotiations. From 1916 to 1921 he was honorary engineer secretary of the Research Council of Canada. He was one of the representatives of the government of Canada in 1915 at the International

Engineering Congress in San Francisco, and in 1924, at the First World Power Conference in London, during which he was presented to His Majesty King George at Buckingham Palace.

The outstanding success of Canadian participation in the World Power Conference is largely attributable to his organizing genius and the thorough manner in which he planned for this important event.

He was one of the founders and members of the first council of the Town Planning Institute, and of the Professional Institute of Civil Servants. The Ontario Provincial Legislature, two years ago, named him one of the three representatives of the civil engineers upon the provisional council of the Association of Professional Engineers of Ontario.

Mr. Challies joined *The Institute* as an Associate Member in 1907, being transferred to Membership in 1914. In *Institute* affairs Mr. Challies has been an active, constructive force. For a number of years he acted as secretary of the Ottawa Branch. He has performed signal service on many committees of *The Institute*, his outstanding contribution being made in his capacity as chairman of the Committee on Policy, the report of which committee was published in June 1922, and adopted by *The Institute* in 1923. During 1920, 1921, and 1922, Mr. Challies was a member of Council and is now vice-president, as well as chairman of the Committee on International Co-operation and chairman of the Committee on Engineering Education and Degrees.

Judging from Mr. Challies' splendid record, his well known ability, energy and enthusiasm, it is certain that in his new field of endeavour he will meet with continued and well merited success.

American Museum of Safety

The American Museum of Safety, formerly the Safety Institute of America, which is located at 120 East 28th Street, New York City, has extended an invitation to all members of *The Institute* to visit the museum when in New York. The museum is open daily from 10 a.m. to 5 p.m., and on Saturdays from 10 a.m. to 12 noon.

Russell Sage Laboratory, Rensselaer Polytechnic Institute, Troy, New York, U.S.A.

ELECTIONS AND TRANSFERS

At the meeting of Council held on Tuesday, October 21st, 1924, the following elections and transfers were effected:

Members

POOLER, Max A., E.E., (Purdue Univ.), vice-president and general manager, New Brunswick Power Company, St. John, N.B.

STEPHENS, John, B.A., B.E., M.A., M.E., (Dublin Univ.), dean of the faculty of applied science, University of New Brunswick, Fredericton, N.B.

Associate Members

GAREY, John Dennis, chief engineer, New Brunswick Power Company, St. John, N.B.

URRY, Douglas Perry, designing dftsman., Port Arthur Shipbuilding Co. Ltd., Port Arthur, Ont.

Juniors

LAURIE, William Little, B.A.Sc., (Univ. of Toronto), in charge Edmonton Detachment, R.C.C.S., Northwest Territories Radio System, Edmonton, Alta.

RICHARDS, George Henry, with Messrs. Lee and Nash, engineers and contractors, Brantford, Ont.

Transferred from the class of Student to that of Associate Member

ADLARD, Leonard Stanley, B.A.Sc. (Univ. of Toronto), asst. executive engr., Public Works Dept., Punjab, India.

DICKSON, William Lochead, B.A.Sc. (Univ. of Toronto), demonstrator in engineering drawing, University of Toronto, Toronto, Ont.

GAGE, Charles Edwin, B.A.Sc., (Univ. of Toronto), member of firm, The Toronto Contracting and Haulage Company, Toronto, Ont.

RYAN, Charles Cedric, B.Sc., M.Sc., (McGill Univ.), acting head, dept. of mech. engr., and associate professor of mech. engrg., University of British Columbia, Vancouver, B.C.

Transferred from the class of Student to that of Junior

GREEN, Frederick Gordon, B.Sc. (McGill Univ.), of St. John, N.B.

MAXWELL, Harold James, B.Sc. (Univ. of N.B.), structural detailer, Dominion Bridge Company, Lachine, Que.

MUIRHEAD, Stuart Robert, B.A.Sc. (Univ. of Toronto), equipment supervisor, Saskatchewan Government Telephones, Regina, Sask.

WEST, Thomas Macdonald, B.A.Sc. (Univ. of Toronto), junior member of firm, J. & J. Taylor, Ltd., Safe Works, Toronto, Ont.

The following students were admitted:—

BERRIDGE, Winston W., 48 Rozel Street, Montreal, Que.
CAMPBELL, Christopher F., 128 Bishop Street, Montreal, Que.
DAVIDSON, William, University of Alberta, Edmonton, Alta.
FAN, Pen-Chung, 579 Union Avenue, Montreal, Que.
FARRELL, Alfred James, B.Sc., (McGill Univ.), 4874 Wesmount Avenue, Montreal, Que.
GRAY, Donald Alexander, 976 Tupper Street, Montreal, Que.
MOLLEUR, Gerald, C.E. (Ecole Polytech.), 5814 Park Avenue, Montreal, Que.
STEWART, Donald, Sunnyside Avenue, Lakeside, Que.
WALLACE, Reginald Henderson, Halifax, N.S.
WHITE, Thomas Nash, Jr., 100 Easton Avenue, Montreal West, Que

Institution President Visits Headquarters

Sir Charles L. Morgan, president of the Institution of Civil Engineers of Great Britain, visited Canada in September, spending Friday, September twenty-sixth in Montreal. Sir Charles called at headquarters in the morning and after luncheon with the Secretary was escorted by him to McGill University where he met Dean H. M. MacKay, M.E.I.C., and Doctor J. B. Porter, M.E.I.C.

T. W. Harvie, M.E.I.C., general manager of the Harbour Commission, who is also a member of the Institution of Civil Engineers of Great Britain, kindly arranged for a tour of inspection around Montreal harbour. The party also included F. W. Cowie, M.E.I.C., consulting engineer to the Harbour Commission, and Harold Rolph, M.E.I.C., president, John S. Metcalf Company, who were completing number three elevator and making extensions to other elevators. It was the first time Sir Charles had seen grain handled on such an elaborate scale, and he expressed his admiration for the splendid engineering work in evidence.

Sir Charles had attended the Centenary Celebrations of the Franklin Institute and after leaving Montreal was present at the Centenary of Rensselaer Polytechnic Institute at Troy, New York, on October third and fourth, where he received the degree of Doctor of Engineering.

EMPLOYMENT BUREAU

Situations Wanted

Electrical Engineer

Graduate of the University of Toronto. Three summers on location, supervision of construction, and inspection of highways. One summer on railway and transmission line construction. Overseas with R.A.F. Will go anywhere and commence immediately. Apply box No. 156-W.

Mechanical and Electrical Engineer

Graduate mechanical and electrical engineer with twenty years experience including eight years city engineer and four years manager of street railway, wants responsible, executive position. Efficient in costs and organization. For particulars and references apply box No. 157-W.

Electrical Engineer

Electrical engineer, A.M.E.I.C., A.M.A.I.E.E., desires executive position with large corporation, having extensive plants. Also has considerable knowledge and experience in mechanical and steam engineering. At present holding executive position with large company. Desires change. Future prospects must be assured. Married, age 37. References and further particulars. Apply Box No. 158-W.

Mechanical and Designing Engineer

Mechanical and Designing Engineer, A.M.E.I.C., with considerable experience in plant installations, employing heavy machinery. Holding position at present with large concern. Desires executive position with a large corporation. Married, age 38. Future prospects for advancement essential. Apply Box No. 159-W.

Situations Vacant

Junior Radio Electrical Engineer for the Department of Marine and Fisheries, Ottawa. Initial salary $1680 per annum plus bonus, maximum $2040 per annum. Candidates must be graduates in electrical engineering from a recognized university with two years' experience in radio or electrical engineering work, or have four years' experience in radio or electrical engineering work. They must be British subjects with at least three years' residence in Canada. Apply to the Civil Service Commission, Ottawa, not later than November 22nd, 1924.

Hydraulic and Sanitary Engineer

Applications will be received for a graduate engineer with experience in hydraulic and sanitary engineering work, to join the staff of a consulting engineer in New York City. Apply box 120-V.

Members' Exchange

Periodicals For Sale

Engineering News, for the years 1882-1907, with the exception of the following volumes which are missing: — All of year 1884; volume 2, 1887; volume 1, 1899; volume 2, 1901; volume 2, 1902; all of year 1903. These are bound in two volumes for each year, with the exception of the years 1882 and 1883.

Canadian Engineer, volumes 1893-1907.

Apply box No. 9-E.

Course in Technics of Telephony

The Maritime Telephone and Telegraph Company of Nova Scotia of which J. H. Winfield, M.E.I.C., is managing director, W. A. Winfield, M.E.I.C., general superintendent of plant, F. A. Bowman, M.E.I.C., assistant to general superintendent of plant, and C. M. Crooks, A.M.E.I.C. construction engineer, announces in a monthly bulletin issued by the company, a short course in technics of telephony, which is somewhat unique in Canadian telephone practice.

By collaborating with the Technical College a careful plan for a short term course covering the general principles of electricity, electrical machinery testing, and technical knowledge of telephone traffic, construction, accounting, etc., was evolved. The company's offer to its employees includes a grant of two weeks leave on full pay, and also the payment of the college fees, the student to pay his own travelling expenses and board. The educational qualification called for was high school graduation or its equivalent.

The school opened on Monday, August 18th, with twelve students. The lectures were delivered in the geological lecture room and the physical laboratories of the Nova Scotia Technical College. When the course finished the students were guests of the company at a luncheon at the Green Lantern, on which occasion J. H. Winfield, M.E.I.C., managing director, and W. H. Hayes, general manager, addressed the meeting. It is intended to continue the course next year, with the probability of having two courses, including the present and one advanced course for those who took the course this year.

Competition for Montmorency Bridge Design

The Department of Public Works and Labour, Quebec, has issued the following announcement of a competition for the design of a reinforced concrete or steel arch bridge of a central span of about 200 feet over the Montmorency river, (at the head of the falls), between St-Louis de Courville, Quebec county and St-Jean de Boischatel, Montmorency county.

Every competitor shall be a civil engineer of the province of Quebec, and authorized to practice as such in the province, shall have, at least, five (5) years experience and have prepared plans for important constructions in concrete or have had charge of the carrying out of such works.

He shall give all these particulars when submitting his project.

The department will supply every competitor with a plan and profile of the ground at the site of the proposed bridge, and also all necessary information upon the receipt of an accepted cheque of twenty-five dollars ($25.00).

This cheque will be remitted to the depositors if the documents are returned to the department within 30 days following the closing of the competition.

Every competitor may adopt the design which seems to him the most suitable to the location or site, regarding the aesthetics, the permanency and the cost of the enterprise. He shall submit to the department an elevation of the proposed structure accompanied by cross-sections and plan, etc.; also a special specification, (on sheets supplied for this purpose), giving the required particulars to complete the general specifications of the department for the project in question.

The plans and specifications shall be sufficiently detailed to permit a complete understanding of the project and allow the contractor to base his estimate on same.

A detailed estimate of the cost and also a summary of the quantities and unit prices should also be annexed to the project.

The government does not bind itself to accept nor to have executed any of the submitted projects, but will award for the two best designs submitted, (for reinforced concrete arches only), two prizes, one of one thousand dollars ($1,000.00) and the other of five hundred dollars ($500.00).

If the department adopts one of the designs submitted for a reinforced concrete arch, the plans and specifications shall become its property, as well as the two designs for which prizes have been awarded by the department, and when the construction is decided upon, the successful designer will assume the responsibility and also the superintendence of the execution of said work for 3 per cent of the cost payable according to the progress of the work, and 2 per cent of the cost payable after the final acceptance by this department, unless the design submitted is from a contracting engineer in which case another engineer will be appointed as supervisor.

In the case of the design of a steel arch, the plans for the substructure and also for the superstructure shall be submitted by a company making a specialty of the preparation and erection of steel work and holding office in the province of Quebec.

In the case of the acceptance of one of these designs a contract shall be given to the company whose design has been judged most satisfactory.

The present competition is not open to any of the engineers forming a part of the staff of the Department of Public Works and Labour, Quebec.

All plans and documents regarding the present competition should be remitted to Mr. Ivan E. Vallée, chief engineer of the Department of Public Works and Labour, Parliament Building, Quebec, not later than noon, January 12th, 1925.

(*Signed*) Ivan E. Vallée,
Chief Engineer.

Department of Public Works and Labour,
Quebec, October 6th, 1924.

ANNOUNCEMENT OF MEETINGS

Further information may be secured from the secretaries of the various branches, whose addresses may be found under "Officers of Branches" on page 662 of *The Journal*.

LETHBRIDGE BRANCH:—

Secretary-Treasurer, Geo. S. Brown, A.M.E.I.C.

Nov. 7th. Illustrated address on "Peary's Expedition to the North Pole", by J. Davidson.

Dec. 19th. Address by R. W. Boyle, Ph.D., M.E.I.C., of the University of Alberta, on an electrical subject.

Jan. Address on "Central Heating", by Mr. W. B. Fretter.

MONTREAL BRANCH:—

Secretary-Treasurer, E. A. Ryan, A.M.E.I.C.

Nov. 6th. Address on "Recent Advancement in the Construction and Operation of Grain Elevators", by L. Coke Hill, M.E.I.C. Chairman, T. W. Harvie, M.E.I.C.

Nov. 13th. Address on "The Work of the Quebec Public Service Commission", by F. C. Laberge, M.E.I.C. Chairman, Geo. R. MacLeod, M.E.I.C.

Nov. 20th. Address on "Chain Drives", by H. George, Chairman, J. T. Farmer, M.E.I.C.

Nov. 27th. Address on "Improvements in Design and Appearance of Concrete Bridges", by C. J. Desbaillets, M.E.I.C. Chairman, Prof. H. M. MacKay, M.E.I.C.

Dec. 4th. Address on "Design and Construction of the La Gabelle Development", by S. Svenningson, M.E.I.C. Chairman, Prof. Ernest Brown, M.E.I.C.

Dec. 11th. Address on "Distribution Cost of Electric Power", by P. T. Davies, Chairman, Prof. C. V. Christie, A.M.E.I.C.

Dec. 18th. Annual meeting of the branch.

SASKATCHEWAN BRANCH:—

Secretary-Treasurer, J. W. D. Farrell, A.M.E.I.C.

Nov. 13th. Ladies' night.

Nov. 27th. Address on "Railway Maintenance Problems" by P. C. Perry, A.M.E.I.C.

Dec. 11th. Address on "The Hudson Bay Railway" by Lt.-Col. A. C. Garner, M.E.I.C.

Jan. ..... Address on "Military Engineering" by Capt.G. R. Chetwynd, A.M.E.I.C.

SAULT STE. MARIE BRANCH:—

Secretary-Treasurer, W. S. Wilson, A.M.E.I.C.

Nov. ..... Address on "Weather Forecasts" by A. G. Burns.

ST. JOHN BRANCH:—

Secretary-Treasurer, W. J. Johnston, A.M.E.I.C.

Nov. 12th. Address on "The British Empire Exhibition", by Fraser S. Keith, M.E.I.C.

Dec. 11th. Address on "Tests for Vocational Selection and Guidance", by George J. Trueman, Ph.D.

VICTORIA BRANCH:—

Secretary-Treasurer, E. P. Girdwood, M.E.I.C.

Nov. 5th. Joint luncheon with The Association of Professional Engineers of B.C., at Spencers. Presentation of Branch Charter, by Vice-President, Major Geo. A. Walkem, M.E.I.C.

Addresses Wanted

The work of compiling the revised edition of the Charter, By-laws and List of Members of *The Institute* is about to commence and for this purpose, as well as for general record, it is important that addresses should be brought up to date as soon as possible. The following is a list of members whose addresses are not known and any information that may be supplied as to the addresses of these members will be greatly appreciated by the Secretary.

Members

Brown, L. L.
Ferguson, H. B.
Hawkins, E. E.
Holliday, J. H.
Leslie, R. F.
Macdonald, Chas.
Ord, L. R.
Scott, W. L.
Walker, Miles
Welch, Arch.
Wright, J. A.

Associate Members

Armstrong, Westropp
Augustine, A. P.
Barnes, H. E. R.
Black, J. R.
Bolger, E. J.
Borland, V. J.
Bourgoing, S.
Bowie, Jas.
Butler, J. K.
Calder, J. W.
Campbell, Neil
Chown, R. C. F.
Clarke, Frederick
Davis, C. H.
Drowley, A.
Earl, E. A.
Elliott, G. R.
Gorrie, D. F.
Grange, E. R.
Gray, E. D. A.
Hawkins, S. H.
Herren, P. H.
Hillman, W. A.
Ireland, W. J.
Jones, T. M.
Kearney, Thos.
Lepage, J. S.
Lillico, R. S. B.
Luscombe, H.
MacKenzie, C. G.
Mackenzie, C. M.
Matthews, F. E.
McKenzie, J. E.
Menard, J. P.
Mercieca, A. L.
Millard, C. S.
Moody, J. A.
Mulock, Col. R. H.
Murphy, C. J.
Newton, C. A.
O'Connor, J. F.
Orr, F. O.
Perrin, A. T.
Pinch, H. H.
Porcheron, W. D.
Purvis, F. R.
Putnam, A. A.
Rhodes, J. F.
Rodd, B. T.
Saunders, Walter L.
Scarnegie, D. A.
Schuster, K. R.
Snodgrass, R.
Sprenger, H.
Suttie, J. P.
Tom, J. A.
Wallis, N. J.
Weir, F. E.
Wilkins, Sidney
Williams, C. W.
Yandall, B. A.
Zverina, J.

Juniors

Ardagh, S. V.
Betourney, J. N.
Boulton, C. A.
Bryant, E.
Burton, E. C.
Ells, J. C.
Grupp, C. A.
Igoe, F. J.
Junkin, R. L.
MacKenzie, R. G.
MacKenzie, Norman
MacMillan, M. J.
Mayes, F. L.
Morrison, H. K.
Pearson, Chas.
Roberts, H. A.
Shepherd, H. W. R.
Smith, H. S.

Students

Allen, A. J.
Allen, Wilfred
Bell, W. T. A.
Bickell, W. A. B.
Brodeur, J. C.
Bronstein, S.
Brown, E. C.
Brown, Leo. B.
Buckingham, E. J.
Campbell, A. J. G.
Carp, M.
Circe, J. A.
Circle, J.
Clark, W. J.
Cooper, J. R.
Coulter, W. D.
Davison, J. L.
Deamude, F. V.
DeLormier, J. A.
Desmaisons, O.
Durham, J. B.
Estey, A.
Farnham, D. M.
Foster, M. G.
Gagnon, A.
Gannon, L. J.
Garrett, A. R.
Goldie, J. E.
Grant, W. R.
Haley, J. P.
Hart, L. F. C.
Heurtley, E. S.
Hovey, L. M.
Hubbard, E. B.
Jones, G. L.
Kerr, G. E.
Kerr, T. B.
Kirby, A. R.
Larin, L.
Leger, A.
Lewis, B. W.
MacDonald, W. D.
MacKenzie, B. H. T.
MacLeod, C. H.
Martin, B. E.
McCallum, F. L.
McLeish, R. G. A.
McRae, J. A.
Munroe, K. A.
Noonan, W. H.
Oakley, R. D.
Pearse, H. A.
Porter, J. B.
Porter, W. J.
Read, G. W.
Roy, E. W.
Rumble, Geo. R.
Sims, T. A.
Stewart, M. G.
Tallon, J. A.
Townsend, J. H.
Vanier, G.
Whitlock, W. H.
Wright, H. S.
Young, J. P.

BRANCH NEWS

Border Cities Branch

F. Jas. Bridges, A.M.E.I.C., Secretary-Treasurer.

The first regular monthly meeting of the Border Cities Branch was held at a dinner meeting at the Prince Edward Hotel at 7 p.m. on Friday October 17th. The executive were more than gratified in having such an enthusiastic turnout at the first fall meeting.

After putting away a good "feed" the chairman, J. E. Porter, A.M.E.I.C., called for the reading of the minutes of the previous meeting which were adopted as read. An invitation was read from the Detroit section of the American Society of Civil Engineers for any of the members of the branch to attend any or all of the sessions of the annual fall convention which is to be held in Detroit on the 23rd, 24th, and 25th of October. In connection with this it was agreed to invite any members of *The Institute* who might be attending this convention. Particular reference was made to our president, Dr. Arthur Surveyer, who was expected to be present. It was agreed to give a dinner in honour of those members who could possibly come to Windsor.

In referring to the present drive that is taking place to raise funds for the general hospital, J. Clark Keith, A.M.E.I.C., thought that, as the finances of the branch were in a good healthy state, it would be a worthy object to which the branch might contribute. On the motion of H. Thorne, M.E.I.C., and E. J. McIntire, A.M.E.I.C., the executive was empowered to act on this matter.

With business concluded, the chairman introduced several visitors, executives of the Western Waterproofing Company. These were F. C. Bagby, J. C. Kearney, and Major Reed-Lewis, M.E.I.C., of Toronto.

Waterproofing of Concrete

The speaker for the evening, J. C. Rothermal, was introduced. He took as his subject "The Waterproofing of Concrete". In opening his remarks Mr. Rothermel said the best way to get water tight concrete was to get good concrete, but outside of the laboratory it seems almost impossible to get perfect concrete. This is especially true of large jobs. Slightly porous or honeycomb concrete will be alright structurally but will not be waterproof. Therefore owing to frequency with which unwatertight concrete is encountered it is advisable to make some other provision for waterproofing.

The common ways of waterproofing concrete were the membrane method, the integral method and the plaster coat. The first method is splendid if applied properly but to do so incurs large expense and if a leak develops serious inconvenience is experienced. The "integral waterproofings", comprising powders, pastes, and liquids. The integrals are divided into three classes, inert void fillers, active void fillers and water repellants. Plaster coat system was then taken up and described The speaker then passed on to the ironite process. Ironite is finely ground iron of special make containing sal ammoniac. The waterproofing quality depends on the oxidation of the iron after water is added. The small particles of iron fill the pores of the concrete and as it oxidizes it expands and stuffs or seals the pores. A parallel was cited in the case of the iron pipe line which at first may leak at the joints but as the oxidation or rust takes place the leak stops.

In summarizing he took up six points, viz:

1. There are three methods of waterproofing, membrane, integral, and interior surface treatment.
2. Membrane is good but expensive and hard to mend.
3. Integral is not sure.
4. Inside surface treatment, not as expensive as membrane, is accessible for repairs.
5. Ironite has distinct advantages over last method as it automatically seals over hair cracks and fills the pores.
6. Put waterproofing in responsible hands, as good workmanship and knowledge of waterproofing is 75 per cent of the success of waterproofing.

Cape Breton Branch

D. W. J. Brown, Jr.E.I.C., Secretary-Treasurer.

The regular meeting for September was held on the evening of Tuesday, the 23rd. This was the opening meeting of the season. S. W. Farnham, mining electrical engineer of the Goodman Manufacturing Company, Chicago, was the speaker, and gave a very interesting talk on mechanical cutting, loading, and haulage in coal mines. Mr. Farnham stated that owing to the present keen competition in the coal market, coal operators everywhere are experimenting with new machinery and methods with the hope of reducing the cost of coal to the minimum. The possibilities of the coal cutter, or mining machine, are now well known, and this machine is now part of the regular equipment of all up-to-date coal mines. The possibilities of the mechanical loader, for use underground, are not so well understood and have not been fully demonstrated under the various mining conditions, some of the machines being still in the experimental stage of design.

The introduction of power shovels requires more preliminary work in preparation for it than does the installation of coal cutters and locomotives, and Mr. Farnham said that the failure of many of the earlier installations could be traced to the impossibility of keeping an adequate car supply on hand owing to this preliminary work not being properly done.

In connection with the question of keeping up an adequate car supply, the speaker stated that good power loaders can load at the rate of a ton a minute in thick coal and at the rate of one-half ton a minute in thin coal. With locomotive gathering, a car can be changed at the loader in from one minute to a minute and a half, which means that cars must be delivered at the loader at the rate of one every three or four minutes instead of one every twenty or thirty minutes as is required when hand loading is employed. An increase in cars supplied of five or six times over the hand loading requirements is therefore necessary.

The usual type of mechanical loaders cannot be used in thin seams on account of the headroom required. Mr. Farnham described a type of loader known as the "scraper loader" which can work well in coal as low as twenty inches in thickness and with props set the usual distance from the face. Other advantages of this type of loader are: it saves the cost of room tracks, brings the coal to the entry and it can handle large lumps. In one mine a scraper type loader handled from 70 to 105 tons daily from two wide rooms, a crew of five men, including the motorman, being used. Several interesting lantern slides were shown of this type of loader in use underground. Pictures were shown of another type of loader operated by hydraulic power. This machine loads material at a very low cost per ton and in one mine has regularly loaded two hundred tons per day.

Mr. Farnham also showed illustrations of electric locomotives and coal cutters. In connection with the locomotives used underground he said that a greater number of the trolley type were used than of the storage battery type. As an illustration of the extensive use of locomotives underground it was stated that on American railroads one hundred miles per day is often considered a day's run, and is the length of many short divisions. Many locomotives in use in coal mines travel as much as eighty miles per day. In the United States, one ton out of every six hauled by the railroads is first hauled underground by the electric locomotive.

Referring to coal cutters, the speaker described several of the latest types, including the gas proof machines and the mounted type which cut from twelve to thirty places in a shift. All of this underground labour-saving machinery is helping the operator to obtain lower coal prices by increasing the production of coal per man employed.

At the conclusion of the paper a general discussion took place and Mr. Farnham carefully explained the many points questioned.

Edmonton Branch

W. R. Mount, A.M.E.I.C., Secretary-Treasurer.

On September 29th, nineteen members entertained at dinner in the MacDonald hotel, Major G. A. Walkem, M.L.A., M.E.I.C., a vice-president of *The Institute.* Major Walkem had come from Vancouver in order to present to the branch its Charter.

Major Walkem's address to the meeting was of an inspiring order and after going back to the early days of *The Institute* gave the members his ideas of the functions and uses of the modern professional engineer from a national and social point of view.

Col. B. J. Saunders, M.E.I.C., lead several other members into an interesting discussion of some of the points raised by the guest. Evidence was not wanting of the general enjoyment of the evening and the chairman, when thanking Major Walkem for coming to Edmonton and for addressing the meeting as he had done, found no difficulty in expressing the appreciation of all present.

In the absence of Kells Hall, A.M.E.I.C., A. G. Stewart, A.M.E.I.C., was in the chair for the evening.

Kingston Branch

A. Jackson, A.M.E.I.C., Secretary-Treasurer.

At the first meeting of the Kingston Branch this fall, A. Austin, of the India State Railways, gave a most interesting address on railway construction in India.

Railway Construction in India

Mr. Austin, in introducing his subject, gave statistics on railways in Australia, Europe and North America, comparing private and government owned lines, and gave particulars of the losses resulting in several European countries, when the railways were taken over from private ownership. In Switzerland, prior to the transfer to government control, the railways had been paying twelve and one-half per cent, but after were found to be running at a loss. Italy, in this connection, was pointed out as the most outstanding case where the railways are being operated at an enormous loss, due to the unnecessary employees taken on through influence. In the smaller stations for example, where one man would be ample, a station master would have several assistants.

Referring to conditions in India, the speaker pointed out the difficulty in making progress with construction work as a result of the uncertainty of financial support which at times is withdrawn after work has been commenced. The climate of the country makes railway construction difficult, since sickness is continually responsible for delays. Apart from these conditions the nature of the country interferes with the work. One line, which the speaker built, consisted almost entirely of cut and fill. The cuts in the majority of cases being through rock or very hard shale. In one cut, the rock was of such hardness that it took, on an average, one foot of steel to drill a foot of rock. It eventually had to be undermined and blown with three hundred pound charges of dynamite.

The engineers have many mechanical difficulties to overcome, since, if a special apparatus is necessary, it must be made on the job and as workshops are not available and the material on hand is limited considerably, ingenuity has to be exercised.

The religion of the country which apparently abounds in demons, steps in and causes the engineer more trouble, as he is frequently restrained from cutting into a hill or removing a boulder, because demons are imprisoned, and if the cut were made the demons would be liberated to prey on the adjacent villages. Arrangements can generally be made in such cases to placate the evil spirits by sacrificing a bullock or a sheep. A human sacrifice is now and then demanded and the engineer is delayed again until it can be arranged otherwise.

Lethbridge Branch

Geo. S. Brown, A.M.E.I.C., *Secretary-Treasurer.*

The open season for meetings of the Lethbridge Branch began on September 30th, when Major Geo. A. Walkem, M.E.I.C., vice-president of *The Institute* arrived with the charter for the local branch under his arm.

In one of the most impressive addresses that has been delivered before the local branch, the Major pointed the way to public life for engineers. "We, as engineers, he said, have been a little too prone in the past to be content in working for others. We do not assert ourselves quite enough and I am inclined to blame this tendency on the manner in which we have been schooled. The lawyer is taught to express himself and so is the minister. In fact it sometimes seems to me that everyone has something to say in public life except the engineer. When we talk, it is generally in technical language before a technical body. When we write, we express our thoughts in language difficult for the layman to comprehend. There is a distinct place in public life for the engineer, and we should school ourselves to that end."

The Major, who has recently been elected to the British Columbia legislature, and has been a resident of that province for twenty-five years, expressed the greatest faith in the future of Vancouver as a grain exporting point. He pointed out that the grade on the Canadian National lines west from Edmonton was never greater than 1 per cent and was less than the grades east from Edmonton to Port Arthur. The western route offered great possibilities as an outlet for the prairies. In 1922, he said, 4 million bushels of grain passed through Vancouver, while in 1923 this had jumped to 53 million bushels and the prospects were that 120 million bushels would go through that port this year. Ocean tonnage was available to take care of all the grain that could be shipped. The government had one elevator now operating and another under construction while the Spillers Company are making arrangements for their own elevator and other companies are prospecting the port. Altogether it was a rosy picture that the Major painted of the future Vancouver.

The meeting which was in the form of a dinner opened with John Dow, M.E.I.C., chairman of the branch, presiding and Sam Porter, M.E.I.C., taking his usual role of director of community singing. Sam introduced something new in action songs when he sprung the "Spreading Chestnut Tree". The words seem innocent enough —

Under the spreading chestnut tree
When I held you on my knee
We were happy as could be
Under the spreading chestnut tree

but it was excruciatingly funny to see staid old engineers, many of them ex-army officers, Majors and Captains and Loots, going through this action song led by Sam Porter. Yes, Major Walkem did his share, too.

Solos were sung by Messrs Hazel and Meldrum, but the act that brought down the house was the Quartette when it sang "Gitty ap, dap, we're goin' home." Our own orchestra played throughout the meal and Mrs. Dunning was at the piano for the community singing.

It was a pleasant evening with all the members mingling together and taking part in the programme.

G. N. Houston, M.E.I.C., sketched out his programme for the winter which includes such items as a lantern lecture on the second Peary expedition to the North Pole by J. M. Davidson of Calgary who was himself a member of the party. Professor R. W. Boyle, M.E.I.C., of Alberta University follows with a talk on some electrical subject; a talk on central heating by W. B. Trotter, A.M.E.I.C., while Col. Boyden will visit us again with cement and concrete. The musical and general stunt programme promises some good times during the coming months.

London Branch

E. A. Gray, Jr.E.I.C., Secretary-Treasurer.
R. I. Olmsted, A.M.E.I.C., Branch News Editor.

After complete arrangements had been made by the local executive a special tour meeting of the London Branch was held to the Niagara Peninsula to inspect the new Welland ship canal and Chippawa-Queenston hydro-electric development.

Upon arrival in St. Catharines on August 23rd, at 12 o'clock noon, the London members were met by representatives of the Niagara Peninsula Branch at the old Welland Inn where luncheon was obtained.

Inspection of Welland Canal

The first inspection on the itinerary was the Welland ship canal and was personally conducted by A. J. Grant, M.E.I.C., chief engineer, and E. G. Cameron, A.M.E.I.C., assistant engineer. The Thorold section first received attention, and step by step the most interesting points were visited until the Port Weller harbour was reached. In the locks the vessels will be raised 140 feet in three operations, 46½ feet at each lock. There are two sets of locks side by side, so that one boat may be locking down stream while another is passing through the other set on its way upstream. There will be seven lifts in the entire canal of 46½ feet each. On the old canal there were 28 locks. In comparison with the Panama canal the following figures are given:—Welland ship canal, draft 30 feet, locks 80 feet wide by 800 feet long; Panama canal, draft 40 feet, locks 100 feet wide by 1,000 feet long.

Banquet at Port Dalhousie

After the completion of the inspection of the canal, the members departed for Port Dalhousie where the Niagara Peninsula Branch had arranged a sumptuous banquet at the Lakeside Inn. E. G. Cameron, A.M.E.I.C., son of Ex-Sheriff Cameron, of London, assistant engineer on the Welland ship canal, was the chief speaker at the banquet. He gave an excellent outline of the history of the canal.

Visit to Queenston-Chippawa Plant

On the following day, August 24th, the Chippawa-Queenston scheme was visited, the start being made by motor boat at the head works at Chippawa, thence through the canal to the forebay at Queen-

Members of London Branch on Inspection Trip ston. The party on this trip was under the personal direction of T. V. McCarthy, A.M.E.I.C., assistant laboratory engineer of the Hydro-Electric Power Commission. On arrival at the power house special guides were supplied to take the members to every nook and corner of this great plant.

The Executive Committee of the London Branch expressed their appreciation of the reception accorded the party by forwarding letters of appreciation to the Niagara Branch officials of the works visited.

Problems Affecting Intense Urban Development

The London Branch held the first regular fall meeting on October 15th, in the Board Room of the Board of Education, at 8 p.m. with E. V. Buchanan, M.E.I.C., presiding.

The speaker of the evening, Horace L. Seymour, A.M.E.I.C., consulting engineer, Toronto, presented to the meeting problems affecting intensive urban development, with special reference to their application in London.

Preliminary to the address, lantern slides were shown illustrating town planning schemes, as put into effect in various places such as London, England, Paris, France, New York City, Halifax, Kitchener, Haileybury, etc. Slides were shown of congested traffic conditions prevailing in New York City and the artistic conception of the solution.

In the course of his remarks, Mr. Seymour strongly urged the elimination of grade crossings in the city of London and outlined the reason why it was impossible to consider the question of a union station for the city. The speaker also dealt with the question of erecting elevated tracks or of considering subways as the solution for the level crossing problem. The latter he stated would be out of the question to the excessive cost, although he favoured the consideration of two subways, one at Rectory and the other at Waterloo Streets.

The small number of members present showed lots of enthusiasm and the various points were well discussed. It is to be regretted that more local members did not avail themselves of the splendid opportunity of becoming better acquainted with Mr. Seymour, and lend added weight to the discussion. Here's hoping that at the next meeting the "standing-room-only" sign will be displayed.

Ottawa Branch

F. C. C. Lynch, A.M.E.I.C., Secretary-Treasurer.

That the Empire Exhibition at Wembley had been wonderfully effective in promoting good-will amongst the nations of the world was the testimony borne by Messrs. J. B. Challies, M.E.I.C., John Murphy, M.E.I.C., G. Gordon Gale, M.E.I.C., and B. F. Haanel, M.E.I.C., all of whom were in England this summer and who gave their impressions at a luncheon held at the Chateau Laurier October 16th, under the auspices of the Ottawa Branch.

J. L. Rannie, M.E.I.C., chairman of the branch, who was in the chair, paid a notable tribute to the work of the Canadian delegates at the World Power Conference, who had been so efficient and had made such splendid contributions to the conventions and congresses which they had attended that on all sides flattering references had been made to Canada's share in the international event and great kudos had therefore been won for the Dominion.

Special mention was made during the luncheon of the good work accomplished by Fraser S. Keith, M.E.I.C., in giving full publicity to the reports of the Canadian delegates, which made a very valuable addition to engineering literature and to the very fine record in the Interior Department, of J. B. Challies, M.E.I.C., who has transferred his activities to other spheres.

"So far as Canada is concerned, the World Power Conference spelled certain prosperity in the future," said Mr. Challies. "It was one of the finest opportunities and most fortunate occurrences. The potential possibilities of Canada were widely advertised and all nations now know that Canada, the youngest of them all, is absolutely self-contained in power matters."

"I was surprised by the little attention given to power derived from internal combustion motors and the dependence of civilization to-day on that source of power," said Mr. Haanel, of the department of mines. "Everybody was talking water power, and much attention was given to oil fuel — and yet the supply of this latter is extremely limited and experts estimate that five years will see its end."

"In general, Canadian participation was so definite, clear-cut and at times spectacular," said Mr. Challies, "that the Dominion is now known among the greatest financial and engineering experts of the world as one of the most fortunate and progressive, if not the foremost, power producing country. I can say without reserve that no country had as good a story to tell, and certainly no national delegation made better use of its opportunities than the Canadian."

"Do you, gentlemen, realize that Canada, the youngest among nations, is to-day completely self-contained in respect to hydro power production? We have to our credit some of the largest and most advanced hydro-electric properties in the world. Canadian manufacturers can produce every bit of electrical or hydraulic equipment needed for the most modern system.

"In preliminary investigation, in administration, design, construction, manufacture and operation, Canadian engineers have no peers. That, gentlemen, is a plain, true fact. It was generally and generously acknowledged at the first World Power Conference. With all the engineering facilities needed and having the finest and most fortunately located waterpower resources, can there be any doubt about the future of this country? My answer is emphatically NO, if we but preserve our water powers for our own national needs."

Mr. Gordon Gale said in part:

"I appreciate very much the honour of having this opportunity of telling you something about the trip through Norway and Sweden. The first thing that impressed me was the good fellowship, which developed almost immediately amongst the 32 engineers of 12 nationalities — Bolshevik and anti-Bolshevik, Scandinavian and Latin. Notwithstanding their national differences, they were all united in the common bond of science and engineering.

"A radical difference, is the way in which the domestic consumer pays for his electricity. He buys it on the basis of the kilowatt year. They maintain, and quite correctly, that the power is manufactured by the year, and should be sold on the same basis. This method places a very necessary limit upon the "peak load", but it does not regulate the daily consumption. As a result, quite an extensive research has been made in connection with the storage of heat for cooking, and some very interesting inventions have been developed."

"The method in effect in this part of Canada is almost the opposite — a nominal yearly charge is made, which places no limit upon the peak load, and the consumer pays for his electricity on the kilowatt hour basis."

Mr. John Murphy said in part:

"If you meet a tyro in the power business — and he really wants to learn it — send him to Italy. I fell in love with Italy. The Italians put people in jail for selling electric heaters, or, for using them between 4 and 10 p.m. American engineers have collaborated with the Italians from the very beginning — in 1882. While much waterpower is being developed in Italy — and their power houses and employees' dwellings are more beautiful than our churches — they are also now building steam plants in Italy. Although all their coal comes from America and England, still steam power is cheapest for such intermittent work as peak-hour work. That is a simple fact which powermen have always known. Waterpower is cheapest for continuous loads. Volcanic steam power was profitable during the war because coal then cost $40 per ton. But while coal is about $10 per ton, volcanic-steam plants would not be economical. Italy pays a bonus of $2 per h.p. per year for 15 years to those who develop waterpower."

"Canadians rarely realize," said Mr. Murphy in conclusion, "what liberty we enjoy; how free, and consequently, how happy we are. A trip to any part of the Old World makes us more appreciative of our own country — and glad to come back again."

Peterborough Branch

Paul Manning, A.M.E.I.C., *Secretary*,
W. E. Ross, A.M.E.I.C., *Branch Editor*.

Lest it should be considered that the Peterborough Branch has been inactive during the summer months, the scribe wishes to state that this is not the case, the lack of news being attributable only to the said scribe's derelictions from duty and not to any lack of activity on the part of the branch.

Annual Outing

Two outings have been held during the summer months, the first, on June 28th, being the regular annual outing, when branch members and friends to the number of about sixty motored to South Beach, on the shores of Clear lake, calling en route for visits of inspection at the Canadian General Electric Company's power plant at Nassau, the new concrete bridge over the river Otonabee at Lakefield, and at the new dam at Young's Point on the Trent canal system.

A full programme of sports at South Beach had been planned, but, unfortunately, the weather man failed to live up to expectations and a downpour of rain stopped a perfectly good baseball game after two innings, the opposing teams being captained by E. R. Shirley, M.E.I.C., and A. L. Killaly, A.M.E.I.C.

Between showers a nail driving contest, which by the way is a sort of combination relay race and hammer swinging contest, was staged between teams representing the Members, Associate Members, Juniors, Students, and Affiliates; the last named team proving victorious.

A strenuous tug of war was *pulled off* between teams, consisting of electrical men, captained by P. L. Allison, M.E.I.C., and the "rest of the world" led by R. L. Dobbin, M.E.I.C., in which after a desperate contest the electrical men proved that they had more pull than their brothers in other branches of the profession.

An excellent supper was enjoyed at the South Beach Hotel, enlivened by chorus singing, for which Peterborough Branch has a special aptitude, and a few short addresses. The arrangements were in the hands of P. Manning, A.M.E.I.C., H. A. Fife, Branch Affiliate, and W. E. Ross, A.M.E.I.C., and despite the execrable weather an enjoyable afternoon and evening were spent.

Visit to Niagara

On August 10th and 11th, a party of members and a few friends paid a visit of inspection to Niagara. The party travelled by train to Toronto, thence to Lewiston, N.Y., by boat, where they were met by T. V. McCarthy, A.M.E.I.C., who accompanied them by trolley to Niagara Falls, where lunch was taken at the Imperial Hotel with R. L. Dobbin, M.E.I.C., and E. L. Miles, M.E.I.C., as hosts.

By the courtesy of J. L. Harper of the Niagara Falls Power Company a visit was paid to the new plant where the 65,000 kv.a. generators, the largest in the world, were seen in operation.

On August 11th, a visit was paid to the Buffalo Avenue plant of the same company, the party being conducted through the plant by N. R. Gibson, M.E.I.C. The visitors were also given a demonstration by Col. D. S. Ellis, A.M.E.I.C., using the miniature scale model of the falls, and showing how, by a system of submerged dams, water may be diverted from the falls for power purposes without detriment to their scenic value. The model was well worked out, complete in detail, and most interesting.

The party then crossed to the Canadian side and travelled to Queenston by the Belt Line, arriving at Queenston in time for lunch at the well appointed restaurant maintained by the Hydro-Electric Power Commission at the plant. After lunch, and in accordance with arrangements kindly made by Mr. McCarthy, the party was divided into two groups and conducted through the plant. This completed the itinerary and the party returned to Toronto by boat, thence to Peterboro by rail.

The arrangements for this admirable trip were in the hands of A. H. Munro, A.M.E.I.C., and B. Ottewell, A.M.E.I.C. It was unfortunate that owing to the vacation season being in full swing more members could not take in this trip, which was exceptionally interesting and well arranged. The committee wish to thank Mr. McCarthy of the H.E.-P.C. (Queenston), Mr. Gibson and Col. Ellis of the Niagara Falls Power Company and Mr. R. W. Downie of the Welland Canal staff, for their kind assistance which added materially to the enjoyment of the visit.

Saskatchewan Branch

J. W. D. Farrell, A.M.E.I.C., Secretary-Treasurer.

On October 9th, the Saskatchewan Branch held its first regular meeting of the season, preceded by a dinner, in the restaurant at Parliament Buildings. A very fair attendance was registered in spite of the fact that many engineers are still engaged in field work.

Lieut.-Col. A. C. Garner, M.E.I.C., brought in a report on behalf of the Legislation Committee, which was adopted, and the branch will take further steps to secure legislation which will give some safeguards to the public and some recognition to the profession.

Several members paid tribute to the late Mr. W. A. Begg, A.M.E.I.C., both as to his standing in the profession and his high qualities as a man and a fellow citizen. The branch by a standing vote expressed the deep esteem in which Mr. Begg was regarded and a deep regret felt at his death.

Field Control of Concrete

The chairman then called on Col. H. C. Boyden of the Portland Cement Association, Chicago, for his paper on the Field Control of Concrete.

Col. Boyden's paper was illustrated by a good collection of slides and gave an account of methods recommended for the scientific use of concrete. By means of scientific design as compared with the use of imperical formulae, either greater strength could be secured for the same quantity of cement or the required strength could be obtained at a much decreased expenditure for cement. As an example Col. Boyden cited the experience of the Ontario Hydro-Electric Power Commission. Regarding consistency, Col. Boyden recommended a four-inch slump for nearly all work and an occasional use of a seven-inch slump. The necessity for uniform methods to obtain comparable results was particularly stressed.

The paper was followed by a general discussion, in which further points were brought out and questions answered by Col. Boyden. In responding to a vote of thanks, Col. Boyden touched on the intimate relations that exist between Canada and her neighbour to the South and expressed the desire that these relations continue to become more cordial.

Sault Ste. Marie Branch

W. S. Wilson, A.M.E.I.C., Secretary-Treasurer.

Following a dinner at the Y.W.C.A. rooms, a regular meeting of the Sault Ste. Marie Branch was held on September 26th, with LeRoy Brown, A.M.E.I.C., in the chair.

The St. Lawrence River Project

The speaker of the evening was J. W. LeB. Ross, M.E.I.C., who is superintending engineer of the ship canal here. Mr. Ross was formerly engineer of the St. Lawrence canal system and his knowledge of the topography of the section under discussion made the address of great interest. To illustrate the subject the speaker exhibited a splendid series of charts which he had specially made showing clearly the different schemes mooted both for canals and water power development. This set of tracings represents a lot of work and we appreciate very much the opportunity to study the project with their aid. Mr. Ross outlined the various schemes of development suggested by the Engineering Board of the International Waterways Commission with particular reference to the water power development and contrasting the different schemes advocated by the Hydro-Electric Power Commission and others. The present effects of ice on the river flow and observed sections taken by soundings through ice jams at different sections and at different periods were also shown, as well as the probable effects of the dams and other proposed power development works on the ice formation and transportation.

Considerable discussion followed the address centering particularly on the formation of ice, (frazil and anchor ice), and the conditions essential to their formation. Apparently, on the St. Lawrence river, the frazil ice travels considerable distances under the floating ice cover. The points brought out in the discussion indicated that intense cold and agitation of the water surface are not essential to the formation of frazil ice.

Major Walkem Presents Branch Charter

On October 16th, an interesting and unusual event took place in Sault Ste. Marie, this being the presentation of the Charter to the Sault Ste. Marie Branch. The executive of the branch met Major and Mrs. Walkem at the station and took Major Walkem to the Sault Ste. Marie Country Club for the programme, while Mrs. Walkem was entertained by the wives of the executive.

A dinner for twenty members and six guests was served at the Country Club, which is beautifully situated on the old channel of the St. Mary's river in such a position as to command a view of the shipping passing up and down the river. Music was furnished by a local orchestra. After dinner the members and guests adjourned to the lounge room where the wood fire made an hospitable setting.

LeRoy Brown, A.M.E.I.C., chairman, then called upon C. H. E. Rounthwaite, A.M.E.I.C., our councillor, to introduce the guest of the evening.

Major Walkem after a few fitting remarks explained the intention of headquarters was to have had the presentation of charters made during the regime of our late lamented president, Mr. Walter J. Francis, whose signature appears on the charter, but who was never able to visit the branches and make the presentation. Consequently as senior vice-president, the speaker, had been called upon to visit the branch and present the charter. He then proceeded to touch upon the early history of the Canadian Society of Civil Engineers and gave us some interesting personal reminiscences of the early days in British Columbia, and his experiences in the arena of municipal and provincial politics, dealing with the constructive work that could be done by an engineer in municipal councils and the opportunities presented to give moral support to ones professional brethren employed by these bodies. The ability to plan ahead and to direct development of our urban communities along intelligent lines will have a tremendous economic value.

Major Walkem touched briefly on the grain handling equipment of the port of Vancouver and the probable development of the grain traffic east and west. The greetings to the Sault Ste. Marie Branch from the western branches of *The Institute* were conveyed and are reciprocated by our branch. In this connection we would welcome visitors from other branches. The address was then concluded by the presentation of the charter which was received by J. W. LeB. Ross, M.E.I.C., the senior member of the branch.

LeRoy Brown, A.M.E.I.C., gave a few notes as to the formation of the branch, remarking that there were a good many of the original members still with the branch. The proceedings were interspersed with selections by the orchestra and a solo by Jas. Dale who was tendered a hearty vote of thanks.

Major Walkem and Mrs. Walkem continued their journey westward boarding the C.P.R. steamer at the Canadian lock at midnight, the moonlight and the myriad lights of the canals and local industries making an impressive setting for the embarkation. The visit was much appreciated by all.

St. John Branch

W. J. Johnston, A.M.E.I.C., Secretary-Treasurer.

That the policy of the branch executive in advertising branch meetings open to the public was a wise policy as shown by the large attendance at the opening meeting of the season. About 125 persons were present to hear a lecture on "The Construction and Operation of The Queenston-Chippawa Power Canal", delivered by A. C. D. Blanchard, M.E.I.C., hydraulic engineer, New Brunswick Electric Power Commission.

Construction and Operation of Queenston-Chippawa Power Canal

The work of diverting water around Niagara Falls for use in hydro-electric development was effected by the construction of the Queenston-Chippawa canal. The canal had a total length of 13 miles and was diverted from the upper part of the Niagara River at Chippawa by means of the dredged section of the Welland river for four miles and by an artificial canal in dry excavation for nine miles to the power house at Queenston. The work was started in 1917, the first unit in operation December 28, 1921, and total cost to March, 1922, was $62,000,000.00.

The work was carried out by the Hydro-Electric Power Commission of Ontario. The Canadian Niagara Power Company in 1904 had completed a unit of 10,000 horse power which was the largest hydro-electric unit in operation up to that time, and the total development at that time undertaken by three private companies amounted to 160,000 horse power. The speaker described in the larger scheme units of 55,000 horse power were installed, and the present capacity of the turbines operating or under contract amounts to 507,000 horse power and may later be increased to 550,000 horse power, the limiting capacity of the canal.

The design of the canal involved careful studies in large sized models extending over several years prior to construction. By means of charts it was shown how a canal section was arrived at which would be the most economical for the conveyance of a certain quantity of water corresponding to a stated horse power development. It was further shown how the limit in the size of the canal was arrived at so that a larger section would not give a corresponding larger power output.

The work involved the removal of 4,000,000 cubic yards of rock, 13,000,000 cubic yards of earth, and the placing of 500,000 cubic yards of concrete. For considerable distances the depth of cut was 140 feet of which the lower 80 feet was rock. An interesting feature of the removal of the rock was the channeling of the upper 10 feet of sides of cut leaving a vertical face along cut to prevent unnecessary shattering of rock beyond limits of canal.

The size of the undertaking and the need for early completion made necessary unusual construction methods and the design of equipment as the work progressed. The sliding steel forms for concreting sides of cut may be mentioned as an innovation adopted on this work. Another feature was three electrically-operated steam shovels with 8-cubic yard bucket and 90-foot boom loading into cars 60 feet above bottom of cut in rock and 48 feet in earth.

The clearance for concrete floors and lining walls was designed as six inches in thickness and in some cases it was necessary to trim the walls after excavation had been completed. Even in the rock cuts 40 to 50 feet deep it was found the side walls squeezed together as much as two inches on each side so that in later work it was necessary to compensate by enlarged width.

Two standard gauge tracks totalling 80 miles of railway were built the length of the canal and trains electrically-operated used for construction work. The track on one side of the canal was used for removal of excavated material and on opposite side of canal for the supply of materials for concrete work.

To carry highway and railway traffic over the canal it was necessary to build sixteen first class bridges at a cost of $2,200,000. It was also necessary to maintain during construction and build telegraph, telephone and transmission lines, so that service of private companies crossing along line of canal might not be interfered with.

There was employed 8,500 men of whom 5,000 were housed by the Commission; the number of buildings constructed for all purposes was over 500. A feature of the work was the provision of a field hospital and dressing station and the various devices maintained for the safety of the men employed.

Vancouver Branch

P. H. Buchan, A.M.E.I.C., Secretary-Treasurer.

Visit to the Municipal Works in Point Grey

The Vancouver Branch opened its fall and winter programme on September 27th, with an inspection visit to a number of the recent municipal works in Point Grey, having features of special interest.

The event was arranged through the kindness of Reeve Geo. A. Walkem, M.L.A., M.E.I.C., and the municipal engineer, W. B. Greig, A.M.E.I.C. Between thirty and forty members of the branch availed themselves of this opportunity to spend a very pleasant afternoon studying municipal engineering from comfortable automobiles provided to convey them to the various points of interest. Reeve Walkem's interview with the weatherman, produced ideal results, as the occasion of this visit was favoured with the most charming September sunshine imaginable.

The party assembled at the corner of Granville street and Sixteenth avenue where it was welcomed by Reeve Walkem, at 2.30 p.m.; and after being loaded into automobiles, was conveyed over some of the newly surfaced roads, paved with asphaltic macadam, tarvia macadam, course concrete and asphaltic concrete. Of the last named type, the most recent is Pine street, which is being surfaced with 2-inch asphaltic concrete.

In addition to road improvements, the members were shown the new ornamental street-lighting system in the Shaughnessy Heights addition, a number of new schools, special features in connection with the development of municipal parks, and points of interest in reference to waterworks, including the 3,000,000 gallon service reservoir.

The members of the party were also given an opportunity of seeing the development work going on in the new subdivision in the Provincial Government Reserve, adjacent to the new and permanent site of the University of British Columbia. This work is progressing rapidly under the direction of E. A. Cleveland, M.E.I.C., representing the provincial government.

A visit was paid to the new buildings in course of erection for the University of British Columbia, which together with a substantial tea served at the camp, put a very agreeable finish to a most enjoyable afternoon.

The branch on this occasion was fortunate in having as a member of the party K. M. Cameron, M.E.I.C., chief engineer, Department of Public Works, Ottawa.

Victoria Branch

E. P. Girdwood, M.E.I.C., Secretary-Treasurer.

At the regular meeting of the Victoria Branch on October 8th, the Discussion on British Columbia Dams was opened by E. Davis, M.E.I.C., chief engineer of the provincial Water Rights Branch, who gave brief descriptions of dams of various types, hydraulic earth fill, earth with puddle and concrete cores, earth and rock fill, timber crib and rock fill, and concrete plain and reinforced.

Photographs of many of the dams mentioned were passed around and a series of coloured sections, illustrative of the dams, with additional technical data was submitted by E. G. Marriott, A.M.E.I.C.

The meeting was well attended and all members present took keen interest and part in the discussion. Some very interesting questions developed, and were ably answered by Mr. Davis and Mr. Marriott.

The branch will hold a joint luncheon with the Professional Engineers Association in honour of Geo. A. Walkem, M.E.I.C., president of zone "A", who will present the branch charter, on November 5th.

Winnipeg Branch

P. Burke-Gaffney, A.M.E.I.C., Secretary-Treasurer.

Jas. Quail, A.M.E.I.C., Branch News Editor.

Professor A. E. McDonald addressed the Winnipeg Branch on the evening of Thursday, September 18th. Professor McDonald's subject was The Construction of Reinforced Concrete Grain Elevators. The members who listened to Professor McDonald congratulated themselves that they had heard a most interesting and instructive address from one who is intimate with all the details of the design and operation of grain elevators as well as with the economics of the grain trade that made the existence of the immense terminal elevator necessary. It was regretted that the attendance of members was below normal.

Professor McDonald's address was profusely illustrated with lantern slides that showed the construction of a number of important elevator buildings erected within the past year. Notable on the list were the Bawlf and Stewart elevators at Port Arthur and the Canadian Government elevator at Edmonton. Professor McDonald drew attention to the fact that the construction of the latter building was carried out in record time. Ground was broken on the 2nd of May this year and on Monday, September 15th, the first car of grain passed through the elevator. The storage annex capable of holding 2,000,000 bushels of grain was completely poured in eleven days. Four of those days were used in the hopper bottoms.

A cordial vote of thanks to the speaker was moved by Professor Finlayson, M.E.I.C., and heartily endorsed by the members.

In the absence of the chairman, D. A. Ross, M.E.I.C., occupied the chair.

Dr. Robert W. Boyle, M.E.I.C., returns after Conducting Experiments on the Atlantic Coast

Successful experiments off the Atlantic coast during the summer months for the detection of icebergs, hidden reefs, and nearby ships, as well as in the development of deep water telegraphy and telephony have been conducted by Dr. Robert W. Boyle, M.E.I.C., professor of physics at the University of Alberta, who returned to the city at the week-end from the east. Dr. Boyle was accompanied by Charles Reid, a former student at the university, who will continue his work at Harvard. The experiments have been in progress since the middle of April and were conducted on the ice-breaker Montcalm. The scene of operations was off the coasts of Labrador, Newfoundland, Cape Breton and in the Straits of Belle Isle.

CORRESPONDENCE

Discussion on Hydraulic Efficiency Tests

The Editor,
The Engineering Journal,
Dear Sir:—

The paper by W. R. Way, Jr.E.I.C., in the October *Journal* is a very interesting account of the tests of a large hydro-electric unit by two methods which, in so far as the hydraulic part of the tests is concerned, are essentially different in their underlying principles.

The results of one series of tests differ from those of the other series by amounts which vary somewhat in degree, but which exhibit a remarkable consistency in sign. The fact that the resulting efficiency by one series is always lower than the result by the other indicates a consistency in the signs of the errors of both series which is somewhat remarkable, and points to some undisclosed systematic errors in either or both. There is no indication as to which series is the more accurate or as to what the probable sign of the error may be. An analysis of the test results by the method of least squares might give an indication as to the relative reliability, apart from systematic errors, of the two methods of test, but it could give no indication of the effects of any systematic errors due to apparatus or to defective application of theory. It may, therefore, be profitable to examine the modus operandi and the underlying theory with a view to fixing the possible causes of systematic errors, and then by weighing these causes arrive at some indication as to the relative reliability of the two methods.

In principle, the Allen method reduces to timing the passage of a definite volume of the fluid over a measured length of conduit. In this respect it differs only in degree from several other methods, such as by colour, floats, moving screen or other varieties which embody the same underlying principle. In all these, an attempt is made to time the passage of a sufficient number of particles so that the mean of the observed times will be a close approximation to the mean time of passage of the whole volume. These methods may be considered as direct or nearly so. The principal improvement in the Allen method is in substituting mechanical observation and recording for visual personal observations and records. It eliminates a variable personal factor, but introduces a possibility of systematic error due to the imperfections of the observing apparatus. The exchange is probably beneficial in good hands and with good apparatus, but it might quite as well be the reverse were the conditions not good.

Observation and recording the time of passage is mechanical, but the interpretation of the records is still a personal matter and subject to all the limitations which personal interpretation involve. The chief source of error, or rather of variation, is in fixing the end points of the time of passage. Although the injection of the salt solution at the upper station may be practically instantaneous, its passage across the lower stations occupies an appreciable time and the true beginning and end of this time is indefinite. The farther apart the stations, the greater the diffusion and the more indefinite the end points. If there are curves or bends between the stations the diffusion is greater than if the conduit were straight.

Another possible source of error is lack of uniformity in diffusion of the indicator across the cross-section of the conduit. Where this occurs, there is the possibility that some of the indicator may fail to record at the upper station. The nearer the upper station is to the point of injection the greater the probability of error from this cause. It appears that this source of error was present in the case under discussion. The saw-tooth contour of the line at X is an indication that the diffusion was not uniform. It will be noticed that this saw-tooth outline has been smoothed out at station Y.

The Gibson method is indirect. What is actually observed and recorded is the time-pressure effect induced by a more or less sudden alteration in the mean velocity, and the mean velocity is deduced from the records by the application of theory. The result can be no more accurate than the theory which, in turn, can be no more accurate than the hypotheses behind it. Practically all hydro-dynamic theory is based on the hypothesis that the kinetic energy of a stream is proportional to $\frac{V^2}{2g}$ in which V is the mean forward velocity. In a perfectly smooth straight pipe this hypothesis would be correct, but in practice it is not, and it may not even be a close approximation. If the conduit contains bends or obstructions, even some distance from the point of observation, the disturbances in the fluid may be so great that the hypothesis may be a long way out.

The observations in the test by this method seem to have been made in a way which leaves little chance for systematic errors due to the personal factor, and those due to the apparatus were no doubt fully ascertained and allowed for. But, leaving aside any defects in the theory, there seems to be a considerable chance for systematic errors in the many corrections which appear to be required. In addition to those for surges, distortion of the blue-print, leakage and other factors, it would be interesting to know if any correction was found necessary for distortion of the film during developing and printing.

It would undoubtedly require a close acquaintance with the details of the tests described and the manner in which they were carried out, as well as a long and varied experience in turbine testing in general before one could assign proper weights to the various sources of error pointed out in this discussion. Giving equal weights to all, it appears to the writer that the Allen method has somewhat the better of the argument. It is more nearly direct and, on the principle that direct measurements will have a smaller probable error than indirect measurements, it should therefore be the more accurate. But after giving the proper weights to the arguments the condition might easily reverse.

Yours truly,

H. B. Muckleston, M.E.I.C.

A Rough Temporary Shelter.

Kaduna Bridge on Main Line Logos to Kano, March 1924.

Railway Construction in Northern Nigeria on which Bernard H. Hughes, A.M.E.I.C., has been engaged for sometime past.

Preliminary Notice

of Applications for Admission and for Transfer

October 20th, 1924.

The By-laws now provide that the Council of the Institute shall approve, classify and elect candidates to membership and transfer from one grade of membership to a higher.

It is also provided that there shall be issued to all corporate members a list of the new applicants for admission and for transfer, containing a concise statement of the record of each applicant and the names of his references.

In order that the Council may determine justly the eligibility of each candidate, every member is asked to read carefully the list submitted herewith and to report promptly to the Secretary any facts which may affect the classification and election of any of the candidates. In cases where the professional career of an applicant is known to any member, such member is specially invited to make a definite recommendation as to the proper classification of the candidate.*

If to your knowledge facts exist which are derogatory to the personal reputation of any applicant, should be promptly communicated.

Communications relating to applicants are considered by the Council as strictly confidential.

The Council will consider the applications herein described in November 1924.

FRASER S. KEITH, Secretary.

*The professional requirements are as follows:—

A Member shall be at least thirty-five years of age, and shall have been engaged in some branch of engineering for at least twelve years, which period may include apprenticeship or pupilage in a qualified engineer's office, or a term of instruction in a school of engineering recognized by the council. The term of twelve years may, at the discretion of the council, be reduced to ten years in the case of a candidate for election who has graduated from a school of engineering recognized by the council. In every case the candidate shall have held a position in which he had responsible charge for at least five years as an engineer qualified to design, direct or report on engineering projects. The occupancy of a chair as a professor in a faculty of applied science or engineering, after the candidate has attained the age of thirty years, shall be considered as responsible charge.

An Associate Member shall be at least twenty-seven years of age, and shall have been engaged in some branch of engineering for at least six years, which period may include apprenticeship or pupilage in a qualified engineer's office or a term of instruction in a school of engineering recognized by the council. In every case a candidate for election shall have held a position of professional responsibility, in charge of work as principal or assistant, for at least two years. The occupancy of a chair as an assistant professor or associate professor in a faculty of applied science of engineering, after the candidate has attained the age of twenty-seven years, shall be considered as professional responsibility.

Every candidate who has not graduated from a school of engineering recognized by the council, shall be required to pass an examination before a board of examiners appointed by the council. The candidate shall be examined on the theory and practice of engineering with special reference to the branch of engineering in which he has been engaged. This examination may be waived at the discretion of the council if the candidate has held a position of professional responsibility for five or more years.

A Junior shall be at least twenty-one years of age, and shall have been engaged in some branch of engineering for at least four years. This period may be reduced to one year, at the discretion of the council, if the candidate for election has graduated from a school of engineering recognized by the council. He shall not remain in the class of Junior after he has attained the age of thirty-three years.

Every candidate who has not graduated from a school of engineering recognized by the council, or has not passed the examinations of the first year in such a course, shall be required to pass an examination in the following subjects: geography, history, (that of Canada in particular), arithmetic, geometry, euclid (books I, IV and VI), trigonometry, algebra up to and including quadratic equations.

A Student shall be at least seventeen years of age, and shall present a certificate of having passed successfully an examination equivalent to the final examination of a high school or the matriculation of an arts or science course. He shall either be pursuing a course of instruction in a school of engineering recognized by the council, in which case he shall not remain in the class of student for more than two years after graduation; or he shall be receiving a practical training in the profession, in which case he shall pass an examination equal to that prescribed for admission to the grade of Junior in the foregoing section and he shall not remain in the class of Student after he has attained the age of twenty-seven years.

An Affiliate shall be one who is not an engineer by profession but whose pursuits, scientific attainments or practical experience, qualify him to co-operate with engineers in the advancement of professional knowledge.

The fact that candidates give the names of certain members as references does not necessarily mean that their applications are endorsed by such members.

FOR ADMISSION

BRANCH—ALEC JOHN, of Monarch, Alta. Born at London, England, April 26th, 1889; Educ., Private study; 1905-06 and 1907-10, asst. to ar ht. and surveyor, London, England; 1910-14, asst. engr., waterworks and sewers, to G. H. Altham, city engr., Macleod. Inspector for town of Macleod on constrn. of $80,000 water filtration plant; 1914-19, overseas. Can. Engrs.; 1919 (July-Nov.), leveller and topographer, Dominion Irrigation Dept., Cardston district; 1920 (May-Nov.) and 1921-23, instr'-man. and inspr., on constrn., Lethbridge Northern Irrigation Project; 1923 (Feb.-Oct.), res. engr. on constrn. and Oct. 1923 to date, watermaster on Lethbridge Northern Irrigation District, Lethbridge, Alta.

References: H. B. Muckleston, P. M. Sauder, C. M. Arnold, F. S. Dyke, F. M. Wood, E. I. H. Ings.

BAKER—REGINALD STENNETT, of Temiskaming, Que. Born at Iberville, Que., Nov. 13th, 1891; Educ., 2 years Science, McGill Univ. 1910-11. 1 winter mech. dfting, by chief dftsman., Canadian Ingersoll Rand Co.; 1 year Chicago Tech. College; Summer surveying with C.P.R. out of Winnipeg, and city work for engrg. and roads depts.; 1913-14, asst. to the supt. of motive power for the Demerara & Birkice Rly. in British Guiana, South America; Went overseas as gunner in 1st McGill Battery, 1917-19, officer in 11th Batt. C.R.T.; After the Armistice in charge of rebuilding a considerable portion of Arras Douai line under L. E. Silcox; 1919-21, engr., in charge of design and constrn. of all dams, roads, bridges, bldgs., etc. as well as all machinery employed in the woods operation, for the Wayagamack Pulp & Paper Co. Ltd., Three Rivers; 1922-23, outdoor manager, Boys' Farm and Training School, Shawbridge Que., instructing boys in outdoor work, engrg., etc.; Jan. 1924 to date. asst. mill engr. and research engr., Riordon Pulp Corpn., Temiskaming, Que.

References: L. S. Dixon, J. G. MacLaurin, A. K. Grimmer, E. S. M. Lovelace, J. H. Wallis

KRIBS—GORDON, of 2 Mecklenburg Street. St. John, N. B. Born at Hespeler, Ont., Feb. 9th, 1884; Educ., Univ. of Toronto; 1903, Goldie & McCulloch, Gait, Ont.; 1904, Galt, Preston & Hespeler Elec. Ry. Co.; 1905, elec. dftsman., Westinghouse Elec. Mfg. Co., Pittsburgh; 1906, student course, Westinghouse Elec. Mfg. Co., at Hamilton, and 1907-08, erection engr. for same company at Montreal; 1909-10, in charge elec. design for Smith Kerry & Chace, Toronto, Ont.; 1910-11, elec. engr., Mount Hood Rly. & Power Co., Portland, Oregon; 1911-12, asst. to chief engr., Pacific Power & Light Co., Portland, Oregon; 1912-13, asst. to chief engr., Texas Power & Light Co., Dallas, Texas; 1914, special work—valuations and reports, hydro dept., city of Toronto; 1915-21, asst. engr. in charge of eastern district, H. E. P. C. of Ont.; 1923 to date, elec'l. engr., New Brunswick Power Commission, St. John, N. B.

References: S. R. Weston, G. L. Dickson, A. C. D. Blanchard, F. P. Vaughan, B. Wilson, H. G. Acres, F. A. Gaby, K. H. Smith, R. F. Howard, A. L. Mudge, N. R. Gibson.

PETFORD—HERBERT STANLEY, of 537 Maplewood Avenue, Montreal, Que. Born at St. Croix, West Indies, Oct. 17th, 1892; Educ., B.Sc. McGill Univ. 1922; 1915-17, chief inspr. of shrapnel shell shop and general machine shop work, Steel Company of Canada; 1917-18, travelling inspr., Imperial Ministry of Munitions; 1918 (May-Dec.), chief inspr. and efficiency engr., munitions dept., Canada Cement Company; 1919 (Feb.-Aug.), estimator and dfting designer in sheet metal dept., Geo. W. Reed & Co.; 1919-21, estimator and struct'l. designer, John MacGregor Limited; 1922-24, estimator and struct'l. designer, John Quinlan & Company; 1924 (Jan.-Sept.), with F. A. Combe and E. A. Ryan, heating and ventilating and power plant work.

References: E. A. Ryan, F. A. Combe, J. Chalmers, C. M. McKergow, A. R. Roberts.

STEINMAYER—OTTO C., of Room 1006, C.P.R. Building, Toronto, Ont. Born at La Salle, Ill., U.S.A., Dec. 18th, 1880; Educ., B.S. Univ. of Illinois, 1902; Post grad. work at Mass. Inst. Tech.; 1903-04, asst. chemist, 1904-08, chemist, tie and timber dept., Atchison, Topeka & Santa Fe Rly.; 1908-12, general treating inspector, Chicago & Eastern Illinois, St. Louis San Francisco, Chicago Rock Island & Pacific Rlys.; 1912-24, supervisor, timber preservation, St. Louis San Francisco Rly.; At present, supt., timber preservation, Canada Creosoting Co. Ltd., Toronto, Ont.

References: C. B. Brown, M. S. Blaiklock, J. M. R. Fairbairn, R. L. Latham, J. E. Armstrong.

VANDERVOORT—GERALD ADDISON, of Musquash, N.B. Born at Belleville, Ont., May 10th, 1889; Educ., Matric. Private tutoring in maths., physics and elec. theory; 1907-08, elect'n., 1908-09, chief elect'n. Belleville Portland Cement Co., Belleville, Ont.; 1909-10, operator, Seymour Power Co., Campbellford, Ont.; 1911, tech. clerk, head office of Electric Power Co. Ltd.; 1912, chief elect'n., Crown Portland Cement Co., Wiarton, Ont.; 1913, chief elect'n., Cordova Mines, Ltd., Havelock, Ont.; 1914, in charge of elect'l. constrn., N. S. Steel & Coal Co., Sydney Mines, N.S.; 1915-18, plant supt., station No. 14, H.E.P.C. of Ont., Campbellford, Ont.; 1918-22, system operator (C.O.S.), H.E.P.C. of Ont.; 1922 to date, supt. of operation, New Brunswick Electric Power Commission, St. John, N.B.

References: S. R. Weston, G. L. Dickson, H. Phillips, A. C. D. Blanchard, F. P. Vaughan, B. Wilson, R. H. Cushing, W. R. Pearce.

FOR TRANSFER FROM CLASS OF ASSOCIATE MEMBER TO THAT OF MEMBER

FRITH—HUGH WALTER, of Vancouver, B.C. Born at London, England, Jan. 22nd, 1884; Student with Messrs. Reid and Green, Cape Town and Johanesburg, S. A. Student of Technical Institute, Cape Town, 1902; 1906, asst. engr., roads and highway construction, Canden Construction Co. Ltd., Cape Town; 1907-08, asst. chief dftsman., Franco-British Exhibition, London, England; 1909-10, Imperial International Exhibition, London, England; 1911, supt. of constrn., Reeds Electrical Co. Ltd., London, England; 1912-14, underground constrn., city engr's. dept., Vancouver, B.C.; 1915, asst. on hydrographic survey of Fraser River and Squamish, Public Works Canada; 1916 to date with Vancouver Harbour Commissioners as follows: 1916, reclamation and building Granville Island False Creek, 1917, mtce. engr., 1919 to date, asst. chief engr.

References: W. G. Swan, C. Brakenridge, C. C. Worsfold, E. F. Carter, A. E. Foreman, E. G. Matheson.

VINET—EUGENE, of Chicago, Ill. Born at Montreal, Quebec, March 31st, 1888; Educ., B.Sc., McGill Univ. 1911; From graduation till 1922 with the Shawinigan Water & Power Company, in various capacities; dfting., designing, constrn. operation, administration and asst. to vice-president; During war, saw active service in France as officer C.F.A.; 1922 to date, asst. to vice-president, in charge of electrical and hydraulic engrg., Middle West Utilities Co. of Chicago.

References: F. S. Keith, F. B. Brown, G. G. Gale, W. Maclachlan, F. T. Kaelin.

FOR TRANSFER FROM CLASS OF STUDENT TO HIGHER GRADE

MAWHINNEY—JAMES GARNET, of Oak Park, Ill. Born at Holland, Man., August 1st, 1900; Educ., B.Sc. (C.E.), Univ. of Man. 1924; Summer work: 1919, rodman and levelman, Good Roads party survey, Man.; 1920, instr'man. on location and constrn. of Good Roads Prov. Highway, Man.; 1921, res. engr. on constrn. of prov. highway in municipality of Hamiota, Man.; 1923, transitman on O.L.S. party; office work on profiles and cross sections; 1924, temporarily connected with the commercial engrg. dept. of the Illinois Bell Telephone Company; At present transitman on mtce of way, for the C.B. & Q. Rly.

References: J. N. Finlayson, E. P. Fetherstonhaugh, M. A. Lyons, W. M. Scott, A. J. Taunton, B. A. Johnston, W. H. Hunt, H. R. Urie.

Engineering Index

This Index is prepared by the American Society of Mechanical Engineers.

In this department will be published from month to month the titles of current engineering papers with the authors and source and a brief extract of the more important. It is designed to give the members of The Institute a survey of all important articles relating to every branch of engineering profession.

A

AIR COMPRESSORS

Development for Track Work. Development of the Air Compressor for Track Work and the Uses to Which It Can Be Put, W. F. Nichols. Compressed Air Mag., vol. 29, no. 9, Sept. 1924, pp. 993-994, 6 figs. Describes 4-tool, 8-tool and 12-tool machines for tamping ties, drilling holes for bond wires, running up track nuts on new rail, etc. Abstract of paper read before Int. Track Supervisors' Club, Buffalo, N. Y.

Heating, Prevention of. Prevention of Air Compressor Heating, R. A. Cultra. Power Plant Eng., vol. 28, no. 18, Sept. 15, 1924, pp. 965-967, 4 figs. Dust drawn in with air mixes with oil and causes valves to stick, resulting in heating and loss of efficiency.

Portable. The "Broomaster" Portable Air Compressor. Engineering, vol. 118, no. 3057, Aug. 1, 1924, p. 179, 1 fig. Shown at Wembley exposition by Broom and Wade, Ltd.; engine and compressor, having two cylinders each, combined in a single unit.

AIRPLANE ENGINES

Fuel-Air Ratio, Relation to Performance. Relation of Fuel-Air Ratio to Engine Performance, S. W. Sparrow. Nat. Advisory Committee for Aeronautics, report no. 189, 1924, 16 pp. 18 figs. Concludes that (1) with gasoline as fuel, maximum power is obtained with fuel-air mixtures of from 0.07 to 0.08 lb. of fuel per lb. of air; (2) maximum power is obtained with approximately same ratio over range of air pressures and temperatures encountered in flight; (3) nearly minimum specific fuel consumption is secured by decreasing fuel content of charge until power is 95 per cent of its maximum value.

High-Speed. Comparison of Three Types of Airplane Engines (Comparaison de trois types de moteurs d'aviation), M. Martinot-Lagarde. Technique Moderne, vol. 16, no. 15, Aug. 1, 1924, pp. 519-522, 4 figs. Details of design and construction of Renault, Lorraine-Dietrich and Farman engines of 400 to 600 hp., their equipment and efficiency; gives tables of principal characteristics.

AIRPLANE PROPELLERS

Models, Turbine Drive for. Turbine Drive for Propeller Models, L. H. Crook. Franklin Inst.—Jl., vol. 199, no. 1, July 1924, pp. 85-91, 6 figs. Details of construction of air turbine for U. S. Navy aero-dynamic laboratory to drive propeller in 8- by 8-ft. wind tunnel with air pressure of 90 lb. per sq. in. and its successful application.

AIRPLANES

Performance Estimation. Charts for Graphical Estimation of Airplane Performance, W. S. Diehl. Nat. Advisory Committee for Aeronautics, report no. 192, 1924, 12 pp. 19 figs. Gives charts for estimating propeller diameter and efficiency, maximum speed, initial rate of climb, absolute ceiling, climb in 10 min., time to climb to any altitude, maximum speed at any altitude, and endurance.

AIRSHIPS

Motors for. *See Gas Turbines, Automobiles.*

Semi-Rigid. The Italian Semi-Rigid Airship "MR." Flight, vol. 16, no. 36, Sept. 4, 1924, pp. 550-551, 2 figs. Also Aviation, vol. 17, no. 8, Aug. 25, 1924, p. 913, 1 fig. Particulars of smallest airship in world: overall length 105 ft.; diameter 25 ft. 6 in.; capacity 33,900 cu. ft.; useful load 992 lb.; speed 40 m.p.h. May be usefully employed for short-radius scouting, experimental work, etc.

ALLOYS

Aluminum. *See Aluminum Alloys.*
Bearing Metals. *See Bearing Metals.*
Bronzes. *See Bronzes.*

Preparation. The Preparation of Pure Alloys, R. F. Mehl. Am. Electrochem. Soc., Advance Paper No. 2, for meeting Oct. 2-4, 1924, pp. 9-36, 6 figs. Discusses metallographic data, with particular reference to effect of impunities upon electrical measurements; contamination; preparation of pure basic oxide crucibles; new method of making pure magnesia crucibles of high strength and density, for use up to 1200 deg. cent.: describes combined furnace and casting apparatus for preparation of very pure alloys in a form suitable for measurement of electrical properties; methods for measurement of thermoelectromotive force and temperature coefficient of resistance of aluminum-magnesium alloys; results of preliminary measurements of temperature coefficient of resistance and of thermoelectromotive force and its temperature coefficient, upon certain compositions of system Al-Mg.

ALUMINUM

Castings. Casting Aluminum Cycle Parts, H. R. Simonds. Foundry, vol. 52, no. 17, Sept. 1, 1924, pp. 661-664, 8 figs. Congested condition of streets in business sections of cities has opened new fields for motorcycle. Many parts being made of aluminum to secure lightness. Notes on methods employed by Springfield Malleable Iron Co., Springfield, Mass., in modern aluminum and brass foundry recently started to care for increased demands for aluminum alloy castings and other non-ferrous foundry business.

Properties. Effect of Cadmium on. The Influence of Cadmium upon the Mechanical Properties of Aluminum, N. F. Budgen. Metal Industry (Lond.), vol. 25, nos. 7 and 8, Aug. 15 and 22, 1924, pp. 145-147 and 172-174, 8 figs. From results of investigations it appears that cadmium has no beneficial influence on aluminum and is not comparable with zinc in this respect. Moreover, addition of cadmium to "burnt" aluminum has no recuperative effect.

Substitute for. Magnesium Alloy a Substitute for Aluminum. Can. Foundryman, vol. 15, no. 6, June 1924, pp. 22-23. Castings are stronger and lighter; easily machined and polished; proof against alkalies but not acids, reverse of aluminum; manganese deoxidizer of copper.

ALUMINUM ALLOYS

Aluminum-Zinc. Studies in the Aluminum-Zinc System, T. Tanabe. Inst. of Metals, Advance paper no. 13, for Mtg. Sept. 8-11, 1924, 38 pp., 32 figs. partly on supp. plate. Describes investigation made to confirm new diagram of Hanson and Gayler, and to make clear nature of age hardening. Mechanical properties also studied.

The Mechanical Properties of Aluminum-Zinc Alloys Containing Cadmium, N. F. Budgen. Chemistry & Industry, vol. 43, no. 33, Aug. 15, 1924, pp. 273T-276T. Range of alloys examined includes mixtures containing from 0 to 24 per cent Zn, 0 to 10 per cent Cd and 66 to 100 per cent Al; from certain alloys containing 10 per cent Cd, small beads of more fusible constituent exude from surface after chill casting; under hammer all specimens cracked badly above 250 deg., but those containing less than total of 18 per cent Zn + Cd forged well below this temperature.

Castings. Aluminum Alloy Castings from Sheet Scrap, H. C. Knerr. Am. Foundrymen's Assn., Preprint No. 417, for Mtg. Oct. 11-16, 1924, 12 pp., 7 figs. Outlines methods by which a very small foundry, started on an experimental basis, succeeded in meeting requirements for sound and dependable aluminum alloy sand castings, only scrap aluminum sheet and copper available at factory being used. Castings made were required to meet government specifications corresponding approximately to S.A.E. specifications No. 30.

Duralumin. *See Duralumin.*

Properties. Comparative Tensile Properties of Copper-Silicon-Aluminium and Other Aluminium Alloys as Obtained on Separately Cast Specimens and Specimens Cut from a Crank-Case Casting, E. H. Dix and A. J. Lyon. Inst. of Metals, Advance paper no. 4, for Mtg. Sept. 8-11, 1924, 14 pp., 21 figs. on supp. plates. Particulars of investigation undertaken by Metallurgical Sec., Eng. Division U. S. Air Service, to furnish information on comparative physical properties to be expected in large castings to aircraft designers.

Aluminum and Some of Its Physical Characteristics. Metal Industry (N. Y.), vol. 22, no. 9, Sept. 1924, pp. 349-351. Discusses properties of alloys made by Aluminum Co. of America; aluminum die castings, and wrought aluminum.

APPRENTICES, TRAINING OF

Foundry. Apprentice Course Is Established, E. C. Kreutzberg. Iron Trade Rev., vol. 75, no. 7, Aug. 14, 1924, pp. 413-414, 2 figs. Foundrymen's Assn. of New Jersey inaugurates plan of instruction in practical foundry work to recruit ranks of iron molders in that district. Outline of course.

Repair-Shop Mechanics. Training Men for Automobile Repair Work, J. Younger. Am. Mach., vol. 61, no. 11, Sept. 11, 1924, pp. 423-425, 3 figs. Outline of plan used for training men for Buick service stations and showing how flat rates are set for automobile repairs.

ARCHES

Reinforced-Concrete, Centering for. An Economical Design for Arch Centres, A. E. Wynn. Engineering, vol. 118, no. 3060, Aug. 22, 1924, pp. 257-259, 4 figs. partly on supp. plate. Describes centering built in fall of 1922 for bridge over Salmon River at Pulaski in New York State. Design, being so successful in its first use, has been adopted practically as a standard by contractors, and this design, and same lumber is being used for third time. Pulaski Bridge is a two-rib open spandrel arch of 200 ft. clear span and rise of 26 ft. 6 in., distance from crown to river bed being about 40 ft. Paper read before Sec. G. of British Assn. at Toronto.

ATOMS

Theory. Theory of Atom (Ueber Atomtheorie), M. Born. Elektrotechnische Zeit., vol. 45, no. 34, Aug. 21, 1924, pp. 889-897, 7 figs. Summarizes present conception of atoms as kind of planetary systems, including periodic system of elements, fundamental laws of mechanics of atom, quantum theory, laws of spectra, Bohr theory of H atom, etc.

AUDITORIUMS

ACOUSTICS. Acoustics of Auditoriums, F. R. Watson. Franklin Inst.—Jl., vol. 199, no. 1, July 1924, pp. 73-83, 2 figs. Discusses mathematical equations for loudness of voice and tune of reverberation deduced from tabulations of acoustic data of auditoriums pronounced good by public opinion.

AUTOMOBILE FUELS

FRANCE. Economic Considerations as to the Future of Artificial Liquid Fuels in France (Considérations économiques sur l'avenir des combustibles liquides artificiels en France), M. DeConinck. Chaleur et Industrie, vol. 5, no. 50, June 1924, pp. 269-276. Discusses gasoline problem, especially in connection with coke; manufacture of liquid hydrocarbons by fixation of hydrogen on organic fossil materials; hydrogenation of solid fuel, etc.

(*See also Internal-Combustion Engines, Fuels.*)

AUTOMOBILES

CRANKCASE-OIL DILUTION. The Danger Point of Dilution. Soc. Automotive Engrs. —Jl., vol. 15, no. 2, Aug. 1924, pp. 117-121. Twenty-six makers report views on dilution factors and propose remedies.

ELECTRIC. Electric Storage-Battery Automobiles (Les automobiles électriques à accumulateurs), A. Billaz. Vie Technique et Industrielle, vol. 5, no. 58, July 1924, pp. 232-239, 11 figs. Discusses lead and iron-nickel batteries, construction and prices, battery motors, batter trucks and tbeir construction, operation and control.

Test of Electric Storage-Battery Vehicles (Essais de véhicules à traction électrique par accumulateurs), M. Rossignol. Arts et Métiers, vol. 77, no. 48, July 1924, pp. 260-265. Gives details of Frencb competition and tables of data on principal French makes.

INSPECTION. Inspection Methods Symposium, C. S. Stark, A. H. Frauenthal and C. J. Jones. Soc. Automotive Engrs.—Jl., vol. 15, no. 2, Aug. 1924, pp. 156-162, 4 figs. Series of papers on inspection of processed materials, influence of numerous handlings on inspection cost, and maintenance of higb-quality production.

LUBRICATION. Saving Lubricant. Motor Transport (Lond.), vol. 39, no. 1017, Aug. 25, 1924, pp. 245-247, 8 figs. Details of system tbat eliminates need for lubricating many parts of chassis.

PAINTING. Automatic Equipment Cuts Painting Cost. Iron Age, vol. 114, no. 10, Sept. 4, 1924, pp. 555-557, 4 figs. How frames for Ford cars are cleaned, painted, dried, and delivered to freight-car door at rate of 10 a minute by means of a new painting and conveying unit recently placed in operation.

AVIATION

COMMERCIAL. Wbat Is the World Flight Going to Mean to Commercial Aviation? A. Klemin. Automotive Industries, vol. 51, no. 9, Aug. 28, 1924, pp., 397-400, 1 fig. Fire hazard has largely been eliminated, heavy loads bave been carried, variegated climates with abrupt changes can be negotiated and speed and endurance are proved.

B

BEAMS

DEFLECTIONS CALCULATION. Calculating Deflections of Beams By a Simple Method. P. G. Laurson. Eng. News-Rec., vol. 93, no. 11, Sept. 11, 1924, pp. 424-425, 1 fig. Describes method for computing deflection at any point of a beam resting on two supports or of a cantilever beam, requiring no calculus. Procedure based on Fraenkel's formula. Summation of products of two moments along beam gives deflection.

BEARING METALS

ANTI-FRICTION. Anti-Friction Bearing Metals, P. W. Priestley. Automobile Engr., vol. 14, no. 192, Aug. 1924, pp. 225-230, 2 figs. Considers chemical, thermal, and physical cbaracteristics of tin-base alloys.

BEARINGS, BALL

CRANKSHAFT. How and Wby Ball Bearings are Used on Car and Truck Crankshafts, P. M. Heldt. Automotive Industries, vol. 51, no. 6, Aug. 7, 1924, pp. 282-285, 9 figs. Discusses application and advantages of ball bearing and describes number of cars and trucks using them for crankshafts.

BEARINGS, ROLLER

ROLLING-MILL. New Types of Bearings for Rolling Mills, D. C. Holzweiler. Iron Age, vol. 114, no. 8, Aug. 21, 1924 pp. 442-443, 5 figs. Results from application to German mill practice; staggering of special bearings; automatic lubrication. Abstracted from Stahl u. Eisen, Apr. 17, 1924.

BEARINGS, THRUST

MICHELL. The Pad System Applied to Large Journal Bearings, Johnstone-Taylor. Mar. Eng. & Shipg. Age, vol. 29, no. 8, Aug. 1924, pp. 476-478, 5 figs. Discusses practical application of principle; journal bearing and other applications.

BELT DRIVE

SHORT-CENTER. Short-center Belt Drives, G. A. Frenkel. Machy. (N. Y.), vol. 30, nos. 10, 11 and 12, June, July and Aug. 1924, pp. 747-753, 876-882 and 956-958, 23 figs. Deals with efficient transmission of power by belting, as determined by numerous experiments and extensive research. June: General characteristics, advantages, and methods of arrangement to meet different requirements. July: Determining coefficient of friction and procedure in designing drive for transmitting given amount of power. Aug.: Tension rollers and their bearings; arms, equalizing weights, fulcrum stands and shock absorbers. See also Machy. (Lond.), vol. 24, nos. 612, 615 and 620, June 19, July 10 and Aug. 21, 1924, pp. 353-358, 457-462 and 645-647, 23 figs.

BLASTING

LIQUID OXYGEN. The Effect of the Temperature of Liquid Oxygen Explosives on Cordeau-Bickford, D. B. Gawthrop. U. S. Bur. Mines, Reports of Investigations, serial no. 2619, June 1924, 5 pp. Results of experiments show that Cordeau-Bickford can be used with liquid oxygen as with otber explosives.

BLOWERS

BLAST-FURNACE, RECONSTRUCTION OF. Reconstruction of Blast-Furnace Blowing Engines, W. Benedict. Power, vol. 60, no. 8, Aug. 19, 1924, pp. 290-291, 4 figs. By substitution of plate spring valves for heavy rotary valves and gearing, speed was increased from 75 to 95 r.p.m. and capacity correspondingly increased on six 3200-hp. twin blowing engines.

BOILER FEEDWATER

TREATMENT. Investigation of Boiler-Water Treatment, R. E. Hall. Power Plant Eng., vol. 28, no. 16, Aug. 15, 1924, pp. 843-845, 2 figs. Boiler-water conditioning viewed from standpoint of chemical equilibria of inorganic salts; details of tests, 42 days with permanently hard water and 76 days of temporary bard water.

Use of Linseed as Water Softener (Emploi de la graine de lin comme antitartre), M. Courdurier. Chaleur et Industrie, vol. 5, no. 51, July 1924, pp. 325-329, 3 figs. Test carried out by French Navy; linseed is boiled in steam and used for reducing salt content of sea water; details of process and apparatus used.

Water Purification at the Gennevillicrs Central Station (L'épuration de l'eau d'appoint à la Centrale de Gennevilliers), Chaleur et Industrie, vol. 5, no. 50, June 1924, pp. 277-279, 4 figs. Details of feedwater treatment and apparatus used, based on two years' practical working and giving entire satisfaction.

BOILER FURNACES

COMBUSTION CONTROL. Controlling Combustion by Temperature, G. Simmons. Power Plant Eng., vol. 28, no. 17, Sept. 1, 1924, pp. 906-908, 4 figs. Furnace and exit gas temperatures control dampers and fuel feed through thermocouples.

BOILER OPERATION

HIGH RATINGS. Boiler Operation at High Ratings, H. A. Reichenbach. Blast Furnace & Steel Plant, col. 12, no. 8, Aug. 1924, pp. 354-359, 10 figs. Trumbull Steel Co. combines pulverized coal methods in power and heating furnace; discusses pulverized-coal preparation plant; crushing and raw-coal storage; drying; pulverizing; conveying; remote control for distribution system, etc.

BOILERS

EVAPORATIVE CAPACITY. Evaporative Capacity of Boilers, A. A. Arnold. Mech. Wld., vols. 75 and 76, nos. 1956, 1961, 1963 and 1966, June 27, Aug. 1, 15 and Sept. 5, pp. 405, 69-70, 104-105 and 151. Considers normal evaporative capacity of boilers which may be obtained under usual conditions of working and when circumstances may be regarded as moderately favorable. Gives table showing average evaporation from Lancasbire and Cornisb boilers according to tbeir heating surface. Stationary locomotive-type boilers, vertical cross-tube boilers, vertical Cochrane boilers and tbeir performances.

LOCOMOTIVE. *See Locomotive Boilers.*

WASTE-HEAT. Generating Steam from Waste Heat, C. H. S. Tupholme. Power Plant Eng., vol. 28, no. 18, Sept. 15, 1924, pp. 943-945, 2 figs. Discussion of design of and results of tests on waste-heat boilers, which must be designed to evaporate water almost wholly from heat of convection.

YARROW. Yarrow Boilers at Londonderry. Power Station. Engineering, vol. 118, no. 3057, Aug. 1, 1924, pp. 177-178, 3 figs. Details of Yarrow boilers (large combustion space and straight tubes) and test data; heating surface, 3255 sq. ft.; superheating surface, 410 sq. ft.; economizer surface, 1550 sq. ft.; total grate area, 88.7 sq. ft.

BOILERS, WATER-TUBE

POWER-STATION. Notes on the Origin and Development of Water-Tube-Boilers for Power Stations, E. Kidwell. Combustion, vol. 11, nos. 2 and 3, Aug. and Sept. 1924, pp. 146-152 and 214-216, 15 figs. Shows origin of a few leading types of boilers used today in American plants and principal influences which shaped their development.

BRAKES

AIR. Air Brake Investigation by I. C. C. Completed. Ry. Mech. Engr., vol. 98, no. 9, Sept. 1924, pp. 521-523. See also Ry. Age, vol. 77, no. 7, Aug. 16, 1924, pp. 296-297. Report of Interstate Commerce Commission investigation on power brakes for both passenger and freight trains. Adoption of more complete specifications for maintenance and operation are recommended.

BRIDGES, CONCRETE

ARCH. Unusual Spandrel-Braced Arcb Bridge Built at Portland, O. Laurgaard. Eng. News-Rec., vol. 93, no. 9, Aug. 28, 1924, pp. 328-330, 5 figs. Design of Alexandra Ave. bridge in Portland, Ore. Dead loads reduced by use of high-strength concrete and short-span floorbeams. Trestle used as falsework in constructing arcbes.

Long Span Concrete Arch Design in France, C. S. Whitney. Eng. News-Rec., vol. 93, no. 12, Sept. 18, 1924, pp. 463-466, 1 fig. Special methods adopted by Freyssinet, noted frencb engineer, to reduce shrinkage, rib sbortening and abutment deflection in concrete spans approaching 600 ft.

MULTIPLE-ARCH, DISTORTION MEASUREMENTS. Measured Changes in Shape of Multi-Arch Bridge, P. L. Brockway. Eng. News-Rec., vol. 93, no. 8, Aug. 21, 1924, pp. 304-306, 2 figs. Measurements were made on Maple St. bridge over Arkansas River, Wichita, and expected distortion from progressive filling not verified. No cbanges found after two years' service.

BRIDGES, STEEL

CONSTRUCTION. Bridge Construction at Isle Maligne, J. P. Chapleau and C. M. Goodrich. Contract Rec. & Eng. Rev., vol. 38, no. 37, Sept. 10, 1924, pp. 892-895, 5 figs. Great power project of Quebec Development Co. on upper Saguenay involved construction of three steel bridges; cold weather concreting was feature of interest.

BRONZES

HIGH-TIN. Some Experiments on the Effect of Casting Temperature and Heat-Treatment on the Physical Properties of a High-Tin Bronze, F. W. Rowe. Inst. of Metals, Advance paper no. 11, for Mtg. Sept. 8-11, 1924, 7 pp., 12 figs. partly on supp. plates. Describes experiments carried out to gain some idea of mechanical properties of a high-tin bronze under various methods of handling. Alloy used had following nominal percentage composition: copper, 84.00; tin, 15.95; phosphorus, 0.05.

BUILDING CONSTRUCTION

REINFORCED-CONCRETE. Fast Work Is Feature of Buffalo Winter Construction. Eng. News-Rec., vol. 93, no. 10, Sept. 4, 1924, pp. 368-371, 7 figs.Large 8-story reinforced-concrete and brick building closed in less than 3 months in midwinter. Notes on methods employed. Old structure used as part of housing; unusual formwork.

STEEL ESTIMATING. Estimating the Structural Steel of Buildings, R. Fleming. Eng. News-Rec., vol. 93, no. 10, Sept. 4, 1924, pp. 387-390. Hints from experience with problems and difficulties of estimating; approximate and close estimates; influence of specifications; common errors and recommended cautions.

C

CABLES, ELECTRIC

SUBMARINE. Installing Cable Across Hudson River, F. A. Westbrook. Elec. Wld., vol. 84, no. 8, Aug. 23, 1924, pp. 355-357, 3 figs. Rocky bottom and swift tidal current necessitate spiral armor of steel tape reinforced with steel wires. Cable laid by tugboat especially adapted to cope with difficulties met in this type of work. Is 2,700 ft. in length, and is to carry current from east side of river to west side for local distribution in immediate vicinity of Garrison.

CALORIMETERS

STEAM, BUREAU OF STANDARDS. Calorimeter for Steam Investigations Developed by Bureau of Standards, P. W. Swain. Power, vol. 60, no. 7, Aug. 12, 1924, pp. 246-248, 7 figs. Developed for A.S.M.E. steam research program, insuring utmost reliability.

CARBURETORS

ADJUSTMENT. Saving Gasoline and Increasing Mileage by Proper Carburetor Adjustment, G. W. Jones and A. A. Straub. U. S. Bur. Mines, Reports of Investigations, serial no. 2616, June 1924, 9 pp., 1 fig. Discusses heat losses due to improper carburetor adjustment.

CARS, FREIGHT

TIMBER PRESERVATION. Treating Freight Car Timber Will Cut Repairs, H. S. Sackett. Ry. Age, vol. 77, no. 8, Aug. 23, 1924, pp. 337-339, 1 fig. States that preservation of lumber will add equivalent of 100,000 cars through reduced delays.

TRUCKS. Improved Co-ordinating Six-Wheel Truck. Ry. Age, vol. 77, no. 12, Sept. 20, 1924, pp. 487-489, 5 figs. Describes new truck designed by Boyden Steel Corp., Baltimore, Md., known as type C-2-S, purpose of which is to reduce curve resistance and permit greater vertical flexibility.

CASE-HARDENING

GASES EVOLVED DURING. Gases Evolved During Carburization, V. E. Hillman. Iron Age, vol. 114, no. 11, Sept. 11, 1924, pp. 611-614, 8 figs. Chemical study of behavior of five solid commercial compounds. Theory of process.

CAST IRON

GRAY, STRUCTURE OF. Study Structure of Gray Iron, J. W. Bolton. Foundry, vol. 52, no. 16, Aug. 15, 1924, pp. 628-634, 24 figs. Also Iron Trade Rev., vol. 75, no. 9, Aug. 28, 1924, pp. 544-550, 25 figs. Discusses macroscopic and low-power magnification methods which reveal general structure of gray iron and semi-steel; microphotography is considered.

Structural Segregation in Gray Iron, J. A. Bolton, Iron Age, vol. 114, no. 12, Sept. 18, 1924, pp. 685-689, 23 figs. Normal occurrence and practical significance of non-homogeneous structures. Relation to composition and phys cal properties.

IMPROVEMENT BY NICKEL INTRODUCTION. Improving Cast Iron by Introduction of Nickel, P. D. Merica. Can. Foundryman, vol. 15, no. 8, Aug. 1924, pp. 14-15 and 21, 3 figs. Nickel improves machinability of castings, particularly of thin section; increases hardness, produces finer grain and increases resistance to oxidation and corrosion. Bibliography.

SYNTHETIC, ELECTRIC-FURNACE MANUFACTURE OF. Manufacture of Synthetic Foundry Iron in the Electric Furnace, C. E. Sims, C. W. Williams and B. M. Larsen. Foundry Trade Jl., vol. 30, no. 419, Aug. 28, 1924, pp. 183-185. Carburization difficulties; factors governing carburization; type of furnace and method of operation; costs; etc. Paper read before Am. Foundrymen's Assn.

CEMENT

ALUMINA. Fused Alumina Cement; E. C. Blanc. Rock Products, vol. 27, no. 17, Aug. 23, 1924, pp. 37-41, 2 figs. Review of European progress. Bibliography.

CEMENT MANUFACTURE

SILICA CEMENT. How Silica Cement Is Made, P. H. Jung. Chem. & Met. Eng., vol. 31, no. 12, Sept. 22, 1924, pp. 465-467, 1 fig. Discussion of problems of technology and production of an important commodity that must meet difficult industrial specifications.

CEMENT, PORTLAND

MANUFACTURE. Hermitage Company Prepares to Enlarge. Cement & Eng. News, vol. 36, no. 8, Aug. 1924, pp. 11-17, 17 figs. Hermitage Portland Cement Co., Nashville, Tenn. proposes to add new unit and raise capacity of plant from 2,000 to 3,000 bbl. per day. Discusses quarrying operation, limestone crushing, raw grinding, preparation of coal, clinker handling, etc.

Henry Ford's Cement Plant in Operation, G. M. Earnshaw. Rock Products, vol. 27, no. 16, Aug. 9, 1924, pp. 25-31, 22 figs. Describes 1,000-bbl.-per-day plant at River Rouge, Detroit, Mich., making portland cement from blast furnace slag by wet process.

CENTRAL STATIONS

ANTHRACITE-BURNING. Burning Anthracite in a Modern Steam Plant, E. E. Rowe. Power, vol. 60, no. 8, Aug. 19, 1924, pp. 292-294, 4 figs. Shows special design of furnace at Amsterdam plant of Adirondack Power & Light Corp. and gives results of series of boiler tests with anthracite.

DIESEL-ENGINED, OPERATION OF. Operating a Diesel Power Plant, R. G. Melrose. Power, vol. 60, no. 9, Aug. 26, 1924, pp. 324-325. Outline of principal sources of operating difficulties experienced with oil engines, together with remedies.

INTERCONNECTION. Interconnection of Electrical Systems. Power Plant Eng., vol. 28, no. 18, Sept. 15, 1924, pp. 949-952, 2 figs. Discusses possible distances of transmissions in future, high-tension distribution networks, present-day transmission problems, and one-million-volt line. States that scheme of interconnection which will fully utilize hydraulic resources will undoubtedly show greatest economy.

PULVERIZED-FUEL BURNING. Pulverized Fuel at the Cleveland Electric Illuminating Company's Lake Shore Plant, W. H. Aldrich. Mech. Eng., vol. 46, no. 9, Sept. 1924, pp. 519-520 and (discussion) 520-522 and 545. Data on pulverized-fuel equipment at this plant and experience gained in operation; description of coal-handling and burning apparatus.

CIRCUIT BREAKERS

OIL TYPE. Oil Circuit Breaker Investigation as Carried on With a 26,700-Kv-a. Generator, J. D. Hilliard. Am. Inst. Elec. Engrs.—Jl., vol. 43, no. 9, Sept. 1924, pp. 818-824, 16 figs. Discusses some of the characteristics of oil circuit breakers as determined from tests with this equipment, and indicates effect of some of the factors considered: oil viscosity and other oil characteristics; duty cycle tests.

COAL

CARBONIZATION. Carbonization, W. B. Davidson. Gas Jl., vol. 167, nos. 3194, 3195 and 3196, July 30, Aug. 6 and 13, 1924, pp. 447-448, 515-516 and 580-581. Endeavors to set out briefly and clearly main accomplishments of research work on carbonization described in three Cantor lectures by E. V. Evans (Study of Destructive Distillation of Coal.)

Carbonizing Coal With Regenerated Heat, C. H. S. Tupholme. Chem. & Met. Eng., vol. 31, no. 10, Sept. 8, 1924, pp. 388-389, 1 fig. Description of new type of plant for complete gasification of coal, in which fuel is converted into gas in a single operation, leaving ash, liquor, and tar as residuals, in such a way that a large proportion of potential energy of coal is available as city gas.

Low-Temperature Carbonization of Coal, C. M. Garland. Power, vol. 60, no. 13, Sept. 23, 1924, pp. 490-493, 2 figs. Coal coked evenly and continuously by superheated steam at one pound pressure generated from volatile and residue of coking process. Including fixed charges on investment, cost of treating coal containing 5 per cent moisture is estimated at 80 cents per ton.

Practical Coal Carbonization, F. W. Sperr, Jr. Chem. Age (N.Y.), vol. 32, nos. 6 and 7, June and July 1924, pp. 277-279 and 297-299, 4 figs. Discusses high- and low-temperature carbonization with special reference to American conditions, value of by-products, coke as boiler fuel.

CLEANING. Cleaning Coal with Spiral Separators and Concentrator Tables. Gas Engr., vol. 40, no. 580, Aug. 1924, pp. 176-177, 2 figs. Spiral separator consists of central post with number of separating threads running spirally from top to bottom and slightly inclined towards centre, down which coal and stone slide under action of gravity; for dealing with coal below ⅜ in. in size H-H concentrator table is used; sole driving mechanism for this table consists of single unbalanced pulley carried on shaft which is clamped fast to heavy yoke at head end of shaking frame.

PULVERIZED. *See Pulverized Coal.*

RELATIVE PLANT VALUES. Relative Plant Values of Coal, K. M. Holaday. Elec. Wld., vol. 84, no. 8, Aug. 23, 1924, pp. 363-365, 1 fig. Shows how heating values, moisture content, ash content, and fusing temperature as determined by laboratory test, in conjunction with a grading table, can assist in comparing fuels of different quality.

COAL HANDLING

PIERS. Virginian Ry. Builds Double Car-Dumper Coaling Pier. Eng. News-Rec., vol. 93, no. 12, Sept. 18, 1924, pp. 452-455, 5 figs. Describes coaling pier at Sewalls Point, Va., and its equipment. Car dumpers handling 120-ton cars load 130-ton elevator buckets for charging motor transfer cars on deck of pier. Travelling towers on lower deck place coal in ship and trim cargo.

COAL MINING

POWER DATA. Power Data for Illinois Coal-Mining, A. J. Hoskin. Technograph, vol. 36, no. 11, Jan. 1924, pp. 74-75, 102 and 104, 2 figs. Explains why Illinois power companies can buy coal, develop power from it and sell power back to coal mining companies cheaper than they can develop it themselves.

SHOT FIRING. Safety in Shot Firing in Flammable Medium (La sécurité du tir en milieu inflammable), M. E. Audibert. Revue de l'Industrie Minérale, no. 87, Aug. 1, 1924, pp. 373-390, 6 figs. Discusses methods used at Montlucon for determining safety of explosives for firing in firedamp mines, velocity of decomposition of explosives, detonation of nitroglycerine, etc.

COAL WASHING

ALABAMA. Coal Washing Practice in Alabama, H. S. Geismer. Am. Inst. Min. & Met. Engrs.—Trans., Advance Paper no. 1363-C, Sept. 1924, 17 pp., 6 figs. For producing coking coal, three-compartment jigs are favoured: mines providing steam and commercial coal use single-compartment jigs exclusively. Chemists are as necessary to washing plants as recording gages are to power plants. Experiments in Alabama indicate that sludge released by coal washing plants can be deposited in streams and on agricultural lands without disastrous results.

FLOTATION. The Washing of Fine Coal by the Froth-Flotation and Concentrating-Table Processes at Oughterside Colliery, Cumberland. Instn. Min. Engrs.—Trans., vol. 67, part 4, July 1924, pp. 374-389, 8 figs. Discusses principle of froth flotation, gives flow sheets, cost of plant and running costs, etc.

FROTH FLOTATION. The Application of Froth Flotation to Coal Washing, L. Dessagne. Fuel, vol. 3, no. 9, Sept. 1924, pp. 320-327, 6 figs. Discusses theory and use of froth flotation washer, its economic value and conditions for its use.

COKE

REACTIVITY OF. The Reactivity of Coke. Gas Jl., vol. 167, no. 3195, Aug. 6, 1924, pp. 513-514, 1 fig. Discusses causes of variations in combustibility, effect of degree of gasification, change in specific gravity and hardness, etc.

COKE OVENS

BY-PRODUCT. The Becker By-Product Coke Oven. Iron & Coal Trades Rev., vol. 109, no. 2945, Aug. 8, 1924, pp. 233-234, 9 figs. Details of design and construction of Becker type of Koppers Co. ovens recently introduced into Great Britain.

CONCRETE

AGGREGATES. Chert Unfit for Coarse Aggregate in Concrete, F. V. Reagel. Eng. News-Rec., vol. 93, no. 9, Aug. 28, 1924, pp. 332-334, 1 fig. Origin of flints and cherts, distribution, occurrence and characteristics. Experiments and tests in Missouri highway work show chert causes decomposition in surface after freezing.

IMPURE WATERS. Impure Waters for Mixing Concrete. Concrete & Constructional Eng., vol. 19, no. 8, Aug. 1924, pp. 527-529. Conclusions from exhaustive tests on effect of using impure water for mixing concrete, undertaken by Prof. Duff Abrams, Lewis Inst., Chicago.

CONCRETE CONSTRUCTION

MARINE STRUCTURE. Shingle Beaches and the Wear of Concrete, H. S. Owens. Engineer, vol. 138, no. 3580, Aug. 8, 1924, pp. 157-158, 3 figs. Describes method for concrete structures erected on foreshore and exposed to grinding action of shingle or boulders, which has been used successfully and aim of which has been to provide for concrete a surface that would (1) resist abrasive action of shingle as much as possible consistent with limitations as to cost and (2) permit of easy renewal when worn.

CONCRETE CONSTRUCTION, REINFORCED

LOADING TESTS. A Study of Loading Tests on Reinforced Concrete Structures, E. S. Andrews. Concrete & Constructional Eng., vol. 19, nos. 6 and 7, June and July 1924, pp. 369-375 and 443-449, 6 figs. Considers some of more prominent tests made by experimental engineers and studies their principal results in light of ordinary methods of design, explaining how results may be interpreted. June: A two-way hollow-tile floor. July: British tests in one-way hollow tile floors.

CONCRETE MIXERS

GRAVITY. Gravity Material Supply Cuts Handling Costs. Eng. News-Rec., vol. 93, no. 11, Sept. 11, 1924, pp. 420-422, 4 figs. Describes concrete mixing plant employed for track elevation work on Pennsylvania R.R. at Cleveland, Ohio. Located, of necessity, in a restricted place, it required special layout. It is a one-yard mixing plant and delivers 400 cu. yd. in a 10-hr. day.

CONDENSERS, STEAM

DESIGN. The Principles of Condenser Design, D. G. McNair. Power Engr., vol. 19, no. 221, Aug. 1924, pp. 304-307, 2 figs. General survey of three main types, showing how their leading dimensions may be roughly determined.

SINGLE- VS. DOUBLE-PASS. Single-Pass Condensers Require Less Pumping Power Than Double-Pass, P. Bancel. Power, vol. 60, no. 10, Sept. 2, 1924, pp. 371-372, 2 figs. Neglecting external head, a single-pass condenser requires about one-eighth pumping power for same amount of cooling water as with a double-pass unit. Discusses resistance of external piping and rearrangement of condenser design, so as to utilize single flow to best advantage.

TUBES. Condenser-Tube Packing. Steamship, vol. 36, no. 423, Sept. 1924, pp. 88-91, 10 figs. Shows underlying causes and points out way to satisfactory and economical solution of problem; discusses condenser-tube disintegration, deformation, damage, life of condenser packing and condenser ferrules.

CONSTRUCTION WORK

FORCE ACCOUNT CONSTRUCTION. Force Account and Winter Work on Small City Jobs, I. E. Houk. Eng. News-Rec., vol. 93, no. 8, Aug. 21, 1924, pp. 292-293. Experience in building public works by force account at Dayton, O., has shown that method is often, but not always, advisable.

COPPER

CASTINGS. Making Copper Castings From Cupola Melted Metal, T. F. Jennings. Am. Foundrymen's Assn., Preprint No. 421, for Mtg. Oct. 11-16, 1924, 7 pp. Describes methods used in making sound copper castings by melting metal in a cupola. Preparation of cupola and liberal use of charcoal in charges emphasized.

CORROSION OF. Seventh Report to the Corrosion Research Committee of the Institute of Metals, G. D. Bengough and R. May. Inst. of Metals, Advance paper no. 3, for Mtg. Sept. 8-11, 1924, 176 pp., 35 figs. partly on supp. plates. Deals with corrosion of copper, zinc, 70:30 brass, and condenser tubes. Mainly concerned with mode of formation and behavior of "scales" which form on copper and brass in presence of sea-water.

HARDNESS DUE TO COLD WORKING. Note on the Effect of Progressive Cold-Rolling on the Brinell Hardness of Copper, H. Moore. Inst. of Metals, Advance paper no. 9, for Mtg. Sept. 8-11, 1924, 3 pp., 1 fig. Details of experiments made to confirm conclusion that by severe cold-working a metal could be brought into a state in which its hardness would be little or no higher than that of annealed metal and that in this state metal could not be hardened by further cold-work.

IRON IN, EFFECT OF. Investigation of the Effects of Impurities on Copper. Part II The Effect of Iron on Copper, D. Hanson and G. W. Ford. Inst. of Metals, Advance Paper no. 7, for Mtg. Sept. 8-11, 1924, 27 pp., 23 figs. partly on supp. plates. Describes an investigation of effect of small quantities of iron on properties of copper, discussing constitution and microstructure, casting, hot- and cold-rolling, density, hardness, tensile tests, effect of heat treatment electrical conductivity, fatigue range, notched-bar impact tests, softening after cold work, microstructure, and machining properties.

CORES

BINDERS. Core Oils—Their Composition and Advantages, W. G. Smith. Can. Foundryman, vol. 15, no. 6, June 1924, pp. 13-16, 5 figs. Discusses binders, not only those in oil group, but those of all classes, putting special emphasis on advantages of properly mixed oils over pure linseed oil; linseed is good base but far from perfect; Chinese oils, corn oil, mineral oil, rosin, and fossil gums when properly blended make ideal core binder. Abstract of paper read before Detroit Foundrymen's Assn.

CORONA

FORMATION, HYSTERESIS CHARACTER OF. The Hysteresis Character of Corona Formation, H. J. Ryan and H. H. Honline. Am. Inst. Elec. Engrs.—Jl., vol. 43, no. 9, Sept. 1924, pp. 825-830, 9 figs. Discusses two items encountered which clearly indicate hysteresis character of corona formation, viz.: (1) value of power lost through corona from a transmission line closely approximates that given by product of charging current and voltage in excess of critical voltage, and (2) dominating importance of crest voltage in relation to corresponding corona loss.

CORROSION

PREVENTION. Corrosion Prevention. Machy. Market, no. 1239, Aug. 1, 1924, pp. 17-18, 4 figs. Special reference is made to "bitumastic" specialties which are now made in various shades; black solution is quick drying and has great durability forming impervious film over metal, effectively keeping out causes of corrosion, while cracking and peeling from movement of metal due to change of temperature is entirely prevented by elastic nature of solution.

TARNISHING AND. The Relation Between Tarnishing and Corrosion, U. R. Evans. Am. Electrochem. Soc., Advance paper no. 6, for Mtg. Oct. 2-4, 1924, pp. 75-100, 7 figs. partly on supp. plate. Describes investigations into attack of gaseous sulphur dioxide on iron and zinc, and that of hydrogen sulphide on copper, with special reference to part played by water in each case, and also to essential difference between tarnishing and corrosion proper.

COUNTERBORES

MANUFACTURE. Manufacturing Interchangeable Counterbores. Machy. (Lond.), vol. 24, no. 619, Aug. 7, 1924, pp. 592-596, 15 figs. Unusual operations and fixtures employed in making counterbores and holders.

COUPLINGS

SHAFT. Cast-iron Shrouded Shaft Couplings. Machy. (Lond.), vol. 24, no. 619, Aug. 7, 1924, pp. 582-583, 1 fig. Table giving modern proportions of shaft couplings and additional information that is required when designing a coupling.

CRANES

POWER-PLANT. Types of Cranes for the Power Plant. Power Plant Eng., vol. 28, no. 16, Aug. 15, 1924, pp. 846-848, 4 figs. Crane capacity may be determined by weight of equipment to be installed in future.

TRAVELLING. 1½-Ton Electric Overhead Travelling Crane with Underslung Bridge. Engineering, vol. 118, no. 3057, Aug. 1, 1924, pp. 164-166, 2 figs. Details of crane built by J. Adamson & Co., Hyde, Eng., with underslung bridge for transferring goods from barges on one side of workshop into store sheds on other without travelling longitudinally.

CULVERTS

CORRUGATED. Part Circle Corrugated Culverts in City Drainage. Eng. & Contracting (Roads & Streets), vol. 62, no. 3, Sept. 3, 1924, pp. 499-502, 8 figs. Details of installations in California cities showing application of system at street intersections and other points of small clearance.

D

DAMS

CONSTRUCTION. Cableways Handle Excavation and Fill on Wisconsin Dam. Eng. News-Rec., vol. 93, no. 8, Aug. 21, 1924, pp. 301-302, 3 figs. Particulars of new dam for Wausau Paper Mills Co., on Wisconsin River at Brokaw, Wis.; designed to develop approximately 4,000 hp. under a 17-ft. head. Cofferdam excavated and concrete gravel delivered by one slackline cableway; two used to construct earth dike.

DIESEL ENGINES

CENTRAL STATIONS. Diesel Engine for Stand-By Service, H. L. Conklin. Power Plant Eng., vol. 28, no. 16, Aug. 15, 1924, pp. 851-852, 2 figs. Diesel engine shows lower fuel cost than steam equipment for peak-load service in water-power plant.

COSTS. Bids Show Range in Diesel Costs. Mar. Rev., vol. 54, no. 9, Sept. 1924, pp. 347-348, 2 figs. Analysis of bids and of reasons for difference; compares different types of Diesel engines, two- and four-cycle, single- and double-acting, air- and solid-injection.

DOUBLE-ACTING. An American Double Acting Diesel. Mar. Eng. & Ships. Age, vol. 29, no. 9, Sept. 1924, pp. 528-530, 2 figs. See also Pac. Mar. Rev., vol. 21, no. 9, Sept. 1924, pp. 454-455, 2 figs. Details of design and construction of four-cylinder, double-acting, two-cycle Worthington Diesel engine designed to develop 2,400 s. hp.

HEAVY-OIL-BURNING. Burning Boiler Oil in Diesel Engines, C. L. Ruegg. Power, vol. 60, no. 13, Sept. 23, 1924, pp. 488-489, 3 figs. Discusses use in Diesel engines of heavy oil now being burned under boilers. Since price is below that of refined oils, owners of Diesel engines should make necessary rearrangement of fuel system to permit them to take advantage of the situation. Deals with changes necessary.

DRAINAGE

DITCHES. South Dakota Drainage Ditches With Flood Gates, P. S. Egbert. Eng. News-Rec., vol. 93, no. 9, Aug. 28, 1924, pp. 334-335, 2 figs. Country with slight fall but subject to floods complicates drainage problem. Diked channel through big slough.

DRILLING MACHINES

SLOT. A New Duplex Slot Drilling Machine. Machy. (Lond.), vol. 24, no. 620, Aug. 14, 1924, pp. 627-628, 3 figs. Describes latest duplex slot-drilling and keyseating machine built by Smith & Coventry, Ltd., Salford, Eng.; convenience of operation and compactness of design, combined with accessibility of all adjustments, are prominent features. Has single belt drive.

VERTICAL. Possibilities of Heavy-duty Drilling. Machy. (Lond.), vol. 24, no. 624, Sept. 11, 1924, pp. 737-739, 5 figs. Points out possibilities of vertical heavy-duty box-column drilling machine by presenting examples of work done in automobile plants.

DURALUMIN

PRODUCTION AND USES. Duralumin, Its Composition and Treatment, S. H. Phillips. Am. Mach., vol. 61, no. 10, Sept. 4, 1924, pp. 371-374, 5 figs. Data concerning production and uses.

E

ELECTRIC CURRENT, ALTERNATING

FREQUENCY ANALYZERS. An Electrical Frequency Analyzer, R. L. Wegel and C. R. Moore. Am. Inst. Elec. Engrs.—Jl., vol. 43, no. 9, Sept. 1924, pp. 798-802, 9 figs. Theory and construction of apparatus by means of which it is possible to obtain a permanent record of frequency and magnitude of each component of a complex alternating current; its use in various fields.

ELECTRIC GENERATORS

ASSEMBLING. Assembling 22,000-Kva. Waterwheel Generator, R. Brown. Power, vol. 60, no. 8, Aug. 19, 1924, pp. 278-281, 7 figs. Involved special method of handling field poles and adjusting air gap to relieve load on bearing. Drying out windings and placing machine in service.

ELECTRIC LOCOMOTIVES

DEVELOPMENTS. Recent Developments in Electric Locomotives, N. W. Storer. Mech. Eng., vol. 46, no. 9, Sept. 1924, pp. 523-528, 9 figs. Describes some of the recent designs of electric locomotives and discusses some of the tendencies in design, especially of mechanical parts.

SOUTH AFRICAN RAILWAY. 3,000-Volt Locomotives for South African Railway. Elec. Ry. Jl., vol. 64, no. 11, Sept. 13, 1924, pp. 390-391, 3 figs. Describes locomotives designed for use on narrow-gage line, three 75-ton units being coupled together to haul a 1,430-ton freight train.

ELECTRICAL APPARATUS

STATIONARY, ALTITUDE EFFECTS. Temperature Rise of Stationary Electrical Apparatus as Influenced by Radiation, Convection and Altitude, V. M. Montsinger and W. H. Cooney. Am. Inst. Elec. Engrs.—Jl., vol. 43, no. 9, Sept. 1924, pp. 803-812, 9 figs. Discusses temperature rise of various shaped surfaces as influenced by radiation and free convection for a given altitude, giving results of tests made on a large plate to determine formula for free convection, also results of tests and discussion on effect of different colored cases on temperature rise of transformers in shade and sunshine; and effect of altitude on temperature rise of transformers having different shapes of tank surfaces, of rheostats, bus bars, reactors, etc.

ELECTRICAL MACHINERY

BROWN-BOVERI. Progress in Brown Boveri Design During Recent Years, K. Sachs and P. Faber. Brown Boveri Rev., vol. 11, no. 8, Aug. 1924, pp. 147-187, 84 figs. Discusses electrical machinery and apparatus, induction motors, direct-current machines, transformers, mercury arc power rectifiers, high-tension switchgear, electrical apparatus, selective protection and electric furnaces.

ELECTRIC MOTORS

SYNCHRONOUS, FAULTS LOCATING. Locating Faults in Synchronous Motors, A. A. Fredericks. Power, vol. 60, no. 12, Sept. 16, 1924, pp. 451-453, 3 figs. Difficulties that may be experienced in operation of synchronous motors and causes of heating in bearings and windings.

ELECTRIC MOTORS, A.C.

INDUCTION. The New Compensated Asynchronous Motors (Les nouveaux moteurs asynchrones compensés), C. Toulet. Vie Technique et Industrielle, vol. 5, no. 59, Aug. 1924, pp. 312-314, 4 figs. Discusses reactive current and its elimination, constructional and technical characteristics of compensated asynchronous motors and their advantages.

SQUIRREL-CAGE. Theory and Calculation of the Squirrel Cage Repulsion Motor, H. R. West. Am. Inst. Elec. Engrs.—Jl., vol. 43, no. 9, Sept. 1924, pp. 783-790, 11 figs. Results of analytical study of operation of motor. Derivation of method of calculation is outlined and some of the more interesting results are given.

STARTERS. Automatic Starting of Synchronous Motors. Power, vol. 60, no. 8, Aug. 19, 1924, pp. 282-283, 4 figs. Describes new type of controller for automatically starting synchronous motors in which reduced starting voltage is obtained through reactance coils.

ELECTRIC MOTORS, D.C.

RECONNECTING. Reconnecting Direct-Current Machines—Changing Speed and Voltage, A. C. Roe. Power, vol. 60, no. 10, Sept. 2, 1924, pp. 363-365, 4 figs. Problems are worked out showing how to figure a new winding for a shunt compound and series motor to operate with a change in speed and voltage.

TESTING. Tests To Make on Direct-Current Motors When Putting Them Into Service, C. A. Armstrong. Power, vol. 60, no. 11, Sept. 9, 1924, pp. 398-400, 9 figs. Methods for determining if connections are correct on series, shunt and compound motors before putting them into service, and how to test polarity of series- and shunt-field coils in compound motors.

ELECTRIC TRANSMISSION LINES

CALCULATIONS. The Hyperbolic Method of Transmission Line Solution, H. Waddicor. World Power, vol. 2, no. 8, Aug. 1924, pp 97-102, 5 figs. Mathematical and graphical solutions for various terminal conditions.

RURAL. Economical Rural Power Transmission by Means of Galvanized Iron or Copper Lines with Ground Return (Distributions rurales économiques d'énergie par lignes en fer galvanisé ou en cuivre avec retour par la terre), G. Viel. Industrie Électrique, vol. 33, no. 770, July 25, 1924, pp. 277-283, 6 figs. Discusses rural power production; single phase high tension galvanized iron or copper lines; comparison with three phase copper lines as to cost, precautions necessary for lines with ground return.

SHORT CIRCUITS. Short-Circuit Calculating Board, L. G. Smith, Elec. Wld., vol. 84, no. 7, Aug. 16, 1924, pp. 308-311, 3 figs. Baltimore Co. designs table for two interconnected systems of 210,000 kw.; arrangements for metering, method of applying voltages, operation and use of board discussed.

110,000-VOLT. Design for 110,000-Volt Line, H. T. Pierce. Elec. Wld., vol. 84, no. 11, Sept. 13, 1924, pp. 506-510, 12 figs. Describes new transmission line of New England Power Co. which connects distant hydro plants and large industrial centers, particularly adapted to withstand severe periodic sleet storms.

ELECTROMETALLURGY

DEVELOPMENT. Review of Electrochemistry and Electrometallurgy Between 1914 and 1923 (Aperçu sur l'Électrochimie et l'Électrométallurgie de 1914 à 1923), G. Flusin. Houille Blanche, vol. 23, no. 89-90, May-June 1924, pp. 71-75. Discusses electric furnaces and electrodes, electrolytic electrochemistry and electrometallurgy, electrothermic electrochemistry and electrometallurgy and advancement in their activities.

ELEVATORS

ELECTRIC, OPERATION OF. Operation of Electric Elevator Machines—General Principles, F. A. Annett. Power, vol. 60, no. 11, Sept. 9, 1924, pp. 414-416, 6 figs. Explains operation of semi-magnetic controlled elevators, describes the different automatic stopping devices and tells how to adjust terminal landing limits.

EMPLOYEE REPRESENTATION

EXAMPLES OF. Discussion on Employee Representation, A. H. Young. Iron Age, vol. 114, no. 12, Sept. 18, 1924, pp. 689-691. Some facts and factors which measure its success. Examples taken from periods of strife.

EMPLOYMENT MANAGEMENT

EMPLOYEE SPECIFICATIONS. Employee Specifications, P. M. Atkins. Indus. Mgt. (N. Y.), vol. 68, no. 2, Aug. 1924, pp. 115-118. Establishing standards similar to those used in purchase of materials.

EXPLOSIVES

DEVELOPMENT AND USE. Development and Use of Industrial Explosives, A. La Motte. Min. & Metallurgy, vol. 5, no. 213, Sept. 1924, pp. 428-432. Discusses history and characteristics of dynamite, development of new types, strength of explosives, velocity of detonation, improvements in safety and efficiency, methods of using, etc.

EXTRUSION OF METALS

BRASS RODS. The Extrusion of Brass Rod By the Inverted Process, R. Genders. Inst. of Metals, Advance paper no. 6, for Mtg. Sept. 8-11, 1924, 11 pp., 6 figs. partly on supp. plate. Method of overcoming formation of coring defect favoured by author consists in completely altering direction of flow in receiver by inverting process, so that die is pressed into billet, rod being extruded through a hollow plunger. Describes experiments carried out on a manufacturing scale with a press designed to extrude by new method.

F

FACTORIES

LOCATION OF. How Would You Pick a Factory Location? M. G. Farrell. Factory, vol. 33, no. 3, Sept. 1924, pp. 336-338, 438 and 440-445, 1 fig. Discusses importance of studying thoroughly the various districts when searching for a manufacturing location, when it is profitable to locate in a segregated district, why it is necessary to study labor conditions in district surrounding proposed location, etc.

FANS

CENTRIFUGAL. Application and Operation of Centrifugal Fans, R. E. Cramer. Combustion, vol. 11, no. 3, Sept. 1924, pp. 199-201, 3 figs. Analysis of conditions surrounding application and operation of centrifugal fans in boiler plants from viewpoint of influence of fan and its method of control upon capacity and overall economy of plant.

FATS

HYDROGENATION. The Bergius Process (Le procédé Bergius), A. Kling. Chimie & Industrie, vol. 11, no. 6, June 1924, pp. 1067-1077, 8 figs. Discusses mechanism of dissociation, cracking process, Bergius patents, berginization of heavy oils, asphalts, etc. and its application in France.

FIRECLAYS

PROPERTIES. The Properties of Fireclay. Foundry Trade Jl., vol. 30, no. 420, Sept. 4, 1924, pp. 195-199, 1 fig. Abstracts of portions of book "Refractory Materials: Fireclays, Analyses and Physical Tests", written as a special report on mineral resources of Great Britain by F. R. Ennos and A. Scott. Deals with mineralogical composition, changes during firing, effect of impurities on properties, refractoriness in relation to chemical composition, influence of chemical analyses on refractoriness, etc.

FLAME PROPAGATION

SPARK INTENSITY. Flame Speed and Spark Intensity, D. W. Randolph and F. B. Silsbee. Nat. Advisory Committee for Aeronautics, report no. 187, 1924, 14 pp., 7 figs. Describes series of experiments undertaken to determine whether or not electrical characteristics of igniting spark have any effect on rapidity of flame spread in explosive gas mixture which it ignites. Results show that no such effect exists. Flame velocity in carbon-monoxide-oxygen, acetylene-oxygen, and gasoline-air mixtures was found to be unaffected by changes in spark intensity from sparks which were barely able to ignite mixture up to intense condenser discharge sparks having 50 times this energy.

FLOOD CONTROL

KILBOURN, WIS. River Regulation Determined by Hydraulic Experiments. Eng. News-Rec., vol. 93, no. 11, Sept. 11, 1924, pp. 429-431, 4 figs. Bank erosion on Wisconsin river at Kilbourn, Wis., due to flood flow over dam of Southern Wisconsin Power Co., has been overcome by construction of a concrete training wall, location of which was determined largely by experiments made at hydraulic laboratory of Univ. of Wis.

FLOTATION

COPPER ORE. Selective Flotation at Nacozari, W. T. MacDonald. Eng. & Min. Jl.-Press, vol. 118, no. 12, Sept. 20, 1924, pp. 445-454, 11 figs. Describes methods developed by Moctezuma Copper Co. at Macozari, Sonora, Mexico, and results obtained.

Selective Flotation as Applied to Canadian Ores, C. S. Parsons. Can. Chem. & Metallurgy, vol. 8, no. 8, Aug. 1924, pp. 187-190. Reviews results of investigations of ore dressing and metallurgical laboratories of Dept. of Mines at Ottawa; selective flotation problems; oils and reagents used; control of flotation pulp; examples of selective flotation.

FLYING BOATS

TESTS. Experiments with Model Flying Boat Hulls. 24th Series Report; Comparison of Longitudinal With Transverse Steps, G. S. Baker and E. M. Keary. Aeronautical Research Committee, no. 893, Aug. 1923, 13 pp., 5 figs. Object of experiments was to test merits or demerits of form having longitudinal instead of transverse steps.

FOUNDRIES

CAR-WHEEL. Make Wheels and Brakeshoes, P. Dwyer. Foundry, vol. 52, no. 18, Sept. 15, 1924, pp. 707-712, 12 figs. Describes plant of Canada Iron Foundries, Ltd., manufacturing cast-iron chilled wheels for railway cars, brakeshoes, and miscellaneous castings, principally municipal work and pipe fittings. Two foundries draw supplies from same stockyard and are served by metal from a battery of four cupolas charged from a common platform.

COST ACCOUNTING. A Foundry Cost System. Foundry Trade Jl., vol. 30, no. 417, Aug. 14, 1924, pp. 157-160. Outlines foundry cost accounting system arranged primarily for iron foundries producing castings of varied designs and of wide range in weight, but underlying principles upon which it is based can be rendered applicable to brass, malleable and steel foundries by changing terminology and altering arrangement of cost details to suit conditions prevailing therein.

Cost Finding in a Foundry, W. J. Corbett. Am. Foundrymen's Assn., Preprint No. 410, for Mtg. Oct. 11-16, 1924, 36 pp., 6 figs. Discusses factors justifying a manufacturer in operating a foundry and uses of an effective cost system. Explains necessity for foundry industry to adopt uniform cost finding methods, and shows the great variations in ascertaining casting costs by comparing figures based on methods used in some 80 steel foundries. Outlines a general cost-accounting system for a foundry with reference in a general way to main elements of foundry costs, and describes in detail a job cost system which furnishes necessary data that should be supplied by a good foundry cost system.

Departmental Costs in the Foundry, H. B. May. Am. Foundrymen's Assn., Preprint No. 415, for Mtg. Oct. 11-16, 1924, 13 pp. Engineering or departmental costs show profit or loss of each unit, whether unit be job, contract, line of product or operating department. Advocates careful analysis of each department to determine correct basis on which to distribute burden. Discusses departments of a foundry to clarify this idea and to show divisions of foundry costs.

ELECTRIFIED. A Completely Electrified Foundry, E. J. Cipperly. Elec. Wld., vol. 84, no. 11, Sept. 13, 1924, pp. 515-517, 5 figs. Describes plant of Alloy Steel & Metals Co., Los Angeles, Cal., which has been in successful operation for more than a year. Melting, core baking, heat treating and welding all performed electrically.

METALLURGICAL CONTROL IN. Metallurgical Control in the Iron Foundry, J. A. Holden. Foundry Trade Jl., vol. 30, no. 420, Sept. 4, 1924, pp. 207-208. Deals separately with controlling light and heavy castings.

FUEL ECONOMY

TEMPERATURE MEASUREMENT, IMPORTANCE OF. Fuel Economy and the Measurement of High Temperatures, R. Hadfield. Foundry Trade Jl., vol. 30, no. 419, Aug. 28, 1924, pp. 179-181. Survey of fields where pyrometry has enabled accurate heat balances to be obtained, including steam boilers, forge furnaces, furnaces for heat treatment of steel, and open-hearth furnaces. Temperature measurement in France; flame temperature and furnace efficiency; regenerators and recuperators. Abstract of paper read before First World Power Conference.

FUELS

RELATIVE VALUE. Relative Value of Fuels, R. O. Wynne-Roberts. Am. Gas Jl., vol. 121, no. 9, Aug. 30, 1924, pp. 791-792 and 806. Discusses heat service, waste incurred in use of all fuels, relative value of gas and other fuels, efficiency of gas of different qualities, etc.

SOLID, TEST CODE FOR. Test Code for Solid Fuels, Mech. Eng., vol. 46, no. 9, Sept. 1924, pp. 558-562, 5 figs. Preliminary draft of a code in series of nineteen being formulated by A.S.M.E. Committee on Power Test Codes.

See also Coal; Oil Fuel; Pulverized Coal.

FURNACES, METALLURGICAL

ALUMINUM- AND ALUMINUM-ALLOY-MELTING. Aluminum and Aluminum-Alloy Melting Furnaces, R. J. Anderson. Am. Foundrymen's Assn., Preprint for Mtg. June 5-9, 1924, 44 pp., 14 figs. Reviews work undertaken by U. S. Bur. Mines to decrease metal and fuel losses in melting aluminum and its light alloys. All of the types of furnaces used in United States for rolling mill practice, foundry practice, for die casting and permanent mold practice and for smelting and refining are mentioned. Detailed information and description of pit, stationary and tilting crucible, stationary and tilting iron pot, open flame, reverberatory, and electric furnaces. Factors governing selection and operations of furnaces. Information regarding melting temperatures. Selected bibliography in which many articles pertaining to aluminum alloy melting furnaces are listed.

G

GAS PRODUCERS

DEVELOPMENTS. Modern Developments in Gas-Producing Plant, F. H. Beebe. Gas Engr., vol. 40, no. 580, Aug. 1924, pp. 172-174, 5 figs. Discusses reduction of back pressure, shorter cycle operation, automatic chargers, fuel feed to generators, wasteheat boilers, and purification process.

GAS TURBINES

AUTOMOBILES. The Gas Turbine, Its Use for Automobiles and Airships (La turbine à gaz, son utilisation en automobilisme et en aéronautique). Technique Automobile et Aérienne, vol. 15, no. 125, 1924, pp. 33-37, 2 figs. Discusses their efficiency, variation of power, weight per hp.; cycles of constant-volume combustion and constant-pressure combustion; comparison with steam turbines.

GEARS

CALCULATION, CHARTS FOR. Charts for Gear Calculation, F. H. Towler. Machy. (Lond.), vol. 24, no. 622, Aug. 28, 1924, pp. 678-679, 3 charts on supp. plate. Gives charts relating to machine-cut straight-toothed spur and double helical gearing, also pitch-line-velocity chart. Constructed on logarithmic principle.

CASES. Molds Large Iron Gear Cases, P. Dwyer. Foundry, vol. 52, no. 16, Aug. 15, 1924, pp. 623-627, and 652, 10 figs. Detailed description of molding practice involved in production of these large shells in which bulk is out of all proportion to weight.

INVOLUTE. Involute Gear Teeth. Automobile Engr., vol. 14, no. 192, Aug. 1924, pp. 237-242, 8 figs. Notes on interference, undercutting, and conditions of contact in spur gears.

TESTING. Gear Testing. British Machine Tool Eng., vol. 3, no. 28, July-Aug. 1924, pp. 81-83, 12 figs. Gives methods of testing teeth of gear wheels, illustrating and describing a number of gear-testing jigs.

H

HARDNESS

Brinell Test. Improvements in the Brinell Test on Hardened Steel, Including a New Method of Producing Hard Steel Balls, A. Hultgren. Iron & Steel Inst., Advance paper no. 7, for Mtg. Sept. 1924, 30 pp., 12 figs. partly on supp. plate. Describes a method of producing steel balls considerably harder than those heretofore available, and therefore especially suitable for Brinell tests on hardened steel.

Pendulum Hardness Tester. Investigations on the Herbert Pendulum Hardness Tester, C. Benedicks and V. Christiansen. Iron & Steel Inst., Advance paper no. 2, for Mtg. Sept. 1924, 20 pp., 7 figs. Construction and working of this new instrument which permits of use of even very small specimens, and comparison of results with those of Brinell method.

HEATING, STEAM

Central. Applying Centralized Control to Steam Heating Systems. Power, vol. 60, no. 11, Sept. 9, 1924, pp. 417-419, 5 figs. How central-station steam was supplied to an office building and what arrangements were made for heating a factory where public-utility power had supplanted that from a private plant.

HIGHWAYS

Development. Points of Interest in Highway Development, E. O. Hathaway. Minnesota Federation of Architectural & Eng. Soc.—Bul., vol. 9, no. 8, Aug. 1924, pp. 11-18. Discusses finances, publicity and education, investigations, design, materials, construction and maintenance and statistics.

Motor Traffic. Trunk-Highway Motor-Traffic, W. G. Sloan. Soc. Automotive Engrs.—Jl., vol. 15, no. 3, Sept. 1924, pp. 238-245 and (discussion) 245-250, 12 figs. Discusses effect of development of motor-vehicle industry on property values, probable future conditions, improvements at Camden, revenue available for building roads, requirements for satisfactory highways, best wearing surfaces, adjustment of gradients, etc.

HOBBING MACHINES

Lees-Bradner. Gear Hobbing Machine Specially Designed for Producing Transmission Gears. Automotive Industries, vol. 51, no. 9, Aug. 28, 1924, pp. 402-404, 5 figs. Describes gear generator specially designed for production of automobile transmission gears, developed by Lees-Bradner Co., Cleveland, O. Straddle housing eliminates overhang of work and hob spindle, and adds rigidity of support, which is claimed to increase speed of production, life of hob and number of gears cut for each sharpening.

HYDRAULIC TURBINES

Draft Tubes. A Rational Form of Draft Tube for Water-Turbines, A. Melovich. Engineering, vol. 118, no. 3057, Aug. 1, 1924, p. 153, 2 figs. Discusses two different kinds of draft tubes at Queenston Power Station, Ont. used for comparison of efficiency and shows that one draft tube does not fulfill conditions for full bore flow, rendering comparison invalid.

Kaplan. Historical Note on the Kaplan Turbine J. Kneidl. Engineering, vol. 118, no. 3057, Aug. 1, 1924, p. 183, 1 fig. World Power Conference paper describing new type of water turbine suitable for medium and low heads.

Switzerland. Some Notable Modern Turbine Installations (Quelques installations remarquables de turbines modernes), R. Hoffman. Bulletin Technique de la Suisse Romande, vol. 50, no. 17, Aug. 16, 1924, pp. 209-214, 7 figs. Details of propeller turbines of Wynau hydro-electric plant, and tests carried out showing their advantages.

HYDRO-ELECTRIC DEVELOPMENTS

N. Y. State Barge Canal. Power Developments in the Barge Canal. Power Plant Eng., vol. 28, no. 17, Sept. 1, 1924, pp. 882-886, 8 figs. Two 8000-hp. water power plants now under construction. Power for lock operations supplied by 32 small plants.

St. Lawrence River. The Development of the St. Lawrence River for Power and Navigation. Engineering, vol. 118, nos. 3059 and 3060, Aug. 15 and 22, 1924, pp. 239-241 and 271-273, 9 figs. See also Can. Engr., vol. 47, nos. 8 and 9, Aug. 19 and 26, 1924, pp. 253-256 and 265, and 277-283, 11 figs. Considers characteristics of Upper St. Lawrence which have an important bearing on design, construction, and operation of development works. Methods of development. Estimates of cost. Paper read before Sec. G of British Assn. at Toronto.

HYDRO-ELECTRIC PLANTS

Design. Great Works Hydro-Electric Plant Has Original Design, R. J. Andrus. Elec. Wld., vol. 84, no. 7, Aug. 16, 1924, pp. 305-307, 7 figs. New automatic station constructed by combining dam, bridge, and building parts for triple use; development cost per kilowatt about $284.

Ice Control. Combating Ice in European Hydro-Electric Plant. Eng. News-Rec., vol. 93, no. 7, Aug. 14, 1924, pp. 265-266. Abstract of papers read by A. Frey and Arvid Ruths at First World Power Conference, Lond., dealing with methods employed in Norway and Sweden, chief sources of trouble, ice pressure, and effects of regulation.

Ice Control Methods at Shelburne Falls, J. H. Kennedy. Power Plant Eng., vol. 28, no. 17, Sept. 1, 1924, pp. 895-896, 5 figs. Constant work is required to keep channels open and units running up to capacity on Deerfield River in Massachusetts at plants of New England Power Co. Abstract of article in Contact, May 1924.

I

ICE PLANTS

Charleston, W. Va. Performance of a Modern Ice Plant. South. Engr., vol. 41, no. 7, Sept. 1924, pp. 35-39, 5 figs. Gives operating results of 100-ton ice-making plant of Diamond Ice & Coal Co., Charleston, W. Va.

Oil-Engine-Driven. Ice Plant Changes to Oil Engine Drive. Power Plant Eng., vol. 28, no. 17, Sept. 1, 1924, pp. 910-912, 5 figs. How Pure Water Ice Co. at Waukegan, Ill., reduced operating costs so it readily competes with natural-ice producers.

INDUSTRIAL MANAGEMENT

Budgetary Control. Budgetary Control, W. Carswell. Paper Trade Jl., vol. 79, no. 7, Aug. 14, 1924, pp. 51-54 and 60. Outlines general principles of budgetary control in relation to all principal activities of an enterprise which apply with equal value to any business whether manufacturing, trading or merchandising, treating subject in its application to all activities of the business. Discussed under following heads: Advantages to be gained by operating under a budget; Preparation of budget; Control. Address before Can. Soc. Cost Accountants.

Drafting Department. Putting the Drafting Room on a Production Basis, W. E. Irish. Indus. Mgt. (N. Y.), vol. 68, no. 2, Aug. 1924, pp. 121-126, 2 figs. A system which, being based on fundamentals, is flexible enough for wide application.

Inspectors' Card System. A Card System to Help the Inspector, K. H. Crumrine. Am. Mach., vol. 61, no. 9, Aug. 28, 1924, pp. 349-350, 4 figs. How inspector can be aided by engineering department.

Psychology in Industry. Industrial Psychology, H. S. Person. Taylor Soc.—Bul., vol. 9, no. 4, Aug. 1924, pp. 163-171. Discusses psychology as science of nature and causes of conduct and of its control, and problems of psychology in industry.

Quality Measurement. Measurement of the Quality of Product, G. S. Radford. Mech. Eng., vol. 46, no. 9, Sept. 1924, pp. 546-547 (includes discussion). Considers possibility of reducing control of quality and inspection function to a mathematical basis, and concludes that this is neither feasible nor desirable. Sets up standards by which performance of inspection division can be judged.

Steel Foundry. Organization and Practice in a Steel Foundry Finishing Department, C. W. Heywood. Am. Foundrymen's Assn., Preprint No. 422, for Mtg. Oct. 11-16, 1924, 11 pp. Believes gang system produces most satisfactory results from standpoint of both output and costs. Where gang system is not feasible, another successful plan is to employ a pace-maker. Layout of equipment has a great deal to do with best routing and these two features are discussed in detail.

INSULATORS, HEAT

Steam Pipe. Removable Insulating Covers (Manchons calorifuges amovibles), H. and L. Faron. Revue Industrielle, vol. 54, no. 2181, Aug. 1924, pp. 233-235, 8 figs. Details of patented removable sectional insulation or insulating jackets, their composition, making of joints and advantages.

INTERNAL-COMBUSTION ENGINES

Applications. Present Applications of Internal-Combustion Engines (Les applications actuelles des moteurs à combustion interne), A. Witz. Technique Moderne, vol. 16, no. 15, Aug. 1, 1924, pp. 501-509, 5 figs. Discusses use of engines up to 100 hp. in small industries, and up to 2300 hp. in medium and large scale industries; fuels; types of engines; engines for central stations, for metallurgy, for traction and driving airplanes.

Fuels. Contribution to the Theory of Fuels for Engines (Contribution à la théorie des combustibles pour les moteurs), M. Brutzkus. Société d'Encouragement pour l'Industrie Nationale—Bul., vol. 136 no. 5, May 1924, pp. 397-425, 1 fig. Discusses combustion-engine fuels, including mineral oils, tar oils, gaseous fuel; fuel increasing and decreasing in volume; efficiency of combustion.

Decomposition of Lead Tetraethyl and Its Use in Explosion Engines (Sur la décomposition du plomb tétraéthyle et son application aux moteurs à explosion), P. Jolibois and G. Normand. Académie des Sciences— Comptes rendus des séances, vol. 179, no. 1, July 7, 1924, pp. 27-28. This fuel allows increase of compression and reduces chances of spontaneous explosion of gaseous mixture.

Lignite Distillate, Chas. E. Kerchner. Mech. Eng., vol. 46, no. 9, Sept. 1924, pp. 516-518, 4 figs. Its possibilities as an internal-combustion-engine fuel. Data, on tests made with a small Hvid engine operating on lignite oil, as compared with gas oil and kerosene. Shown to be an efficient and likely fuel.

Supercharging. Supercharger Pros and Cons, W. G. Aston. Autocar, vol. 53, no. 1507, Sept. 5, 1924, pp. 413-416, 3 figs. Considers advantages and disadvantages of latest development in internal-combustion engine design; shows supercharger has far wider potentialities and discusses advantages that may accrue from its general adoption.

Temperature-Entropy Diagram. A Modified Temperature-Entropy Diagram for a Gaseous Working Substance. G. E. Scholes. Engineering, vol. 118, no. 3059, Aug. 15, 1924, pp. 215-216, 1 fig. Construction of chart. Transference of indicator diagram to T chart.

(See also Airplane Engines; Diesel Engines; Oil Engines.)

IRON

Electrolytic. Electrolytic Iron. Iron & Coal Trades Rev., vol. 109, no. 2942, July 18, 1924, pp. 117-118. Discusses processes for commercial production of electrolytic iron in tubes, sheets, etc., i. e., with anodes formed and soluble anodes shaped but insoluble, anodes soluble but unformed. Abstract of paper read before World Power Conference.

IRON AND STEEL

Canadian Industry. The Iron and Steel Industry in Canada, C. S. Cameron. Engineer, vol. 138, nos. 3578 and 3579, July 25 and Aug. 1, 1924, pp. 112-113 and 128-129. History of industry and account of resources and present condition. Paper presented to Empire Min. & Met. Congress.

Corrosion Prevention. Prevention of Corrosion of Iron and Steel, C. P. Perin. Engrs. & Eng. vol. 41, no. 8, Aug. 1924, pp. 223-225. Gives diagram showing causes external and those inherent in metal, general theory and prevention of corrosion.

IRON CASTINGS

Production Cost Finding. Finding Actual Cost of Castings, G. B. Cocker. Iron Trade Rev., vol. 75, no. 7, Aug. 14, 1924, pp. 421-422. System devised by southern foundry for determining selling price. Two factors used namely, actual time required to produce castings and amount of metal needed to pour them. From paper presented at meeting of Carolina members of Southern Metal Trades Assn. See also Foundry, vol. 52, no. 17, pp. 665-666.

Production Increase. A Shop Laboratory that Improves the Product, C. O. Herb. Machy. (N. Y.), vol. 31, no. 1, Sept. 1924, pp. 1-3, 6 figs. How metallurgical laboratory at Niles Tool Works, Hamilton, O., has helped to produce better castings.

Run-Outs. Run-Outs and Their Remedies, F. C. Edwards. Metal Industry (Lond.), vol 25, no. 9, Aug. 29, 1924, pp. 203-204, 1 fig. Causes of run-outs, safeguards, and remedies.

L

LIGHTING

Highway. Highway Lighting and Public Safety, G. A. B. Halvorsen, Jr., and S. C. Rogers. Nat. Safety News, vol. 10, no. 3, Sept. 1924, pp. 35-36, 4 figs. Discusses correct lighting of automobile roads with particular reference to "S" curves.

LIGHTING, ELECTRIC

Calculation. Quick Method of Determining a Project for Electric Lighting (Méthode rapide d'établissement d'un projet d'éclairage électrique), J. Wetzel. Electricien, vol. 40, no. 1352, July 15, 1924, pp. 319-321. Discusses determining intensity of light, coefficient of utilization method and simplified method and how to apply it.

LIGHTNING ARRESTERS

Application. Lightning Arrester Application from the Economic Standpoint, A. L. Atherton. Am. Inst. Elec. Engrs.—Jl., vol. 43, no. 9, Sept. 1924, pp. 813-817, 4 figs. Evaluates extent and cost of failures to average system, if entirely unprotected, with assumption that yearly expense so incurred may justifiably be spent for lightning arresters. Minimum transformer size for which protection is warranted.

Surge-Type. Lightning Arresters, C. E. Bennett. Am. Inst. Elec. Engrs.—Jl., vol. 43, no. 9, Sept. 1924, pp. 791-797, 14 figs. Describes a surge arrester, composed of two essential parts: liquid resistance, and high-speed gap, which are explained separately.

LOCOMOTIVE BOILERS

DEVELOPMENTS. Locomotive Boilers (Notes sur la Chaudière Locomotive), M. Demoulin. Génie Civil, vol. 85, nos. 2 and 3, July 12 and 19, 1924, pp. 34-36, and 59-62, 5 figs. Discusses continued improvements in locomotive operation, boiler developments, variation of power, induced draft, long-distance running, increase in boiler tubes, etc. Process of combustion, feeding fuel, Penn. Ry. tests, conclusions.

LOCOMOTIVES

DIESEL-ELECTRIC. An Italian Diesel-Electric Locomotive (Una locomotiva italiana Diesel-elettrica), G. Sona. Rivista Tecnica delle Ferrovie Italiane, vol. 25, no. 5, May 15, 1924, pp. 145-158, 9 figs. Details of experiments on Calabro-Lucana line with 440-hp. units constructed by Italian Brown-Boveri and Fiat companies.

Oil-Engined Locomotive Proves Its Worth. Oil Engine Power, vol. 2, no. 8, Aug. 1924, pp. 417-419, 3 figs. 24-hr. operation in Manhattan's busy railroad yards proves satisfactory. Characteristics of engine, which has striking method of fuel distribution, supplement uncanny flexibility of electrical transmission

DIESEL-ENGINE. Tests of a 60-H.P. Diesel Locomotive on the London & North Eastern Railway, Ry. Gaz., vol. 41, no. 6, Aug. 8, 1924, pp. 178-180 and 193, 6 figs. Describes locomotive which is of Austrian manufacture, 0-4-0 type, and equipped with 60-hp. six-cylinder Diesel engine, which transmits its power through Lentz hydraulic transmission mechanism.

DRIVING-BOX REPLACEMENT. Replacement Driving Boxes on the New York Central, L. C. Morrow. Am. Mach., vol. 61, no. 8, Aug. 21, 1924, pp. 309-312, 12 figs. Practice of West Albany shops. Operations on driving boxes, crown brasses, shoes, and wedges.

ELECTRIC. *See Electric Locomotives.*

RESISTANCE OF. Locomotive Resistance and Tractive Force, K. Asakura. Ry. Mech. Engr., vol. 98, no. 9, Sept. 1924, pp. 523-527, 9 figs. States that locomotive resistance should be partly represented as so many pounds per ton weight and partly as a function of mechanical efficiency. Formula for mechanical efficiency is developed and method of calculating tractive effort by applying mechanical efficiency explained. Results of calculation according to this method are nearly equal to those calculated by speed-factor method; can be applied to a locomotive whose boiler capacity is less than 100 per cent.

STEAM-TURBINE. Turbine Locomotives (Locomotives à turbines), M. Lamy. Revue Industrielle, vol. 54, no. 2181, Aug. 1924, pp. 217-221, 7 figs. Describes Escher Wyss type of Swiss Ry., Ljungström type in Sweden and their design, construction and operation

SUPERHEATERS FOR. Locomotive Superheaters. Ry. Gaz., vol. 41, no. 7, Aug. 15, 1924, p. 224, 2 figs. Describes return bend evolved by Northeastern Mar. Eng. Co., Ltd., to meet most exacting conditions of service.

SWITCHING. Oil-Electric Locomotive Built for Switching Service. Eng. News-Rec., vol. 93, no. 10, Sept. 4, 1924, pp. 390-391, 3 figs. Particulars of locomotive designed and built by Ingersoll-Rand Co. and Gen. Elec. Co. for N. Y. Central R. R. Co., for use in city streets; 300-hp. oil engine directly connected to a 200-kw. generator; four motors of a nominal rating of 95 hp. each, one of which is geared to each of four axles.

TESTING. Testing Locomotives on the Great Western Railway. Ry. Gaz., vol. 41, no. 7, Aug. 15, 1924, pp. 216-221, 8 figs. Abstract of paper read before First World Power Conference.

TRACKING QUALITIES, TESTING. Ortheograph Records Locomotive Characteristics, P. M. Gillilan. Ry. Age, vol. 77, no. 7, Aug. 16, 1924, pp. 283-286, 9 figs. Use of device properly calibrated gives accurate determination of tracking qualities of equipment.

LUBRICATING OILS

CLASSIFICATION. Practical Hints on Oils and Machinery Lubrication, W. E. Biggs and W. R. Woolrich. Nat. Engr., vol. 28, no. 9, Sept. 1924, pp. 129-131. Discusses qualities of good oil; some engineroom tests for oils; classification of oils; what oils to use for different services; grease and solid lubricants.

FRICTION OF. Determination of Friction of Lubricating Oils (Zur Bestimmung der Schmiermittelreibung), R. Vieweg. Petroleum, vol. 20, no. 19, July 1, 1924, pp. 899-903, 6 figs. Discusses method which enables determination of friction losses in any bearings with any lubricant on basis of measurement of operating temperature and efficiency.

PURIFICATION. Conservation, Upkeep, and Purification of Lubricating Oils (Conservation, manutention et purification des huiles de graissage principes généraux et méthodes modernes), J. Lévy. Technique Moderne, vol. 16, no. 13, July 1, 1924, pp. 453-460, 14 figs. Discusses storage, purification of used oils, nature and origin of impurities, filters, centrifugal separation, etc.

TESTING. Tests for Lubricating Oils. Power Plant Eng., vol. 28, no. 16, Aug. 15, 1924, pp. 853-854. Details of number of tests and their comparative value.

M

MACHINE SHOPS

INEFFICIENT MACHINERY, COST OF. How Much Are Inefficient Machines Costing You? K. H. Condit. Am. Mach., vol. 61, no. 12, Sept. 18, 1924, pp. 451-452, 1 fig. Machine equipment sets production limits. Keeping track of cost of inefficient machines. Cost data show when to throw out obsolete equipment.

MACHINE TOOLS

DEMAND FORECAST. Forecasting Demand for Industrial Equipment, E. F. DuBrul. Mech. Eng., vol. 46, no. 9, Sept. 1924, pp. 539-542, 5 figs. Business cycle in machine-tool industry. Co-operative study of stabilization. Machine-tool barometer.

DESIGN. Methods of Machine Tool Design, A. L. De Leeuw. Am. Mach., vol. 61, no. 8, Aug. 21, 1924, pp. 317-320, 7 figs. Feeds of intermittent type.

MAGAZINE ATTACHMENTS. Design of Magazine Attachments, A. A. Dowd. Machy. (Lond.), vol. 24, no. 620, Aug. 14, 1924, pp. 617-620, 8 figs. Magazine attachments for irregular work.

OLYMPIA EXHIBITION, ENG. British Machine Tools at the Olympia Exhibition. Engineer, vol. 138 no. 3585, Sept. 12, 1924, 16 pp. (Supp.), 47 figs. Descriptions of some of the British machine tools exhibited.

Standardization Versus Individuality, L. D. Burlingame. Mech. Eng., vol. 46, no. 9, Sept. 1924, pp. 529-530 and 538. Discusses standardization in machine-tool industry, giving a word of caution against the too eager adoption of ill-advised standards.

MAGNESIUM

PRODUCTION. Magnesium. Chem. & Met. Eng., vol. 31, no. 10, Sept. 8, 1924, pp. 383-386, 2 figs. Mechanical properties of pure magnesium and of magnesium-aluminum alloys; new American process for producing magnesium; difficulties of casting, forging and welding; etc. New methods of producing this metal are rapidly changing its industrial status, especially as a material of construction.

MALLEABLE CASTINGS

EUROPE. A European View of the Malleable Question, T. Levoz. Foundry Trade Jl., vol. 30, no. 419, Aug. 28, 1924, pp. 175-177. Discusses what is suitable metal, selection of furnace, electric-furnace experiments, methods of producing malleable iron, etc.

MAPPING

AERIAL. Aerial Maps Made to Facilitate California Home-Site Survey, T. V. Mini. Eng. News-Rec., vol. 93, no. 7, Aug. 14, 1924, pp. 264-265, 1 fig. Mosaic superimposed on plane-table topographic sheet eases work of plotting roads and trails in hills near Pasadena.

MATERIALS

OVERSTRAIN AND STRENGTH. A New Theory on Overstrain and Strength of Materials, H. P. Troendly and G. V. Pickwell. Am. Soc. for Steel Treating—Trans., vol. 6, no. 2, Aug. 1924, pp. 145-170, 7 figs. Discusses new theory on mechanics of overstrain and strength, i. e., plastic transfer of proportional elastic range; increase in strength in any direction is at expense of strength in opposite direction; increase in strength in direction of overstrain is through mechanism of slip, etc.

MATERIALS HANDLING

FORD MOTOR CO. PLANT. Mechanical Handling at River Rouge, M. W. Potts. Indus. Mgt. (N. Y.), vol. 68, no. 2, Aug. 1924, pp. 67-114, 103 figs. Describes receiving and distributing raw materials, blast furnace as a materials-handling problem, world's most modern foundry, handling large castings through production operations in machine shop, power-house fuel handling and electric-furnace building, sawmill and the tractor assembly, successful innovations in plate-glass manufacture, mechanical handling in by-products plant, and miscellaneous industries within Ford plant.

MEASUREMENTS

MACHINE-SHOP. Shop Measurements, E. Buckingham. Mech. Eng., vol. 46, no. 9, Sept. 1924, pp. 535-538. English and metric standards of length and their interrelation. Accuracy and purposes of shop measurements.

METALLOGRAPHY

APPLICATIONS. Practical Metallography, S. P. Rockwell. Am. Mach., vol. 61, no. 13, Sept. 25, 1924, pp. 487-492, 18 figs. Applications of metallography to solution of problems in average plant. Practical methods of procedure. Illustrated studies of various examples. Paper read before Am. Gear Mfrs. Assn.

METAL SPRAYING

CAPABILITIES AND APPLICATIONS. Metal Spraying and Sprayed Metal, T. H. Turner and W. E. Ballard. Inst. of Metals, Advance Paper no. 14, for Mtg. Sept. 8-11, 1924, 17 pp., 25 figs. on supp. plates. Indicates critically actual capabilities of metal spraying as now practised in England and other countries. Investigation includes examination of history of process and of its present capabilities and applications. Bibliography.

METALS

MACROGRAPHY. New Process of Metal Macrography by Direct Impression on Films (Nouveau procédé de macrographie des métaux par impression directe sur pellicule), J. Durand. Génie Civil, vol. 85, no. 6, Aug. 9, 1924, pp. 131-133, 6 figs. Discusses direct examination of metals more or less polished and etched with reagent as part of acceptance test, giving details especially of segregations, deformations due to working, solidification, and effect of any factor modifying the structure.

MICROSTRUCTURE. Anomalies in Metals Disclosed by the Metallographic Microscope (Le anamalie dei metalli rilevate dal microscopio metallografico), V. Prever. Ingegneria, vol. 3, nos. 6 and 8, June 1 and Aug. 1, 1924, pp. 196-200 and 273-278, 38 figs. Discusses size of grain, annealing and cooling, and effect on microstructure and properties; heterogenous inclusions, cavities, impurities, abnormal thermal conditions, etc.

PLASTIC DEFORMATION. The Effect of Free Surfaces on the Plastic Deformation of Certain Metals, F. C. Thompson and W. E. W. Millington. Iron & Steel Inst., Advance Paper no. 9, for Mtg. Sept. 1924, 14 pp., 3 figs. partly on supp. plate. Gives reasons for believing that at free surfaces deformation will differ distinctly from that within mass; and shows importance of this in connection with determination of elastic limit and with elastic failure.

TENSILE STRENGTH. The Relationship Between Tensile Strength, Temperature, and Cold-Work in Some Pure Metals and Single Solid Solutions, D. H. Ingall. Inst. of Metals, Advance Paper no. 8, for Mtg. Sept. 8-11, 1924, 24 pp., 7 figs. Results of investigation on silver, aluminum, nickel, 70:30 brass, and 80:20 cupro-nickel.

MILLING MACHINES

HIGH-PRODUCTION MILLING. How Milling Machine Service Has Helped Manufacturers, F. H. Colvin. Am. Mach., vol. 61, no. 11, Sept. 11, 1924, pp. 405-409, 12 figs. Shows how high-production milling can be secured on standard machines by use of well-designed fixtures.

SPECIALIZED WORK. Wide Range of Specialized Work Now Performed by Milling Machines, W. L. Carver. Automotive Industries, vol. 51, no. 8, Aug. 21, 1924, pp. 356-360, 10 figs. Standard machines with special heads do great variety of work at small additional expense, and place this type of tool in semi-automatic class.

MINES

VENTILATION. The Ventilation of Mines, D. Hay and R. Clive. Iron & Coal Trades Rev., vol. 108, no. 2938, June 20, 1924, pp. 1058-1061, 6 figs. Discusses objects and principles of ventilation, splitting of air, regulation of splits, influence of leakage and size of airway; varying natural ventilation effect due to difference between weight of air in upcast and downcast, etc. Abstract of paper read before Min. Sec., Empire Min. & Metallurgical Congress.

Ventilating Mines by Exhaust Steam. Colliery Guardian, vol. 128, no. 3319, Aug. 8, 1924, pp. 356-357, 1 fig. Details of British patent no. 212802, improved method of utilizing heat liberated by condensation of exhaust steam for heating outgoing air, steam being derived from mine engines installed above or below ground.

MOLDING MACHINES

SANDSLINGER. Recent Developments in Moulding Practice. Eng. Production, vol. 7, no. 143, Aug. 1924, p. 263, 2 figs. Details of design and construction of sandslinger machines.

TYPES. Moulding Machines, J. McClelland, pp. 57-60 (includes discussion), 7 figs. Describes hand-operated, power, and jolt-ramming machines, and a boxless machine.

MOLDING METHODS

CONDENSER. A Method of Moulding a Condenser. Foundry Trade Jl., vol. 30, no. 415, July 31, 1924, pp. 101-102, 4 figs. Practical details of molding and core making for making of a condenser. Main dimensions of casting are: Depth, with top and bottom flanges, approximately 8 ft.; diameter, 10 ft.; inside diameter of body, 9 ft.; thickness of metal, 1½ in.

MOTOR BUSES

DESIGN. European Motor Bus Design. Elec. Ry. Jl., vol. 64, no. 12, Sept. 20, 1924, pp. 448-452, 13 figs. Double-deck design coming in use more and more; effort being made to inclose upper deck for all weather; light wood bodies used; weight limitation imposed by Dept. of Police.

Types. Discussion of Papers at the 1924 Annual Meeting. Soc. Automotive Engrs.—Jl., vol. 15, no. 2, Aug. 1924, pp. 163-174, 4 figs. Discussions of papers on Field and Future of Motorbus, J. A. Emery, Double-Deck Motor Omnibus, R. W. Meade and Essentials of Successful Constant-Compression Engine, C. E. Sargent.

MOTOR TRUCKS

Lighting. Self-Contained Magneto Generator Designed for Truck and Tractor Lighting. Automotive Industries, vol. 51, no. 12, Sept. 18, 1924, pp. 529-530, 3 figs. Describes electric generator brought out by Harris Elec. Co. of San Francisco, Cal. Less than 0.5 volt and less than 0.3 ampere shown as a difference in output at engine speeds from 800 to 3,000 r.p.m. Lubrication effected from oiling system of engine.

Manufacture. Complete Gaging System Fosters Pride in Maintaining High Quality, W. L. Carver. Automotive Industries, vol. 51, no. 11, Sept. 11, 1924, pp. 472-476, 9 figs. Every individual in shop is convinced of benefits derived from accuracy in work made possible by exceptional tools for checking all parts manufactured in plant of Gen. Motors Truck Co.

Wheels. Laboratory Strength-Tests of Motor-Truck Wheels, T. W. Greene. Soc. Automotive Engrs.—Jl., vol. 15, no. 2, Aug. 1924, pp. 150-155 and 174, 13 figs. Discusses tests of mechanical properties of six types of wheels as shown in radial compression test, skid test, elastic resiliency, also character of failures, load deflection curves for skid test, etc.

O

OIL

Refining. California Development in the Preparation and Use of Adsorptive Clays in Refining, C. J. vonBibra. Petroleum Wld., vol. 21, no. 288, Sept. 1924, pp. 359-364. Discusses theory of adsorption, developments, treated clays, clay treating methods, recovery of spent clay and economic aspects.

Shale-Oil. Status of the Shale-Oil Industry, G. W. Wallace. Eng. & Min. Jl.—Press, vol. 118, no. 8, Aug. 23, 1924, pp. 290-292, 6 figs. Summarizes general conditions including deposits, technology and geology.

OIL ENGINES

Heavy-Oil. Evolution of the Heavy-Oil Engine (L'évolution des moteurs à huiles lourdes), R.-E. Mathot. Société des Ingénieurs Civils de France— Mémoires et Compte Rendu des Travaux, vol. 77, nos. 1-2-3, Jan.-Mar. 1924, pp. 143-181, 20 figs. Discusses properties of fuel oils, Diesel-type engines, explosion engines, and their design and construction.

Power-Plant. Types of Modern Power Plant Oil Engines. Oil Engine Power, vol. 2, no. 8, Aug. 1924, pp. 419-422, 6 figs. Savings due to elimination of air compressor and of geared camshaft drive have been applied to improvements in general features of design; chain which is used in place of timing gears has big factor of safety against wear.

Water-Works. Oil Engines for New York City's Water Supply. Oil Engine Power, vol. 2, no. 8, Aug. 1924, pp. 426-427, 2 figs. Specifications which are being prepared for replacement of steam-driven pumps at Clove Station, Staten Island.

OIL FIELDS

Canada. The Fort Norman Oilfields of Canada, G. S. Hume. Petroleum Wld., vol. 21, no. 288, Sept. 1924, pp. 353-357. Gives geology of district where Canada's largest well (2,000 bbl. daily) was brought in.

OIL FUEL

Burning. How They Heat with Fuel Oil on the Pacific Coast, C. W. Wright. Heat & Vent. Mag., vol. 21, no. 8, Aug. 1924, pp. 41-43 and 45, 4 figs. Notes on present practice in section of country where oil burning has long been successfully applied.

Ignition Point of. The Ignition Point of Fuel Oils Under Pressure, J. Tauss and F. Schulte. Mar. Engr. & Motorship Bldr., vol. 47, no. 564, Sept. 1924, pp. 325-328, 10 figs. Account of recent important experimental work. Translated from Zeit. des Vereines deutscher Ingenieure, May 31, 1924.

OIL TANKS

Concrete. Concrete Oil Tanks Reinforced With Outside Bands, W. Travell. Eng. News-Rec., vol. 93, no. 11, Sept. 11, 1924, pp. 422-424, 3 figs. Details of design and construction of 20,000-bbl.-capacity storage tanks of Cal. Portland Cement Co., at Colton, Cal. Nominal reinforcement only in body of concrete walls but reliance against bursting pressure on tightened hoops.

ORE TREATMENT

Cyanide Solutions, Dissolved Oxygen Determination. Determination of Dissolved Oxygen in Cyanide Solutions, A. J. Weinig and M. W. Bowen. Am. Inst. Min. & Met. Engrs.—Trans., advance Paper no. 1361-M, Sept. 1924, 9 pp., 4 figs. Describes method which is a modification of Schutzenberger's whereby solution in titrations and standards are protected from atmosphere by a layer of kerosene. Indigo-disulphonate is indicator and sodium hydrosulphite standard.

OXY-ACETYLENE CUTTING

Cast Iron. Cutting Cast Iron, J. Fitzgibbons. Welding Engr., vol. 9, no. 8, Aug. 1924, pp. 23-24, 2 figs. Chemical discussion of cutting cast iron by oxy-acetylene; elements found in cast iron and their affinity for oxygen.

OXY-ACETYLENE WELDING

Efficiency. Present State of Autogenous Welding and Cutting of Metals (L'état actuel de la soudure autogène et du découpage des métaux), M. R. Thomas. Société des Ingénieurs Civils de France—Mémoires et Compte Rendu des Travaux, vol. 77, no.s 1-2-3, Jan.-Mar. 1924, pp. 182-201, 6 figs. Discusses methods of assembling and welding, welding rods, cutting, equipment, etc.

Practice. Oxy-Acetylene Welding. Welding Engr., vol. 9, no 8, Aug 1924, pp. 34-40. Discusses torch manipulation; training welders; selection of welding rods and test of rods.

P

PAINTS

Heat-Absorption-Reducing. Paints of High Luminosity to Reduce Refrigeration Losses, H. A. Gardner and H. C. Parks. Paint Mfr.'s Assn. of U. S., Sci. Sec., circular no. 213, Sept. 1924, pp. 82-84, 2 figs. Suggests use of white or light tints for refrigerating cars or ships to reduce heat absorption.

Insulation Value. Insulation Value of Paint and Its Effect in Reducing Condensation, H. A. Gardner. Paint Mfr.'s Assn. of U. S., Sci. Sec., circular no. 212, Sept. 1924, pp. 80-81, 1 fig. Shows insulating power by metal pipes carrying cold water in warm room, painted parts of which show no condensation.

Thickening. Thickening of Paints (L'épaississement des peintures), C. Coffignier. Chimie & Industrie, vol. 11, no. 6, June 1924, pp. 1083-1085. Discusses phenomenon of thickening; thickening with polymerized and crude oils; how to avoid it.

PAPER MACHINERY

Combined Beating and Refining Engine. Beating and Refining Engine. Paper, vol. 34, no. 20, Sept. 4, 1924, pp. 899-900, 2 figs. Describes combined beating and refining engine invented by Sheldon Leicester, designed to produce a continuous flow of stock, beaten as to length, hydration and flexibility (1) by regulating speed of motor, (2) by set of bedplates and (3) by dilution of stock.

Grinders. A Permanent Grinder for the Production of Wood Pulp for the Manufacture of Paper. Eng. Progress, vol. 5, no. 8, Aug. 1924, pp. 157-159, 6 figs. Describes method and practical design of grinder and results achieved in practice; grinding stone may be driven either electrically, hydraulically or by some other power.

PAPER MANUFACTURE

Drying. Paper Drying Tests. Paper Trade Jl., vol. 79, no. 9, Aug. 28, 1924, pp. 52-54, 6 figs. Results of tests made by a number of paper mills based on Drying Code, which has been compiled by Paper Drying Committee of Tech. Assn. Pulp & Paper Industry in co-operation with a similar committee of Can. Tech. Sec.

Sizing. Keeping Qualities of Paper Sized With Rubber Latex, J. B.-Vinekers. Paper Trade Jl., vol. 79, no. 8, Aug. 21, 1924, pp. 47-49, 3 figs. Confirms conclusions of Shaw and Carson and extends work in that it showst hat mechanical properties, which are at first increased by addition of latex, l kewise gradually fall off with time. Translated from Papierfabrikant, May 18, 1924, pp. 217-219.

Waterproofing. Waterproofing Paper and Board, J. Frere. Paper, vol. 34, no. 17, Aug. 14, 1924, pp. 891-895. Review of methods, processes and formulas used or proposed for use in manufacture of waterproof papers and boards. Translated from Revue des Produits Chimiques.

PAPER MILLS

Electric Drive. Details of Paper-Mill Drives and Power Service, H. E. Stafford. Indus. Engr., vol. 82, no. 8, Aug. 1924, pp. 360-367 and 400-401, 11 figs. Includes transformation and distribution of electric power throughout mill, together with types of motors and kinds of drive used to connect motors to their loads and characteristics of paper-mill loads.

Model Plant. Model Paper-Making Plant. Engineer, vol. 138, no. 3578, July 25, 1924, pp. 95-99, 12 figs. partly on p. 106. Describes working model of up-to-date paper-making plant provided by nearly three dozen different firms, under organization of Paper Makers' Assn. of Great Britain and Ireland, as a joint exhibit at British Empire Exhibition. Designed to produce a finished roll of paper, 30 in. wide, at rate of 20 ft. to 100 ft. per minute, i. e., up to 1 cwt. dry paper in an hour.

Steam Pressure and Consumption Regulation. Workings of Ruths' Steam Accumulator. Paper, vol. 34, no. 15, July 31, 1924, pp. 662-664, 4 figs. Description of installation of Ruths' steam accumulator in Lessebo sulphite and paper mills, Lessebo, Sweden, showing results obtained by regulating variations in steam pressure and consumption. Translated from article by M. Kreyssig in Wochenblatt fuer Papier-fabrikation.

PAVEMENTS

Black Base. Black Base Pavement Construction in Mercer County, N. J., H. F. Harris. Highway Engr. & Contractor, vol. 11, no. 3, Sept. 1924, pp. 27-30, 4 figs. Discusses construction of "black base" pavement on sub-foundation of stone, which stone was taken from excavated material and topping "black base" with regular standard sheet asphalt pavement 1½ in. thick. Gives analyses of black base and advantages of work.

Rubber Paving Blocks. Interlocked and Nailed Rubber Pavement, E. Swanson. India Rubber Wld., vol. 70, no. 6, Sept. 1, 1924, p. 783, 4 figs. Effective attachment needed to overcome traction wave; gives two practical suggestions; interlocking rubber blocks.

PAVEMENTS, BRICK

Principles. Important Principles of Brick Pavement Design with Recommendations, W. D. P. Warren. Mun. & County Eng., vol. 67, no. 2, Aug. 1924, pp. 55-61, 1 fig. Treats of original conditions and factors which governed early design, emphasizes changed conditions and discusses design of brick pavement considered as engineering structure.

PAVEMENTS, CONCRETE

Accelerated Wear Tests. Accelerated Wear Tests of Concrete Pavements, F. H. Jackson and J. T. Pauls. Eng. & Contracting (Roads & Streets), vol. 62, no. 2, Aug. 6, 1924, pp. 302-313, 2 figs. Report of tests by U. S. Bur. Public Roads.

Construction. Concrete Pavement Construction, H. C. Boyden. Eng. & Contracting (Roads & Streets), vol. 62, no. 3, Sept. 3, 1924, pp. 537-543, 7 figs. Discusses present day practice. Abstract of paper read before Annual Convention of Can. Good Roads Assn.

PIERS

Concrete. Construction of the Ballantyne Pier, Vancouver, A. L. Harvey. Can. Engr., vol. 47, no. 8, Aug. 19, 1924, pp. 249-252, 5 figs. New pier greatly improves shipping facilities at port; pier which is 1200 ft. long and 341 ft. wide is principally of concrete construction, equipped with modern cranes and complete electrical installation.

PIGMENTS

Oil Absorption of. The Oil Absorption of Pigments, J. H. Calbeck. Chem. & Met. Eng., vol. 31, no. 10, Sept. 8, 1924, pp. 377-382, 12 figs. A study based upon recent investigations of wetting properties of paint and varnish vehicles and upon volume relationship between vehicle and pigment. Bibliography. Paper read before Paint and Varnish Sec., Am. Chem. Soc.

PIG IRON

Judging and Mixing. The Judging and Mixing of Pig-Iron. H. J. Young. Metal Industry (Lond.), vol. 25, no. 10, Sept. 5, 1924, pp. 227-228. Author's reply to the various criticisms of his recent paper by above title.

PIPE

Joints. Pipe Joints for High Pressures and Temperatures. Power, vol. 60, no. 11, Sept. 9, 1924, pp. 396-397, 8 figs. Describes various types.

PIPE, CAST-IRON

Cement Lined. Modern Cement Lined Service Pipe, R. J. Newsom. Can. Engr., vol. 47, no. 9, Aug. 26, 1924, pp. 283-284. Cast-iron pipe lined with modified portland cement mixture has proved satisfactory for water services; fittings lined with lead or tin. Abstract of paper read before Am. Water Works Assn.

Manufacture. Manufacture of Cast-iron Pipe in the South, R. Moldenke. Am. Inst. Min. & Met. Engrs.—Trans., Advance Paper no. 1365-S, Sept. 1924, 5 pp. Discusses some economic conditions which have made career of cast-iron pipe industry in United States a checkered one. Describes the two new developments in manufacture of cast-iron pipe, both along lines of centrifugal casting, and presents, advantages and disadvantages of both processes. Statistics on production of pipe in United States at present time, as well as plants, and their capacities, so far as they are situated in South.

Modern Methods of Pipe Manufacture by the Centrifugal Process, E. J. Fox and P. H. Wilson. Foundry Trade Jl., vol. 30, no. 417, Aug. 14, 1924, pp. 131-139, 16 figs. Describes methods at works of Stanton Iron-works Co., Ltd., Stanton, operating on de Lavaud process.

PISTONS

METALS FOR. Use of Light and Ultra-Light Metals for Pistons of Explosion Engines (au sujet de l'emploi des alliages légers et ultra-légers pour les pistons de moteurs à explosion), M. de Fleury. Académie des Sciences, Comptes rendus des séances, vol. 178, no. 26, June 23, 1924, pp. 2161-2164. See also Génie Civil, vol. 85, no. 5, July 19, 1924, pp. 71-72. Discusses advantages of light metal from standpoint of cooling and of lightness of piston.

POWER FACTOR

IMPROVEMENT. Chart for Determining the Reactive Power and the Necessary Capacity for Improving the Power Factor (Nomogramme pour la détermination de la puissance réactive et de la capacité nécessaire pour améliorer le facteur de puissance), J. Hak. Revue Générale de l'Electricité, vol. 16, no. 6, Aug. 9, 1924, pp. 235-237, 2 figs. Discusses chart for solving fundamental equations of power factor.

POWER PLANTS

MANAGEMENT. State Versus Private Management of Power Plants, A. T. Hadley. Engineering, vol. 118, no. 3058, Aug. 8, 1924, pp. 209-211. Concludes that history of state management creates strong presumption against encouragement of government-owned electric plants. Abstract of paper read before World Power Conference.

RAILWAY. A Model Oil-Burning Railroad Power Plant. Ry. Age, vol. 77, no. 6, Aug. 9, 1924, pp. 237-240, 9 figs. Details of steam, air and electric power equipment of Missouri, Kansas & Texas Ry. Terminal, oil-fired boilers, evaporating 14.21 lb. water per lb. of oil, cost of generating electric power is less than one cent per kw. hr.

PRESSES

HYDRAULIC, PLATEN DESIGN. The Design of Hydraulic Press Platens. Machy. (Lond.), vol. 24, no. 662, Aug. 28, 1924, pp. 693-694, 2 figs. Suggestions on designing of platens; table giving suitable proportions for a range of circular platens capable of withstanding working loads of from 30 to 300 tons

PUMPS

BRITISH EMPIRE EXHIBITION. British Empire Exhibition: Pumps and Pumping Machinery. Engineering, vol. 118, no. 3059, Aug. 15, 1924, pp. 216-220, 11 figs. Describes exhibits, including motor-driven two-throw double-acting pump and 20,000-gal. turbo boiler-feed pump of G. and J. Weir, Ltd.; emergency bilge pump and 4-in. salvage pumping set of Drysdale & Co., Ltd.; Gwynne-Pennel rotary trap; and steam turbine boiler-feed pump and other pumping machinery of Gwynnes Engineering Co., Ltd.

CLASSIFICATION. Classification of Pumps (Classification des Pompes), H. Meuris. Assn. des Ingénieurs sortis des Ecoles Spéciales de Gand—Annales, vol. 14, series 5, 1924, pp. 172-182, 3 figs. Shows that inventors have exhausted all possible systems and that progress must be sought in analysis of details, improvement in mechanical construction, etc.

ROTARY. Positive Rotary Pumps for Oil-Engine Drive. Oil Engine Power, vol. 2, no. 9, Sept. 1924, pp. 480-482, 4 figs. Discusses characteristics of direct-connection to oil engines and pressures developed by them.

SELECTION. Comparison of Pumping Equipment, R. T. Livingston. Power Plant Eng., vol. 28, no. 16, Aug. 15, 1924, pp. 849-850. Discusses types of pumps and practical method of comparing pumping equipment.

PUMPS, CENTRIFUGAL

CHARACTERISTICS CURVES. Centrifugal Pump Characteristics Curves, W. E. W. Millington. World Power, vol. 2, no. 8, Aug. 1924, pp. 103-107. 10 figs. Indicates a method of analysis of pump characteristic curves which, in author's opinion, is much more valuable in actual practice than usual method of employing equations which have proved to be unreliable in actual use.

R

RADIOTELEGRAPHY

AMPLIFIERS. Two Stages of High Frequency Amplification, R. H. Cook. Wireless Wld., vol. 14, no. 20, Aug. 13, 1924, pp. 565-569, 13 figs. Constructional article describing how to make useful high frequency amplifier.

SHORT WAVE RECEPTION. Reception Under Difficulties, H. Andrewes. Wireless Wld., vol. 14, no. 20, Aug. 13, 1924, pp. 561-563, 4 figs. Gives further details of experiments recently carried out by Radio Soc. of St. Britain on Scotch express; details of one of the receiving sets which gave good results under most severe operating conditions on train.

STATIONS. The Rugby Wireless Station. Engineer, vol. 138, no. 3584, Sept. 5, 1924, pp. 262-264, 15 figs. Describes wireless station capable of direct communication with India, Australia and other distant parts, which is being erected by Post Office at Hillmorton, near Rugby, Eng. To have 12 masts, arranged in two groups.

RAILWAY ELECTRIFICATION

COAL CARRIERS. Electrification of Coal Carrying Railroads, T. C. Wurts. Modern Min., vol. 1, no. 1, Aug. 1924, pp. 2-4, 5 figs. Describes electric operation of Norfolk & West. Ry.; locomotives used are split-phase type; single-phase power, at potential of 11,000 volts, is collected from trolley wire and stepped down to operating potential by means of transformers mounted on locomotive.

PROGRESS. Electrification Progress and Power Supply. Ry. Age, vol. 77, no. 8, Aug. 23, 1924, pp. 333-336, 1 fig. Also Ry. Elec. Engr., vol. 15, no. 9, Sept. 1924, pp. 292-299, 1 fig. Brief abstracts of several papers presented on electrification at First World Power Conference, held at Wembley, Lond., Eng., which shows status of railway electrification in various countries.

RAILWAY MOTOR CARS

DEVELOPMENT. Automotive Rail-Cars and Their Development. Soc. Automotive Engrs.—Jl., vol. 15, no. 3, Sept. 1924, pp. 195-198. Discussion of following papers printed in June 1924 issue of Journal: The Modern Motor Rail-Car, M. L. McGrew; Motorized Railroad Equipment, E. J. Brennan; Motorization of "Light-Service" Rail-Transportation, E. Wanamaker.

GASOLINE. Gasoline Motor Coaches Missouri Pacific R.R. Ry. Rev., vol. 75, no. 9, Aug. 30, 1924, pp. 307-310, 4 figs. Three new gasoline motor coaches built by J. G. Brill Co., Phila., Pa. for Missouri Pacific Ry. are of model 55 combination type having passenger and baggage compartments and are being used in districts where passenger traffic is light.

Self-Propelled Passenger Car on N.Y., N.H. & H. Ry. Mech. Engr., vol. 98, no. 9, Sept. 1924, pp 534-537, 5 figs. Describes combination passenger and baggage unit car, propelled by a 150-hp. Ricardo engine, through a transmission consisting of one Universal hydraulic variable-delivery pump, supplying oil to two Universal hydraulic variable-speed motors, one mounted on each truck frame.

GASOLINE-ELECTRIC. Distinctive Features Involved in New Gas-Electric Motor Rail Car. Ry. Rev., vol. 75, no. 10, Sept. 6, 1924, pp. 343-348, 8 figs. Describes gas-electric motor rail car built by Electro-Motive Co. in shops of St. Louis Car Co. having six-cylinder, 175-hp. gasoline engine; discusses power plant, car construction, car body, etc

Railcar Maintains Steam Train Schedule in Four Month Test. Automotive Industries, vol. 51, no. 10, Sept. 4, 1924, pp. 432-434, 6 figs. Describes powerful car built by Nat. Steel Car Co. for Can. Nat. Rys., operating on main line between Hamilton and Toronto, Canada. Designed primarily for carrying passengers, with baggage a sa secondary consideration; all-steel construction; length, 55 ft. 9½ in.; width, 8 ft. 9 in.; floor height above rails, 3 ft. 9⅝ in.; drives through mechanical gearing to one axle of each truck.

RAILWAY OPERATION

EMPLOYEES-MANAGEMENT CO-OPERATION. Practical Method of Securing Co-operation. Ry. Age, vol. 77, no. 11, Sept. 13, 1924, pp. 453-456. Underlying principles of method in effect on Pennsylvania Railroad System for bringing about co-operation between management and employees, and manner in which it operates.

I.C.C. REPORT. Construction and Repair of Railway Equipment. Ry. Age. vol. 77, no. 7, Aug. 16, 1924, pp. 293-296. Interstate Commerce Commission censures six carriers for high cost of locomotive repairs in contract shops.

STATISTICS. Report Shows Improved Railroad Performance. Ry. Age, vol. 77, no. 7, Aug. 16, 1924, pp. 299-302, 4 figs. National Industrial Conference Board studies increased utilization of labor in train service.

RAILWAY REPAIR SHOPS

STREET-CAR. Repairing Street Cars at the Hillcrest Shops. Can. Machy., vol. 32, no. 9, Aug. 28, 1924, pp. 19-21, 4 figs. Toronto Transportation Commission, with 1030 cars in service, overhauls units of system in well-equipped building covering five acres of ground; discusses Jones underfeed stokers, tunnel 650 ft. long, "emergency patients" and car straightener.

RAILWAY SIGNALING

INTERLOCKING. New Reading Interlocking at Camden, A. H. Yocum. Ry. Signaling, vol. 17, no. 9, Sept. 1924, pp. 338-341, 10 figs. Electropneumatic plant with alternating current control includes unique train starting system describes tower and machine, alternating-current track circuits, air-line and conduit system, instrument and relay cases, etc.

RAILWAY SHOPS

INSPECTION SHOPS. Modern Inspection Facilities for the Interborough System. Elec. Ry. Jl., vol. 64, no. 9, Aug. 30, 1924, pp. 305-308, 6 figs. Describes two of six storage yards and inspection buildings being built by City of New York to provide for 2266 cars of Interborough Rapid Transit system.

RAILWAY TIES

CONCRETE. A New Design of Concrete Tie. Elec. Traction, vol. 20, no. 8, Aug. 1924, p. 369, 2 figs. Division engineer on British Ry. in India invents concrete tie of interesting type, consisting of two concrete blocks joined together by steel bar of small cross-section.

TREATING PLANTS. New Treating Plant Employs Modern Methods. Ry. Age, vol. 77, no. 9, Aug. 30, 1924, pp. 359-361, 6 figs. Describes tie and timber treating plant which Atchison, Topeka & Santa Fe is now completing at National City, Cal., for treatment of Douglas fir ties and timbers to be used on Santa Fe coast lines. Represents striking example of present-day tendencies in operating arrangements of such facilities.

RAILWAY TRACK

CURVES, GUARD RAILS FOR. Guard Rails on Sharp Curves, J. J. Burns. Ry. Rev., vol. 75, no. 9, Aug. 30, 1924, pp. 327-329, 5 figs. Louisville & Nashville Ry. uses new type of guard-rail fastening on lines of sharp curvature and heavy traffic.

ELEVATION OF. Important Track Elevation Work Completed at Elyria, Ohio. Ry. Rev., vol. 75, no. 9, Aug. 30, 1924, pp. 312-315, 8 figs. Completion of work gives New York Central four tracks through Elyria, eliminating seven crossings in heart of city.

RAIL CANTING. Canting of Rails Now Favored by Many Roads. Ry. Age, vol. 77, no. 10, Sept. 6, 1924, pp. 404-406, 1 fig. Developments which have taken place on 36 representative roads in United States and Canada on question of canting rail inward in order to provide a bearing surface more nearly coinciding with contour of car and locomotive wheels.

STRESSES. Relations of Track Stresses to Locomotive Design. Eng. News-Rec., vol. 93, no. 9, Aug. 28, 1924, p. 336. Wheel spacing, tire flanges, counterbalance important. Effect of new locomotive designs on maintenance costs. Abstract of paper read before Mech. Sec. of Am. Ry. Assn. by C. T. Ripley.

RAILWAY YARDS

GRADE-ADJUSTING DEVICE. Mechanical Adjustment of Grade for Gravity Switching. Eng. News-Rec., vol 93, no. 7, Aug. 14, 1924, pp. 260-262, 4 figs. Describes "mechanical hump" for varying grade at summit of incline for gravity switching at Ecorse freight yard at new Detroit terminals of Pennsylvania-Detroit R. R.; table which forms summit of hump raised and lowered by jacks; starting grade varied from 1 to 3 per cent.

REFRIGERATING MACHINES

PACKING FOR. Packing for Refrigerating Machines, B. E. Seamson. South. Engr., vol. 41, no. 7, Sept. 1924, pp. 39-41. Requirements of suitable packing for rod stuffing boxes on refrigerating machines.

REFRIGERATING PLANTS

RULES AND FORMULAS FOR. Some Rules and Formulae for the Refrigeration Engineer, W. H. Motz. Refrigerating Eng., vol. 11, no. 2, Aug. 1924, pp. 51-56 and (discussion) 56-60 and 64-65. Gives general rules and formulas concerning mechanical equipment of ice-making and refrigerating plants; rules pertain to displacements, speeds, and power requirements of compressors; heat removed in condensers; water and surface requirements for condensers; capacities of ammonia receivers; refrigerating coils in air, evaporators for refrigerating liquids; quantity of brine and power requirements of brine circulation systems; refrigeration pipe, cans per ton of ice.

REFRIGERATION

TECHNICAL TRAINING IN. Technical Training in Refrigeration, W. S. Douglas. Ice & Cold Storage, vol. 27, no. 317, Aug. 1924, pp. 204-206. Abstract of paper presented at Fourth Int. Congress of Refrigeration, Commission 15, Lond.

REFUSE DISPOSAL

AMERICAN PRACTICE. Resume of American Practice in the Disposal of Refuse, S. A. Greeley. Surveyor & Mun. & County Engr., vol. 66, no. 1700, Aug. 15, 1924, pp. 149-150. Describes methods more extensively used in America; reduction of garbage, hog feeding, incineration and comparison of methods. Abstract of paper read before Int. Conference on Sanitary Eng.

SEPARATION AND SALVAGE. Refuse Disposal by Separation and Salvage, J. Gair. Surveyor & Mun. & County Engr, vol. 56, no. 1702, Aug. 29, 1924, pp. 185-186. Discusses disposal methods of Sheffield, Westminster, Newark, Birmingham and Marylebone; steam from refuse. Abstract of paper read before Int. Conference on Sanitary Eng.

RESERVOIRS

SILTING. Methods of Overcoming Silting of Reservoirs Outlined. Eng. News-Rec, vol. 93, no. 8, Aug 21, 1924, pp. 306. Four methods of overcoming trouble from silt, as given in studies of water power of Deep River in North Carolina, made by North Carolina Geol. & Economic Survey. Development of streams reduces trouble from silt.

RIVERS

BANK PROTECTION. Curbing a Threatened Diversion of the Missouri River. Eng. News-Rec., vol. 93, no. 10, Sept. 4, 1924, pp. 372-375, 5 figs. Destruction of railway and highway communications and disastrous results to river-front city all threatened in recent sudden erosion of south bank of Missouri River near Glasgow, Mo. Particulars of emergency protective work. Permanent protection work under way.

ROAD CONSTRUCTION

REFINED TAR. Refined Tar in Highway Construction, J. S. Grandell. Eng. & Contracting (Roads & Streets), vol 62, no. 2, Aug 6, 1924, pp. 315-320, 6 figs. Useful suggestions on building tar macadam. Abstract of paper read before Can. Good Roads Assn.

ROADS, GRAVEL

MAINTENANCE Gravel Road Maintenance in Maine, P. D. Sargent. Eng. & Contracting (Roads & Streets), vol. 62, no 2, Aug 6, 1924, pp. 295-300. Discusses practice of State Highway Commission. Abstract of paper read before 11th Annual Convention of Can. Good Roads Assn.

ROLLING MILLS

POWER CONSUMPTION Power Consumed in Rolling Steel, G. Fox. Iron & Coal Trades Rev, vol 109, no 2945, Aug. 8, 1924, pp. 235-236, 13 figs. Discusses ratio of demand to connected load, power consumption by main roll drives, power consumption and elongation, power consumption and rate of rolling. Abstract of paper read before Am. Iron & Steel Inst.

ROLLS

HARDENED AND GROUND Hardened and Ground Rolls, J. R. Adams. Foundry Trade Jl, vol. 30, no. 420, Sept. 4, 1924, pp. 200-201. Comparison of hardened steel and chilled-iron rolls; melting and forging, annealing and machining, hardening, grinding. Extract from paper read before Am. Iron & Steel Inst.

ROOF TRUSSES

FINK. The Fink Roof Truss and Its Problem, R. Fleming. Can. Engr., vol. 47, no. 11, Sept. 9, 1924, pp 309-312, 6 figs. Various graphical solutions given of problem of Fink truss; methods of general case and their originators given.

S

SAND, MOLDING

RESEARCH WORK. Research Work on Molding Sand—New and Old. Can. Foundryman, vol. 15, no. 9, Sept. 1924, p. 19. Extracts from tentatively adopted standardized testing methods and résumé of activities of joint committee on molding sand research.

TESTING. Report on Molding Sand Tests. Foundry, vol. 52, no. 17, Sept. 1, 1924, pp. 675-680, 4 figs. Report of joint committee on molding sand research, Am. Foundrymen's Assn., giving tests for determining fineness and dye absorption properties, and methods for sampling shipments of sand.

SCREW THREADS

CUTTING. Threading Tool and Gage Forms for the New Screw Thread Standard, R. E. Flanders. Am. Mach., vol. 61, no. 13, Sept. 25, 1924, pp. 481-486, 15 figs. Consideration of important points in manufacture of threads conforming to new Am. (National) Screw Thread Standards. Shape of cutting edges for threading tools and taps; proper outlines for gage points; preparation of charts for inspection by optical projection; Hartness comparator.

STANDARDS. American Standard Screw Threads. Am. Mach., vol. 61, nos 10, 11 and 12, Sept 4, 11 and 18, 1924, pp 383-387, 421-422 and 457-460, 3 figs. Standardization and unification approved by Am. Eng. Standards Committee, May 1924. For bolts, machine screws, nuts and commercially tapped holes.

WORM. The Gauging of Finish-ground Worms by Cylinders, H. E. Merritt. Engineer, vol 138, no. 3580, Aug 8, 1924, pp. 162-163, 3 figs. Shows that from certain fundamental worm dimensions size and position of a cylinder to gage any point on thread contour may be calculated, and in spite of apparent difficulty of problem, solution is very simple and easy of application.

SEWAGE DISPOSAL

ACTIVATED SLUDGE. Elasticity of the Activated Sludge Process, J. Bolton. Surveyor & Mun. & County Engr., vol. 66, no. 1697, July 25, 1924, pp. 85-86. Experience gained from unavoidable stoppage of power to 50,000-gal. unit shows that process is very elastic.

DEWATERING ACTIVATED SLUDGE. Dewatering Activated Sludge, L. Pearse. Public Works, vol. 55, no. 8, Aug. 1924, pp. 262-265. Apparatus and methods employed in United States and results obtained in operating and test plants. Abstract of paper read before Int. Conference on Sanitary Eng., Lond.

IMHOFF TANKS. Some Problems in the Operation of Imhoff Sewage Tanks, E. L. Waterman. Mun. & County Eng, vol. 67, no 2, Aug. 1924, pp. 101-104. Discusses gas as by-product, operating procedure cleaning screens and grit chambers, cleaning sides and bottom of settling chamber, removing floating material from sedimentation chamber, treatment of scum on gas-vent chamber, observing depth of sludge, etc.

INDUSTRIAL WASTES, TREATMENT OF. Treating Industrial Wastes, F. Bachmann and E. B. Besselievre. Chem. & Met. Eng, vol 31, no 10, Sept. 8, 1924, pp. 386-387. Treatment so that wastes are no longer injurious is becoming a legal necessity in most states. Describes one method of treatment. From paper read before Am. Inst. Chem. Engrs.

SEWAGE TREATMENT. The Part Which Bio-Aeration May Yet Play in Purifying Sewage, J. D. Watson. Engineering, vol. 118, no. 3060, Aug. 15, 1924, pp. 241-242.

WORKS, ENGLAND. New Sewage Works at Tilbury. Engineer, vol. 138, no. 3583, Aug. 29, 1924, pp 242-245, 8 figs. Description of new sewage disposal works of Thurrock, Grays and Tilbury Joint Sewerage Board, and difficulties which were encountered and overcome in carrying out undertaking.

SEWERS

CONCRETE. Making the Concrete Pipe for Los Angeles Outfall Sewer. Eng. News-Rec., vol 93, no. 8, Aug. 21, 1924, pp 296-298, 5 figs. Outfall will extend 5400 ft. into ocean and will consist of a reinforced-concrete pipe 7 ft. in diameter inside, which is being made in sections in a casting yard nearby; sections are 12 ft. 3 in. long and weigh 18 tons each. Describes design and manufacture of pipe.

SHERARDIZING

DEVELOPMENT. Sherardizing: Its Inception and Development, S. Cowper-Coles. Engineering, vol. 118, no. 3061, Aug. 29, 1924, pp. 277-278, 3 figs.

SILVER MINES

COBALT, ONTARIO, CAN. Cobalt: Bonanza Silver District of Ontario, A. A. Cole. Eng. & Min. Jl.—Press, vol. 118, no. 9, Aug. 30, 1924, pp. 325-330, 7 figs. Notes on geology, ores, costs, sampling, concentration, etc. Has averaged two tons of fine silver per day for 20 years.

SNOW REMOVAL

DOUBLE-ENDED PLOW. Double-Ended Plow Will Clear Light Snowfall or Can Buck Deep Drifts. Bus Transportation, vol. 3, no. 9, Sept. 1924, pp. 403-405, 8 figs. Snow-fighting operations in routes of Auto Interurban Co., Spokane, Wash., have developed improvement in equipment from time to time, culminating in 8-ton vehicle equipped with two independent motors and with both V and rotary snowplows.

PRACTICES. Making Ready for Winter Service, R. E. Plimpton. Bus Transportation, vol. 3, no. 9, Sept. 1924, pp. 415-418, 4 figs. Practices followed by many companies are brought out in nationwide survey; faster snow removal is demanded; precautions to be taken with motor equipment.

SOAPSTONE

CANADA. Wabigoon and Trap Lake Soapstone Deposits, Ontario, J. F. Wright. Can. Min. Jl., vol. 45, no. 36, Sept. 5, 1924, pp. 871-872. Geology of Wabigoon Lake basin, geology of soapstone prospects, petrography of soapstone and associated rocks; origin of soapstone and economic possibilities.

SOILS

SUBGRADE, TESTS FOR. Practical Field Tests for Subgrade Soils, A. C. Rose. Public Roads, vol. 5, no. 6, Aug. 1924, pp. 10-15, 12 figs. Suggested methods for measuring character of highway subgrades.

SOLDERING

FLUXES FOR. Fluxes for Soft Soldering, T. B. Crow. Metal Industry (Lond.), vol. 25, no. 10, Sept. 5, 1924, pp. 224-226, 9 figs. Definitions; theory of soldering; experimental work carried out in connection with cleaning and protective properties of various fluxes, efficiency in causing solder to wet surface, efficiencies of tallow and resin as fluxes, influence of flux on surface tension of solder; tests under hydrogen. Contribution to a general discussion on "Fluxes and Slags in Metal Melting and Working" held by Faraday Soc. and Inst. of Metals with co-operation of British Non-Ferrous Metals Research Assn. and Inst. Brit. Foundrymen.

SOOT BLOWERS

MECHANICAL. Tests of Mechanical Soot Blowers, R. June. Power, vol. 60, no. 9, Aug. 26, 1924, pp. 325-328, 4 figs. Describes tests made on an oil-fired horizontal water-tube boiler and on 12,000-sq. ft. boilers. They confirm some of the general claims that have been made from a strictly fuel-saving point of view.

SPRINGS

COILED. Study on Coiled Springs (Une étude sur les ressorts enroulés), D. Landau. Technique Automobile et Aérienne, vol. 15, no. 125, 1924, pp. 47-49, 2 figs. Discusses helical, conical and spiral springs, and gives formulas for calculating tensile and bending stresses for various cross-sections and a table of coefficients.

STEAM

PRESSURE-VOLUME-TEMPERATURE RELATION. M.I.T. Investigates Pressure-Volume-Temperature Relation of Steam, P. W. Swain. Power, vol. 60, no. 8, Aug. 19, 1924, pp. 284-286, 5 figs. Describes apparatus and methods employed at Mass. Inst. Technology for determining volume of water at various temperature and relation between pressure, temperature and volume of saturated and superheated steam.

PRODUCTION FROM BY-PRODUCT PRODUCER GAS. Power and Process Steam From By-Product Producer Gas, C. H. S. Tupholme. Chem. & Met. Eng., vol. 31, no. 8, Aug. 25, 1924, pp. 300-303, 6 figs. Description of a highly efficient combination system evolved for plants using steam in course of production.

STEAM ENGINES

INDICATOR DIAGRAMS. Study of Indicator Diagrams Made Easy, E. K. Benedek. Power, vol. 60, no. 7, Aug. 12, 1924, pp. 255-256, 6 figs. Discusses construction of characteristic lines and gives simple method of diagram analysis.

POWER CALCULATION. New Method for Calculating Power of Reciprocating Engines (Méthode nouvelle pour calculer la puissance de la machine à piston), E. Tournier. Académie des Sciences—Comptes rendus des séances, vol. 179, no. 2, July 16, 1924, pp. 101-102. Gives formula for calculating hp. from weight of dry steam, adiabatic drop per unit weight of steam, actual condenser pressure, loss of steam, and maximum efficiency of engine.

UNIFLOW. Comparison of Four-Valve and Two-Valve Unaflow Engines, M. L. Barker. Power, vol. 60, no. 8, Aug. 19, 1924, pp. 289-290, 4 figs. Results of tests.

STEAM PIPES

EXPANSION. Comparison of the Linear Expansion of Steam Pipes, H. Menk. Eng. Progress, vol. 5, no. 7, July 1924, pp. 128-138, 8 figs. Discusses heat expansion of long piping and connecting by application of compensators between sections of pipe line, flexible compensating pipe, joined compensation, pipe glands, etc.

STEAM POWER PLANTS

DEVELOPMENT. High Lights from the World Power Conference, A. L. Rice. Power Plant Eng., vol. 28, no. 16, Aug. 15, 1924, pp. 862-866, 3 figs. Economics of power development; advances in boiler practice; effect of high pressures on turbine design.

PULVERIZED-ANTHRACITE-SLUSH BURNING. Susquehanna Collieries Co. Burns Pulverized Anthracite Slush at Lykens, Pa. Coal Age, vol. 26, no. 8, Aug. 21, 1924, pp. 253-257, 10 figs. One of the first power plants to utilize anthracite slush in pulverized form. Coal mixed with 75 per cent water pumped to plant; boiler plant contains six 5000- and six 6000-sq. ft. water-tube boilers; present generating capacity, 6,400 kw.

STEAM TURBINES

BRUNNER. Brunner High-Pressure Turbine Shows Improved Economy. Power, vol. 60, no. 13, Sept. 23, 1924, pp. 498-500, 4 figs. Steam velocities below those of usual practice are among refinements contributing to an efficiency, when non-condensing, comparable with uniflow engine.

DEVELOPMENT. Evolution of Steam Turbines (L'évolution de la turbine à vapeur), C. Monteil. Technique Moderne, vol. 16, nos. 14 and 16, July 15 and Aug. 15, 1924, pp. 469-474 and 533-541, 22 figs. July 15: Discusses reaction in hydraulics and in steam turbines. Brown-Boveri-Parsons turbines; stages of speed and multiple turbine wheels, etc. Aug. 15: Discusses adaptability of steam turbines for high pressures, power factors, difficulties of last wheel; describes 40,000-kw. turbines of 1500 r.p.m., 12,000 to 15,000-kw. of 3000 r.p.m.; application of low-power turbines, use of high pressures and high superheating.

High-Pressure. Steam at 1,200 Deg. F. in a Unique Power Plant. Power, vol. 60, no. 1, Sept. 9, 1924, pp. 405-406, 1 fig. A turbine for 1200 deg. fahr., 350 lb., supplied by a boiler where fuel and water are intimately mixed, at high combustion efficiency, used for propelling torpedoes. Features suggest possibilities for more economical stationary practice.

Improving Efficiency of. Steam Turbines, C. Parsons. Engineer, vol. 138, no. 3579, Aug. 1, 1924, pp. 140-142, 4 figs. Describes four methods of improving thermal efficiency of thermodynamic cycle without going to higher maximum temperature, and their application in turbine plant of 50,000-kw. power station to be erected at Crawford Avenue, Chicago, now nearing completion at Newcastle-on-Tyne. Abstract of paper read at World Power Conference.

Steam-Flow Calculation. Calculating Steam Flow for Turbines, J. Y. Dahlstrand. Power Plant Eng., vol. 28, no. 18, Sept 15, 1924, pp. 945-946, 1 fig. Method by which steam consumption of a turbine may be calculated.

STEEL

Magnetic Testing of. Field of Magnetic Testing Board. Iron Trade Rev., vol. 75, no. 11, Sept. 11, 1924, pp. 663-665, 4 figs. Development sin magnetic method of examining steel open way to many new applications, particularly in case of irregular shapes; employment of method on regular shapes commercialized.

Annealed Carbon, Strength of. Elastic Limit and Resistance of Annealed Mild Steels in Combined Elongation and Torsion Test (Limite élastique et résistance des aciers doux recuits dans le cas d'efforts combinés de traction et de torsion), M. Seigle and M. Cretin. Académie des Sciences—Comptes rendus des séances, vol. 179, no. 4, July 28, 1924, pp. 253-256. Experiments with circular bars of 2.5 mm. cross-section for elastic and permanent deformation by elongation and torsion to establish curves of deformation.

Magnetization of Steel Under Tensile Stress (Aimantation de l'acier à la traction), C. Fraichet. Technique Moderne, vol. 16, no. 16, Aug. 15, 1924, pp. 541-547, 14 figs. Discusses apparatus for recording variation of magnetization of bar when under tensile stress, and results of tests carried out with it, showing that magnetization curves gives more accurate indication as to nature and treatment of metal.

Melting in Cupo'a. Melting Steel in a Cupola, J. Grennan. Am. Foundrymen's Assn., Preprint No. 411, for Mtg. Oct. 11-16, 1924, 17 pp., 11 figs. Data of experiments conducted with a view to observing what actually happens to steel when it is melted in a cupola and to compare melting of steel with that of pig iron and scrap cast iron.

Parts, Hot-Pressing of. Hot-pressing Steel Parts. Machy. (Lond.), vol. 24, no. 612, Aug. 28, 1924, pp. 681-682, 4 figs. New application of a process heretofore employed only in manufacturing parts from softer metals. Now possible to hot-press steel parts in an almost endless variety of shapes. Briefly, process consists of heating slugs of steel to about 1800 deg. fahr. and then pressing them to desired shape in tungsten-steel dies having cavities corresponding to outside of desired part.

Special, Metallurgy of. Modern Developments in the Metallurgy of Special Steels, W. H. Hatfield. Iron & Coal Trades Rev., vol. 108, no. 2938, June 20, 1924, pp. 1055-1057. Discuss improvement in process of manufacture and manipulation resulting in increases reliability, modified and new composition resulting in improved or new properties, more intimate knowledge of properties of s eel from designers' standpoint. Abstract of paper read before Iron & Steel Sec., Empire Min. & Metallurgical Congress.

Stainless. The "Stainless" Chromium Steels, W. H. Hatfield. Am. Electrochem. Soc., Advance Paper no. 5, for meeting Oct. 2-4, 1924, pp. 63-73. Interesting aspects of influence of corroding media upon stainless chromium steels. Article confined to stainless steels in which 12 to 16 per cent of chromium is essential alloyed element.

STEEL CASTINGS

Cleaning. Cleaning Steel Castings Economically. Foundry, vol. 52, no. 17, Sept. 1, 1924, pp. 688-690, 6 figs. Notes on methods of Ohio Steel Foundry Co., Springfield, O.

Production. The Production of a Large Steel Casting, H. V. Fell. Foundry Trade Jl., vol. 30, no. 4 6, Aug. 7, 1924, pp. 114-116, 18 figs. Describes an example of this class of work as carried out by a large British firm, especially molding operations.

Semi-Steel, Manufacture of. The Making of Semi-Steel Castings, G. W. Gilderman. Foundry Trade Jl., vol. 30, no. 413, July 17, 1924, pp. 44-45. Discusses mixtures and charging, preparation of mold, pattern proportion, and alloys.

X-Ray Examination. Technic of X-Ray Is Improving. Iron Trade Rev., vol. 75, no. 11, Sept. 11, 1924, pp. 668-671, 7 figs. Experience at Watertown arsenal, Watertown, Mass., in application of X-ray process to steel castings yields more accurate and definite results. Interpretation of radiographs are reduced to formulas.

STEEL, HEAT TREATMENT OF

Hardening. The Hardening of Steel, W. Rosenhain. Iron & Steel Inst., Advance Paper no. 8, for Mtg. Sept. 1924, 17 pp., 9 figs. partly on supp. plate. Describes some of the outstanding phenomena connected with hardening and tempering of certain non-ferrous alloys, in order to show analogy which exists between these phenomena and well-known behavior of iron-carbon alloys, and considers its applicability to particular case of steel.

Salt Baths. Salt Baths, S. Tour. Am. Soc. for Steel Treating—Trans., vol. 6, no. 2, Aug. 1924, pp. 171-186, 2 figs. Discusses reasons for employing liquid heating mediums; design of furnaces and containers for melting salt baths; gives tables of composition of salt mixtures, salt baths for carbon tool steels, alloy tool steels and high-speed steels, etc.

Spring Steel. Heat Treatment of Steel Springs, J. K. Wood. Am. Mach., vol. 61, no. 12, Sept. 18, 1924, pp. 443-446. Commercial considerations; general requirements for a spring; spring steels and their compositions; coiling, forming, and heat treating helical and leaf springs.

STEEL, HIGH-SPEED

Forging and Tempering. Forging and Tempering High-Speed and Carbon Tool Steels. Ry. Rev., vol. 75, no. 8, Aug. 23, 1923, pp. 282-283. Tool standards at Atchison, Topeka & Santa Fe Ry. are maintained by instructions in regard to proper methods for various classes of work.

Nature of. On the Nature of High-Speed Steel, M. A. Grossmann and E. C. Bain. Iron & Steel Inst., Advance Paper no. 6, for Mtg. Sept. 1924, 24 pp., 23 figs. partly on supp. plates. Amount of physical phenomena occurring in high-speed steel from time of casting homogeneous melt to production of hardened tools, so far as changes in nature, amounts, and distributions of well-known constituents of such steel are concerned.

STEEL INDUSTRY

Lubrication in. Lubrication in the Steel Industry. Lubrication, vol. 10, no. 7, July 1924, pp. 73-84, 21 figs. Discusses soaking pits, rolling mills, lubrication, accessory equipment and power equipment.

STEEL MANUFACTURE

Blast-Furnace Process. Effect of Sulfur on Blast-furnace Process, T. L. Joseph. Am. Inst. Min. & Met. Engrs.—Trans., Advance Paper no. 1374-S, Sept. 1924, 11 pp., 3 figs. Points out distribution of this impurity in blast-furnace materials and indicates how its presence alters composition, quantity, and free-running or critical temperature of slag, and relation between these factors, fuel economy, and cost of iron. Pub. by permission of U. S. Bur. Mines.

STEEL WORKS

Cold-Drawing Plants. Operates New Cold Drawing Plant, J. D. Knox. Iron Trade Rev., vol. 75, no. 7, Aug. 14, 1924, pp. 423-427, 8 figs. Modern works of Anchor Drawn Steel Co., at Latrobe, Pa., 38 miles east of Pittsburgh. Various departments are laid out for straight-line production; primary annealing of coils is executed in gas-fired lead pots; description of cold-drawing process.

Electricity in. Electricity's Contribution to the Steel Industry, K. A. Pauly. Am. Inst. Elec. Engrs.—Jl., vol. 43, no. 9, Sept. 1924, pp. 831-839, 4 figs. Outline of processes involved in production of steel, followed by a discussion of characteristics of the various rolling mills and types of motors used to drive them. Considerations affecting choice of frequency.

STOKERS

Lubrication of. Lubrication of the Automatic Stoker. Lubrication, vol. 10, no. 8, Aug. 1924, pp. 85-90, 11 figs. Discusses types of stokers, stoker drives, stoker lubrication and construction, design, and operating features involved.

Savings with Small Boilers. Mechanical Stoker Savings with Small Boilers, R. June. Power House, vol. 17, no. 16, Aug. 20, 1924, pp. 23-24, 2 figs. Reduction in cost of producing steam, increase in efficiency and availability of cheaper grades of fuel, among factors which prove installation economical.

STREAM FLOW

Measurement. Using Observations Made with Movable Barrage Dams for Determining the Supply Diagram (Utilisation des Observations faites aux Barrages à Fermettes pour la détermination du diagramme des débits), F. Charles. Revue Universelle des Mines, vol. 3, no. 1, series 7, July 1, 1924, pp. 26-34, 11 figs. Applies this method for determining flow of River Meuse.

STREET CLEANING

Sprinkler, Tractor-Hauled. A Tractor-Hauled Street Sprinkler. Motor Transport, vol. 39, no. 1015, Aug. 11, 1924, p. 182, 1 fig. Adaptable unit for municipal work; low capital cost makes attractive proposition for small local authorities.

STREET RAILWAYS

Cars. Reducing Weight of Rapid Transit Cars Saves $108,000 a Year, J. Lindall. Elec. Ry. Jl., vol. 64, no. 8, Aug. 23, 1924, pp. 269-274, 7 figs. Steps by which weight was reduced, carrying capacity increased and strength maintained in new rolling stock for East Boston service; electric door openers give good results.

STRESSES

Riveted Tension Members. Net Section of Riveted Tension Members, T. R. Loudon. Can. Engr., vol. 47, no. 9, Aug. 26, 1924, pp. 269-271, 7 figs. Discusses many specifications for calculating net sections are inadequate; investigations being conducted in photo-elastic laboratory of University of Toronto may develop new theory of stress distribution in riveted members.

SUBSTATIONS

Portable. Portable Substation with Telescopic Tower. Elec. Ry. Jl., vol. 64, no. 9, Aug. 30, 1924, pp. 309-310, 4 figs. Suitable spacing for 33,000-volt outdoor apparatus and overhead clearance when station is moving over right-of-way are obtained by telescoping arrangement employed on interstate 300-kw. portable.

Standardization. Standardizing Small Substations, J. C. Gaylord. Elec. Wld., vol. 84, no. 8, Aug. 23, 1924, pp. 357-359, 7 figs. Describes three types standard stations developed by South. Cal. Edison Co. for 2200-volt or 4000-volt distribution with capacity up to 6000 kva.

SUPERHEATED STEAM

Research. Harvard Throttling Experiments Extend Data on Superheated Steam, P. W. Swain. Power, vol. 60, no. 9, Aug. 26, 1924, pp. 329-332, 4 figs. Work being done by Prof. Davis and Dr. Kleinschmidt at Harvard, where extremely accurate measurements are being made of Joule-Thomson effect.

T

TACHOMETERS

Kourkene. The Kourkène Tachometer (Le taéchomètre, système Kourkène). Génie Civil, vol. 85, no. 7, Aug. 16, 1924, pp. 154-157, 9 figs. Design and construction of direct reading apparatus made by Précision Moderne at Paris, measuring heights as well as distances.

Speed-Indicating-and-Recording. Speed Indicating and Recording. Shipbldg. & Shipg. Rec., vol. 24, no. 6, Aug. 7, 1924, p. 171, 2 figs. Description of electrical tachometer equipment.

TALC

Canada. Talc and Steatite Situation in Canada. Can. Min. Jl., vol. 45, no. 36, Sept. 5, 1924, pp. 873-875, 1 fig. Resume of conditions in 1923.

TANKS

Horizontal, Chart for. A Quick and Useful Horizontal Tank Chart, W. F. Schaphorst. West. Machy. Wld., vol. 15, no. 7, July 1924, pp. 227-228, 1 fig. Chart gives gallons of liquid in any horizontal tank without use of tables, formulas, figures, or computations of any kind. Inversely chart may be used for determining length of tank necessary to hold given number of gallons where diameter of tank and depth of liquid are known.

TELEGRAPHY

Printing Systems. The Teletype, Description and Operation (Le télétype, description et fonctionnement). Annales des Postes Télégraphes et Téléphones, vol. 13, no. 8, Aug. 1924, pp. 911-925, 7 figs. Details of design of Bandot apparatus, formation and transmission of signs, printing mechanism, translating figures into letters and vice versa.

TELEPHONY

Transmitter Circuit. Transmitter Circuit Theory, A. F. Puchstein and W. H. Snook. Telephone Engr., vol. 28, no. 9, Sept. 1924, pp. 23-25, 5 figs. Analytical study of transmitter circuit with extension of alternating current theory and its application in local battery and common battery circuits.

TILE

CONCRETE ROOFING. Concrete Roofing Tile Successful in Chicago. Cement & Eng. News, vol. 36, no. 8, Aug. 1924, pp. 35-36 and 44, 3 figs. Describes tile machine, type and color and method of laying tile as made by Hawthorne Roofing Tile Co., Chicago, Ill.

TOOLS

SHEET-METAL WORK. Comparative Methods of Tool Design, D. H. Chason. Mech. Eng., vol. 46, no. 9, Sept. 1924, pp. 531-534 and 538, 9 figs. Discussion in relation to quantity production of sheet-metal parts.

TRANSFORMERS

INSPECTION. Transformer Inspection. Elec. Wld., vol. 84, no. 9, Aug. 30, 1924, pp. 412-414, 2 figs. Methods employed by People's Light Co. of Davenport, Iowa. Demand determinations made yearly. Five-year results.

SECONDARIES, GROUNDING. Grounding Transformer Secondaries, J. R. Gibbs. Power, vol. 60, no. 9, Aug. 26, 1924, pp. 323-324, 5 figs. Some of the principal rules concerning grounding of transformer secondaries.

TUBES

BRASS, INTERNAL STRESS MEASUREMENT. A Method for Measuring Internal Stress in Brass Tubes, R. J. Anderson and E. G. Fahlman. Inst. of Metals, Advance Paper no. 1, for Mtg. Sept. 8-11, 1924, 13 pp., 7 figs. partly on supp. plates. Nature of stress in drawn tubing. Strip method, developed by authors, for measurement of stress in drawn tubes.

TUNGSTEN

METALLIC, PREPARATION OF. The Preparation of Metallic Tungsten and Some of Its Alloys, L. Kahlenberg and H. H. Kahlenberg. Am. Electrochem. Soc., Advance Paper no. 4, for meeting Oct. 2-4, 1924, pp. 51-61. Particulars of research based upon new discovery that tungsten trioxide and tungstic acid are soluble in fused alkali chlorides, and that from such fusions metallic tungsten and also alloys of tungsten may be prepared by electrolysis.

TUNNELS

VENTILATION. Natural Ventilation in the Liberty Tunnels, A. C. Fieldner and W. P. Yant and L. L. Satler, Jr. Eng. News-Rec., vol. 93, no. 7, Aug. 21, 1924, pp. 290-291, 2 figs. Systematic observations of six months' use of one-mile vehicle tunnels without forced ventilation show normal condition satisfactory. Dangerous carbon monoxide concentration during traffic jam. Pub. by permission U. S. Bur. Mines.

Temperatures and Locomotive Gases in Tunnels, S. H. Katz and E. G. Meiter. Ry. Rev., vol. 75, no. 11, Sept. 13, 1924, pp. 391-396, 6 figs. Bur. of Mines investigates temperatures and composition of atmosphere in engine cabs while passing through tunnels.

TURBO-ALTERNATORS

DESIGN. Hungarian Practice in High Speed Turbo-Alternator Design, E. Wilczek. Engineering, vol. 118, no. 3058, Aug. 8, 1924, pp. 206-207, 10 figs. Details of methods adopted in high-speed design, by O. T. Blathy, including two and four pole rotors, stator-winding and bracing arrangement, ventilation and efficiency. Abstract of paper read before World Power Conference.

V

VARNISHES

TESTS. Physical Tests on Some Commercial Varnishes, H. A. Gardner and H. C. Parks. Paint Mfr.'s Assn. of U. S., Sci. Sec., circular no. 210, Aug. 1924, pp. 69-77. Discusses method of examination, color, viscosity, drying, time, hot and cold water tests, alkali and gas tests, kauri reduction test and permeability.

VENTILATION

PROBLEMS. Some Aspects of the Ventilation Problem, R. Grierson. Domestic Eng. (Lond.), vol. 34, no. 7, July 1924, pp. 146-153. Experiments show that rate of heat emission varies with state of physical rest or work and with age and sex of person under test; deals with all scientific and physiological aspects of ventilation and considers matters affecting design of plant.

VIBRATION

BUILDINGS. Study of Vibrations Produced in Buildings by Passing Vehicles (Étude des vibrations produites dans les édifices par la circulation des véhicules), P. Prache. Société d'Encouragement pour l'Industrie Nationale—Bul., vol. 136, no. 6, June 1924, pp. 548-559, 5 figs. Details of instruments for measuring vibrations and their application in measuring vibrations by street cars on macadam roads, asphalted roads, etc.

W

WASTE UTILIZATION

METHODS. Making the Most of Waste Materials, R. S. Emmet. Factory, vol. 33, no. 3, Sept. 1924, pp. 340-342 and 386, 7 figs. Scrap handling and disposal methods of salvage and scrap department of Schenectady, N.Y., works of Gen. Elec. Co.

WATER

MEASUREMENT OF. Bulk Measurement of Water. Power Engr., vol. 19, no. 221, Aug. 1924, pp. 302-303, 6 figs. Gives notes on modern weir records and electric level records.

WATER SUPPLY

DISTRIBUTION SYSTEM. Locating Leaks in the Distribution System, C. C. Behney. Fire & Water Eng., vol. 76, no. 12, Sept. 17, 1924, pp. 637-638, 648, 657-661, 5 figs. Discusses how to determine cause of waste; use of pitot tube.

WATER TREATMENT

AERATION. Water Purification by Aeration. Public Works, vol. 55, no. 8, Aug. 1924, pp. 251-252. Discusses conditions resulting from aeration and probable causes; promotes chemical activity; electrification of drops by spraying; aids in coagulation and in iron removal.

METHODS. Bad Water Made Suitable for Domestic and Power-Plant Use by Treatment and Purification, F. L. Serviss. Coal Age, vol. 26, no. 12, Sept. 18, 1924, pp. 398-402, 5 figs. Methods of analysis and treatment; water usually requires less treatment for domestic use than for steam power-plant supply; accumulation of scale in boilers often greatest operating difficulty; any water can be made suitable.

RAILWAYS. How the Chemical Engineer Tacklets the Water Problems of a Railroad, W. M. Barr. Chem. & Met. Eng., vol. 31, no. 9, Sept. 1, 1924, pp. 348-351, 6 figs. Points out some of the many problems of water supply on a railroad and emphasizes necessity of solving them with aid of a chemical engineer rather than a laboratory chemist. Elimination of scale-forming solids and simultaneous production of non-foaming water all over a railroad system is a major technical problem.

SETTLING BASINS. Principles of Four Kinds of Flow in Settling Basins, W. Kiersted. Eng. News-Rec., vol. 93, no. 9, Aug. 28, 1924, pp. 346-347, 3 figs. Effect on sedimentation in straight-line, radial, rotary and spiral inward-flow basins with evaluation of each.

WELDING

EQUIPMENT. Welding Equipment in Service. Can. Machy., vol. 32, no. 8, Aug. 21, 1924, pp. 26-27 and 46-47, 1 fig. Describes proper methods for setting up tank outfit, crank open valves, averting trouble, release adjusting screws, regulators carefully made, disconnecting equipment, etc.

OXY-ACETYLENE. *See Oxy-Acetylene Welding.*

REPAIR JOBS. New Welding. Motor Transport, vol. 39, no. 1016, Aug. 18, 1924, p. 206, 1 fig. Specialized methods that save badly damaged machinery parts from scrap heap.

WIRE

STEEL. Tensile Properties of Some Steel Wires at Liquid Air Temperatures, W. P. Sykes. Am. Soc. for Steel Treating—Trans., vol. 6, no. 2, Aug. 1924, pp. 138-144, 2 figs. Compares tensile properties of low-carbon, nickel, and chrome-molybdenum steels at room temperature and that of liquid air (—180 deg. cent.).

WIRE DRAWING

EFFECT ON STEEL PROPERTIES. Wire Drawing and Properties of the Steel, G. F. Comstock. Iron Age, vol. 114, nos. 11 and 12, Sept. 11 and 18, 1924, pp. 621-624, and 705-707, 24 figs. Some of the changes due to progressive cold drawing. Static and structural effects. Analogy with copper. Changes due to progressive drawing traced by photomicrographic analysis. Study of grain size.

X

X-RAYS

SCATTERING. The Scattering of X-Rays, A. H. Compton. Franklin Inst.—Jl., vol. 199, no. 1, July 1924, pp. 57-72, 5 figs. Deals with theories of scattering of x-rays, spectroscopic examination of scattered rays from light elements, intensity of scattered x-rays, etc.

Z

ZINC METALLURGY

SMELTING. Combining the Retort Process with Electric Smelting of Zinc Ores, E. W. Hale. Eng. & Min. Jl.—Press, vol. 118, no. 11, Sept. 6, 1924, pp. 375-377. Describes Johnson-Hale duplex process for smelting zinc ores, which combines present fire-heated retorting of zinc ores with a final electric smelting, and recovers zinc, lead, copper, gold, and silver in one completed equipment.

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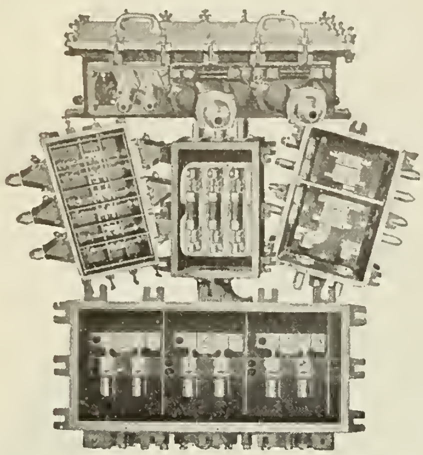

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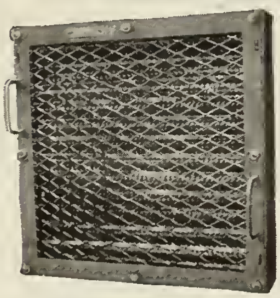

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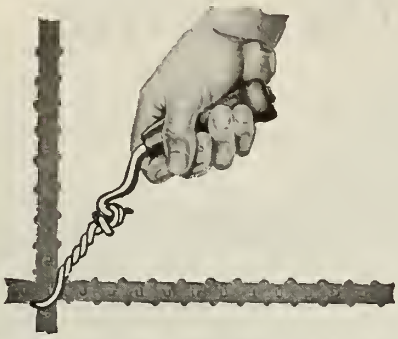

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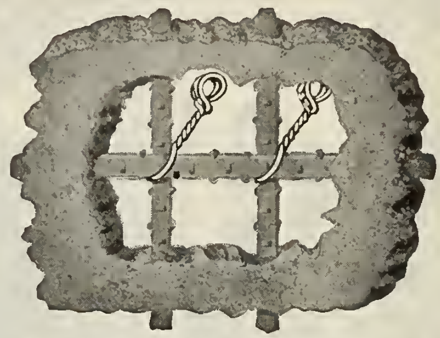

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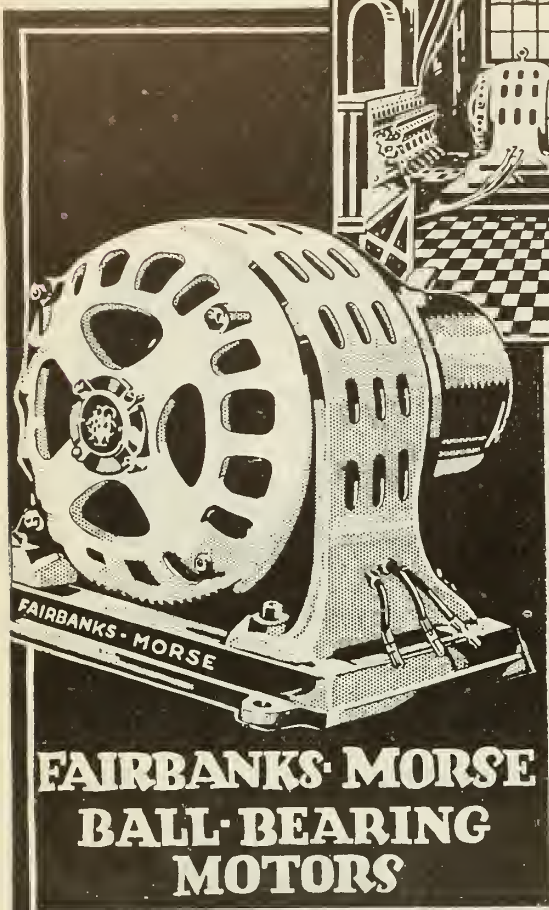

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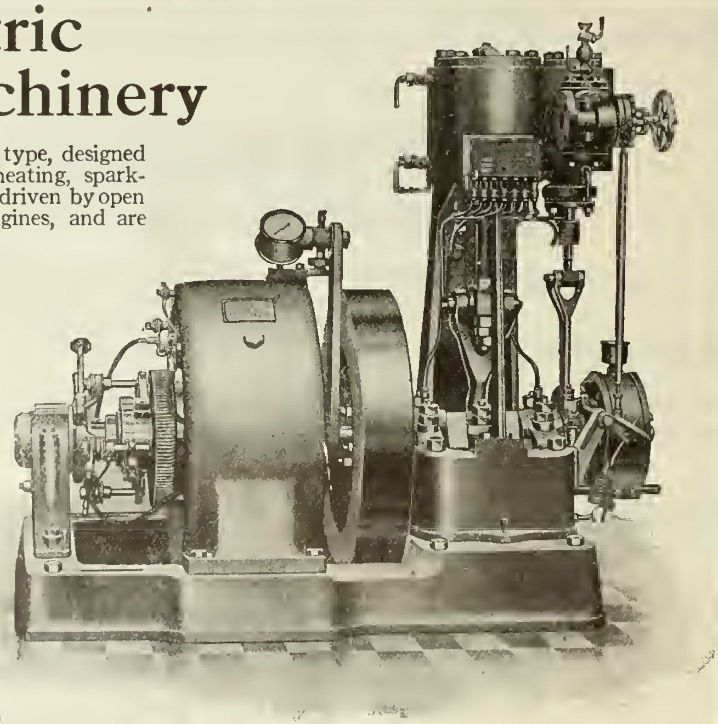

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Acids:
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Lancashire Dynamo and Motor Co. of Can. Ltd.
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Mussens Ltd.
Cranes, Pillar:
Industrial Works.
Cranes, Transfer:
Industrial Works.
Cranes, Travelling:
Dominion Bridge Co., Ltd.
Cranes, Tunnel:
Industrial Works.
Cranes, Wrecking:
Industrial Works.
Creosote Oils:
Barrett Co., Ltd.
Cross Arm Braces:
Burlington Steel Co., Ltd.
N. Slater Co., Ltd.
Crushed Stones:
Jno. E. Russell Co., Ltd.
Crushers, Jaw, Gyratory:
Canadian Vickers Ltd.
F. H. Hopkins & Co., Ltd.
Culvert Pipe:
Gartshore-Thomson Pipe and Foundry Co., Ltd.
Jno. E. Russell Co., Ltd.
Cutters, Milling:
Pratt & Whitney Company of Canada, Ltd.
Cutting off Machines:
John Bertram & Sons Co., Ltd

D

Damper Regulation:
Under-Feed Stoker Co., of Canada, Ltd.
Dampproof Coating:
Canadian Johns-Manville Co., Ltd.
Derricks:
Mussens Ltd.
Die Screw Plates:
Pratt & Whitney Company of Canada, Ltd.
Dies:
Pratt & Whitney Co., of Canada, Ltd.
N. Slater Co., Ltd.
Doors, Fireproof:
Mussens Limited.
N. Slater Co., Ltd.
Dredges:
Canadian Vickers Ltd.
Drills:
Pratt & Whitney Company of Canada, Ltd.
Drilling Machines, Metal:
John Bertram & Sons Co., Ltd.
Drill Sharpeners:
Lancashire Dynamo and Motor Co. of Can. Ltd.

Firms advertising in The Journal are considered as absolutely reputable.

Purchaser's Classified Directory

Dry Cells:
Dominion Battery Co. Ltd.
Dumb Walters, Electric:
Turnbull Elevator Co., Ltd.

E

Economizers:
Babcock-Wilcox & Goldie-McCulloch Ltd.
Combustion Engineering Corp., Ltd.
General Supply Co., of Canada Ltd.
Electric Cranes, Locomotive, Pillar, Transfer, Wrecking:
Industrial Works.
Electric Motors:
Lincoln Electric Co., of Canada, Ltd.
Electric Welders:
Lincoln Electric Co., of Canada, Ltd.
Electrical Appliances:
Northern Electric Co. Ltd.
Electric Railway Car Couplers:
Dominion Insulator & Mfg. Co., Ltd.
Electrical Supplies:
Northern Electric Co., Ltd.
Elevator Safety Gates:
Turnbull Elevator Co., Ltd.
Elevators, Freight:
Turnbull Elevator Co., Ltd.
Elevators, Passenger:
Turnbull Elevator Co., Ltd.
Elevators, Push Botton:
Turnbull Elevator Co., Ltd.
Enamels, Acid & Fume Resisting:
Dominion Paint Works, Ltd.
Enamels, Industrial Lighting:
Dominion Paint Works, Ltd.
End Mills:
Pratt & Whitney Company of Canada, Ltd.
Engines, Gas and Oil:
Canadian Fairbanks-Morse Co. Ltd.
Canadian Vickers Ltd.
Engines, Gas & Oil, Filters:
Midwest Canada Limited.
Engines, Steam:
Combustion Engineering Corp., Ltd.
Babcock-Wilcox & Goldie-McCulloch Ltd.
Laurie and Lamb.
E. Leonard & Sons, Ltd.
Excavators:
Canadian Equipment Co., Ltd.
Mussens Limited.
Excavators, Dragline:
Canadian Equipment Co. Ltd.
Link-Belt Ltd.
Exhaust Steam Injectors, Locomotive:
Superheater Co., Ltd.

F

Fan Engine Regulators:
Under-Feed Stoker Co., of Canada, Ltd.
Feed-Water Heaters, Locomotive:
Superheater Co., Ltd.
Fence Posts, Steel:
Burlington Steel Co., Ltd.
Fillers, Wood and Metal:
Dominion Paint Works, Ltd.
Filters, Air:
Midwest Canada, Ltd.
Fire Alarm Apparatus:
Northern Electric Co., Ltd.
Floor Stands:
Jenkins Bros., Ltd.
Flange Couplings:
Cumberland Steel Co.
Flanges, Companion:
Jenkins Bros., Ltd.
Flashlights:
Dominion Battery Co., Ltd.
Files, Valve:
Jenkins Bros., Ltd.
Flooring, Fireproof:
Irving Iron Works Co.
Flooring, Open Steel:
Irving Iron Works Co.
Flooring, Steel:
Irving Iron Works Co.
Flooring, Non-Slipping:
Irving Iron Works Co.
Flooring, Ventilating:
Irving Iron Works Co.
Floors, Monolithic:
Canadian Johns-Manville Co., Ltd.
Forgings:
British Empire Steel Corp., Ltd.
Dominion Bridge Co., Ltd.
N. Slater Co., Ltd.

Friction Clutches:
Link-Belt Ltd.
Canadian Johns-Manville Co., Ltd.
Fuel, Oil:
Imperial Oil, Ltd.
Furnaces, Automatic:
Under-Feed Stoker Co., of Canada, Ltd.

G

Galvanizing, Hot Dip:
N. Slater Co., Ltd.
Gantry Cranes:
Industrial Works.
Gasoline:
Imperial Oil, Ltd.
Gauges:
Pratt & Whitney Co., of Canada, Ltd.
Gear Reductions:
Hamilton Gear & Machine Co.
Gears:
Canadian Vickers Ltd.
Hamilton Gear & Machine Co
Link-Belt, Ltd.
Gears, Machine Cut:
Jones and Glassco, Regd.
Gears, Double Helical:
De Laval Steam Turbine Co.
Generators:
Canadian General Electric Co., Ltd.
Canadian Westinghouse Co.Ltd.
Griswold & Co., Ltd.
Lancashire Dynamo and Motor Co. of Can. Ltd.
Grab Buckets:
Link-Belt Ltd.
Mussens Limited.
Grating, Steel:
Irving Iron Works Co.
Gratings, Area, Sidewalk:
Irving Iron Works Co.
Ground Joints Unions:
Dart Union Co., Ltd.
Ground Pipe Caps & Points:
G. & W. Electric Specialty Co.
Ground Shafting:
Cumberland Steel Co.
Guards, Truck Radiator:
Irving Iron Works Co.

H

Hammers, Steam:
John Bertram & Sons Co., Ltd.,
Industrial Works.
Hangers:
Link-Belt Ltd.
Midwest Canada Limited.
Hangers, Door:
N. Slater Co., Ltd.
Hydraulic Turbines:
Boving Hydraulic & Engineering Co.
Canadian Vickers Ltd.
Dominion Engineering Works, Ltd.
General Supply Co., of Can. Ltd.
Headlights, Electric Railway:
Dominion Insulator & Mfg. Co., Ltd.
Heaters, Boiler Feed-Water:
Babcock-Wilcox & Goldie-McCulloch Ltd.
Combustion Engineering Corp., Ltd.
Heating Material:
Crane Ltd.
Hobs:
Pratt & Whitney Company of Canada Ltd.
Hoisting Engines:
Clare Osborn, Ltd.
F. H. Hopkins & Co., Ltd.
Lancashire Dynamo and Motor Co. of Can. Ltd.
Mussens Ltd.
Hoists, Electric:
Lancashire Dynamo and Motor Co. of Can. Ltd.
Link-Belt Ltd.
Taylor Stoker Co., Ltd.
Hoists, Hydraulic:
Canadian Vickers Ltd.
Turnbull Elevator Co., Ltd.
Hoists, Mono-Rail:
Link-Belt Ltd.
Taylor Stoker Co., Ltd.
Hydraulic Press Control Systems:
Taylor Stoker Co., Ltd.

I

Industrial Electric Control:
Canadian General Electric Co Ltd.
Dominion Engineering Agency, Ltd.

Insulated Rail Joints, Continuous.
Rail Joint Co., of Canada, Ltd.
Insulation, Steam Pipe Casing:
Pacific Coast Pipe Co. Ltd.
Insulation, Underground Systems:
Canadian Johns-Manville Co. Ltd.
Insulators, Porcelain:
Dominion Insulator & Mfg. Co. Ltd.

J

Joints, Filler Paving:
Barrett Co., Ltd.

K

Kerosene:
Imperial Oil Ltd.

L

Ladder Steps, Steel:
Irving Iron Works Co.
Lathes:
John Bertram & Sons Co., Ltd.,
Leaders, Pile Drivers:
Industrial Works.
Lightning Arrestors:
Canadian General Electric Co., Ltd.
Dominion Engineering Agency, Ltd.
Lighting Equipment, Industrial and Street:
Canadian General Electric Co., Ltd.
Line Materials:
Dominion Insulator & Mfg. Co., Ltd.
N. Slater Co., Ltd.
Locomotives:
Canadian Equipment Co., Ltd.
Clare Osborn, Ltd.
F. H. Hopkins & Co., Ltd.
Mussens Ltd.
Locomotive Cranes:
Canadian Equipment Co., Ltd.
Industrial Works.
Locomotives, Electric:
Canadian General Electric Co., Ltd.
Canadian Westinghouse Co.,Ltd.
Lubricating Oils & Greases:
Imperial Oil Ltd.
Lumber, Asbestos:
Canadian Johns-Manville Co., Ltd.

M

Machine Tools:
John Bertram & Sons Co., Ltd.
Machinery:
Canadian Fairbanks-Morse Co., Ltd.
Dominion Engineering Works, Ltd.
Machinery, Bag Filling and Weighing:
Bates Valve Bag Co.
Mackinaw Clothing:
Grant-Holden-Graham, Ltd.
Mandrels:
Pratt & Whitney Company of Canada, Ltd.
Marine-Machinery:
William Kennedy & Sons, Ltd.
Material Handling Plants:
Canadian Vickers Ltd.
Link-Belt Ltd.
Mussens Limited.
Men's Furnishings:
Grant-Holden-Graham, Ltd.
Merchant Bars:
British Empire Steel Corp., Ltd.
Metal Lath:
Trussed Concrete Steel Co. of Canada, Ltd.
Milling Cutters:
Pratt & Whitney Co., of Canada, Ltd.
Milling Machines:
John Bertram & Sons Co., Ltd.
Mine Hoists, Steam and Electric:
Lancashire Dynamo and Motor Co. of Can. Ltd.
Mining Machinery:
William Kennedy & Sons, Ltd.
Motors:
Canadian Fairbanks-Morse Co., Ltd.
Dominion Engineering Agency Ltd.
Lancashire Dynamo and Motor Co. of Can. Ltd.

Motors, Electric:
Canadian General Electric Co., Ltd.
Canadian Westinghouse Co., Ltd
Lancashire Dynamo and Motor Co. of Can. Ltd.
Lincoln Electric Co., of Canada, Ltd.
Motor Oils:
Imperial Oil Ltd.

N

Nails:
British Empire Steel Corp., Ltd.
Nuts:
British Empire Steel Corp., Ltd.

O

Oil Burning Equipment:
Combustion Engineering Corp., Ltd.
Oil Purifiers, Centrifugal:
De Laval Steam Turbine Co.

P

Packings, Asbestos Sheet:
Canadian Johns-Manville Co., Ltd.
Packings, Rod and Plunger:
Canadian Johns-Manville Co., Ltd.
Paints, Metal Protectives:
Barrett Co., Ltd.
Paper Bags:
Bates Valve Bag Co.
Paper Mill Machinery:
Dominion Engineering Works, Ltd.
Paving Contractors:
Standard Paving Ltd.
Pencils:
American Lead Pencil Co.
Penstocks:
Canadian Vickers Ltd.
Horton Steel Works, Ltd.
Pacific Coast Pipe Co., Ltd.
Pile Drivers:
Industrial Works.
Pinions:
Hamilton Gear & Machine Co.
Jones & Glassco, Reg'd.
Pipe Coils:
Superheater Co., Ltd.
Pipe, Concrete:
Jno. E. Russell Co., Ltd.
Pipe Couplings, Union:
Dart Union Co., Ltd.
Pipe Fittings:
Crane Ltd.
Pipe, Lead:
Steel Co. of Canada, Ltd.
Pipes, Cast Iron:
Canada Iron Foundries, Ltd.
Gartshore-Thomson Pipe and Foundry Co., Ltd.
General Supply Co., of Canada Ltd.
Kennedy & Company, Ltd.
National Iron Corp., Ltd.
Pipe Insulations:
Canadian Johns-Manville Co., Ltd.
Pipe Lock Bar:
General Supply Co., of Canada, Ltd.
Pipe, Wood Stave:
Pacific Coast Pipe Co., Ltd.
Pipes, Reinforced Concrete:
Jno E. Russell Co., Ltd.
Pipes, Wrought Iron:
Crane Ltd.
Planing Machines, Metal:
John Bertram & Sons Co., Ltd.,
Plate Rolls:
John Bertram & Sons Co., Ltd.,
Plates, Brass and Copper:
Openshaw & Bennet, Ltd.
Plates, Steel:
British Empire Steel Corp., Ltd.
Canadian Vickers Ltd.
Hamilton Bridge Works Co.,Ltd.
Vulcan Iron Works, Ltd.
Plumbing Material:
Crane Ltd.
Pole Line Hardware:
Canadian Line Materials, Ltd.
Posts, Indicator:
Jenkins Bros., Ltd.
Porcelain, Insulators:
Dominion Insulator & Mfg. Co., Ltd.
Pot Heads:
G. & W. Electric Specialty Co.
Power Apparatus:
Northern Electric Co., Ltd.

Purchaser's Classified Directory

Power Plant Equipment:
- Babcock-Wilcox & Goldie-McCulloch Ltd.
- Combustion Engineering Corp. Ltd.
- Canadian Vickers Ltd.
- Midwest Canada Limited.

Presses, Hydraulic:
- John Bertram & Sons Co., Ltd.

Propellor Wheels:
- Canadian Vickers Ltd.
- Wm. Kennedy & Sons, Ltd.

Pulp Mill Machinery:
- Dominion Engineering Works, Ltd.
- William Hamilton Co., Ltd.

Pulp Pumps:
- De Laval Steam Turbine Co.

Pulpwood Machinery:
- Canadian Vickers Ltd.

Pulverized Fuel Systems:
- Combustion Engineering Corp., Ltd.
- Under-Feed Stoker Co., of Canada, Ltd.

Pump Governors:
- Under-Feed Stoker Co., of Canada, Ltd.
- C. A. Dunham Co., Ltd.

Pump Valves:
- Jenkins Bros., Ltd.

Pumps:
- Canadian Fairbanks-Morse Co., Ltd.
- Dominion Engineering Works, Ltd.
- General Supply Co., of Canada, Ltd.
- Jones & Glassco, Reg'd.
- Mussens Limited.

Pumps and Condensers:
- Babcock-Wilcox & Goldie-McCulloch Ltd.

Pumps, Centrifugal:
- De Laval Steam Turbine Co.
- Dominion Engineering Works, Ltd.
- Laurie & Lamb.

Pumps, Hydraulic:
- Taylor Stoker Co., Ltd.

Pumps Oil:
- Taylor Stoker Co., Ltd.

Punches and Punch Dies:
- Pratt & Whitney Company of Canada, Ltd.

Punches and Shears:
- John Bertram & Sons Co., Ltd.

R

Radiator Traps:
- Canadian Johns-Manville Co., Ltd.

Radiator Valves:
- Jenkins Bros., Ltd.

Radio Batteries:
- Dominion Battery Co., Ltd.

Radio Receiving Sets:
- Northern Electric Co., Ltd.

Rail Bonds:
- Dominion Insulator & Mfg., Co. Ltd.

Rail Joints:
- Rail Joint Co., of Canada, Ltd.

Rail Saw (Portable):
- Industrial Works.

Rails:
- Algoma Steel Corp., Ltd.
- British Empire Steel Corp., Ltd.
- Burlington Steel Co., Ltd.
- Canadian Equipment Co., Ltd.
- F. H. Hopkins & Co., Ltd.
- Steel Co. of Canada, Ltd.

Railroad Spikes:
- Steel Co., of Canada, Ltd.

Railway Equipment:
- Canadian Equipment Co., Ltd.
- Canadian General Electric Co., Ltd.

Rawhide Pinions:
- Hamilton Gear & Machine Co.

Rawlplugs:
- Dominion Engineering Agency Ltd.

Reamers:
- Pratt & Whitney Co., of Canada, Ltd.

Recording Instruments:
- Combustion Engineering Corp., Ltd.

Refrigerating Machinery:
- Taylor Stoker Co., Ltd.

Reinforcing Steel:
- Burlington Steel Co., Ltd.
- Midwest Canada Limited.
- Trussed Concrete Steel Co., of Canada, Ltd.

Rivets:
- British Empire Steel Corp., Ltd.

Road Oils & Preservatives:
- Barrett Co., Ltd.

Road Rollers:
- Canadian Equipment Co., Ltd.
- Dominion Insulator & Mfg. Co., Ltd.
- Mussens Limited.

Rock Drills, Air and Steam:
- Lancashire Dynamo and Motor Co., of Can. Ltd.

Rods, Steel:
- British Empire Steel Corp., Ltd.

Roofing, Prepared:
- Barrett Co., Ltd.

Rolling Mill Rolls:
- Canadian Steel Foundries Ltd.

Roofs, Built up, Felt & Pitch:
- Barrett Co., Ltd.

Roofing, Asbestos and Prepared:
- Canadian Johns-Manville Co., Ltd.

Roofs, Asbestos Built up:
- Canadian Johns-Manville Co., Ltd.

Roofing, Asbestos Ready-to-lay:
- Canadian Johns-Manville Co., Ltd.

Roofing, Corrugated Asbestos:
- Canadian Johns-Manville Co., Ltd.

Rope, Wire:
- Dominion Wire Rope Co., Ltd.
- Mussens Limited.

Rubber Goods, Mechanical:
- Jenkins Bros., Ltd.

S

Safes:
- Babcock-Wilcox & Goldie-McCulloch Co., Ltd.

Sash, Steel:
- Trussed Concrete Steel Co., of Canada, Ltd.

Sawmill Chains:
- Link-Belt Ltd.

Sawmill Machinery:
- William Hamilton Co., Ltd.

Scales:
- Canadian Fairbanks-Morse Co., Ltd.

Screening Equipment:
- Canadian Vickers Ltd.
- Link-Belt, Ltd.
- Mussens Limited.

Screw Blanks, Lead:
- Cumberland Steel Co.

Series Cut Outs:
- G. & W. Electric Specialty Co.

Sewer Pipe:
- Jno. E. Russell Co., Ltd.

Shaft Couplings, Flexible:
- De Laval Steam Turbine Co.

Shafting, Anchorage:
- Midwest Canada, Ltd.

Shafting, Cold Drawn:
- Cumberland Steel Co.

Sheathing:
- Barrett Co., Ltd.

Sheets:
- Steel Co., of Canada Ltd.

Shingles, Asbestos:
- Canadian Johns-Manville Co., Ltd.

Shingles, Prepared Asphalt:
- Barrett Co., Ltd.

Skip Hoists:
- Combustion Engineering Corp., Ltd.
- Link-Belt Ltd.
- Mussens Limited.

Sleeping Robes:
- Grant-Holden-Graham, Ltd.

Smoke Stacks:
- Canadian Vickers Ltd.
- Combustion Engineering Corp., Ltd.
- Horton Steel Works, Ltd.

Sodas:
- Nichols Chemical Co., Ltd.

Speed Reducers, Gear:
- Hamilton Gear & Machine, Co.

Spikes:
- British Empire Steel Corp., Ltd.

Springs:
- B. J. Coghlin Co., Ltd.

Sprinkler Tanks:
- Horton Steel Works, Ltd.

Stair Steps, Safety:
- Irving Iron Works Co.

Staples:
- British Empire Steel Corp., Ltd.

Steam Heating Specialties:
- C. A. Dunham Co., Ltd.

Steam Shovels:
- Canadian Equipment Co., Ltd.
- F. H. Hopkins & Co., Ltd.
- Mussens, Ltd.

Steam Traps:
- C. A. Dunham Co., Ltd.
- Canadian Johns-Manville Co., Ltd.

Steel, Ground Alloy:
- Cumberland Steel Co.

Steel Head Frames:
- Hamilton Bridge Works Co.,Ltd.

Steel Pipe:
- Horton Steel Works, Ltd.

Steel Plate Construction:
- Horton Steel Works, Ltd.

Steel Shafting:
- Cumberland Steel Co.

Steel Stacks:
- Midwest Canada Limited.

Stokers:
- Combustion Engineering Corp. Ltd.
- Under-Feed Stoker Co., of Canada, Ltd.

Stokers, Side-feed:
- Combustion Engineering Corp. Ltd.
- Under-Feed Stoker Co., of Canada, Ltd.

Stokers, Under-feed:
- Combustion Engineering Corp., Ltd.
- Taylor Stoker Co., Ltd.
- Under-Feed Stoker Co., of Canada, Ltd.

Stone Crushers:
- General Supply Co., of Canada, Ltd.
- Mussens Limited.

Structural Steel:
- Algoma Steel Corporation, Ltd.
- British Empire Steel Corp., Ltd.
- Canadian Bridge Co., Ltd.
- Canadian Vickers Ltd.
- Hamilton Bridge Works Co.,Ltd.
- Standard Steel Constrn.Co.,Ltd.
- Steel Co. of Canada, Ltd.
- Vulcan Iron Works, Ltd.

Superheaters:
- General Supply Co., of Canada, Ltd.
- Superheater Co., Ltd.

Switches, Disconnecting:
- Canadian Line Materials, Ltd.

Switchboards, Power Lighting:
- Canadian General Electric Co., Ltd.
- Canadian Johns-Manville Co., Ltd.

Switchgears:
- Lancashire Dynamo and Motor Co. of Can. Ltd.

T

Tanks, Cylindrical:
- Horton Steel Works, Ltd.

Tanks, Oil:
- Horton Steel Works, Ltd.

Tanks, Steel:
- Canadian Vickers Ltd.
- Horton Steel Works, Ltd.
- E. Leonard & Sons, Ltd.

Tanks, Wood Stave:
- Pacific Coast Pipe Co., Ltd.

Taps:
- Pratt & Whitney Co., of Canada, Ltd.

Tar:
- Barrett Co., Ltd.

Tents:
- Grant-Holden-Graham, Ltd.

Tie Plates:
- British Empire Steel Corp., Ltd.

Tools, Small:
- Pratt & Whitney Co., of Canada. Ltd.
- E. Leonard & Sons, Ltd.

Tools, Wrecking:
- Industrial Works.

Track Tools:
- B. J. Coghlin Co., Ltd.

Tractors:
- Mussens Limited
- F. H. Hopkins & Co., Ltd.

Transfer Tables:
- Industrial Works.

Transformers, Lighting & Power:
- Canadian General Electric Co., Ltd.

Transmission Machinery:
- Link-Belt Ltd.

Trolley Materials:
- Dominion Insulator & Mfg. Co., Ltd.

Tubing, Seamless Steel:
- Openshaw & Bennet Ltd.

Turbines Hydraulic:
- Boving Hydraulic & Engineering Co., Ltd.
- Canadian Vickers Ltd.
- Dominion Engineering Works, Ltd.
- General Supply Co., of Canada, Ltd.

Turbines, Steam:
- De Laval Steam Turbine Co.

Turbo Generators:
- De Laval Steam Turbine Co.

U

Under-feed Stokers:
- Combustion Engineering Corp., Ltd.
- Taylor Stoker Co., Ltd.

Union Pipe Couplings:
- Dart Union Co., Ltd.

V

Valve Boxes:
- Jenkins Bros., Ltd.

Valve Files:
- Jenkins Bros., Ltd.

Varnishes, Acid Resisting:
- Dominion Paint Works, Ltd.

Varnishes, Insulating:
- Dominion Paint Works, Ltd.

Valves:
- Canadian Fairbanks-Morse Co., Ltd.
- Crane Limited.
- C. A. Dunham Co., Ltd.
- Dominion Engineering Works, Ltd.
- Jenkins Bros., Ltd.
- Kerr Engine Co., Ltd.

Valves, Automatic Cut-off:
- Under-Feed Stoker Co., of Canada, Ltd.

Valves, Penstock:
- Dominion Engineering Works, Ltd.

Valves, Regulating:
- C. A. Dunham Co., Ltd.
- Under-Feed Stoker Co., of Canada, Ltd.

Valves, Relief:
- Under-Feed Stoker Co., of Canada, Ltd.

Venturi Meters:
- General Supply Co., of Canada, Ltd.

W

Washers:
- British Empire Steel Corp., Ltd.

Water Meters:
- Neptune Meter Co., Ltd.

Water Meters, Volumetric:
- Canadian Johns-Manville Co., Ltd.

Water Power Plant Machinery:
- Canadian Vickers Ltd.
- Wm. Kennedy & Sons, Ltd.

Waterproofing:
- Barrett Co., Ltd.
- Canadian Johns-Manville Co., Ltd.

Water Softening Plants:
- Laurie & Lamb.

Waterworks Constructional Articles:
- Lincoln Electric Co., of Canada, Ltd.

Welding Machines, Electric and Accessories:
- Canadian General Electric Co., Ltd.
- Canadian Westinghouse Co., Ltd
- Dominion Insulator & Mfg., Co., Ltd.
- Lincoln Electric Co., of Canada, Ltd.

Wharf Cranes:
- Industrial Works.

Wheelbarrows:
- Bateman-Wilkinson.

Winches:
- Taylor Stoker Co., Ltd.

Wire:
- British Empire Steel Corp., Ltd.
- Steel Co.,of Canada, Limited.

Wire Bag Ties:
- Bates Valve Bag Co.

Wire Bar Ties:
- Bates Valve Bag Co.

Wire Mesh:
- Trussed Concrete Steel Co., of Canada, Ltd.

Wire Rope:
- Dominion Wire Rope Co., Ltd.
- F. H. Hopkins & Co., Ltd.

Wires and Cables:
- Northern Electric Co., Ltd.

Wood Grapples:
- Industrial Works.

Wood Preservations:
- Barrett Co., Ltd.

Woodruff Key Cutters:
- Pratt & Whitney Company of Canada, Ltd.

Worm Gear:
- Hamilton Gear & Machine Co.
- Link-Belt Ltd.

Wrecking Cranes:
- Industrial Works.

Wrecking Tools:
- Industrial Works.

Consult the advertiser, his information is valuable.

TENDERS

DEPARTMENT OF PUBLIC WORKS
CANADA

SEALED Tenders addressed to the undersigned, and endorsed "Tender for Two Steel Caissons, Esquimalt, B.C." will be received at this office until *12 o'clock noon, Thursday, December 4th, 1924*, for the construction of Two Steel Floating Caissons for the New Drydock at Esquimalt, B.C.

Plans and forms of contract can be seen and specification and forms of tender obtained at this Department, at the offices of the District Engineers, Post Office Building, Victoria, B.C.; Post Office Building, New Westminster, B.C.; Equity Building, Toronto, Ont.; Postal Station "H", Montreal, Que.; Post Office Building, Quebec, Que., and Custom House Building, St. John, N.B., and at the Post Offices, Vancouver, B.C , and Esquimalt, B.C.

Tenders will not be considered unless made on printed forms supplied by the Department and in accordance with conditions contained therein.

Each tender must be accompanied by an accepted cheque on a chartered bank, payable to the order of the Minister of Public Works, equal to 5 per cent of the amount of the tender. Bonds of the Dominion of Canada or bonds of the Canadian National Railway Company will also be accepted as security, or bonds and cheque if required to make up an odd amount.

NOTE.—Blue prints can be obtained at this Department by depositing an accepted cheque for the sum of $50.00, payable to the order of the Minister of Public Works, which will be returned if the intending bidder submit a regular bid.

By order,
S. E. O'BRIEN,
Secretary.

Department of Public Works,
Ottawa, October 17, 1924.

DEPARTMENT OF RAILWAYS AND CANALS

WELLAND SHIP CANAL
Section 7
NOTICE TO CONTRACTORS

CONTRACTORS are hereby notified that the time for receiving tenders in connection with the construction of Section 7, Welland Ship Canal, has been extended to 12 o'clock, noon, Monday, December 1st, 1924.

By order,
J. W. PUGSLEY,
Secretary.

Department of Railways and Canals,
Ottawa, October 21, 1924.

Notice

The partnership entered into on April 1st, 1910, between Willis Chipman and George Herbert Power, Civil Engineers, Toronto, has been dissolved by mutual consent this first day of October 1924.

DEPARTMENT OF RAILWAYS AND CANALS

WELLAND SHIP CANAL
Section 7
NOTICE TO CONTRACTORS

SEALED TENDERS, addressed to the undersigned and marked "Tender for Section 7, Welland Ship Canal", will be received at this office until 12 o'clock noon, Monday, December 1st, 1924.

Plans, specifications and form of contract to be entered into can be seen on or after this date at the office of the Chief Engineer of the Department of Railways and Canals, Ottawa, and at the office of the Engineer in Charge, Welland Ship Canal, St. Catharines, Ont.

Copies of plans and specifications may be obtained from the Department on the payment of the sum of fifty dollars. To bona fide tenderers this amount will be refunded upon the return of the above in good condition.

An accepted bank cheque on a chartered bank of Canada for the sum of $575,000.00 made payable to the order of the Minister of Railways and Canals, or War Loan Bonds of the Dominion of Canada to the same amount or War Loan Bonds and cheques if required to make up the difference, must accompany each tender, which sum will be forfeited if the party tendering declines entering into contract for the work at the rates stated in the offer submitted.

The cheque or bonds thus sent in will be returned to the respective contractors whose tenders are not accepted.

The cheque or bonds of the successful tenderer will be held as security, or part security, for the due fulfilment of the contract to be entered into.

The lowest or any tender not necessarily accepted.

By order,
J. W. PUGSLEY,
Secretary.

Department of Railways and Canals,
Ottawa, October 1, 1924.

INDEX TO ADVERTISERS

Members are urged to consult The Journal's advertising pages.

PROFESSIONAL CARDS


B-W AND G-McC
OUR PRODUCTS
Water-Tube and Return Tubular Power and Heating Boilers.
Balanced Draft Chain Grate Stokers.
Superheaters, Economisers, Coal and Ash Handling Equipment, Feed Water Heaters and Purifiers.
Horizontal and Vertical Steam Engines.
Steam Turbines.
Vertical and Horizontal Reciprocating Pumps.
REES RoTURBo Centrifugal Pumps.
Tanks, Stacks and Steel Plate Work.
Electric Cranes and Loading Devices.
CANADIAN LICENSEES
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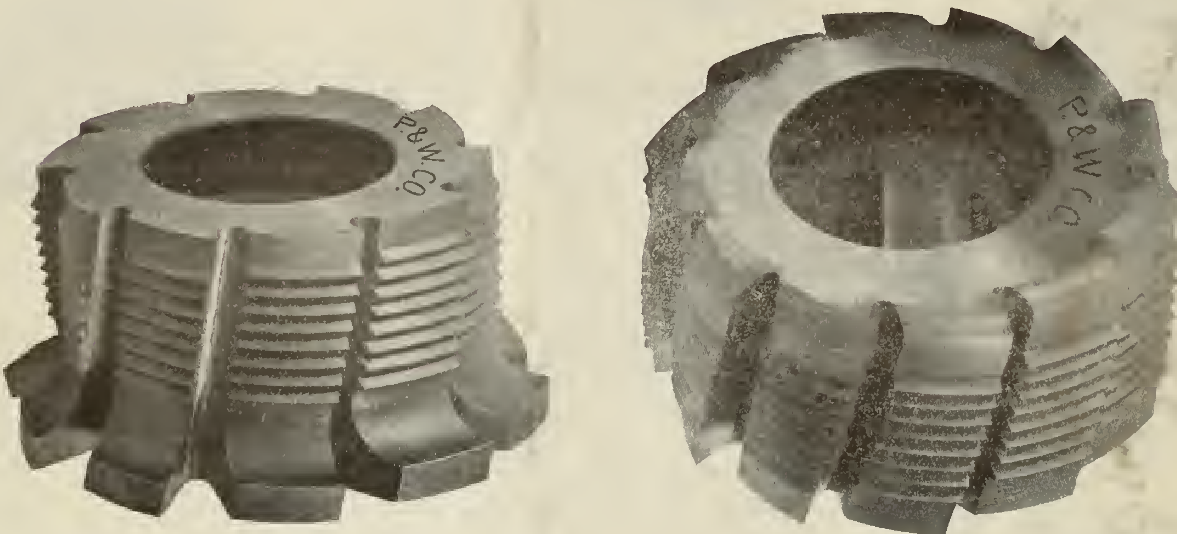

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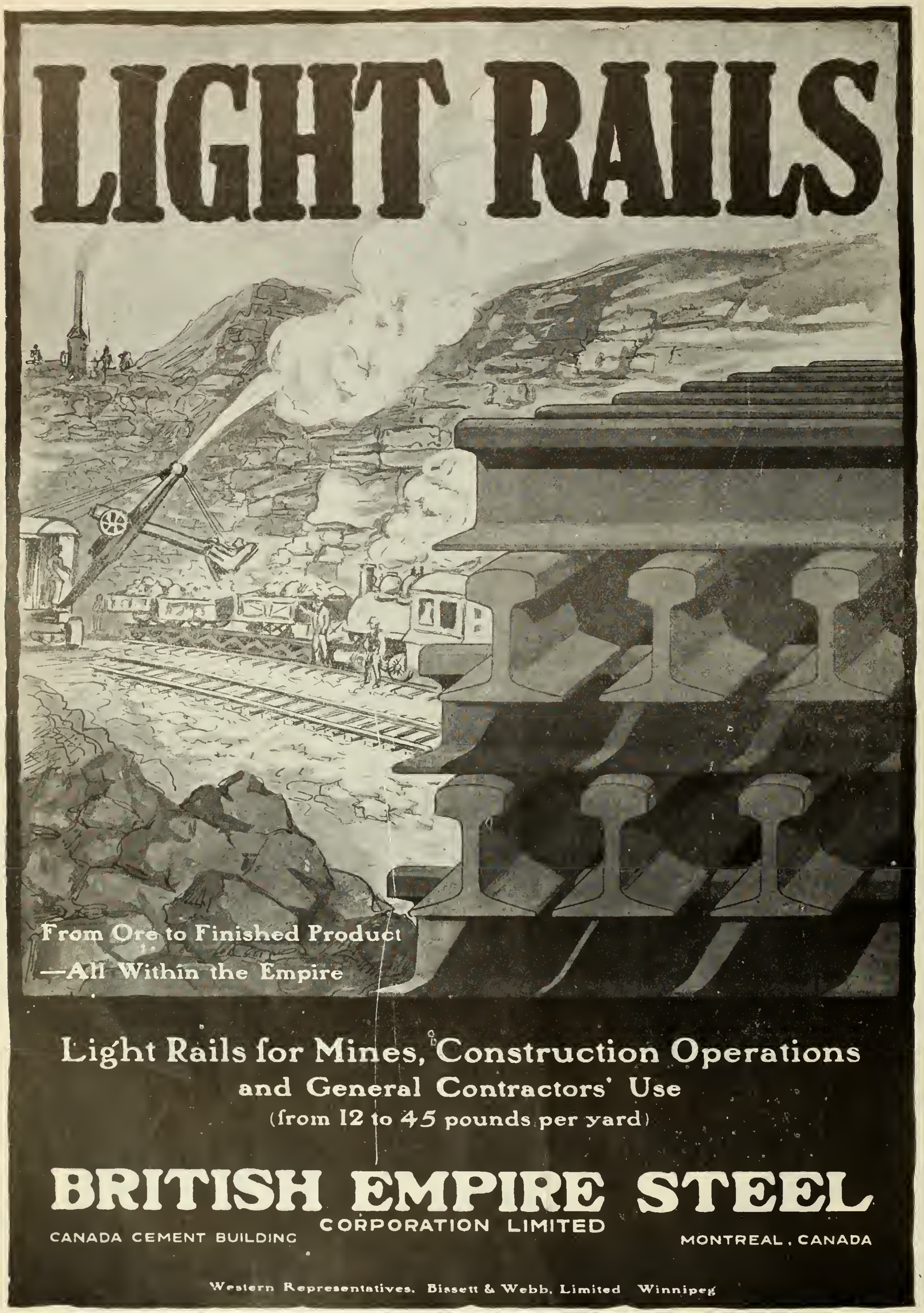
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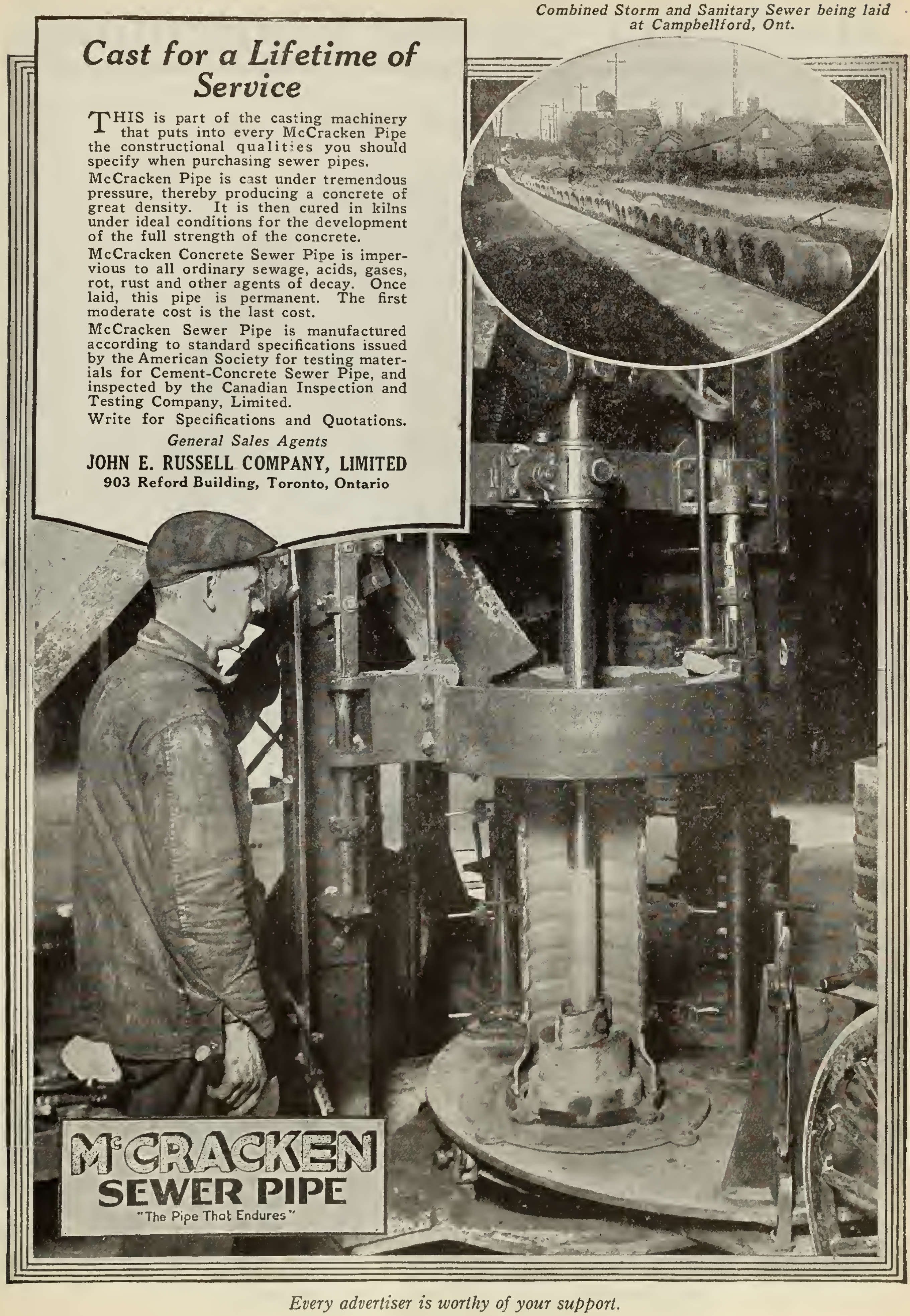

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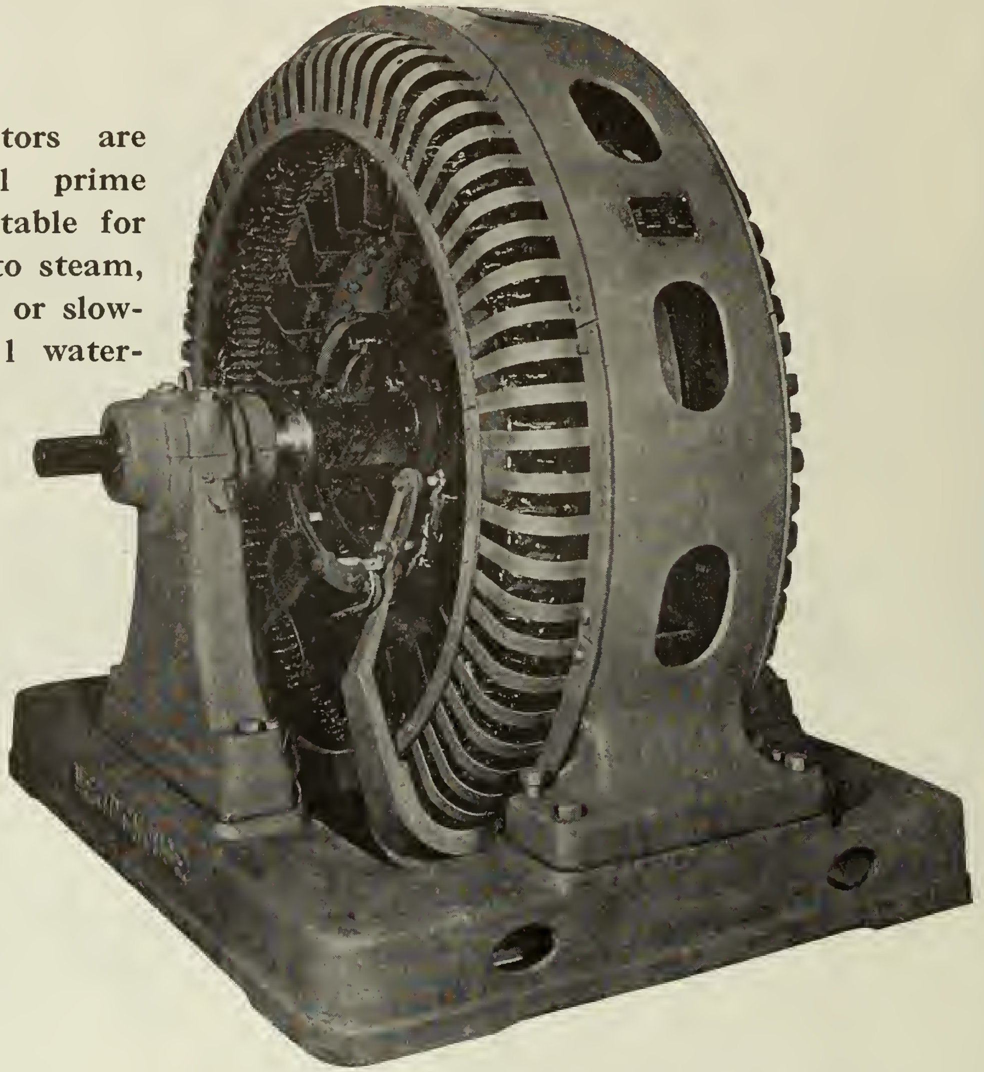

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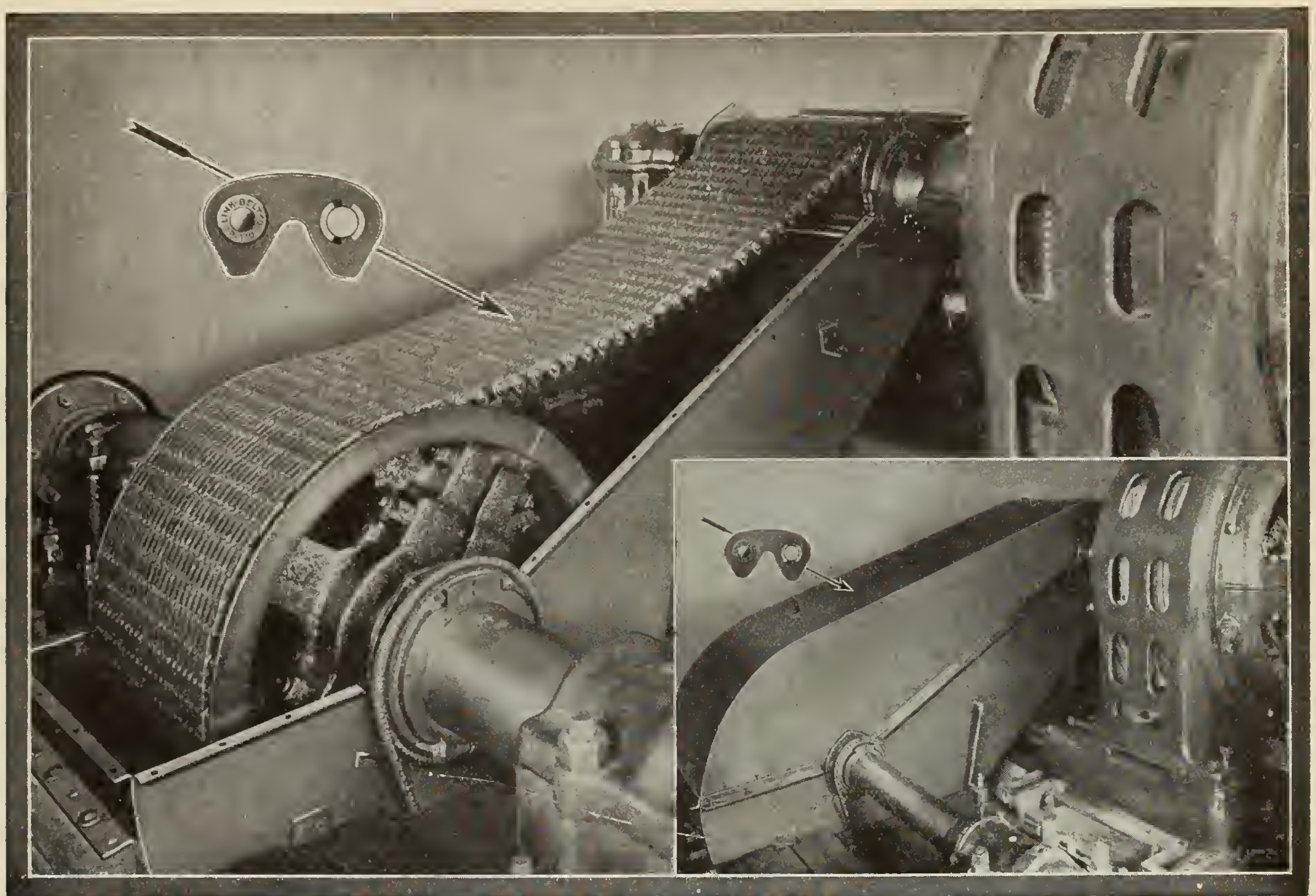

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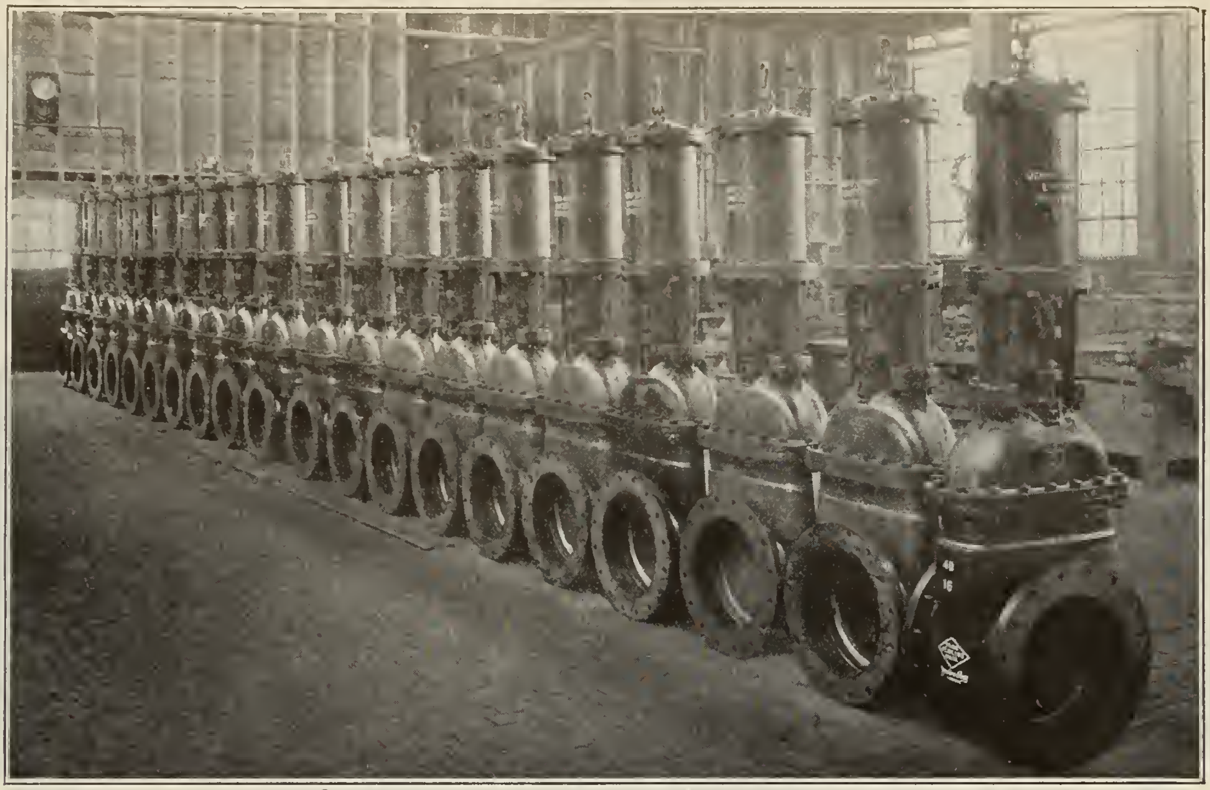

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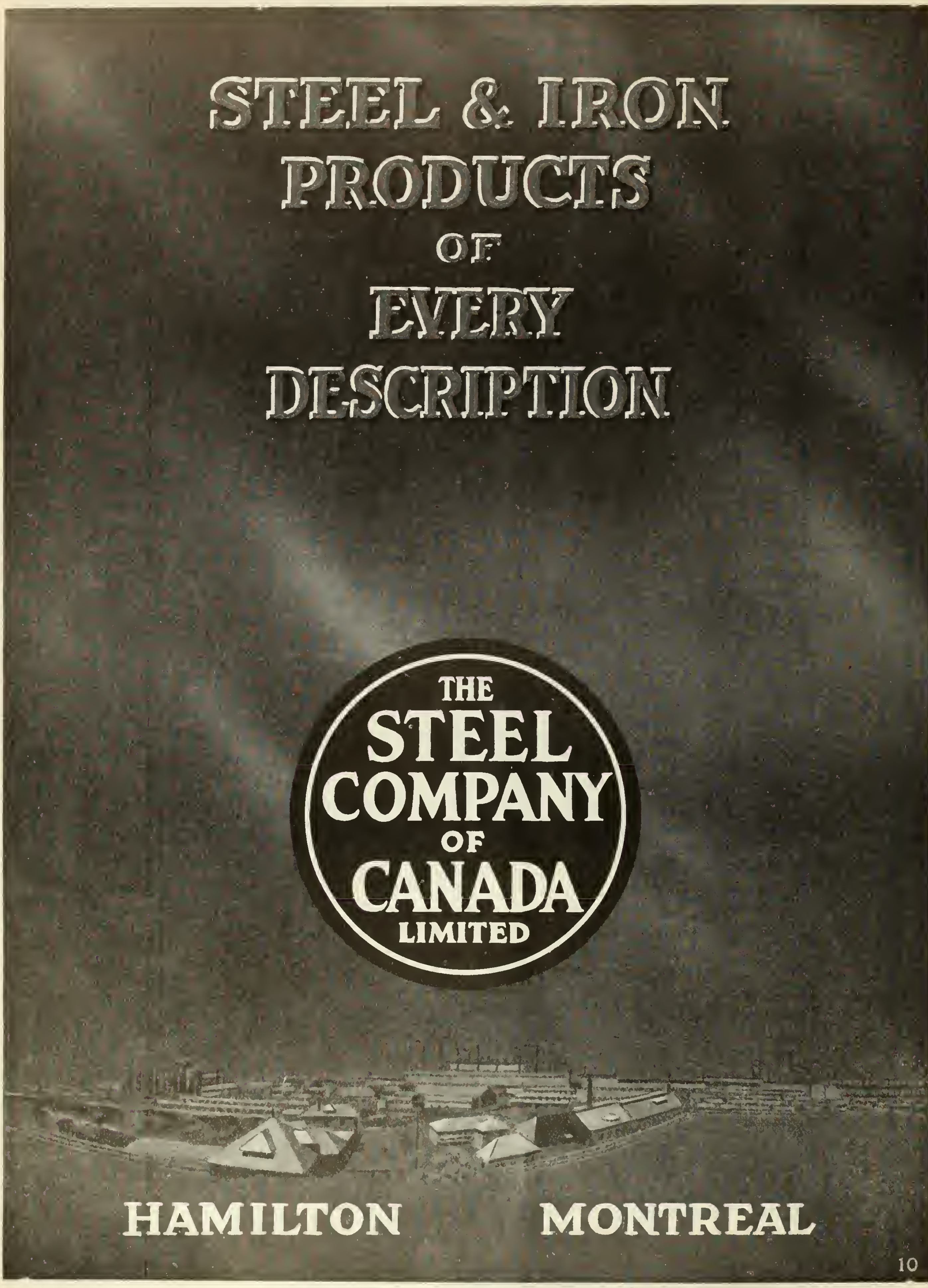
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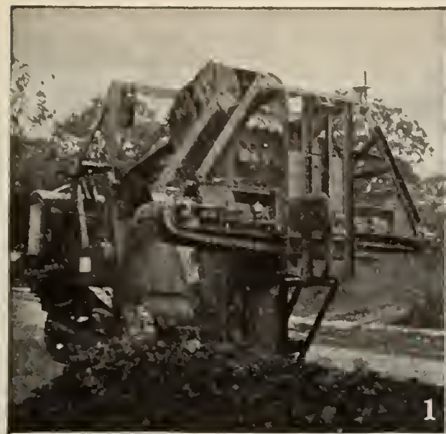
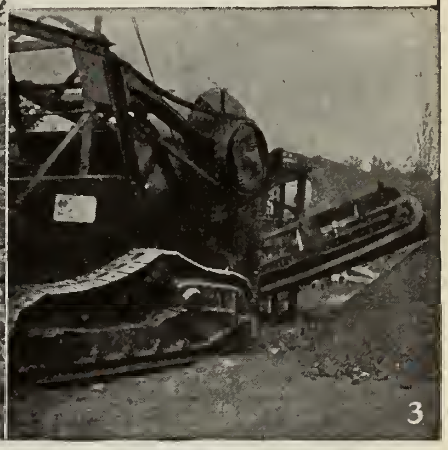
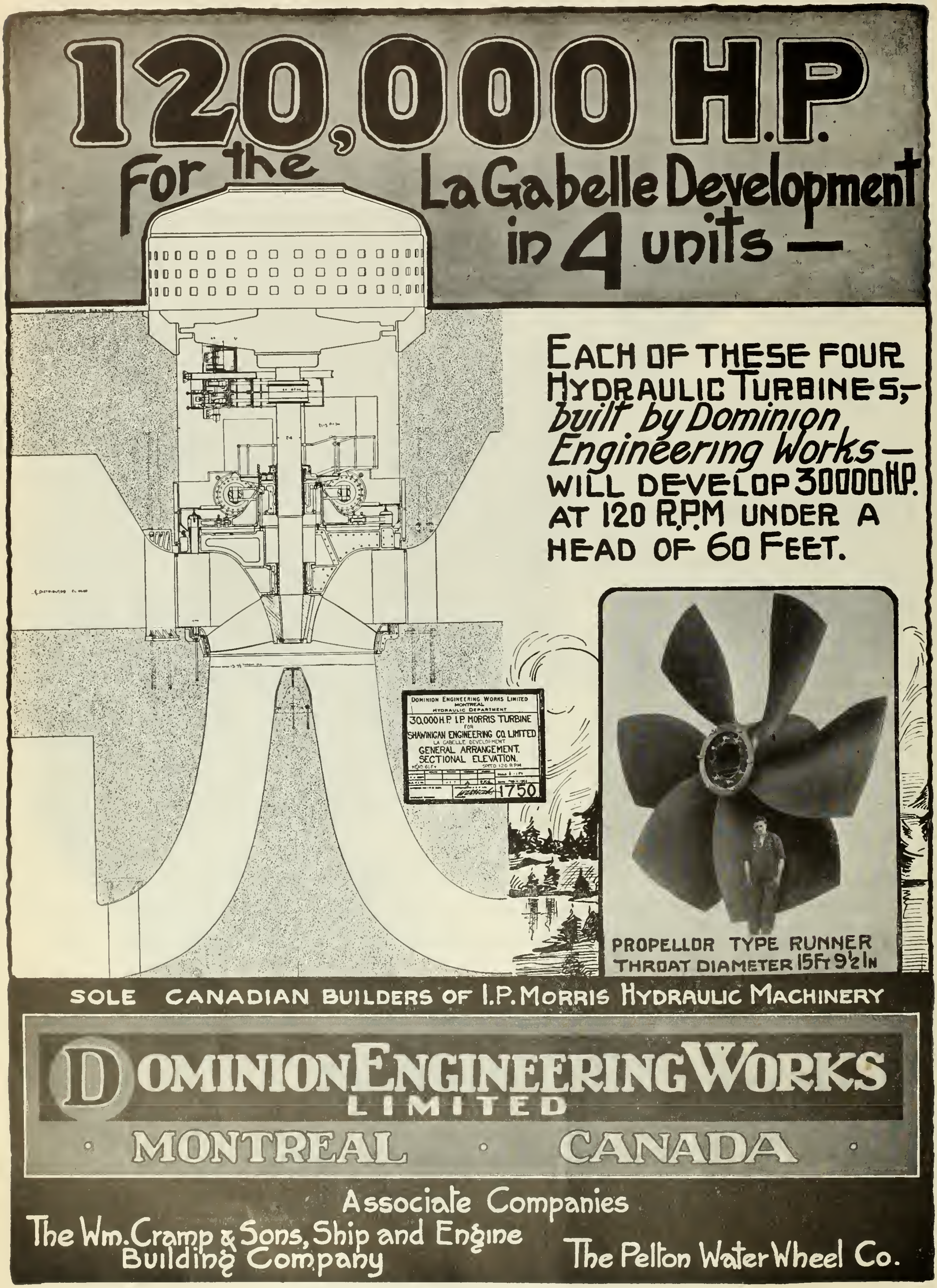


1—R. E. Sholes' Barber-Greene Ditcher cutting through hara going on a Raleigh, N. C., water main job. This photograph shows the discharge ana the vertical digging boom.



2—Notice the clean cut ditch, and the dirt pile placed well back from the cut.

3—A close-up oj the ditcher, showing discharge.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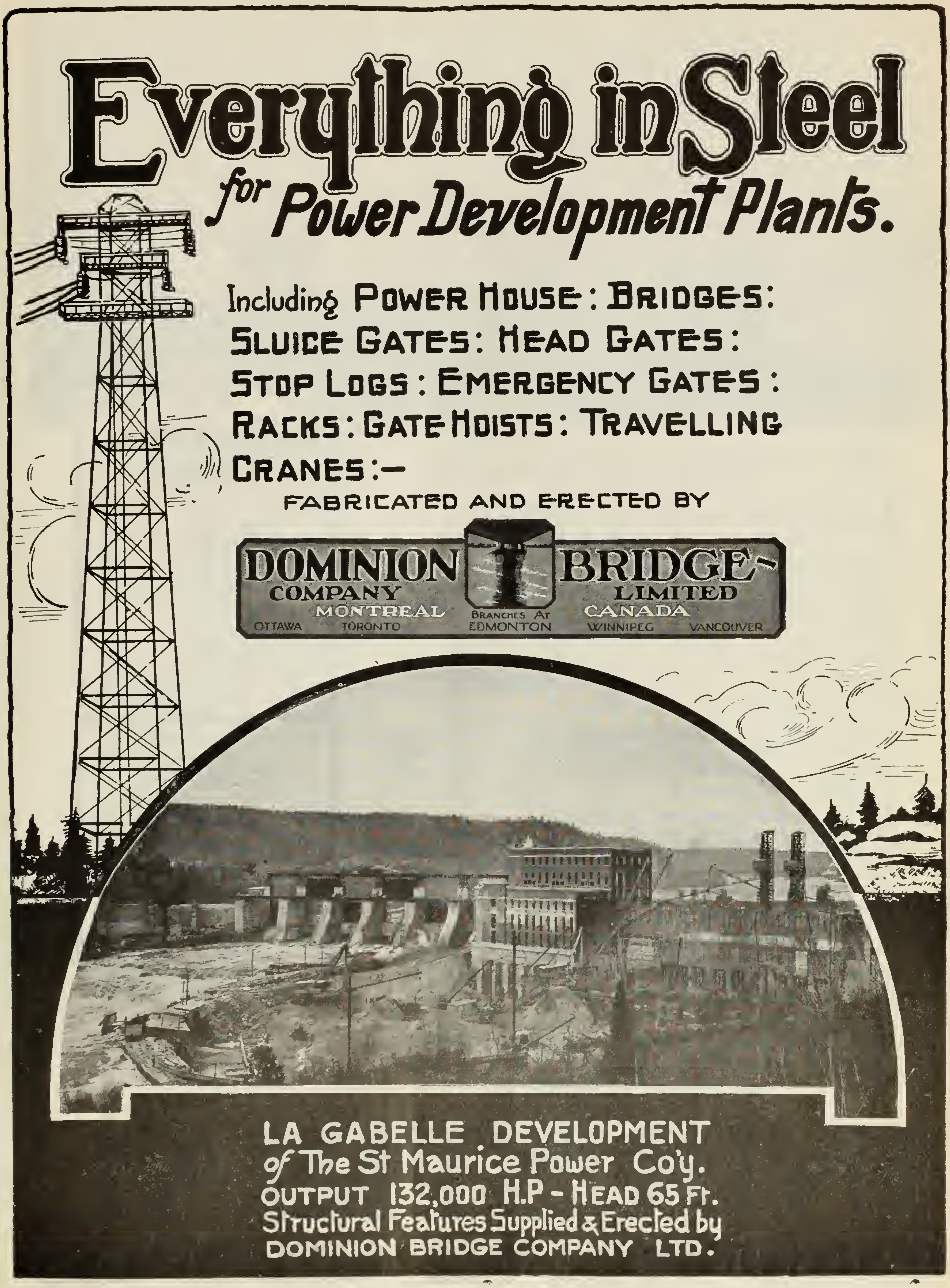
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Steel Rails

Historical outline of progress in design, details of manufacture and requirements to meet present day conditions.

C. B. Bronson,
Assistant Inspecting Engineer, New York Central Lines, New York

Paper read before the Montreal Branch, The Engineering Institute of Canada, October 30th, 1924.

Steel rails are the connecting links between the means of transport and the right of way. Their chief functions are to guide the wheels of the power and equipment, resolve and distribute the stresses of the wheel effects, and transmit the superimposed loads to the ties, ballast and roadbed. The diminutive height of the rail sections compared to the steel giants they sustain brings out in striking and effective manner their duties and the severity of service.

The literature of engineering materials contains numerous and important discussions, reports and researches on their pre-eminent value in the improvements and advancement of railroad science. The real significance of the rail is brought forcefully home as increases in capacity of power and equipment continue as economic necessities for transportation at the least possible cost.

With these thoughts in mind, rail design, manufacture, improvement and future possibilities are subjects for consideration. That the growth of the railroads from meager beginnings has taken place in the short span of less than a century to their present expanse and efficiency is a remarkable tribute to the hardy pioneers and their successors. Being men of foresight, vision and resourcefulness, they started in a practically unknown field, and with crude tools, scant funds, and limited engineering materials mapped out and built those little roads which were the forerunners of the immense systems of today. The efforts of the pioneers were first directed towards securing some means of locomotion to operate on a roughly built track. The track structure was of secondary importance to the steam generator, but with this principle mastered and established, the rail and its support became of increasing interest.

The first substantial tracks were built with a solid foundation, consisting of pits of crushed stone to carry stone blocks which formed the support for heavy wooden stringers placed longitudinally. The guides for the wheels were strips of wrought iron fastened to the top of the stringers. The structure however lacked stability, the strips of iron worked loose and curled up, and it was seen that the basic principle of these primitive tracks must be abandoned.

The next move was to select or develop a form of rail which combined support and rigidity, and contained a head member as guide for the wheels. Ideas were numerous and many novel forms presented, among which were the "U" section, Booth capped rail, pear shaped rail, compound sections of various types, and the "T" section which finally emerged as the standard form and has remained so ever since. Some sections were so complex that only sleight of hand dexterity on the part of roll designers would permit their rolling within the limits of the design submitted.

For over thirty years, wrought iron was the only material available for rails. The inherent softness meant short life, and its fiberous structure was the cause of all too frequent failures, as strips of the iron flaked and split off. It was fortunate indeed for the railroads that Sir Henry Bessemer perfected his pneumatic process for the direct conversion of molten iron into steel. This meant the doom of wrought iron and the advent of steel. The cost of steel rails at first was excessive on account of importation. Funds were being diverted to the construction of the large mileage needed for an expanding country, and Bessemer steel had to wait until its cost became lower. Progressive railway officers however realized the accruing advantages from the use of this new and useful material, invested, and reaped th benefit in the ensuing years. The life of the Bessemer steel rails proved to be beyond expectations, and was from 10 to 15 times that of wrought iron rails, and furthermore was a much safer metal with few failures developing.

The Introduction and Early Development of the Steel Rail

Steel rails, like their predecessors, were rolled in light sections. They were weak and limber and created loose, flexible track. The ends were cut out, ties destroyed by mechanical abrasion and not decay, and the ballast and roadbed disturbed by the light loads of only ten to twelve tons per axle. The wheel effects were concentrated on each tie, and not distributed by the rail section, due entirely to the lack of girder strength of the section, and the loose manner in which the rail ends were joined by the fish plates. Operating and engineering officers were spending large sums in maintenance with the hope of stabilizing the track, which did not materialize. The effect of each year's labour, instead of being cumulative as anticipated, was largely destroyed before the work of the succeeding year could be commenced.

In the late seventies, the eastern railroads were faced with this situation with growing concern. It was at that time that the late Dr. P. H. Dudley began his first intensive studies of rail and track structure, which constituted his life's work. The mechanism he developed for this purpose was a track indicator which travelled over the road at moderate speed and autographically recorded the exact condition of rails, joints and tracks, with all the irregularities of line and surface accurately shown on a roll of paper which was fed slowly through the machine at a predetermined speed. Records were laboriously accumulated on thousands of miles of tracks of all types of construction, rail sections and roadbed, and showed on examination the futility of further expenditures for maintaining the light limber sections then in use.

This paved the way for the introduction of the pioneer 5-inch, 80-pound rail on the New York Central and Hudson River Railroad in 1883, and its installation on the Harlem road in 1884. The basic and essential principle of girder strength was embodied in the design of this rail section for the first time. The stiffness of the section was 66 per cent greater than that of the former 4½-inch, 65-pound rail with an addition of only 15 pounds per yard. This epoch making improvement became generally known and officials of other systems, after investigating the practical installations, were so convinced with the possibilities of improving their right of way that several sections 5 inches in height and weighing 80 to 85 pounds per yard were shortly introduced.

The operating departments were quick to realize the advantage of these stiffer rails in stabilizing the track, and the possibility of hauling greater paying loads on the same track and roadbed structure. Power and equipment departments commenced the development of locomotives of greater steaming capacity and tractive effort, and cars for heavier loads. By 1891, axle loads had been doubled, and in some cases the tonnage of trains had trebled. Fast passenger and express service followed when tracks were sufficiently relayed with the heavier rail. The outstanding example was the inauguration of the Empire State Express in 1891 — an experiment in high speed long distance operation which many doubted could continue as regular operating practice. The train has been in continuous operation since its inception and is widely known all over the world.

Progress has been both continuous and rapid. This is brought out in a striking manner by the chart shown as figure No. 1, which brings together the trend towards increased weight of rail, increase of axle load, and the reduction in undulations per mile of track commencing with 1881, through the formative period of present day heavy and stiff rail sections. The undulations were secured by means of the track indicator, and were summed up into feet and inches per mile. Every rail in the main lines entered into the calculation, as the records were autographically made on the moving strip of paper in the machine. The summations were obtained with a mechanical integrator, and later tabulated and condensed On figure No. 2 are full sized records of the undulations and irregularities for the 65- and 80-pound rails. The vast improvement in the reduction of the undulations and the greater smoothness of the stiffer rail section is well illustrated by this comparison.

Standardizing of Rail Sections

In the light sections, a multiplicity of designs were called for which tied up capital of the mills in rolls and was seen to be an economic waste. Engineers realized that standardization was essential; the first attempt being made by the American Society of Civil Engineers in 1873 when sections 72 pounds and under were developed. The same society made a second study of rail sections in the late eighties, which eventually resulted in the well known and widely used A.S.C.E. series, designed on a standard principle and increased in weight by five pounds to a maximum of 100 pounds per yard. The use of these sections was widespread, and they rendered excellent service for many years, especially in the low phosphorus high carbon Bessemer steel.

With the exhaustion of the ores which were necessary to produce this high grade metal, the high phosphorus low carbon steel was resorted to, but with an increased rate of failure and more rapid wear. The situation was becoming more acute, due to the prevalence of certain base breaks and section failures, as well as the general service being rendered by the A.S.C.E. rail series. A new study of rail design was then made, with the railroads and manufacturers represented in the Committee on Design. A common standard could not be agreed upon, and in 1907 the "A" and "B" series of the American Railway Association, were introduced, ranging from 60- to 100-pounds per yard. It was believed that a single standard would result at some later date when the merits of each of the two types of design had been proven in service.

Less than ten years ago, the study of a single standard was instituted and the outcome has been the introduction of the series known as the R. E. sections. This series differs from its predecessors in that the minimum weight is now 90 pounds per yard. It was agreed that rails under this weight are rapidly disappearing from general service, and that sufficient designs were available without a further addition to this long array. The maximum weight so far adopted is 140 pounds, and the general design aims to secure girder stiffness. The popularity of the series is becoming more evident and many roads have considered their adoption as the requirements of traffic demand a heavier standard.

A marked tendency towards the selection and use of heavy rail sections is now in progress. In change of standard, the former policy of most lines was to increase the weight by 5 or 10 pounds. Most changes now contemplated or consummated have been made by stepping up 20, 30 or even 40 pounds without an intermediate selection. Several roads on a 90-pound basis are considering 110-pound sections. Others have changed from the 90- or 100-pound standard to 130 pounds, believing this is a necessity to keep in advance of traffic requirements, and that the economies of the heavier and stiffer rail more than offset its greater initial cost.

One-hundred-and-five-pound rails were the heaviest in general use as late as 1915, with the exception of a moderate tonnage of 135-pound rail on the Central Railroad of New Jersey which was established as an experiment. The Pennsylvania 125-pound rail was introduced in 1915, although later modified to 130 pounds per yard, by the addition of 1-8 inch in depth of the head. The Lehigh Valley 7-inch, 136-pound rail was introduced a short time after, and at present is the heaviest in service. Many roads have adopted the 130-pound R.E. section or the 130-pound P.S. section as standard. Other roads have rail designs of about similar weight under consideration.

Change of standard, although apparently simple, is a serious proposition. The problem must be considered from every possible angle as to the correctness and efficiency of the design, and also that advantages in maintenance and stability of track will offset the higher initial outlay. Ten to twenty years are required to change the standard of the main lines of many trunk roads, and operating officials are often hesitant in their recommendations until the full merits of the case have been established.

Two Outstanding Types of Rail Sections

The two outstanding types of rail sections are known in common parlance as the "squat" and the "girder" rail.

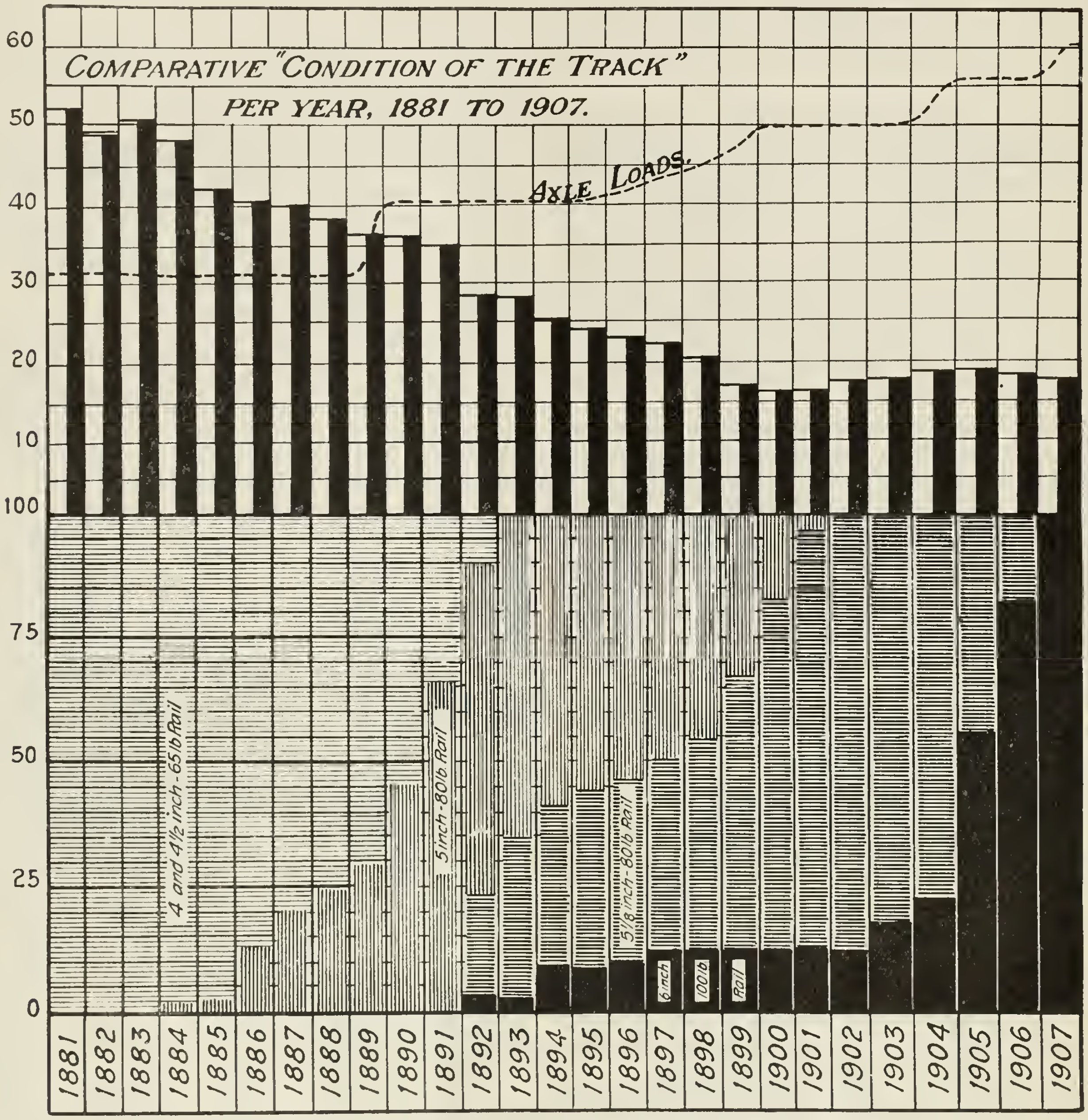


Figure No. 1.—*Shows the comparative vertical heights of the undulations per rail per mile, as measured by the rolling wheels of the Track Indicator, on the different sections of rails, and dates designated. The moments of inertia of the 4½ inch 65 lb., the 5 inch 80 lb., the 5⅛ inch 80 lb., and the 6 inch 100 lb. sections, are respectively 16, 26, 28.5 and 48.5 4th power inches.*

The combined stability of the track on the stiffest section has increased in a greater ratio and remains practically a constant for many years.

The dotted line in thousands of pounds shows the maximum former driving axle load, and the subsequent increase on the reduced undulations.

Both are widely used, and the advocates of each design defend their principles and expound their advantages with equal vigor.

The "squat" has the following features:—

(a) Low section height.
(b) Shallow fishing depth.
(c) Narrow and deep head.
(d) Thick base.

One of the early sections of this type is shown as figure No. 3, while an excellent example of many modern installations is the 100-pound A.R.A. type "B" section, figure No. 4. Girder strength is lacking in this type of section, permitting large deflections under load, and the development of high stresses. Shallow fishing depth is a condition for weak joints, resulting in low, bent and battered rail ends. The general track structure is rendered weak and limber, permitting crushing of ties, churning of ballast, pumping of ties and movement of roadbed.

The theory of the deep head is based on the intent of securing residual metal for wear. The experience of many roads, however, has been that the rails are removed for other causes long before this expected advantage materializes. The desired physical properties of the deeper head cannot be secured in many cases without resorting to a higher range in carbon content, which carries with it an inherent brittleness and greater tendency to breakage and failure. The roll pressures in forming the section do not effectively penetrate the more massive head, and the grain structure lacks refinement and toughness which must be offset or equalized by the use of higher hardening elements.

The thicker base is an advantage in rolling and cooling of the rails on the hot beds, but the flanges are generally made heavier than is necessary in good practice. The thick base dates back several years when large numbers of broken bases developed in the thin flange rails, and was introduced as a precautionary means of overcoming failures of this type. The situation has reversed since the introduction of basic open hearth steel. Half-moon or broken bases are rare even in the rails of thin flanges, where formerly they were legion in Bessemer steel. A fairly heavy base is considered good practice; if too heavy it is a waste of metal.

The "girder" rail has the following general features:—

(a) Maximum height for a given weight.
(b) Maximum fishing space.
(c) Broad and thin head.
(d) Thin or moderately heavy flanges.

The design is well illustrated by figures Nos. 5, 6, 6A, 7 and 8, showing sections of the New York Central Lines. The 105-pound rail was introduced in 1912, the 115-pound section in 1920, while the 127-pound design has not as yet been rolled. The 115- and 127-pound sections are improved types with slightly thicker flanges for rolling at the electrical driven high speed mills where slight variations in temperature effect the finish of the rail base. The heads of these sections are of the equal thickness, and are in turn only 1/16 inch deeper than their predecessors—the 100- and 105-pound rails.

Girder stiffness is the basic and essential feature of the series, which means greater rigidity with less yielding under load and lower rail stresses. The track is more stable with less destruction of ties and movement of ballast. The higher fishing depth makes it possible to secure a stiffer joint bar, reducing battered and low ends. The roll pressures in forming the section penetrate the broad thin head, promoting grain refinement, and secures the maximum physical properties and toughness due to the chemical composition without resorting to higher carbon with its attendant brittleness. The extra width of the head acts as a constraining and supporting column for the adjacent metal of the head in contact with that of the wheel tread, where a high intensity of pressure is developed and the metal is susceptible to flow.

The broad thin head has been looked upon with disfavor by many engineers on the supposition that its shallowness is insufficient for the normal life of the rail. Hundreds of contours and head measurements as to distortion and loss in head depth have been secured on lines with both fast and heavy traffic and conclusively show the average loss in head depth for the 6-inch 105-pound rail on tangents and curves up to 2 degrees 30 minutes is approximately 3/32 of an inch in eight years. Tangents and light curves predominate on perhaps 80 per cent of the mileage in the country, and with this fact known it is logical that rail design should be governed by the majority and not the minority.

Wear of rails on heavy curves may be looked upon in general as a problem calling for separate treatment, as it rightly should be. The service on curves is of greater severity, more intense pressures and increased wear and can be met by other methods such as alloy or treated rails, or separation of high carbon heats within the limits specified for application in this service. These features will be more fully discussed later.

The bulk of rail removals on any system or road are necessitated by the general unevenness in the head surface incident to high speeds, and perhaps to an even greater extent on account of joints being battered and low. The advantage of residual metal in the deeper rail heads disappears, and its usefulness is questionable except perhaps in isolated or peculiar cases.

Current belief among many engineers is that rail design and its service efficiency are controlled by the strength or weakness of the joint. It has been repeatedly stated that 50 per cent of the expenditure for rail maintenance is to keep the rail ends in condition to prolong their life against battering, bending and deflection which in turn cut out the ties and destroy the integrity of the ballast and roadbed beneath. Girder stiffness of the rail and a strong joint bar design based on the maximum fishing depth are of vital and essential importance.

The New York Central Lines have had over thirty years' experience and success with stiff sections joined by efficient splice bars 36 inches long and supported by three ties. The length of the bar has recently been made 38 inches to provide increased tamping space for the larger size ties being furnished. Some of the roads formerly used short bars of the suspended type, with a high rate of failure in the rail ends, along with the other ills of limber rails and weak joints. The remarkable service of the three tie supported joint is shown in a recent report with only 36 rail end failures in eight years for a total of 430,000 tons of rails. The smoother riding is also noticeable at high speeds even for rail that has seen many years of main line service.

The parallel of rail design is the use to which they are subjected in service. The principles of design were mastered and understood in the early eighties of the last century. Little, however, was known of the laws governing the conjoint relationship of wheel load distribution to the rail and roadbed. Mathematical deductions had been made and theories advanced, but no substantiative test data was in evidence. The subject was thoroughly discussed at the London Session of the International Railway Congress in 1895, which the late Dr. P. H. Dudley attended and took a lively interest in the proceedings. Not satisfied with the theoretical deductions, the following year he conceived and built the stremmatograph which culminated in the first successful attempt to measure strains in the rail base under locomotives at high speeds. After the instrument was attached to the rail base, a continuous record of the minute strains of tension and compression created by each passing wheel was scribed on a phosphor bronze slide by a steel stylus. The slide was mounted under the microscope and the minute waves in the record were read by a filar micrometer and translated into stresses. Experimental work accumulated and furnished the basis for the first practical laws governing wheel effect distribution and transmission to the roadbed. The incorrectness of many theories was readily explained when this practical data was analyzed.

Similar data has been secured under more modern power of the present day, with stiffer rail sections and heavier wheel and total loads. The economic and engineering value of greater stiffness is brought out in an interesting manner by figure No. 9. This is a comparative record of the total stresses developed in both the 80- and

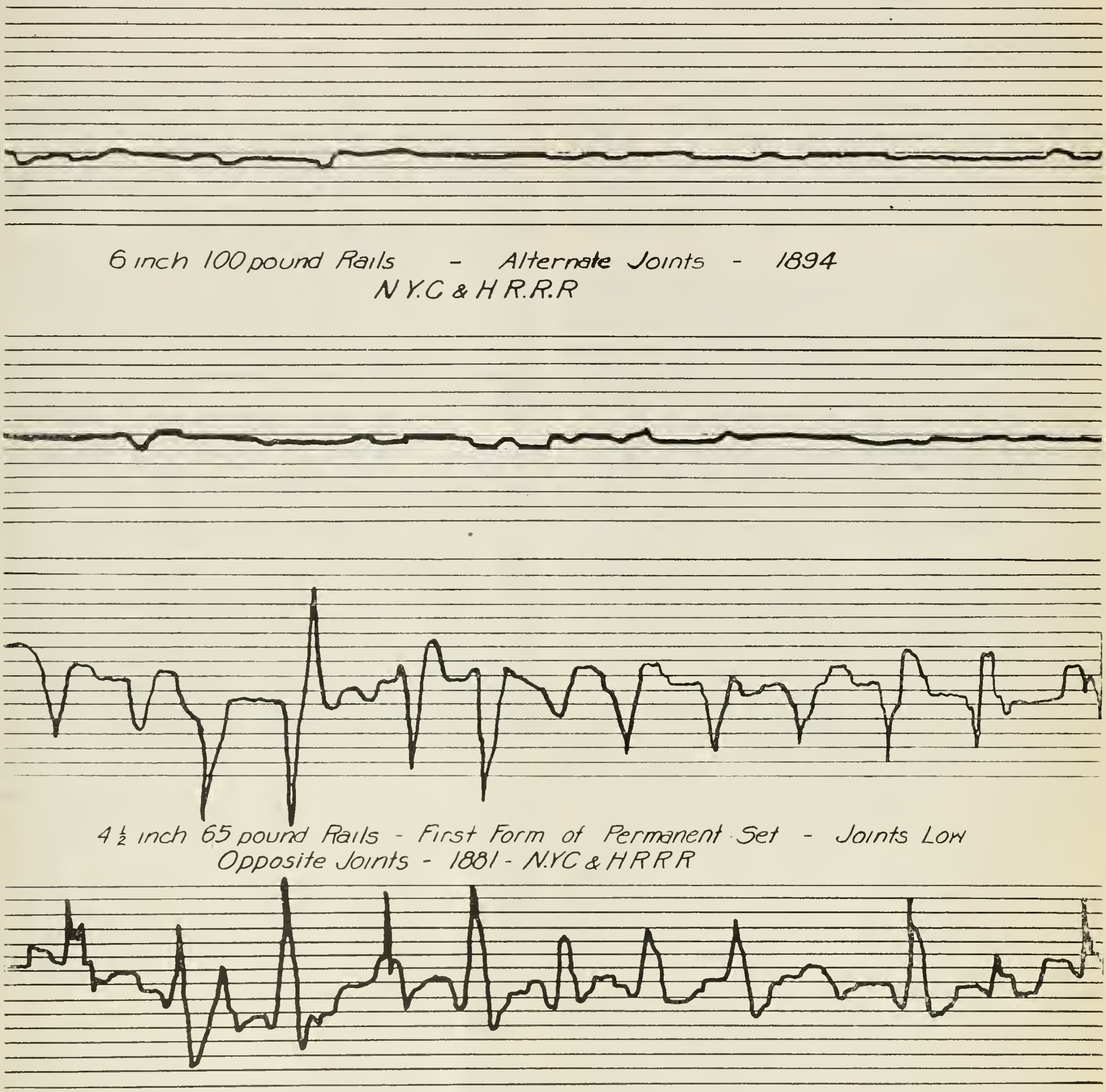


Figure No. 2.—Records of Undulations and Irregularities for 65- and 80-pound Rails.

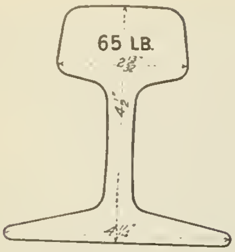


Figure No. 3.—Early section of "Squat" Rail.

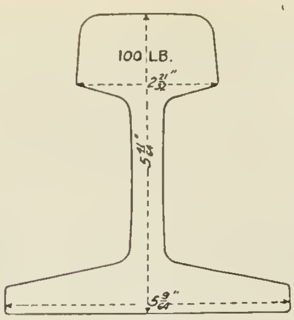


Figure No. 4.—A.R.A. Type "B".

100-pound sections for a Mikado type locomotive with a maximum axle load of 68,000 pounds. The speed range was from 6 to 60 miles per hour, although the latter is not general operating practice but the runs were made to increase the range of experimental evidence. The difference in efficiency of the two rails is very apparent. Reference to the individual readings showed that the lighter section was unable to distribute but a portion of the loads to the negative bending moments, while the resolution of stresses was more uniform for the stiffer 100-pound rail.

Engineers realized the importance of thorough study of this phase of railroad engineering, especially with the steady trend towards increased axle loads and heavier power units. Sentiment was crystallized in 1914 with the formation of a Joint Committee on Track Stresses composed of members of the American Society of Civil Engineers and the American Railway Engineering Association, with Professor A. N. Talbot, chairman, under whose able guidance and leadership one of the most important and far-reaching researches in practical railroad engineering has been in the process of continuous development. The problem is of unusual complexity, but each angle of the field has been attacked as its importance became apparent, and a vast fund of useful information has been accumulated. The size of the task is realized by the statement that for one report alone nearly one-half million readings were taken which had to be reduced, classified, plotted and analyzed. Three progress reports have been issued and are authoritative and complete to serve as a guide to track and maintenance engineers as well as those engaged in the design of power and equipment.

Quality of Rail Material and Methods of Manufacture

The preceding portions of the paper have dealt with rail design, and some reference to the mechanics of its use in service. The ultimate service is bound up with the quality of the material and methods of manufacture and are thus phases of the subject of equal importance.

Rail manufacture is conducted on a large scale basis and is the principal product as well as largest in tonnage at some of the steel plants. Rolling rails is a complicated process in itself, and with the furnaces for steel making and other essential equipment, millions of dollars are tied up as capital investment to manufacture this single product. From the raw ore to the finished rail, the material passes through hundreds of hands, and therefore care and vigilance are essential to insure that each step in the process of manufacture has been successfully accomplished. The days of hand forging have long since passed, together with the little plants of few tons capacity per day, and small ingots and furnaces. Modern high speed mills roll several thousand tons in a week's time utilizing ingots up to 7 tons weight, with great heats of molten steel of 100 to 110 tons tapped from the furnace.

New problems are constantly arising and the manufacturer then introduces new processes, or makes refinements or changes where a cruder method formerly prevailed. That improvements have been steady and effective is realized when the downward trend of rail failures on the curve, published yearly by the A. R. E. A. is investigated. The curve is extended as a "dream," but the earnest desire of the railroads is to make this an anticipated reality.

It is in this light that a few features of manufacture will be discussed in the belief that even better records may be secured from the moregeneral adoption of certain practices.

The popular conception of rail manufacture among many engineers is based on the records of rail failures and wear. The latter is largely controlled and influenced by the design of the section and the composition specified. Rail failures are largely based upon the quality, purity and uniformity of the material, and in turn are influenced by methods of steel making, rolling and handling; not overlooking the important fact, however, that severity of service plays a prominent part in their subsequent development as broken or defective rails.

Head failures predominate on most roads; omitting of course rail end and bolt hole failures which are largely due to the design of rail and joint. The prevalence of a high rate of head failures has been troublesome and a source of difficulty to many rail users. Some roads report 60 to 75 per cent of their failures are of this type, which includes those classified as crushed heads, split heads, compound fissures, horizontal splits or caps, and flowed heads. "A" rail failures predominate, in which the structural condition of the head shows segregation, or indications of wildness in casting with the evolution of occluded cases. The common condition of the "A" rail is illustrated by figure No. 10.

Knowing segregation to be the chief source of the difficulty, the rail user has attacked the problem in a number of ways. Extra discard has been specified, or finished rail analysis with rejection when the carbon segregation was beyond a stipulated percentage. Both methods are costly to manufacturer and user. Standard practice on some roads is to require separate shipment of "A" rails for restricted use in service. A recent innovation requires a large top discard which is rolled into tie plate stock for hot punching and finishing, and thus avoids waste of material as under the other methods.

Instances occur where segregation and poor casting conditions are not limited in their effect to the "A" rail, but have extended far below it. Segregation is more noticeable in the larger ingots, and there is a question as to whether the maximum segregation is in the normal discard, the "A" or the "B" rail. Several mills now use large ingots as their standard practice for rolling. Other remedial measures proposed for the reduction or elimination of segregation in the portions of the ingot which eventually are rolled to rails include special ingot molds with refractory or hot tops, molds with the wall thickness reduced at the upper portion of its height to retard cooling, and several forms of deoxidizers.

Hot tops or sink heads are efficient, but add considerable to the cost to the consumer. In one case, however, a simple hot top was developed using a light refractory rectangular member which was placed directly on the standard ingot mold. This form was inexpensive and some surprising improvements in quality were reported, with a much higher yield to the manufacturer, even though called upon to meet an exacting specification as regards segregation.

Split ingots are shown in figures Nos. 11 and 12. The former is an ingot cast in a sink head mold; the latter shows an ingot cast in the standard form used in rail manufacture at the present time. The improvement in the setting of the steel is marked for the sink head ingot. The long bloom adjacent to the ingot in figure No. 12 is a companion ingot which was charged into the reheating furnace in the regular manner and rolled to bloom size. There is only a trace of the pipe shown in the upper portion of the bloom. Prompt charging of the ingot into the soaking pit will prevent some of the interior shrinkage, reduce the pipe and lessen the segregation within the setting metal.

Several deoxidizers have been recommended and tried. The latest effort in this direction is quite simple and inexpensive, and is the principal feature of the Experimental Specification for Dead Setting Ingots of the AREA. This calls for a minimum silicon content of 0.20 which is ten points higher than the generally accepted practice. Higher silicon aids in deoxidizing the metal and increases its toughness, although the pipe cavity is somewhat deepened. Large tonnages have been rolled to these requirements and within a few years the results of service tests will be available for more general application.

There is a prevalent idea that "piped rail" and "split head" are synonymous terms, and invariably placed in the same category by trackmen. Most split head rails are so classified on the reports, when in fact a failure of a piped rail is of rare occurrence. Split heads are due to segregation as a general rule, and rarely to piping. Of the two evils, the former should be avoided the most. The manufacturers are often advised by the user that many failures are occurring due to pipes, with the result that the instructions to the open hearth department aim to straddle both piping and segregation, which is difficult, to say the least. The restrictions on acceptance of rails with even the slightest web pipe are so severe that efforts in manufacture are directed towards its avoidance. It is a metallurgical axiom and the law of setting steel during its cooling and crystallization that both segregation and piping cannot be entirely avoided, and that either one or both are present in ingots cast and handled in the ordinary manner. The problem of securing sound and solid ingots of purity and uniformity is of the greatest importance, and any improvements which are inaugurated will be followed by many of the rail users with a great deal of interest.

Several features in mill practice are believed to be advantageous in securing a better rail, among which is the practice of reheating or "wash" heating the hot blooms before being rolled to the finished rail. In direct rolling, reliance on proper finishing temperature is dependent on the initial heat of the ingot which must be sufficient to permit the succeeding reductions of the bar as it is formed into the rail and retain the heat to the finishing end or hot saws. Any delays in the mill affect every bar or bloom on the roll tables, while in mills equipped with reheating furnaces, the blooms can be banked or soaked until the changes in the finishing mill have been completed, or the causes of delays overcome. An additional advantage of reheating is the equalizing of the heat of the bloom after the reduction of the ingot, as well as the elimination of grain distortion and deformation created by the stretching and kneading of the ingot in successive passes to the smaller bloom size.

It is a well known fact that interior transverse fissures are developing at a much lower rate in the product of those mills equipped with reheating furnaces, which shows the rail is benefitted by the soaking time in the reheater, and that more widespread adoption of this practice is desirous, if for no other reason than to aid in the reduction of this type of failure.

Rail straightening has caused complaint from a number of sources, due to the fact that the process is severe and oftentimes injurious. The acceptance of rails with a uniform sweep not exceeding one and one-half inches is permitted sometimes in the belief that better rails will be secured without the injurious features of gagging or straightening. It is difficult to lay curved rails and maintain them as smooth riding track.

We attempted this a few years ago, combing the output of one mill for several months to secure rails of heavy section with a uniform sweep of less than one inch. There were 82 rails obtained, of which the majority had less than one half inch sweep, and were then placed in main line high speed tracks. The roughness was so noticeable that the rails were removed after four or five months' service.

Some roads have reported success with sections 90 pounds per yard and under, with an allowable maximum sweep of one and one-half inches. It is doubtful if the heavier and stiffer sections over 100 pounds weight can be accepted in this condition, due to the difficulty of spiking in, and then holding the rails in alignment during successive years of service. Acceptance of light curved rails without straightening does not reach the more important side of the problem. The rails which receive

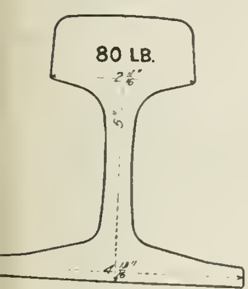
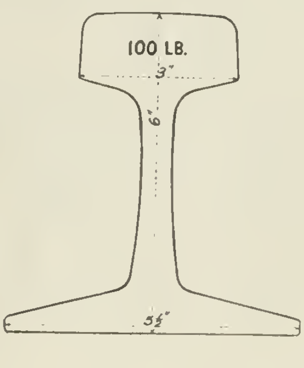


Figure No. 5.



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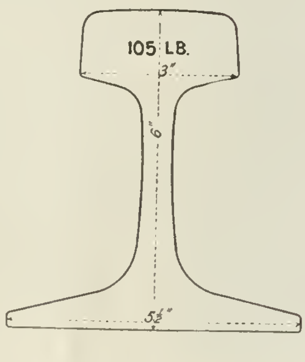


Figure No. 6A.

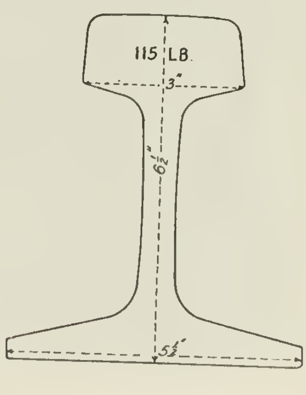


Figure No. 7.

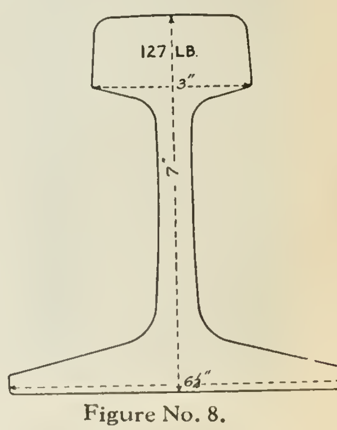


Figure No. 8.

Typical designs of "girder" rail, showing sections used on New York Central Lines.

the most injury in gagging are those with heavy sweeps, short kinks and very wavy in line or surface.

Rail straightening is arduous work and calls for skill and judgment. The curvature of the rail is reduced by the application of blows or gagging at intervals along the length of the bar. The degree or magnitude of the blow is a matter of judgment of the operator. The elastic properties of the steel must be exceeded at each application and a permanent set induced or the resiliency of the metal would cause the rail to curve to its original shape. The skill in applying the blow of the gag irons out the rail, though oftentimes the force is more than required and a high spot is left in the rail which is removed by reversing the blow. Many rail failures have been attributed to the effect of gagging in the straightening press, and the process has been agitated against for forty or fifty years as the records and many discussions show. Frequently, at some plants, rails are broken in the press by the application of one blow, while other rails have been rejected after the rail has been heard to snap or crack, which is an indication of internal rupture although not detected on the surface.

Until 1892 the supports in the presses were centered at 28 or 30 inches, at which time they were spaced 42 inches. The distance has been made 60 inches within the last six years, which is of considerable assistance in

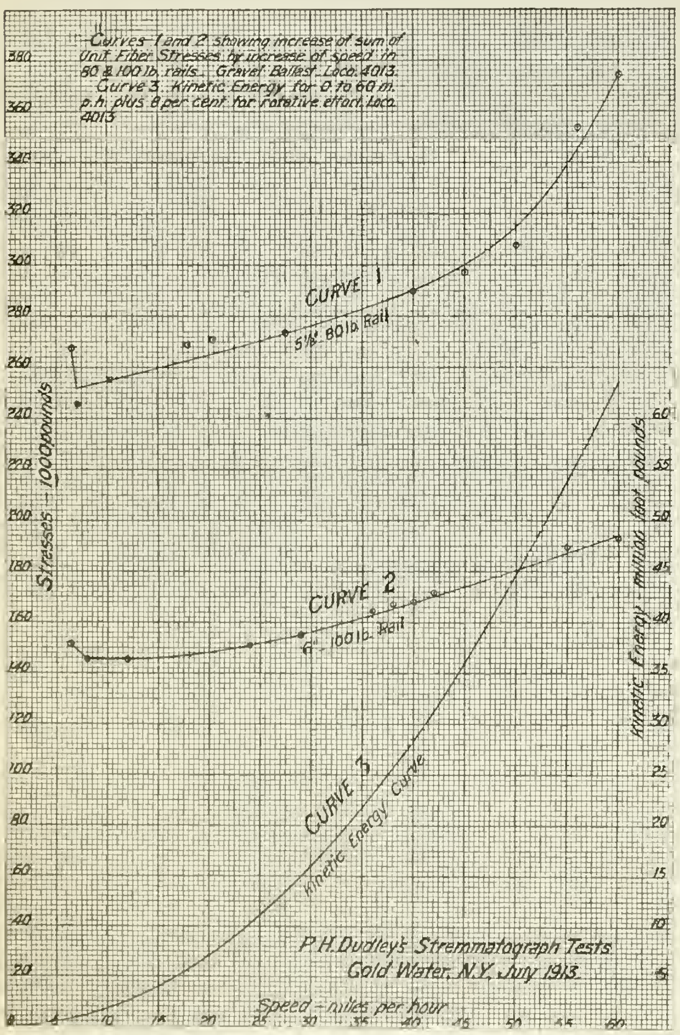


Figure No. 9.—Comparative record of total stresses developed in 80- and 100-pound sections for Mikado type locomotive.

reducing the required pressure. Experiments showed that slightly over 150,000 pounds pressure was required to produce a permanent set of 1/32 inch in the 6-inch 105-pound section when resting on supports spaced 42 inches, and with the load applied centrally. The pressure was reduced to slightly under 100,000 pounds when 60 inch supports were substituted for those spaced 42 inches, and shows the advantage gained by the long span. End kinks are difficult to remove however, but these are overcome by the insertion of a special block which has the effect of a shorter span between the moving head of the press and the support of the rail end.

Several inventions are on record for the removal of the curvature of rails as received from the hot bed by roll straighteners. None of them are in commercial use on the heavier rail sections, due to cost, size of equipment, and the realization that no benefit would be derived by installing the device. Every effort to improve the process should be encouraged as it is realized how injurious the method of gagging may prove to be in the case of heavy rail sections of high carbon material.

The final sweep of the cooling rail as it leaves the hot bed for the finishing department depends upon the camber of the rail and the treatment on the hot bed. Camber is necessary due to the inequality in volume and distribution of metal in the rail head and base. It is a function of both the design of the section and the temperature of the bar. The adjustment of the cambering rolls is made according to the section and type of rail, with little attention given to the temperature of the bar, or the variation in temperature of successive bars through the rolls.

The general hot bed practice is to bunch the rails in groups of two, three, four or more as shown in the upper half of figure No. 13. The ideal method is shown in the lower half of the figure and has been the practice of one mill for over a quarter of a century. The rails are spaced one foot apart by chain conveyors with spacing fingers attached. Uniform cooling conditions are obtained by this method, and is similar in this respect to the spacing and cooling conditions for steel wheels, axles and other important steel products. A wider use of this method at the rail mills would be along the line of desired progress and uniform practice.

Bunching of the rails in groups hastens the cooling of some and retards that of others with the result that some rails are curved high, others low, and some become wavy and kinky. The latter condition may be due to improper hot bed alignment, which needs attention at frequent intervals. Much of the work required to straighten rails can be avoided if the hot bed practice and cambering are improved, which will mean a rail with less distortion and injury and a smoother finish.

Milling the rail ends is a feature which is gaining in popularity, and several plants are equipped to render this service, although not to the fullest extent in all cases. The rail ends are trued up vertically and crosswise, and the heavy burr from the hot saw is removed, saving considerable filing and chipping. Long rails can be milled to proper length which saves several feet in length to the mill, and means less short length rails for the railroad. An objection has been raised to the blurring of the end face by dull cutting knives, apparently obscuring the appearance of pipes. Any injurious pipes however can be detected in the bolt hole drillings and in the end face as well.

A number of roads are desirous of reducing the number of joints per mile and a demand has been created for

Figure No. 10.—Common condition of the "A" rail.

rail lengths greater than 33 feet. The requirement can be met at some mills without interference with production schedule. Other mills find it expensive in their present layout which will necessitate changes and readjustments to accommodate the increased lengths.

Acceptance Tests for Rails

Acceptance tests for rails are found in all specifications, and generally require the determination of their physical fitness for service. The essential physical characteristics investigated are toughness and ductility, which are quickly found under the standard drop testing machine. Several systems for testing are in use, differing principally in the amount and extent of the tests and the acceptance limits.

The system in widest use is to select three test specimens representing the upper, middle and lower part of the heat. The test pieces are the top crops of three ingots, and each is subjected to the impact of a falling weight. Two of the three tests must develop 5 per cent elongation in 2 inches or 6 per cent in one inch, using a 2,000-pound tup falling from a fixed height. The top or "A" rails are rejected when the requirement is not fulfilled, and corresponding tests made from the second, or even third rails of the same ingots, after which the heat is scrapped.

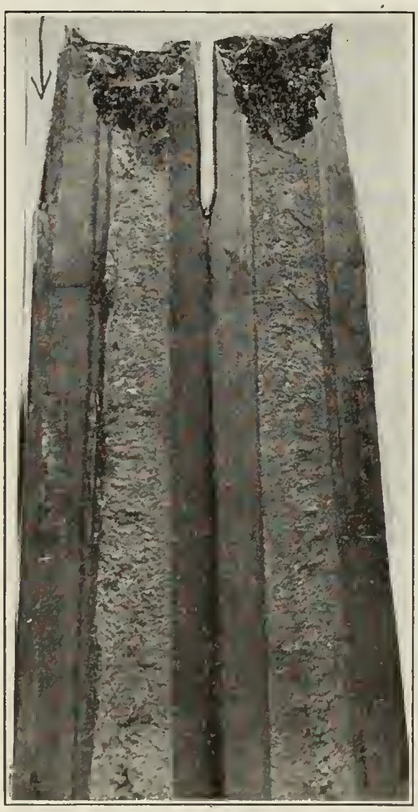
Another method requires the three test butts to develop the specified elongation. Retests are permitted from the top end of the "A" rail of the same ingots, and if any retest fails the heat stands rejected. One specification requires three test butts to show 6 per cent in 6 inches, or a total of 36 per cent in the gage length. This virtually requires the maximum inch to yield slightly over 7 per cent. Failure of the top rails is followed by progressive testing down the ingot through the third or "C" rail, after which the heat is scrapped.

Proposals have been made to discontinue the elongation readings and rely on the permanent set, at the same time requiring the test piece to withstand one blow of the falling weight without failure. The deflection is read as a matter of record. Many engineers are favorable to this method, as the reading of elongation to one hundredth of an inch is difficult. Disputes arise between the inspector and mill representative as to the accuracy of reading where the acceptance or rejection of material may rest on a fraction of one per cent.

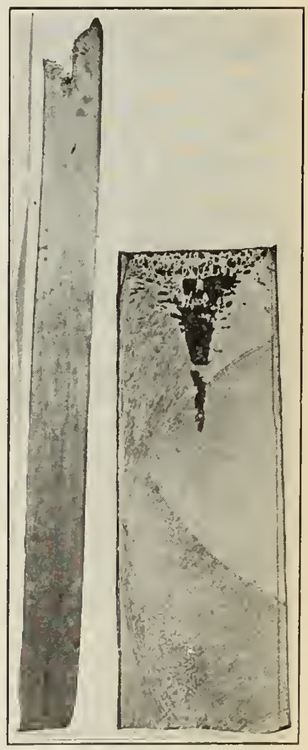
The all-ingot test is perhaps the most thorough in use, and consists of the test of a butt from the top of every ingot. The head is tested in tension with the tup falling 15 feet, and each test is continued to destruction before the elongation is read. The "A" rail of the ingot represented is rejected if the test butt fails to yield the elongation required, and a "B" test follows, but no tests are made below the "C" rail. The same procedure is carried through for each ingot. The ingots and rails must all be numbered to insure that the correct tests are being made and represent the material accepted or rejected. The theory of this method of testing is based upon the fact that each ingot is influenced by rolling, heating and casting conditions and the records bear out the correctness of the supposition, as some rather surprising and unexpected results are often obtained. The drawback to the method is the time consumed and the large amount of testing necessary. It is practical however at mills using large ingots and with small daily output.

Proposals have been frequent to require tensile, small shock or impact tests, as well as the use of the 19 mm. ball impression test. The latter is used on girder rails for street car service in preference to the drop test, and there is some merit in its use as a check test on railroad rails as an indication of resistance to penetration, and toughness.

A magnetic test has been proposed and tested out but is not in commercial use at the rail mills. We made several hundred tests of both new, old and also failed rails, using a magnetizing solenoid, yoke, and the necessary accessories to test full length rails. Many of the failed rails contained interior transverse fissures which were disclosed by fracturing the rails after the tests had been run. The instrument has a high degree of accuracy and each little indication on the oscillograph record repeats itself on check runs with regularity and precision. The difficulty arises in attempting to interpret the significance



Ingot cast in sink head mold.



Ingot cast in standard form at present used.

Figures Nos. 11 and 12.—Split Ingots.

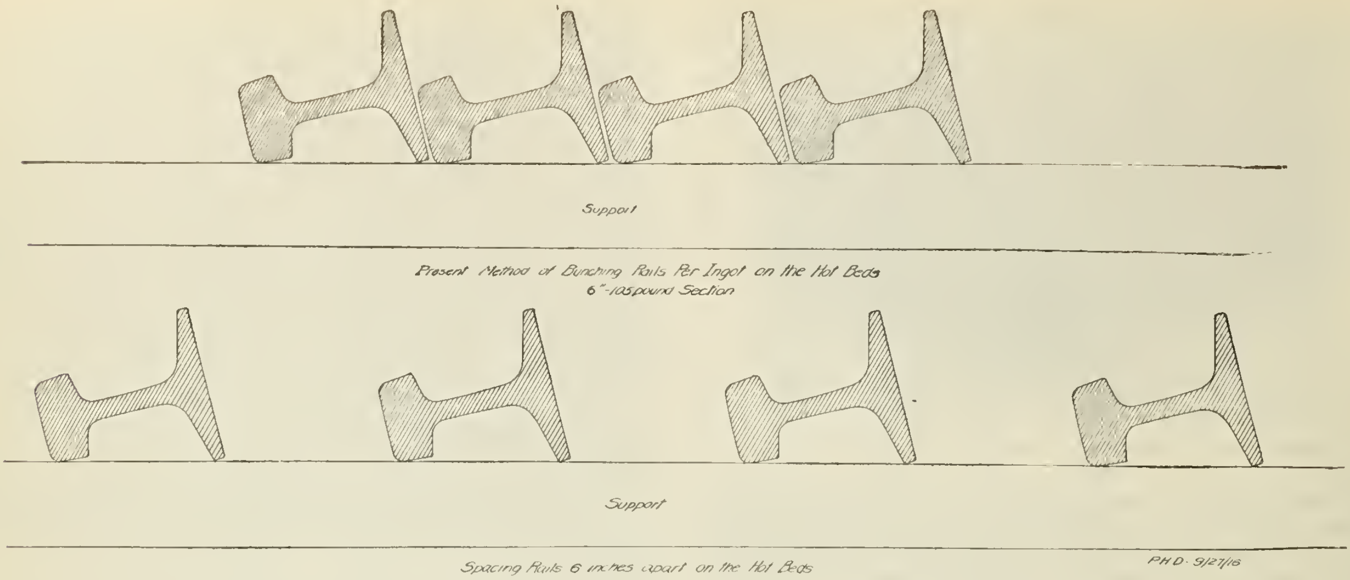


Figure No. 13.—General hot bed practice and ideal method of spacing rails.

of the indications, which has not been solved as yet. The test is ideal in that the material is neither destroyed, injured or distorted, and there is some promise that the apparatus may be perfected along new and novel lines, although it is doubtful in the present layout of the rail mills that the apparatus could be installed without tying up production beyond what is considered economical.

Reduction of Curve Abrasion by Choice of Material

The subject of rail wear on curves was referred to previously and will now be considered from the standpoint of the use of suitable material for the reduction of curve abrasion. This involves the subject of alloy and heat treated steels.

The most economical method of meeting the problem however is the selection and separation of the higher carbon heats within the specified range for this special service. The higher carbon aids in resisting abrasion, though extremely high carbon is to be avoided. The practice of many roads has been to lay the high and low carbon rails indiscriminately in curve service which has often hastened wear instead of retarding it.

Numerous heat treatments for both carbon and alloy steels have been offered, but all have been abandoned or else not attempted except in one or two cases. The heat treatment of a rail due to its length and irregular shape presents a complicated problem especially where hundreds would be handled as a day's work. The uncertainty of treatment leads one to believe that the advantages of increased physical properties and resistance to abrasion are more than offset by the increased cost and the unexpected variations in uniformity in a product of this type. Experimental treatments have been conducted on several small lots of rails, but with the exception of two to be described, none are in commercial use at the present time.

The most successful alloy and treated rail is manganese steel of 10 to 15 per cent manganese and 1.0 to 1.25 per cent carbon. The steel must be cast in hot top molds, and afterward requires long and careful soaking in the pits. Rolling is in the same manner as for open hearth steel, and after sawing the rails are immediately water quenched. Wonderful toughness is imparted to the metal which wears so slowly on the sharpest curves in the heaviest service that a life from 6 to 12 times that of the carbon steel rail is obtained.

Two difficulties are encountered and precautions are necessary. First, the elastic limit of the steel is low, and unless the section rolled has girder stiffness, permanent sets result in service. The rail ends have a tendency to become low, and careful maintenance is essential to overcome this condition. The second difficulty arises from the low coefficient of friction of the metal. Engines stall, and drivers slip badly on steep grades combined with sharp curves destroying the toughness of the head metal. Transverse hair cracks result which continue to progress through the head, but are arrested from further development by the toughness of the web and base. Rails have been known to remain in service several days without complete fracture, even though the break has gone clear through the head. Ten years of experience have proven this to be the safest material available at present, as well as solving curve wear problems on many railroads.

An air treatment of carbon open hearth steel rails has been in commercial use for the past few years, known as the Sandberg sorbitic treatment. Service results place this as a promising method for prolonging the life of rail on curves. In the process, air is blown from a series of jets in a large pipe, and directed against the bearing surface of the rail head. The air pressure is applied just previous to recalescence, producing grain refinement in the head to a depth of 3/8 of an inch or more, creating added toughness to overcome the severe crushing and abrasion on the curves. Some roads in their desire to obtain the full advantage of the treatment have ordered rails rolled with the carbon as high as 0.85. This does not seem desirable as the brittleness of the untreated high carbon rail may be of even greater extent in the treated material.

The impression should not be gained that alloy or treated steels may be unsuccessful, except as above noted. The field of research in alloy steel has hardly been scratched, for one authority states that with 23 elements some 2024 combinations are possible. Some of these may be of hitherto unexpected usefulness. It is the belief of the writer that for a long time to come plain basic open hearth steel will remain as the standard material for rails. This steel when well made has the possibility of carrying even heavier loads than those now in general use. The limiting factor in the capacity of the steel to sustain loads is the intensity of pressure between wheel tread and rail head. The area of contact tends to become smaller even under increased wheel loads with the stiffer and heavier sections. With a well designed rail sect on, and the steel of tough, uniform texture, the indications point to the continued success and usefulness of carbon steel.

Future Rail Design

Prediction of the future in rail design and composition are difficult to make and is a field one generally hesitates to venture into. Rail design is contingent upon the loads to be carried. If the maximum wheel load could be foreseen, the problem would indeed be simplified. No one has prophesied what this will be. It is felt, however, that practical and economic conditions will draw the line and not the rail section or its quality. Maximum rail section has been and will continue to be influenced largely by the weight of motive power, and the full load weights of gondola or hopper cars. Larger power units of course are increasing as greater tonnage freight trains and longer passenger trains become operating necessities. The utility of pullmans, passenger cars, mail, baggage and express, refrigerator, stock and box cars has practically settled their maximum weights, though replacement of light equipment on many lines has been retarded on account of financial difficulties or lack of demand.

The maximum capacity for hopper and gondola cars apparently has not been reached, though their wheel loads have been reduced by the introduction of six wheel trucks. Most equipment however up to 70 tons capacity is handled on four wheel trucks. These cars exercise a controlling influence on rail design, being more often fully loaded, while the dynamic effect or blow from the rolling load is often increased by the coils of the springs being fully compressed. This effect is further magnified if the wheels are out of round or contain flat spots. Such facts need careful consideration in both design and maintenance of equipment.

Information has been presented to indicate the prominent part that the rail section plays in the problem of transportation. With the curve of growth and expansion of the country increasing upwards at a constant and steady rate the rail problem becomes of magnified importance in the volume and scope of its work. Progress will continue based on the co-ordinated effort of the designer and user of rail, the steel maker and the designer and maintainer of equipment. An interchange of the experience and problems of each will have a direct and vital influence on the continued success of the rail as a factor in the problem of transportation.

Development of the Process of Sewage Disposal

Early Efforts Towards Sanitation and the Resulting Development of Modern Systems for the Disposal of Sewage

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Paper read before the Peterborough Branch, The Engineering Institute of Canada, at Lindsay, Ontario, October 16th, 1924.

It is very interesting to study the developments which have taken place in the process of sewage disposal and to notice how for ages man has endeavoured to utilize the forces of nature without understanding them. In every branch of science the secrets of nature — that power which creates and which regulates the material world — have been slowly revealed to us and in nothing has this been more noticeable than in the work of disposing of waste matter.

Records of Early Works

Wherever mankind has assembled in communities the need for sanitation has been recognized. It was demanded by the Mosaic Law, (Deut. 23-12), for strict injunctions were issued to keep the camp clean. Ages later as cities grew, the Greeks and Romans built great conduits to convey water and equally great sewers to dispose of the sewage, sometimes using it for the purpose of irrigating land.

During the prolonged strifes, conflicts and wars, of the dark ages in Europe, although the people gave more attention to the struggle for existence and self-protection than to sanitation with the result that pestilence, plague and black-death spread over the lands decimating the population, there were, despite the prevailing ignorance, sanitarians who struggled to save the people from their own neglect.

The condition generally, until about a hundred years ago, was very unsatisfactory from our present day standpoint, but we should not pride ourselves unduly. We can only march with the progress of knowledge and that moves slowly.

It is interesting in this connection to note that Kircher, a Jesuit scholar, nearly 300 years ago, with simple magnifying lenses was able to observe the presence of minute living worms in putrid meat, vinegar, milk and cheese and suggested that putrefaction and disease were due to minute micro-organisms. Leeuwenhoek, a Dutch linen-weaver who in 1683 made his own microscope, in a letter to the Royal Society of London wrote, "I saw with great astonishment, especially in the material mentioned, (the emulsion of tartar from the teeth), that there were many tiny animals which moved about in a most amusing manner; the largest of these showed the liveliest and most active motion, moving through the water or saliva as a fish of prey darts through the sea. They were found everywhere, although not in large numbers." Linnaeus, a naturalist, and Plenciz, a physician, in 1762, referred to the decomposition of organic substance brought about by germs. Later Louis Pasteur, of France, proved that fermentation was due to organized and living ferments. He dispelled the myth which many scientists advanced about spontaneous generation of life.

The silkworm industry received a great impulse in the discovery, by Pasteur, that the maladies of silkworms were owing to parasitic bacteria, the prevalence of which, sixty years ago, almost destroyed the valuable sericicultural industries of Italy and the south of France. He found a particular kind of bacteria preying upon the silkworms affecting their chrysales, moths, and the egg.

A very large percentage of the worms died, and the industry was threatened with the extinction analogous to that occasioned in some wine-growing districts of France by the phylloxera.

As it was in the main owing to the magnificent work of Pasteur, Schoesing and Muntz in France and Frankland and Warington in England and of others, it was established that the fundamental basis of sewage purification was biological. Thus it may be reckoned that the important discoveries of the use and force of bacteria in relation to sewage treatment date back only about fifty years.

Development of Methods of Sanitation

About a hundred years ago cholera, typhus and other diseases in Europe compelled the thinking people to do something, for, as the industrial activities developed, cities grew rapidly and the movement of the people to populous centres intensified the troubles of insanitation. It is remarkable that so many amazing developments were occurring about that time. The Napoleonic wars terminated at the battle of Waterloo, leaving the European nations exhausted and resulting in serious commercial depression and poverty.

Following this, the new Epoch of Power, about which George S. Morrison wrote so well, was ushered in. Railways, ocean steamboats, factories and works of all kinds were being built. The telegraph, electric power and coal gas were being introduced. Penny post was established. The Institution of Civil Engineers received its charter. Political storms were brewing which effected great changes. The class consciousness of workmen was developing and experiments in socialism were commenced. In short the wonderful Victorian period was in its infancy and we are now enjoying the advantages resulting from that vigorous time.

It needed, however, another outbreak of cholera to arouse public opinion as to the urgent need of sanitation which had been so long neglected. The sanitary authorities were then called upon to adopt adequate measures for the protection of the health of the inhabitants.

Sewers were built extensively in Britain and elsewhere but the method of sewage disposal was unsatisfactory. The streams into which sewage was discharged became dangerously polluted and some land which was irrigated became sewage sick. Royal commissions were appointed to investigate this matter and to report. At first more land was recommended as the basis of improved sewage treatment, as the proper way to conserve the fertilizing value of the organic matter, but, as this treatment so often proved unsuccessful, other methods were suggested, such as tanks in which to settle the sludge; intermittent filters, upwards and downwards; scientific chemical purification and artifical filters, and so on. No less than 400 patents were taken out in Britain between 1865 and 1875 in connection with sewage disposal.

Parliament passed several acts to rectify the condition which then existed still requesting the use of land, notwithstanding the great difficulties already experienced by engineers and municipal authorities. In connection with land irrigation the expenditure was great and the results inadequate, with the result that there was a persistent agitation for a relaxation with respect to disposal by irrigating on land.

Inspection of Sixty Different Works

Just about the time that sanitary engineers were taking a prominent part in the development of better methods, the author was instructed to visit several sewage works and report generally. About sixty different works were inspected and the report on this investigation was re-written and published as a small book on Sewage Disposal, (now out of print).

Bearing in mind that twenty-eight years have since elapsed it will be interesting to quote a few paragraphs which anticipated some of the developments which have more recently taken place.

"The biological process, if considered on the broad basis, may be found all the world over. The whole work of agriculture, forestry, etc., depends on the biological process. Two French chemists, Schoesing and Müntz, in 1877, published the result of preliminary experiments showing that nitrification in sewage and in soils is the result of an act of an organized ferment which occurs abundantly in soils and in most impure waters. Shortly afterwards Mr. Warington was able to isolate the nitrifying organisms and to prepare successive cultures of them, and also, in 1884, expressed his views respecting an artificial filter for the oxidation of sewage."

Mr. W. J. Dibdin, 1887, expressed his views, in a paper read at the Institution of Civil Engineers, in the following words:—"The researches of Warington have demonstrated that the process known as nitrification of the complex nitrogenous bodies existing in sewage during its filtration through land is brought about by definite organisms, who in their life-processes feed upon the sewage matters and evolve the nitrogen in the form of nitric acid. As with the nitrogen, so it is with the carbon, which is absorbed as food and evolved as carbonic acid. Without these life-processes, whether they be of animal or of vegetable nature, no destruction of the objectionable matters can take place. The very essence of sewage purification is the ultimate destruction, or resolution into other combinations, of the undesirable matters."

"Modern experience shows that when this subject is better understood and thoroughly worked out, in all probability the true way of purifying sewage, where suitable land is available, will be first to separate the sludge and then to turn into neutral effluent a charge of the proper organism, whatever that may be, especially cultivated for the purpose, retain it for a sufficient period, during which time it should be fully aerated, and finally discharge it into the stream in a really purified condition."

As an indication of the attitude of some men towards the biological process, one speaker, in criticizing, stated that "Mr. Dibdin's opinions were founded on the physiological fact that organic matter diffused in a very large volume of water and exposed to light and air became the food of minute organism, and that Mr. Dibdin had carried his idea a little too far in proposing the cultivation of such animals to feed upon the sewage. The question of the space and time in which the animals were to eat up the food accumulating at the rate of 150 million gallons a day was rather a serious consideration, but Mr. Dibdin had passed it over by simply saying, — 'Retain it for a sufficient period during which time it should be fully aerated.' "

The author in 1896 reported that one of fhe conditions which was considered necessary to ensure success was that the presence of oxygen is essential to enable the organisms to produce nitrification. It was in 1887 that Hering directed attention to the scientific use of rivers and bodies of water as a means of sewage disposal by dilution.

The works visited by the author in 1896 comprised:—

(1) Land irrigation with crude sewage.
(2) Land irrigation with partially clarified sewage.
(3) Chemical clarification and irrigation.
(4) Chemical clarification and artificial filters.
(5) Electrical treatment.
(6) Biological treatment.
(7) Combinations of the above.

These methods of sewage treatment are still in use, with this difference that engineers are now better acquainted with the fundamental laws of success in each kind of process. The perseverence of chemists, bacteriologists and engineers has resulted in many changes.

The contact filtering beds first built in 1891, which were inspected in 1896, constituted a radical innovation at that time. They were soon followed by the trickling filters. The annual reports of the Massachusetts State Board of Health on the Lawrence experiments started in 1888 are useful milestones in the study of the art of sewage purification.

The Mouras system of sewage treatment in France was a forerunner of septic tank which was exceedingly prominent in the minds of the municipal authorities in 1896. It was first thought that it had to be covered, so that in its hidden recesses, with the absence of air, certain bacteria would function, sludge would be consumed and that troublesome matter would be finally disposed of. It was soon found that septic tanks needed no covering and that sludge would be somewhat reduced by digestion, but there would still be a considerable quantity left for final disposal.

Travis developed his hydrolytic tank in 1904, and Imhoff modified it in 1905. These are two story tanks in which the sewage in passing through is enabled to get rid of the sludge which gravitates to the lower chamber where it is attacked by suitable bacteria and its character changed. Imhoff separated the fresh sewage from the sludge chamber, whereas Travis allowed a small quantity to pass through. Dibdin devised his slate beds in 1904, which gave promise of great success. Lowcock in England, and Waring in America about 1891-2 experimented with the supply of air to the interior of artificial filters.

The investigators in Europe and America continued to make researches into the use of air to oxidize the organic matter in sewage. At Lawrence, (Mass.), it was discovered that aeration produced green algae which was beneficial. Fowler also found that certain iron bacteria with aeration had a clarifying effect on sewage. So, step by step, the biological process was developed, resulting in the introduction of the activated sludge process by Fowler, Ardern and Lockatt at Manchester in 1914. The announcement of this development was a signal for experimentation on similar lines in many countries. Milwaukee and other cities have spent large sums of money in testing this process.

Whilst the original method was being tried out, Howarth at Sheffield abandoned the use of compressed air and adopted paddles to keep the sewage in motion and to change its surface. Bolton, at Bury, applied another method called the Simplex. These processes may be described briefly as follows:—

Compressed Air Diffusion (Ardern & Lockatt)

The raw sewage after passing through screens for the removal of gross solids and flocculent matters flows through a number of parallel aeration tanks in succession, until it reaches the quiescent sedimentation tanks, where the activated sludge is allowed to settle, and the clarified effluent is discharged.

The aeration tanks contain a number of porous tiles, called diffusers, fixed in the bottom. Air is delivered under pressure below the diffusers, passing through them into the sewage in minute bubbles. This causes the tank contents to be agitated, aerated and oxidized. A portion of the sludge in the sedimentation tank is pumped back to the inlet of the aeration tank to inoculate the incoming sewage. The purification is rapid.

Howarth's Surface Aeration

The raw sewage is screened and afterwards flows in a succession of narrow shallow long parallel aeration tanks. Wheel paddles are placed about the middle of the length, and partly immersed in the tank. These paddles cause the sewage to be agitated and to move at a certain velocity. Surface aeration takes place and oxygen is absorbed from the atmosphere which oxidizes the organic matter. After passing through the parallel tanks the sewage reaches the quiescent sedimentation tanks where the sludge settles and the effluent is discharged. A part of the activated sludge is returned into the aeration tanks to inoculate the incoming sewage.

Bolton's Surface Aeration Method. (Simplex)

Bolton's method involved a tank with vertical sides and sloping bottom with an inner wall built a short distance from the tank-wall and extending down to near the bottom of the tank. In the centre there is a vertical pipe having a saucer at the top slightly above the water level and a trumpet mouth at the lower end near the floor of the tank. The saucer contains a revolving cone with vanes suspended on a vertical shaft, and propelled by a motor. As the cone with its vanes is rotated it draws screened sewage and collected sludge up the central pipe and throws the mixture out at the periphery in a film or spray through the atmosphere and thus it is aerated. On striking the surface of the sewage in the inner tank the film forms countless bubbles and imparts an impact which causes the tank contents to circulate.

The principle underlying this process is practically similar in each of the methods. "Aerated sludge assumes a flocculent condition containing a mass of organisms capable of rapidly clarifying and oxidizing fresh sewage when in suspension in the liquid in the presence of dissolved oxygen". This phenomenon was observed over thirty years ago. The author has a book on "Sewage Treatment and Disposal" by Sir Thomas Wardle, published in 1893, much of the contents of which previously appeared in the press. Sir Thomas Wardle when referring to a process for the treatment of trade wastes stated that, "A distinctive feature of the process is that precipitated impurities which accumulate at the bottom of the tanks form a medium in conjunction with air to clarify the inflowing foul water."

It will be observed that after the satisfactory treatment of the sewage the effluent can be discharged into a recipient water, but there remains the sludge which has to be disposed of. Activated sludge is a fertilizer about equal to farm yard manure but farmers and gardeners have not yet fully appreciated its value. It can be ploughed into the earth, dried in lagoons, pressed into cakes, or digested in tanks and afterwards buried or burned.

Sludge from Imhoff tanks usually contains about 85 per cent of water whilst that from activated sludge tanks has about 98½ per cent. These figures do not convey much without an explanation. A simple formula to compare the volume or weight of sludge in the different percentage of moisture is $S = \frac{W \times A}{B}$

S. represents the weight or volume of the partially concentrated sludge.

W. represents the weight or volume of sludge before it is concentrated.

A. represents the percentage of solids in the sludge before concentration.

B. represents the percentage of solids in the partially concentrated sludge.

Comparing Imhoff tank sludge containing 85 per cent water with activated sludge containing 98½ per cent, we find that one hundred tons activated sludge is comparable with about 10 tons of Imhoff sludge because of the higher water content in the activated sludge.

Storm water is another item which engineers have to consider. The public health regulations stipulate that streams must not be polluted, but this must be considered relatively. The first discharge of storm water is generally foul sedimentary matter which is not carried down the sewers by the dry weather flow but is usually washed out by storm water, which may be ten to twenty times as great as the volume of the ordinary discharge. The nature of the treatment of storm water will depend upon whether the recipient water is large in volume so as to secure adequate oxidation by dilution, and whether the water is used for domestic consumption, public bathing or pleasure.

What is the problem which has confronted all sanitarians in the satisfactory disposal of sewage? The introduction of the water carriage system of sewage collection and disposal, although no doubt excellent in itself, gives rise to the difficult task of purifying a varying and complex polluted liquid, fluctuating in quantity and changing in character.

Much of the fresh pure water which is supplied to the houses finds its way into the sewers charged with impurities. Some ground water also finds its way into the sewers, and then there is the storm water. In most cases in Canada these three are conveyed in the same sewer. The more water that is used and misused the greater the volume of sewage that has to be treated, and the less watertight the sewers are built the more ground water mixes with the sewage and increases its volume. As a basis for discussion, we may state that in every 1,000 gallons of sewage, there is about half a gallon of mineral matter such as dust and sand, and about half a gallon of organic animal and vegetable matter. If it was possible to effectually separate the one gallon mineral and organic matter out of the sewage, then the balance could be

Table No. 1,—Statistics of Certain Sewage Disposal Plants installed in Canadian Municipalities since 1914

Municipality	Type of plant	Date when built	Population	Capacity of tanks Imp. galls.	Initial capital cost	Capital cost per capita	Recipient water
Brampton (old tank converted)	Septic tank and act. sludge	1906 1918	4,778	90,000 aer. 45,000 sed. 50,000	$ 5,000 17,000	$ 4.60	Etobicoke river.
Burlington	Imhoff tank sprinkling filters.	1915	2,576	62,500	33,500	13.30	Lake Ontario.
Cochrane (provides for 6,000 population)	Act. sludge	1924	2,868	aer. 100,000	43,000	15.00	Sewage lake
Crystal Beach	Act. sludge	1922	6,000 (summer)	aer. 40,000 sed. 12,000	12,000	2.00	Lake Erie.
Dundas	Tanks and filters	1914	5,070	210,000	100,000	19.70	Lake Ontario.
Guelph (old tanks converted)	Tanks and filters Act. sludge	1909 1922	18,420	240,000 aer. 310,000 sed. 20,500	73,352 83,500	(trunks also) 8.60	Speed river.
Kitchener (2 plants)	Tanks and filters sewage farm	1904 1915	23,571	480,000 280,000	137,000	5.81	Snider's creek.
Leaside (designed for 1,000)	Tanks and filters	1914	374	28,000	14,000	37.50	
London (East end works only)	Tanks and filters	1916	61,369	32,000	50,000		
Simcoe	Imhoff tanks and filters	1914	4,049		34,388	8.50	Lynn river.
Stratford	Tanks and filters Act. sludge	1923	18,244	60,000 aer. 120,000 sed. 296,000	26,325	4.73	Avon river
Timmins	Activated sludge	1921	7,725	aer. 220,000 sed. 50,000	58,750	7.60	Mattagami river.
Whitby	Tanks and Filters	1914	4,174	210,000			Lake Ontario.
Woodstock	Tanks and filters. Act. sludge	1902 1921	10,196	100,000 aer. 450,000 sed. 130,000	7,000 66,500	7.22	Thames river

discharged without danger. But it is this one gallon which causes all the trouble. About one half the matter is in solution and the other half is suspension. The matter in solution is dangerous to the amenities of the streams unless the dilution is ample. Much of that in suspension can be settled in tanks. Sometimes, sewage contains trade wastes which may increase the difficulties referred to. Moreover, sewage carries with it bacteria both harmless and harmful. It contains the bacteria for its own dissolution and destruction if suitable environments are afforded.

Streams also have a variety of bacteria the character of which is dependent upon the purity of the water, and soils contain organisms upon the action of which vegetable life largely grows. In fact our existence depends upon these minute micro-organisms which cannot be seen by the naked eye but which have potentialities for our welfare or adversity.

The question which engineers and municipal authorities have to consider in Ontario, as in other parts, is what method of sewage treatment will best suit each locality. This will depend upon a number of factors, such as the volume and character of the sewage; whether it is domestic, or contains trade wastes some of which may require special consideration; whether there is ample land of suitable composition; whether the recipient water is large in volume and if it is drawn upon to supply consumers; whether there is ample fall or if pumping must be resorted to; local material; the standard of purification, and other matters.

There is no method of sewage treatment which may be said to be satisfactory in all respects. Land irrigation with sewage is still in vogue in suitable climates where the soil is porous. Filtration on sand beds, as in some New England states, on well drained soil or artificial filters after sedimentation, is in operation. Imhoff tanks combined with artificial filters are popular in the United States. Ample capacity and careful management are essential in all cases, but there is a tendency to limit the capital and operating expenditure with the result that even the best designed plant does not always produce the effluent of the required purity.

With the activated sludge process, which appears to more fully answer the requirements of the Provincial Board of Health of Ontario, it is possible to purify the effluent to practically any degree. This method has been adopted by a large number of sanitary authorities in many countries.

In conclusion by permission of Mr. F. A. Dallyn, M.E.I.C., it may be interesting to quote some statistics from a paper by him, entitled "Observations on Operating Experience with Canadian Sewage Disposal Plants," read at the international convention of Sanitary Engineers which was held recently in England.

These statistics are shown in table No. 1 and are with respect to the plants installed since 1914.

The sewage plants of twenty other municipalities mentioned in Mr. Dallyn's tabulations were built prior to 1914.

The annual cost of Woodstock activated sludge plant in 1923 per million gallons treated was:—

Labour	$ 0.81
Power	3.20
Sludge removal and drying	0.09
Repairs, alterations*	4.75
Capital charges	10.20
Total	$19.05
Less alterations	4.75
	$14.30

*Replacing filtros plates by Activated Sludge Ltd., air diffusers. Woodstock has an old septic tank, which is now used as a sludge digestion tank and this modifies the cost of sludge disposal.

The Johnson Street Bridge

Details of Construction Methods and Comparative Costs of The Johnson Street Bridge in Victoria, B.C.

F. M. Preston, A.M.E.I.C.
City Engineer, Victoria, B. C.

Paper read before the Victoria Branch, The Engineering Institute of Canada, February 27th, 1924.

In 1919 after many years of discussion the three parties interested in the building of the Johnson Street bridge, namely: the provincial government, the E. and N. Railway Company and the city of Victoria signed an agreement which called for the building of the bridge by the city of Victoria with contributions from the parties interested. These contributions included $100,000. from the E. and N. Railway Company and $200,000. from the provincial government.

The final cost of the work was 21.7 per cent higher than the estimate and this has brought home to me that in future the right thing to do, when, as was the case of the Johnson Street bridge, no money is available for preliminary plans and estimates, is to put a by-law before the people asking authority to spend the necessary amount on preliminary work, and after these preliminary plans and estimates are prepared, to again submit to them a construction by-law.

The estimate as used for the by-law was based upon one prepared by the Strauss Bascule Bridge Company, and although it was prepared for two individual Bascules the dimensions of the approach spans and details of substructure differed from that finally constructed. After the by-law was passed, work was immediately commenced upon the actual design; the substructure and approach spans being designed in the city engineer's office and the bascules by the Strauss Bascule Bridge Company.

The original intention was to erect the Bascules on large cylinder piers sunk to rock, but upon the advice of the Canadian Pacific Railway bridge department this was changed to practically solid concrete piers carried on piles driven to the rock. Objection was taken at the same time by the Canadian Pacific Railway bridge department to the location of the main trunnion pier in close proximity to the cylinders carrying the turntable of the existing

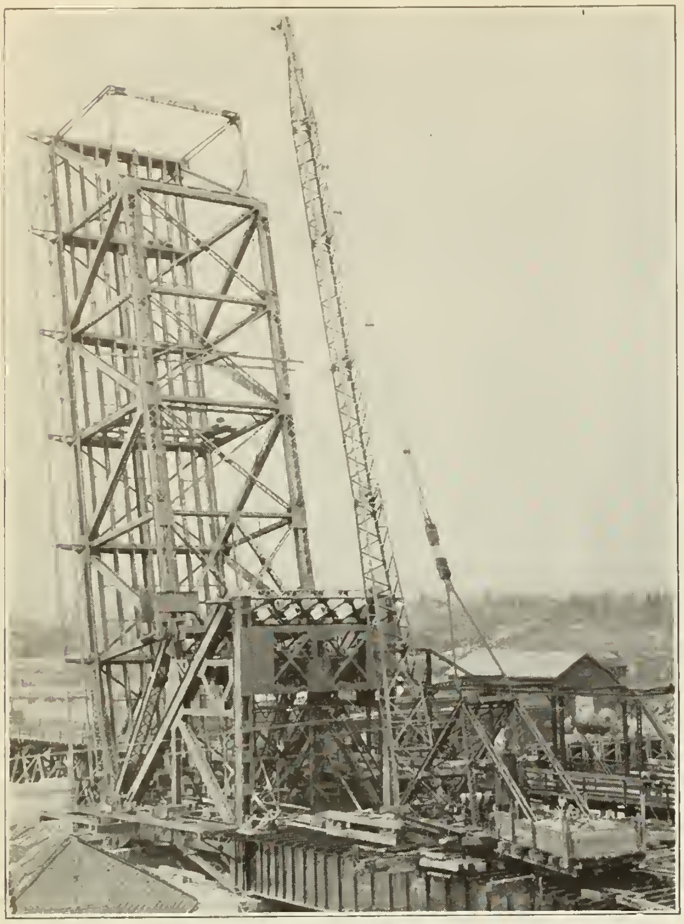

Figure No. 1.—Highway Bascule, Canadian Bridge Company's 180-foot derrick.

swing bridge, and it was therefore decided to take advantage of the fact that the city had provided for a railway loading on their side of the bridge, (for the purpose of giving the British Columbia Electric Railway Company opportunity for handling railway freight cars with electric locomotives, during certain periods of the night). It was decided to first construct the greater part of the substructure, except the northerly quarter of the main trunnion pier and the northerly half of the east abutment, and to then erect the highway steel work, diverting the E. & N. Railway over it when it was completed, and to then remove the old swing bridge and finally erect the railway portion of the new bridge.

Tenders were called for the substructure towards the end of 1920, and the city engineer was also instructed to put in an estimate for carrying out the work by day labour. Opportunity was given for bidding both on a lump sum and a schedule basis. No tenders were received upon the former and the city engineer's estimate being the lowest it was decided to carry out the work departmentally.

Comparative and Unit Costs

The engineer's estimate on the schedule was $177,376. and he would have been paid on the final schedule, supposing he were a contractor, $189,873: the actual cost being $207,897. If the work had been let to the lowest contractor, the latter would have been paid $237,632., approximately $30,000. more.

It will be noted that the *actual cost* above the day labour schedule cost was approximately $18,000. and nearly $17,000. of this was dropped on the rest pier. An additional $8,000. can also be accounted for through unavoidable delay, and for which no doubt a contractor would have been paid and no allowance for this has been made in the engineer's actual cost as given above.

The following individual costs on various sections on the substructure may be of interest. The first cost given in each case being the estimated cost; the second the actual cost and the third the amount that would have been paid to the next lowest tenderer.

East abutment	$14,156.	$17,563.	$19,235.
Counterweight trunnion pier	$64,315.	$66,089.	$69,319.
Main trunnion pier	$43,827.	$43,401.	$44,558.
Rest pier	$35,778.	$52,527.	$64,067.
West abutment	$31,796.	$28,316.	$40,453.

The unit costs for excavation under water, including the cost of the caissons or sheet piling were:

East abutment	$ 3.40
Counterweight trunnion pier	23.23
Main trunnion pier	38.21
Rest pier	23.08
West abutment	5.53

Concrete laid under water averaged approximately $13.27 per cubic yard, and the balance of the concrete on piers $12.70 and $16.00 per cubic yard, averaging about $14.60. Piling averaged 82 cents per lin. foot of pile in place.

In all of the above costs, allowances have been made for rental of equipment amounting to about $16,000. The labour cost on the first portion of the substructure was 35.5 per cent of total and on the second part 43.8 per cent.

Details of Construction

The west abutment and a portion of the east abutment were founded on rock most of which was bare at low water and presented little difficulty in construction. The excavation for the counterweight and main trunnion piers was carried out by open dredging inside timber caissons which were built upon the ways of one of the old shipyards. These caissons were carried up to their twenty-fourth course and they were then launched and floated around to their correct position. Their seams were not caulked in the ordinary way but between each course two layers of jute rope were laid about 5 inches apart, and an asphalt mixture poured between them, before the next course was laid. A strip of canvas 5 inches wide, held in place by a 1 x 3″ batten, was also spiked over the side of the joint. This method was found extremely satisfactory and cheap.

Before the caissons were launched a collapsible bottom was built 5 feet up from their lower edges, for the reason that the depth of water at the ends of the ways was insufficient, and pontoons consisting of old steel water pipe were also strung along their outside edges at about their approximate water line to give them the necessary stability after they were launched. Each caisson took a heavy list when it entered the water, and after the first caisson was launched, and to insure the others listing in a certain direction in order that they might not foul existing obstructions, they were weighted with lumber, which automatically fell free when the desired list was obtained. Each launching was carried out successfully and it was found that this false bottom leaked slowly enough to enable the caissons to be towed into deep water before they had reached their natural flotation level. The caissons were then towed into position and held there by pile stagings, and the balance of the work on them completed. Compressed air for drills and hammers was used freely on all timber work.

The excavation was done by a clam-shell bucket with the assistance of divers and high pressure water jets. The caissons were sunk by means of weighting at their upper edges with sand boxes. When they had reached their correct position washborings were taken and the piles cut off to their finished length, which allowed a five-foot projection into the concrete base of the pier. These piles were driven with a steam hammer using sliding leads and a follower. At times it was found necessary to submerge the hammer, and rather to our surprise, with no evil consequences to it.

Pouring Concrete under Water

After the piles were driven the bases of the piers were poured with concrete under water using a special bucket. The method used was developed by the city engineer and was afterwards patented. The concrete used was a 1: 2: 3 mix, which was deposited into a watertight cylindrical bucket. Its upper door was then closed and the bucket lowered into place under sufficient air pressure to balance the water pressure outside. When it had reached its correct position the bottom door of the bucket was tripped from the surface and it then emptied by gravity, the concrete being displaced by air instead of water. The bucket was held in position by rope and a brake and it worked in sliding leads like a pile hammer. A long spout at the end of the bucket enabled the material to be placed accurately around the pile heads. The resulting concrete, after pumping the caissons out in about 20 days time was found to be excellent, 12 yards per hour can be laid with a one-yard bucket. About 13 feet in depth of under-water concrete was placed by this method. Additional frames weighted with concrete blocks were then slid into place and wedged into position. All the caissons were then pumped out with no difficulty. A small amount of caulking with oakum and shingles making them watertight, and each one was landed within a few inches of its correct position. After the caissons were dry the pier forms were built inside them and the balance of the concreting done in the dry.

Figure No. 2.—Highway Bridge Complete, Railway Bridge Under Construction

Figure No. 3.—Launching Caisson

While sinking the largest caisson the lower edge encountered a thin crust of hardpan and one side broke through unexpectedly and within a few minutes the caisson assumed an angle of 15 degrees to the vertical. This accident although spectacular was easily righted by cutting away the sand boxes on the lower side, excavating under the high side, and using pontoons on the low side; and in spite of the racking it had received this caisson was as watertight as any of the others, which is a strong recommendation for the methods of caulking that were used.

All the concrete was mixed on a floating plant, the mixer scow carrying a one-yard steam driven mixer and hoppers for sand, gravel and cement erected above it, with cement sheds at either end. The sand and gravel were fed by means of a clam-shell bucket operated by the derrick scow, and the cement was raised from the sheds to the level of the hopper by means of air pressure.

The sinking of the caisson for the rest pier proved to be the most difficult operation of all. This was floated into position and a row of sheet piling driven around it to the rock, the caisson being then sunk inside the piling, no attempt being made to bring the caisson itself to the rock bottom. The rock on the northerly one-third of the site was 12 feet higher than that on the south end, with a cliff between, and allowances were made for this in building the caisson.

After excavation had been commenced an unexpected hard layer of material, chalk like in character, which the original wash borings had not shown, from 3 to 4 feet in thickness, was found immediately upon the rock and after trying several methods for its removal without success a solution was found in the use of a 2-inch water jet made out of hydraulic pipe having a nozzle flattened to ¾ inch. This was suspended from a derrick and operated below by a diver. The water at a 100 pounds pressure at the nozzle was found to break up the material sufficiently to allow the clam-shell bucket to remove it. Before concreting a very accurate scale model of the rock was made in order to determine if the foundation was safe against sliding.

The balance of the substructure for the completion of the highway portion was carried out in much the same way, except that the balance of the east abutment was constructed in cofferdams. During this part of the construction the only serious accidents during the work occurred. In the first place the walls of the cofferdam spread, the tie bars parting at the welds, but this was rectified by new tie bars and dumping clay on the outside. Then the concrete mixer scow was sunk through settling with the falling tide on a floating pile stump. It was carrying a load of about 500 sacks of cement at the time, and was blocked on three sides from all possibility of approach and therefore considerable difficulty was experienced in raising it. The northerly portion of the main trunnion pier is practically an independent unit, only being steadied by a key way. It was carried up independently and the key portion poured to below low water separately. Careful records of the levels of the substructure have been kept and show no settlement to date.

The contracts for the superstructure were both let to the Canadian Bridge Company, and the spans consist of two 112-foot plate girder deck spans, 45-foot tower spans, 150-foot Bascule spans, and 73-foot plate girder spans. Both of the Bascules were erected in the open position and for this purpose the Canadian Bridge Company built a special steel derrick with boom consisting of six 30-foot sections of lattice girder, all of which, with the exception of the two end pieces, were interchangeable, and the connections were bolted so that it was possible to carry anything requiring a 60-foot to a 180-foot boom. The derrick was capable of carrying 6 tons at 120-foot radius using the full length of the boom, and 20 tons at a 75-foot radius using a 90-foot boom.

The 112-foot approach span, the girders of which weighed about 54 tons, was first erected by means of jacking the main girders into place from flat cars on a temporary track laid alongside. The large derrick was then erected on this span and the Bascule constructed in the open position. The top cords of the movable leaf were temporarily anchored to the diagonal posts of the tower span, and the bottom of the vertical posts to the 112-foot approach span, and in this way the approach span was used as a counterweight during the erection.

The forms for the concrete counterweight were supported directly by the counterweight trunnion pier and by piles especially driven, no portion of the weight being taken by the steel until the concrete had set. Cavities were left in the counterweight for taking balance blocks, these blocks were made of different weights by the addition of steel punchings for an increase of weight, or cinders for the opposite purpose. The cubic foot weights of the concrete in the counterweight vary; being approximately 142 pounds per cubic foot for the upper, and 156 pounds for the lower portion. The counterweights were afterwards painted with a waterproof paint, and the points at which steel entered caulked with a plastic composition of red lead, asbestos fibre and tallow. The weights are 867 tons for the highway and 550 tons for the railway bridge.

After the concrete was finished, the ties and rails for the two street car tracks, the centre freight track and the subflooring of creosoted lumber were laid while the bridge was still in the vertical position. This work was both difficult and dangerous. The bridges were then lowered and in each case came within a small fraction of an inch of their correct seats. The balance of the work upon them was then completed.

On the highway portion, the operating machinery consists of two 3-phase, 75-h.p., electric motors geared through a differential to the main driving shaft. A 50-h.p., gasoline engine for emergency use is also coupled to the same shaft. The end locks are operated by a 5-h.p., motor, and the entire control for both bridges is centralized in one operator's house. The Bascules can be raised or lowered in just over one minute using electric motors and six minutes using the gasoline engines. The electrical operation is so tied together that before the bridge motors can be started the signals have to be put at danger and the end locks withdrawn.

There are two sets of electrically operated brakes to each bridge as well as a hand emergency brake and these electrical brakes can cut in by the automatic cutting out of the current at certain points of the travel, both up and down, and do so unless they are held off by means of a finger operated button. The idea is that if the operator is suddenly incapacitated his finger would leave the button, and the automatic operation would stop the bridge.

The main trunnion bearings on the highway Bascule are 22 inches in diameter and the counterweight trunnion bearing 38 inches. The upper portion of the bearings are babitted and the lower phosphor bronze. Naturally the lining up of these has to be very carefully carried out.

The old bridge was also removed by the Canadian Bridge Company. It consisted of two pin connected trusses constructed of wrought iron. All of these pins were frozen into place so they adopted a method of cutting it with an oxygen-acetylene torch.

The main pier consisted of four steel cylinders, each cylinder having eight piles driven inside it and the spaces filled with concrete. The average length of these piles was 90 feet of which about 60 were penetration. The cylinders themselves were about 40 feet long. The steel and concrete was cut away from the piles above low water. The balance of the work was of considerable difficulty until the following method was used: Holes were drilled longitudinally down the piles with hand augers and a stick of dynamite was exploded at the bottom of each hole; the effect of this was to force the cylinder open and loosen up the concrete around the piles but the explosion was not sufficient to break the piles themselves. The piles were then pulled by means of tackle carried by a frame erected upon the nose of the derrick scow, giving a pull on the pile of approximately 80 tons.

The railway bridge was designed with Coopers E-50 loading, with 50 per cent impact allowance. The highway bridge for 25-ton motor trucks and class A electric car loads on each car track, with Coopers E-50 on the centre track only, plus the impact allowance for highway bridges, Engineering Institute of Canada, and 80 pounds per square foot on the sidewalk.

The total cost of the bridge amounted to approximately $918,000; substructure $251,153, highway Bascule $213,172, railway Bascule $173,390, highway approach spans $59,000, railway approach spans $38,000. These include inspection and the Strauss Company's fee. The Strauss Company's fee for designing and royalties amounted to $34,125, or 10 per cent of the final Bascule costs. The city engineer received $2,400 for extra work.

The weight of the highway Bascule is 1,602,490 pounds, representing a cost of 13.3 cents per pound. The original estimate was for weight 1,074,000 pounds, at an estimated cost of 16.7 cents per pound. The railway Bascule weighs 1,106,700 pounds, and cost 15.6 cents per pound. The estimate was 820,000 pounds at a cost of 15.5 cents per pound.

The weight of the highway approaches is approximately 629,565 pounds at a cost of 9.4 cents per pound; the railway approaches 404,700 pounds at a cost of 9.4 cents per pound.

The highway flooring on the Bascule span consists of long leaf yellow pine creosoted 3-inch wood blocks, laid on a creosoted 4-inch sub-floor. These blocks are held in place by 2″ x 2″ galvanized angles laid every twelfth row of blocks, and upon three layers of single-ply felt. The flooring on the approach spans is of reinforced concrete laid with only longitudinal joints.

Report of Institute Fuel Committee

Appendix "C"—Coal Review.

1. Canada consumed in 1923, 38,000,000 tons of coal, of this,

17,520,000 tons bituminous
5,170,000 " anthracite
22,690,000

were imported. Practically all of this imported coal was consumed in Ontario and Quebec.

2. For the purpose of a study of the sources, production, transportation and distribution of fuels, Canada can be divided roughly into three regions — Western, Central, and Eastern, with the following limits:—Western — British Columbia coast to Winnipeg; Central — Winnipeg to the general Montreal region; Eastern — Montreal region to the Atlantic seaboard.

3. It is within the knowledge of all that there are immense reserves of lignitic, sub-bituminous, and bituminous coals in the provinces of Saskatchewan, Alberta and British Columbia, all falling in the Western region. In the Eastern region are located large mines in Nova Scotia and New Brunswick. In the Central region, however, there is no coal, and for this reason it may be termed *the acute fuel area of Canada.*

Western Region

4. The possible sources of fuel for the west are roughly as follows: Lignite mines of Saskatchewan; Lignite, sub-bituminous, bituminous and semi-anthracite mines in Alberta; Bituminous mines of varying grades in British Columbia.

It has been generally agreed by investigators that the western coal mines of all classes could increase their capacity from 50 to 100 per cent with no great increase in capital investment. In other words, there are at the present far too many operating mines for economic production. If, on the other hand, larger markets were secured, greater economy could be shown per ton of output for the western mining regions.

5. Therefore no insuperable difficulty need be apprehended to supply fuel for either the domestic or power fields. In this connection note the gradual elimination of American anthracite from the Winnipeg domestic market; the research work of the Alberta Research Council, Professor Robb, M.E.I.C., Geo. R. Pratt, A.M.EI.C., and others; and the adaptation of furnace equipment by various commercial firms to burn the very low grade high moisture fuels in power installations.

6. The following factors all bear on the general solution of fuel, for the Western region, and can ultimately be co-related by the adoption of a businesslike policy. They are mentioned in order that their effect on the general situation may be estimated.

7. Lack of cohesion on the part of western operators resulting in too many mines, too much overhead and high cost of production; tentative efforts of Alberta government in connection with Coal Sales Act, 1923; efforts of individuals on grading and sizing of Alberta coals in order to build up stable market conditions; desire of some of Alberta operators to ship their low grade coals long distances instead of higher grades — using the phrase "domestic", (which means nothing), in order to avoid "lignite" on the one hand, or "sub-bituminous" on the other; open question of whether any Alberta coal but the high grade can stand storage; previous offer of railways of 10 per cent (?) freight reduction if shipped before end of August from Alberta points to Manitoba points; gradual cutting off and increase of price of Pennsylvania anthracite for western consumption; introduction of comparatively high grade briquettes made from low grade lignites by carbonization.

Eastern Region

8. The sources, production, transportation and distribution of fuels in the Eastern region present no basic difficulty. Nova Scotia and New Brunswick and the extreme western part of Quebec have never suffered any fuel famine, except such temporary ones as have followed strikes in Nova Scotia and New Brunswick mines. In other words, the people during normal conditions in this region are accustomed to use successfully and can obtain eastern Canadian coals. Hence consideration lies chiefly in possibility of reduction of present freight rates, for an extension of market, and in coking for domestic fuel.

Central Region

9. This is the *acute fuel area of Canada* and for more thorough study, may be considered under three heads: I. Anthracite from whatever source for domestic heating. II. Bituminous or sub-bituminous coals from whatever source for domestic heating. III. Bituminous coals from whatever source for power purposes.

Anthracite for Domestic Heating

10. The sources of anthracite for domestic heating in the acute fuel area are all foreign, — Pennsylvania and Great Britain. It is well to remember that there is no real anthracite in any quantity in Canada itself.

11. The Pennsylvania anthracite is the anthracite to which 99 per cent of the anthracite consuming public in Ontario and Quebec has been accustomed. It is mined in a comparatively small part of Pennsylvania, the control of which fields is rather closely held. The complete exhaustion of the field is expected in a period of about 80 years, and the exhaustion of that portion of the field, which in the past has mainly shipped its product to Canada, is expected within a period of from 20 to 40 years. Hence the salient facts to realize are:

(a) At the not distant future the supply of American anthracite is going to be cut off either by private or governmental action.
(b) From now until the period of cessation it is probable that there will be a steady advance in price at the mine.

12. The quality of the American anthracite imported into Canada has been steadily declining until to-day it is comparatively common to receive sized American anthracite containing up to 20 per cent of ash.

13. The Welsh anthracite is a very high grade fuel and owing to its low ash content (about 3 per cent) is very acceptable for domestic heating. The quantity of Welsh anthracite for export available to Canada has been estimated to be between 200,000 to 300,000 tons, but this could be increased to perhaps half a million tons if a steady market were created.

14. Scotch anthracite is also a high carbon coal and most satisfactory when used for domestic heating. Approximately 100,000 tons of this coal are available.

15. The transportation of both American and British anthracite affords some interesting comparisons. The freight rate on prepared sizes of American anthracite from northern Pennsylvania is as follows:—

	Prepared sizes	*Pea*	*Buckwheat*		*Fines*
to Montreal	4.42	4.06		3.73	3.05
" Hamilton	3.86	3.41	No. 1	3.41	
			Smaller	3.41	
" Windsor	4.53	4.08		4.08	4.08

The freight rate from Swansea, Wales, to ocean port is about $2.14. Hence it is apparent that on the score of transportation the British anthracite has a marked advantage.

16. The total consumption of American anthracite to-day in Canada ranges about five million tons, and at present there is no chance of Britain being able to supply the whole of this market. The difficulty then in the use of Welsh and Scotch coals is to get the dealers and consumers to depart from known channels of trade and enter upon new arrangements to handle a commodity, (admittedly good) that cannot supply the total market. In other words, those dealers who wish to handle this anthracite to-day must meet very strenuous and bitter opposition on the part of the American operators with all the financial resources and powerful connections behind the latter.

17. The distribution of anthracite throughout the acute fuel area has presented in normal times no large difficulties except such as are incident to winter railroad transportation, and the necessary costs and profits to the retailer. The different freight rates between interior points in Ontario and the large centres of Pennsylvania are not exorbitant in relation to the rates to Toronto, but there is always a spread to the consumer of from $2.50 to $3.75 to cover cost of delivery, handling and pocket charges, degradation and retailers' profit. This charge is usually larger in the large cities than in the smaller towns.

18. One factor of the anthracite situation that must not be overlooked is the possible utilization in Canada of the enormous stores of anthracite fines by means of briquetting. These anthracite briquettes are made by briquetting the fine sizes of anthracite with either a coal tar pitch or petroleum binder. The fines themselves are obtained from the large culm piles, or by dredging in the rivers adjacent to the mines and piles. These dredged fines make excellent briquettes, often superior to those from the culm piles. The briquettes themselves are dense, easy to handle, will stand shipping and storage, and are somewhat freer burning than the ordinary anthracite. Taken all in all they constitute a very acceptable fuel. As far as Canada is concerned, the lower freight rate on anthracite in fine sizes than on lump, makes it possible to import these fines, briquette them and undersell lump anthracite at from $2.00 to $3.00 per ton. Anthracite briquettes fabricated in the United States pay the same freight rate as lump anthracite. This indicates the possible establishment in the not distant future, of briquetting plants in Montreal, Toronto and other places. While it is possible to foresee, at no distant date, the embargo on lump anthracite to Canada by the American government, it seems not unreasonable to suppose that the American Government will consent to export more or less indefinitely waste anthracite fines which by briquetting can be made into high grade fuel. In spite of temporary financial shipwreck due to stock jobbing there is a concern operating in Toronto at the present time.

Bituminous or Sub-Bituminous Coals for Domestic Heating

19. With the gradual realization of the consuming public in the acute fuel area that American anthracite is a luxury fuel not to be enjoyed forever there has been and will increasingly be an attempt made to burn bituminous coals of one kind or another in the domestic heating apparatus. By bituminous coals for this use we do not mean the heavy smoky and coking coals, but rather the low to medium vol. bituminous or lignitic coals that are found to be non-smoky and occur in Virginia, Pennsylvania and Alberta.

20. As the economic factors governing the shipment of the bituminous coals from the four possible sources of supply are the same whether the coals be used for domestic or power purposes, we feel the discussion of bituminous coal for domestic heating under this head should be limited to certain general considerations specifically related to domestic heating and discuss the economic sources of the coal under the next heading.

21. Bituminous or sub-bituminous coals when used in furnaces designed to burn anthracite, present certain difficulties, not, however, insuperable. Some method of firing to get rid of the gases, or in sub-bituminous coals the moisture, as economically as possible must be devised. In other words, the change from burning a high carbon low volatile very low moisture fuel to burning a medium carbon, medium volatile and medium moisture fuel is very marked, and entirely different methods of firing must be followed. There is little doubt that if the householder in the acute fuel area will study carefully the best method of firing his furnace with those bituminous coals suitable for domestic use, he can keep his house comfortable even in the coldest weather at the expense of little more than frequent attention to his furnace, and labour on the part of either himself or his employee in the firing and cleaning. With proper regulation of the draughts, some method of alternate firing and careful attention to supply of air in order to burn the volatiles, reasonably successful operation can be achieved. This phase of the problem resolves itself into careful education of the consuming public to scientific methods of burning and an effort being made to overcome a widespread conviction that we can only be kept warm in Canadian houses by American anthracite coal. In this connection much valuable educational and propaganda work has been done by the Fuel Committee of the Montreal Branch of *The Engineering Institute of Canada.* This committee has published through the Montreal "Star", tables showing the economic values of the fuels available to Montreal consumers, and minute directions for burning the said fuels. Similar educational and propaganda work has been done by the Alberta Government, in the publication of their leaflets and pamphlets entitled "Coal Truths" by

Geo. R. Pratt, A.M.E.I.C., by which householders have been educated in proper methods of firing and burning Alberta coals. This specific phase of the problem also offers an ideal opportunity to the Fuel Committee of the various branches of *The Institute* to do real national service.

Bituminous Coal from whatever source for Power Purposes

22. There are four possible sources of bituminous and sub-bituminous coals for consumption in the acute fuel area of Canada: 1. Alberta; 2. U.S. bituminous fields; 3. Nova Scotia; 4. Great Britain.

23. In general, it now remains to discuss these four fields from the point of view of supply. The Alberta field has immense resources, and all grades of bituminous coals are produced. Some of the Alberta coals are as high grade bituminous coals as can be obtained. The field is very badly organized, unfortunately, the operators being suspicious of one another which results in a practical refusal at the moment to grade or size their coals with the backing of a provincial organization. There are too many mines operating and the miners work too few days in a year, with the result of high operating cost. In addition the overhead fixed charges in most mines are far too high. The potentialities of the field are enormous if markets can be developed, and as before mentioned the output of the Alberta fields could be very largely increased with very little increase of invested capital. The great distance between the fields and the acute fuel area, with the consequent high freight cost is the outstanding difficulty.

24. The American bituminous fields are scattered over large parts of the United States. Those fields, however, which have a direct bearing on the acute fuel area of Canada are located in Pennsylvania, Ohio and West Virginia. These fields are for practical considerations almost inexhaustible. Mining conditions while far from ideal, are very much more stabilized than in Alberta, and there is every prospect of the efficiency of mining with the resultant economy being increased. The freight rates from Pittsburg on bituminous coal to a few salient points in the acute fuel area are as follows:—

Windsor	3.84
Hamilton	3.14
Montreal	4.23
Quebec	5.21

25. The bituminous fields of Nova Scotia are also well organized, from the point of view of centralization of control, but with their export and bunkering trade they are working fairly well to capacity, under limitations of certain present adverse conditions. In other words, no large increase can be looked for from this field in the near future without betterment of those conditions and the lowering of transportation costs to permit an extension of markets. F. W. Gray, M.E.I.C., a member of this Committee, states:—

"Given sufficient expenditure and the necessary lapse of time to open new and extend existing collieries, there is no reason why Nova Scotia should not produce twice its present output of coal."

This would bring the maximum economic production from the Nova Scotia and New Brunswick fields to about 10,000,000 tons per year. Naturally the aim should be to supply the requirements of the Province of Quebec and the eastern portion of Ontario from Nova Scotia.

26. Great Britain possesses large reserves of bituminous coals and would be able to export considerable quantities to Canada if the price c.i.f. port Montreal could compete successfully with a similar price on Nova Scotia coals. To date there has not been much import of British bituminous coals for power purposes, but with the increase in the number of tramp steamers coming to Montreal seeking grain, (a condition that did not obtain before the war), it is possible that rather than come out in ballast, a sufficiently low westbound rate might be promulgated to permit such a traffic. This aspect of the question is recorded as one of the possible eventualities.

27. The factors affecting a solution from an economic point of view are as follows:—Such Alberta coals as warrant long haulage can be laid down in Toronto at the cost at mine, (say 4.00 to 5.50), plus $9.00, (minimum commercial rate quoted by National Railways, — subject to some slight alteration perhaps under political pressure, — but this rate only good during early summer months), plus cost of storage and degradation.

Cost at mine	$4.00 — $5.50	
Freight	9.00	
Storage and degradation at 10%	1.45	
		$15.95

American smokeless coals can be laid down in Toronto at cost at mine $2.25 to $4.00 plus about $3.50, (good all year round), plus degradation charges in Toronto, plus duty.

Cost at mine	$2.25 —	$4.00
Freight	3.50 —	4.00
Degradation plus storage at 10%		.80
Duty		.53
		$9.33

Nova Scotia coals vary in price at Toronto, but it is generally conceded that they cannot move west of Montreal economically at present rates. There is every reason to hope, however, that there may be a reduction in their rates, (already mentioned), with a marked effect on movement of Nova Scotia coals westward.

28. To sum up, let there be assumed a mine cost of $3.50 per ton for Alberta coal, a freight rate as low as $6.00 per ton, (which has been mentioned often as one which would permit the marketing of Alberta coals in Ontario), then the cost laid down in Ontario would be $10.50 made up as follows:—

Cost at mine	$ 3.50
Freight	6.00
Degradation and storages	1.00
	$10.50

It is obvious that this figure is an absolute minimum, and yet, it is $1.17 higher than the price of those American bituminous coals suitable for domestic heating. It is inevitable that were any considerable movement of Alberta coals to take place, American operators would export to the acute fuel area certain of the bituminous coals suitable for domestic heating. This is a factor often overlooked in the whole question of the shipment to Ontario of Alberta coals. It may be pointed out also that it is next to impossible to anticipate an American embargo on the export of American bituminous coals, because United States bituminous fields are almost inexhaustible.

29. In considering transportation and distribution, we are brought face to face with an extremely important part of the whole fuel problem of Canada. One of the first steps taken by the Fuel Committee of *The Engineering Institute of Canada* was to recommend, in conjunction with the Institute of Mining and Metallurgy, to the government that a competent enquiry be made into the real cost of moving coal and that the commissioners or committee

be given full authority to examine witnesses, have access to records, etc. This step was not taken with any suspicion that the $9.00 rate quoted by the National Railways was out of reason, but rather with a view of having actual facts at the disposal of those interested in order that a solution might be found for this fuel problem. It is a debatable point whether any figure can be reached that would represent real cost, because of the large number of variables in the equation. Assuming for the moment that a sufficiently low rate were promulgated to enable Alberta coals to compete commercially with American bituminous coals in Ontario, such factors as the following present themselves: Any very low rate involving a large movement would appear to involve an early capital expenditure on the part of the railways of immense sums in equipment. The fixed charges in such an investment would in turn hoist the rate. It seems to be generally admitted also that any very low rate would have to be confined to the early part of the summer in order not to congest the wheat shipments. If this be so, then storage charges have to be taken into consideration, and if handling is to be economical, large storage facilities must be provided. To state the matter in other terms, the problem is one of contrasting the sale of domestic grades of Alberta bituminous coal hauled 1,800 miles with sale of at least equally good grades of bituminous coal hauled only a few hundred miles. These facts while not pleasant from a national point of view must be faced fairly because patriotism will never induce a person to pay voluntarily 25 cents more for his coal. If for national reasons we may not indefinitely import bituminous coals, the answer must be to carry the difference by duties or subsidies, and this point is obviously a matter of national policy to be settled by the Federal Government.

Coke

30. The foregoing preliminary remarks have to do with the sources, distribution, transportation, etc. of raw coals. The solution of the fuel problem of Canada, however, in the long run cannot be confined to this, in view of the past experiences of the public with anthracite and in view of the economic factors that ultimately must govern. Other aspects of the solution must include the possibility of the use of domestic coke in the acute fuel area made at strategic points from either Nova Scotia, Alberta or American bituminous coals. This is one of the most hopeful of the substitutes appearing, and the committee commends with pleasure the splendid investigatory work being done by the Dominion Fuel Board in connection with this and other fuel matters. This board is conducting a complete and thoroughly competent survey of the possibilities of coke.

The Fuel Committee lays special stress on the desirability of burning coke for domestic purposes. Coke is a clean, smokeless fuel, provides a steady heat, and under proper draft control can be burned at higher efficiencies than coal. Owing to its porous characteristics it should be supplied for domestic use preferably in the smaller sizes. In addition to the above-mentioned advantages for domestic furnaces the more general use of coke will allow the valuable by-products of the original coal to be recovered. The smoke inconvenience of the cities is already large enough without having it augmented in any way by burning more bituminous coal, and the smoke nuisance will certainly be reduced by the increasing consumption of coke. The price of domestic metallurgical coke will run in the acute fuel area from $12.00 to $15.00 per ton in the cellars of the consumers. In general metallurgical coke, (by-product coke), is a better fuel for domestic heating than gas house coke, on account of its physical properties. This superiority is not so evident in the analyses as it is in the handling and burning qualities. The metallurgical coke is more solid, harder, less brittle and less friable than gas house coke, and altogether constitutes a very superior class of fuel. The British Empire Steel Corporation has developed to a considerable degree at their Sydney plant a special by-product coke for domestic use, and are now contemplating production on an increased scale in the near future. A by-product coke plant has been built this year at Hamilton which will supply coke for domestic use; and consideration is being given also to the establishing of similar plants in Montreal, Toronto or Port Colborne. The Montreal plant will probably utilize Nova Scotia coal, and the Toronto or Western Ontario plant will probably use American coals.

31. In connection with this coke question, the members of the committee are referred to:—

"Why and How Coke Should be Used for Domestic Heating", by Henry Kreisinger and A. C. Fieldner, Technical Paper No. 242, U.S. Bureau of Mines.

"Comparative tests of By-Product Coke and Other Fuels for House-Heating Boilers." by Henry Kreisinger, John Blizard, H. W. Jarrett and J. J. McKitterick. Technical Paper No. 315, U.S. Bureau of Mines.

Miscellaneous Observations

32. Other factors are the steady increase in development of water powers thereby releasing coal for heating or coking, and the efforts being made to increase the use of auxiliary fuels, especially peat. It is to be noted that in the acute fuel area there are vast quantities of good peat bogs. It is hoped that the work done by the Peat Committee of the Federal and Ontario governments will result before long in the establishment of peat industries at these bogs. The possibility of central heating in urban centers is another very hopeful step. This also is being investigated by the Dominion Fuel Board.

Subsidiary to the foregoing are the following:— Education of the public to better methods of firing; Research work for architects and engineers for better heat insulations in the construction of houses and heating apparatus.

Revised, Montreal, Sept. 25th, 1924.

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THE

ENGINEERING JOURNAL

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OF CANADA

VOL. VII December 1924 No. 12

Contributions to War Memorials

The Honour Roll and War Trophies Committee finds itself under the necessity of making another appeal to the members for funds to provide an appropriate war memorial and honour roll to perpetuate the memory of those who fell and in honour of those who served overseas.

Last spring a letter was sent out which met with a generous response, about twenty-five hundred dollars having been received in response to one appeal.

Some excellent designs were submitted for competition, the awards not having yet been made.

It is certain, however, that the memorials will cost more than originally anticipated, namely, between four and five thousand dollars, and that a larger sum will require to be available.

Many of our members have no doubt overlooked the original letter, consequently this reminder is being issued in the hope that the appeal will meet with a ready response and that the members will rise to the occasion and contribute the necessary amount.

Annual Meeting at Montreal

As previously announced, the thirty-ninth Annual General Meeting of *The Institute*, combined with the General Professional Meeting, will be held in Montreal, Tuesday, Wednesday and Thursday, January twenty-seventh, twenty-eighth and twenty-ninth, nineteen hundred and twenty-five. In addition to the routine business associated with the annual meeting, there will be two features of outstanding importance at this convention, one of them being the entire day devoted to engineering education and the other the joint session and luncheon with the Association of Canadian Building and Construction Industries.

The tentative programme which is reproduced below is subject to revision but contains many features of what is being outlined at the time of going to press. During the past months the question of engineering education has been foremost in the minds of the engineering societies, the universities and the profession at large. It was consequently decided that the importance of this subject demanded the serious consideration of *The Institute* at the present time. A number of notable papers will be presented on this subject including one from the director of investigations of the Society for the Promotion of Engineering Education, two or more from deans of engineering universities in Canada, one from a prominent practising engineer and at least one from an engineer occupying a high place in industry.

The Council has issued invitations to every engineering university in Canada to be represented, in the hope of bringing out a complete discussion on the subject from the university viewpoint.

Emphasis will be given to the advisability of winter construction in the papers presented on the occasion of the joint session, these being contributions from men prominent in engineering construction.

The headquarters of the gathering will be at the Windsor Hotel, Montreal, and it is hoped that many members of *The Institute* will plan to attend what promises to be one of the most interesting gatherings we have yet held.

Engineering Institute Annual and Professional Meeting

Montreal, January 27th, 28th, 29th, 1925.

Programme

TUESDAY—JANUARY 27th.
Morning: 9.00 to 10.00 a.m. Registration.
10.00 a.m. Business Session.
Report of Council.
Reports of Committees.
Reports of Branches.
Noon: Luncheon.
Afternoon: Business Session continued:
Scrutineers' Report.
Installation of President.
Evening: Smoker.

WEDNESDAY—JANUARY 28th. *Professional Meeting.*
Morning: Engineering Education.
Afternoon: Continuation of papers and discussion on Engineering Education.
Evening: Reception and Dance.

THURSDAY—JANUARY 29th.
Morning: Joint session with Association of Canadian Building and Construction Industries.
Subject: Engineering Construction.
Noon: Joint Luncheon with Association of Canadian Building and Construction Industries.
Afternoon: Visit to Winter Construction Operations.

A Message from the Secretary

During the year nineteen twenty-four, there has been a notable advancement in the direction of securing greater recognition and appreciation, by the public at large, of the work of the engineering profession. Evidence of this is not lacking: The Institute, through its members, has been called upon to give counsel on many matters of national import; in the daily press constantly appears news of the achievements of our members, reports of their pronouncements on public matters, and detailed quotations from their technical discussions; in the technical press the activities of The Institute find conspicuous space; to the important gatherings of sister technical societies in the Republic to the south as well as abroad, representatives of our Institute receive cordial invitations; and in the industries of our country recognition of the engineer's true value finds expression in the rapid adoption of policies whereby the technically trained man is being drafted into industry to fill positions of responsibility.

The achievement of this recognition, is in no small measure due to the whole-hearted co-operation of our members, and it is only through the continuation of our united efforts that the fullest appreciation of our services may be attained.

In thanking each and every member for his splendid support, it is the sincere wish of your Secretary that the Christmas season may be filled with gladness for all and that the coming year may be one of great prosperity.

FRASER S. KEITH

Proposed South

Connecting the Island of Montreal

Reproduction of Drawing Accompanying Designs and Plans for South Shore Bridge, Submitted

LT.-COL. C.N. MONSARRAT, M.E.I.C., Consulting Engineer, Montreal.

P. L. PRATLEY, M.E.I.C., Consulting Engineer, Montreal.

Whose appointments, with J. B. Strauss, M.E.I.C., as a joint association of designing and consulting engineers for the proposed South Shore Bridge, has been announced.

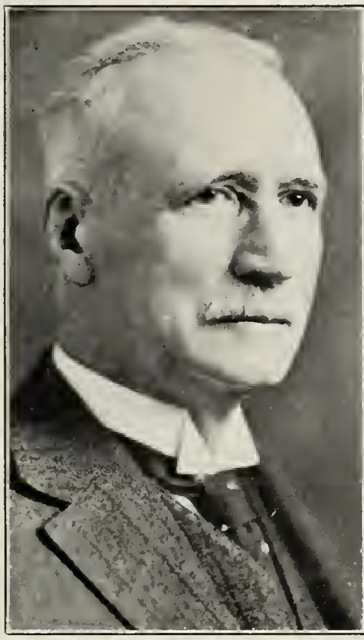
T. W. HARVIE, M.E.I.C. General Manager of Harbour Commissioners of Montreal; Member of Advisory Board for the proposed South Shore Bridge.

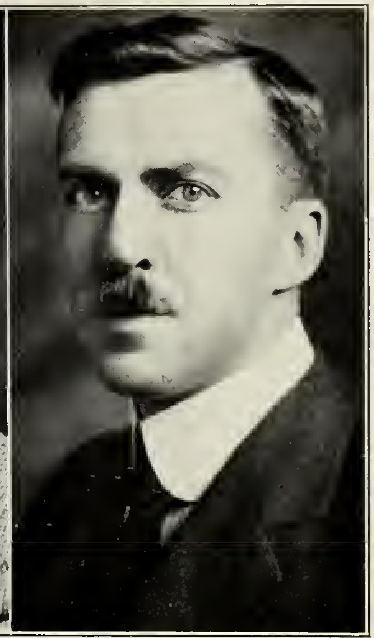
Reproduction of Drawing Accompanying Designs and Plans for South Shore Bridge, Submitted

Shore Bridge

with the South Shore Mainland

to the Harbour Commissioners by Lt.-Col. C. N. Monsarrat, M.E.I.C., and P. L. Pratley, M.E.I.C.





G. H. DUGGAN,
D.Sc., LL.D., M.E.I.C.,
President of the Dominion Bridge Company, Limited; Appointed Consulting Engineer to Advisory Board for the South Shore Bridge.

PROF. H. M. MACKAY,
M.E.I.C.,
Dean of the Faculty of Applied Science, McGill University; Member of Advisory Board for the proposed South Shore Bridge.

H. A. TERREAULT,
A.M.E.I.C.,
Director of Public Works of the City of Montreal; Member of Advisory Board for the proposed South Shore Bridge.

IVAN E. VALLÉE,
A.M.E.I.C.,
Chief Engineer, Quebec Department of Public Works and Labour; Member of Advisory Board for the proposed South Shore Bridge.

to the Harbour Commissioners by J. B. Strauss, M.E.I.C., and F. W. Cowie, M.E.I.C.

Appointment of Engineering Board *for* South Shore Bridge, Montreal

Following a meeting of the Harbour Commissioners of Montreal, on November 19th, it was announced that resolutions had been adopted and contracts sanctioned under which an engineering association was brought into being which will function in the capacity of joint designing and consulting engineers. At its head are Lt.-Col. C. N. Monsarrat, M.E.I.C., and P. L. Pratley, M.E.I.C., designated as registered engineers, and Joseph B. Strauss, M.E.I.C., designated as associate engineer.

There was also constituted an advisory board of engineers to be composed of five members to be designated upon the basis of a representative of harbour and navigation interests who shall act as chairman, a representative each for the province of Quebec and the city of Montreal; a bridge engineer of outstanding rank and prestige and of recognized high professional attainments, who shall also act as chief consulting engineer to the advisory board; together with another bridge engineering authority of acknowledged professional standing and practical experience.

Experts who have been designated to serve the latter board and who have signified their acceptances are the following: T. W. Harvie, M.E.I.C., late chief engineer and present general manager of the Harbour Board; G. Herrick Duggan, D.Sc., LL.D., M.E.I.C., and Prof. H. M. MacKay, M.E.I.C., dean and professor of engineering, Faculty of Applied Science, McGill University; Ivan E. Vallée, A.M.E.I.C., chief engineer, Department of Public Works and Labour of the province of Quebec; H. A. Terreault, A.M.E.I.C., director of public works for the city of Montreal.

"It is no small satisfaction to the Commissioners," said Dr. W. L. McDougald, president of the Montreal Harbour Commission, "that they have been able, after irritating and what must have seemed to the onlooking public inexplicable delays, to evolve out of what at one time looked like comparative chaos and irreconcilable conflict, a programme which in their judgment will enable an immediate start to be made in the initial steps of preparation for actual construction. Within the next week a surveying staff will start on surveys, soundings and borings, while the engineers will proceed with the recruiting of their necessary staff at once."

Memorial to James Watt

At the final session of the World Power Conference, a resolution was carried calling attention to the fact that Heathfield Hall, near Birmingham, built and occupied by James Watt, was shortly to be offered for sale by public auction. The resolution suggested that it would be an appropriate and memorable act for the First World Power Conference to ensure the continued existence of the building in its present condition, and urged that the International Executive Committee should ascertain the terms upon which it might be acquired.

Following the conference the question of the purchase of Heathfield Hall to be preserved for all time as a national memorial was considered by the International Executive Committee. On looking into the question the executive secretary found difficulties unsurmountable in attempting to secure the building and the matter had to be dropped as far as the Power Conference was concerned.

It is satisfactory to learn, however, that the garret workshop containing James Watt's tools, implements and personal belongings, various articles being exactly as left by the great genius, was being transferred with all its contents to the South Kensington Museum, and thus will be preserved for a future generation the tools and apparatus of the man who, more than any other, was responsible for the production of mechanical power.

President Beatty Counsels Engineers

In a notable address at the banquet held at the King Edward Hotel, Toronto on the evening of November ninth, commemorating the fifth reunion of the engineering graduates of Toronto University, E. W. Beatty, chairman and president of the Canadian Pacific Railway, made observations concerning the engineering profession which deserve more than ordinary consideration coming as they do from a university graduate, an eminent member of the legal profession and head of the greatest transportation system in the world. Mr. Beatty pointed out that the engineering profession in this Dominion could render a service to the country by bringing about the realization on the part of Canadians that the future of Canada depended as much on industries and natural resources as on agriculture. The Canadian farmer particularly in the west suffered from the lack of an adequate home market and, having to transport his produce long distances, he resented the price paid him in comparison with the price received for the produce. The great work on the part of the engineer was to reduce the cost of production and the still greater one had been to reduce the factor of distance. He pointed out that the engineer had enormously increased the possibility of employment, thus enlarging the markets and increasing the number of consumers. These facts, continued Mr. Beatty, placed before the farmers of this country will do much to modify the antagonism which unfortunately still prevails between the agricultural prairies and the industrial east.

Showing the result of keen observation, the distinguished speaker explained that the reason why more technical men did not occupy leading technical positions in transportation and other similar corporations was because the average technical graduate was not willing to start at the foot of the ladder and rise as the result of hard work, but wished to get a position somewhere near the middle or near the top. He declared that the splendid training received by men of science fitted them for making a success in any calling, provided they were willing to make the effort necessary to achieve success. On graduation the young man cannot compete with men of similar age who have spent the college period in actual business, but he believed that in ten years technically trained men had a great advantage. He pointed out the erroneousness of the impression that the young graduate was equipped as an officer or for some superior position without going through the arduous work of apprenticeship, with the mental attitude that puts work, hard and intelligent, before every other consideration.

Coming from so eminent a source the advice given by Mr. Beatty to the profession at large and to the recent graduate in particular cannot fail to be of advantage to the profession and to the Dominion as a whole.

OBITUARIES

Lieut.-Col. Frederick Owen Hodgins, D.S.O., M.E.I.C.

Lieut.-Col. Frederick Owen Hodgins, D.S.O., M.E.I.C., younger son of Lieut.-Col. W. E. Hodgins, C.M.G., former Adjutant-General of the Canadian militia, died in Ottawa on November thirteenth after a lingering illness.

Born at Ottawa on October sixth, eighteen eighty seven, Colonel Hodgins graduated with honours from the Royal Military College in 1907. During that year he was engaged in general engineering work and contracting for Petawawa military camp following which he went to Halifax in connection with the barracks and fortifications in that city. In April 1908 he was appointed assistant to the engineer in charge of construction at Petawawa camp. In December of the same year he was placed in charge of all engineering work in connection with the barracks and fortifications at the Citadel and St. Louis Barracks, Quebec. From September 1911 to December 1912, he was in the office of the director of engineering services at Militia Headquarters, Ottawa. From December 1912, to August 1914, he was in charge of all engineering work for the Department of Militia and Defence in Military District Number One, in Western Ontario. At the beginning of the war he enlisted for overseas service and was on active service in France and Belgium with the Canadian Engineers. From August nineteen seventeen to March nineteen eighteen he was staff officer to the director of fortifications and works, Aviation, War Office, London, England, in charge of all aerodrome construction in the United Kingdom. From March 1918 until demobilization, June 1919, he was again on active service in France, Belgium and Germany, part of which time he was staff officer in charge and G. O. C. Canadian Engineers, Canadian Army Corps, which included all engineering work involved in the last advance into Germany and the engineering work in connection with the defence of the Cologne Bridgehead. For his services he was awarded the Distinguished Service Order. He returned to Canada at the end of the war and later went back to England to take a course in the staff college at Camberley. About four years ago Colonel Hodgins was appointed General Staff Officer of Military District Number Three with headquarters at Kingston, which position he occupied up to the time of his death.

With his death Canada loses one of the most brilliant officers, recognized as having exceptional qualities of military leadership to an unusual degree.

The funeral which took place at Ottawa on November sixteenth, was attended by a distinguished gathering, the funeral being one of the most impressive ever held in the capital. Headed by the band of the Governor General's Footguards, the funeral procession was arranged by the

Department of National Defence. Besides his parents, Col. Hodgins is survived by a widow and one child. Colonel Hodgins joined *The Institute* in 1907 and received full membership in 1920.

Louis Joseph Rene Steckel, M.E.I.C.

Louis J. R. Steckel, M.E.I.C., for many years a well known engineer on the staff of the Public Works Department, died at his late residence in Ottawa, on October 31st, 1924. The late Mr. Steckel was born in Wintzenkein, Alsace, on September 6th, 1844, and came to Canada with his parents in 1857. He received his early education in Quebec, and became a naturalized British subject in 1868. His first engineering work was in the position of draughtsman with the Public Works Department, and during the early part of his connection with this department he was engaged on road survey work in Gaspé, along the gulf of the St. Lawrence shore. He was later located in Ottawa in connection with departmental work on governmental buildings in that city. His permanent appointment to the Civil Service took place in 1869, and as a member of the engineering staff of the Public Works Department he was employed in the construction of many important harbour and river works. Among the important works carried out by Mr. Steckel was that of introducing a system of geodetic levelling operations along the St. Lawrence and Richelieu rivers. Following his appointment of chief clerk of the Public Works Department he was engaged in extensive hydrographic survey of the St. Lawrence canals. The late Mr. Steckel was among the earliest members of *The Institute*, having been elected Member of the Canadian Society of Civil Engineers on February 14th, 1888, and on December 22nd, 1920, was made a life member of *The Institute.*

Frederick Fraser Miller, M.E.I.C.

In the death of Frederick Fraser Miller, M.E.I.C., which occurred at his home in Napanee, Ontario, on Saturday, October 18th, 1924, *The Institute* has lost one of its earliest members. The late Mr. Miller was born at Napanee in 1861, and graduated from McGill University in civil engineering, in 1882, where he won the Princess Louise and Marquis of Lorne gold medal. Following his graduation he spent the summer of 1882 on work for the Montreal Harbour Commission, under the late Sir John Kennedy, M.E.I.C., and during the following two sessions he lectured at McGill University in civil engineering. Mr. Miller practised his profession for many years in Canada and the United States, and was a qualified Dominion and Ontario Land Surveyor. In addition to his professional activities he devoted a large part of his time to matters of community interests. The late Mr. Miller was elected Member of *The Engineering Institute of Canada,* (then the Canadian Society of Civil Engineers,) on February 24th, 1887.

Reginald Drayson Fry, A.M.E.I.C.

Reginald Drayson Fry, A.M.E.I.C., died on January 22nd, 1924, at the Leland Hotel, Winnipeg, Man. Mr. Fry was born in Poole, Dorset, England, on January 2nd, 1872, where he received his early education. Mr. Fry came to Canada about the year 1890, and his schooling was continued under private tuition. Practically his entire work was in connection with railway engineering, the earliest part of which was with the National Transcontinental Railway, as engineer in charge of location party No. 9, district F, between the years 1905 and 1906. He was on similar work in the following year and was made assistant engineer in the mountain division of the Grant Trunk Pacific Railway in 1907. His work was largely of a pioneer character on various railways including, the Grand Trunk Pacific; Edmonton, Dunvegan Line; Nelson Harbour; Central Canada Railroad and Power Company; Hudson Bay Peace River and Pacific Railway; and Hudson Bay Railway projects. The late Mr. Fry was elected Associate Member of *The Institute* on May 23rd, 1920.

James Doyle Koen, S.E.I.C.

Sincere regret is expressed at the untimely death of James Doyle Koen, S.E.I.C., who was drowned following the upsetting of his canoe in a small rapids on the Vermillion river, Quebec, on June 22nd, 1924. At the time of his death Mr. Koen was engaged in field work for the Wayagamack Pulp and Paper Company, and was returning to the camp with one of his companions who had taken ill on the work. At the time of the accident there were three in the canoe and in an heroic effort to assist his two companions, by relieving the weight on the overturned canoe, Mr. Koen endeavoured to swim to shore. He had not gone far when he apparently was seized with cramps and disappeared before any assistance could be given him. After a search of five days the body was recovered and brought to Sydenham for burial. The late Mr. Koen was born at Sydenham, Ontario, on March 22nd, 1899, and graduated from Queen's University in the spring of 1923, in civil engineering. He was admitted to *The Institute* as a Student on February 3rd, 1922.

Coleman Meriwether, Affiliate E.I.C.

Coleman Meriwether, Affiliate E.I.C., died on October 8th, 1924, and was buried at his former home in Louisville, Kentucky. The late Mr. Meriwether was born at Louisville, Kentucky on April 14th, 1875. His early work was connected with railway construction involving considerable experience in masonry work in connection with bridges, stations, wharves and terminals. Later his work included the design of concrete sections for sewers and water works for cities and private corporations. Mr. Meriwether was well known for his work in connection with concrete pipe and concrete pipe joints. He was at one time vice-president of the Canadian Lock Joint Pipe Company, Limited; president of the Lock Joint Pipe Company, New York; and later was manager of the Cement Products Bureau, Portland Cement Association, Chicago, which position Mr. Meriwether left about six years ago to develop another joint for reinforced concrete pressure pipe. Mr. Meriwether was elected Associate of *The Engineering Institute of Canada,* (then the Canadian Society of Civil Engineers), on December 10th, 1910.

Concrete Products

"Concrete Products, Their Manufacture and Use", by Wallace R. Harris, M.E.I.C., managing editor, "Concrete Products", Chicago, constitutes a unique contribution to literature on this important subject. The present volume is the second edition and is intended to assist those engaged in the manufacture of concrete products, both in the details of the manufacturing of these products, and in the different factors entering in the marketing of the same. This volume has been attractively produced, both as to binding and preparation of the text. It is highly illustrated and some idea of its broad treatment of the subject may be gained from the fact that it contains 75 chapters, occupying in all 586 pages.

Short Period Courses in Highway Engineering and Transport

Announcement has been made through A. H. Blanchard, M.E.I.C., professor of highway engineering and transport, University of Michigan, Ann Arbor, Michigan, that short period courses in highway engineering and transport, each extending for two weeks, will be given at the University of Michigan between December 8th, and March 20th. These courses are said to be designed primarily for men who are engaged in this branch of engineering. Further information regarding the courses may be secured from Professor Blanchard.

PERSONALS

A. D. Ferguson, A.M.E.I.C., is at present engaged as office engineer for the highways branch, Department of Public Works, Edmonton, Alta.

C. P. Edwards, O.B.E., A.M.E.I.C., director of Radio Services, represented Canada at the third Radio Conference held in Washington during the second week in October.

Fred. V. Seibert, M.E.I.C., has been in western Canada carrying on an investigation of the development of the natural resources of the west, for the Natural Resources Intelligence Service, Department of the Interior.

P. R. Warren, M.E.I.C., of the Armstrong Whitworth Company, who has recently been in Newfoundland for the company, is now located in Hong Kong, China, in connection with the company's work.

John H. Curzon, A.M.E.I.C., secretary-treasurer of the Toronto Branch, has been appointed designing engineer, on the engineering staff of York Township. Mr. Curzon has been on the engineer's staff of the city of Toronto, sewer department, for the past two years.

C. Antony Ablett, M.E.I.C., has been appointed managing director of the Unbreakable Pulley and Millgearing Company, Limited, West Gorton, Manchester, England, and the Cooper Roller Bearings Company, Limited, of King's Lynn, Norfolk, England, which companies have recently been purchased by Mr. Ablett and his associates.

G. A. Bennett, D.L.S., A.M.E.I.C., of the field staff of the Topographical Survey Branch, Department of the Interior, has returned to Ottawa after several months' sojourn in the British Isles. Mr. Bennett visited Wembley Exhibition and toured England by automobile. While there he also spent some time investigating the methods of carrying on surveys in the Old Country.

George H. Power, M.E.I.C., late of the firm of Chipman and Power, announces that he has transferred his offices to rooms nine and ten, Mail Building, Toronto, where he will continue in the practice of municipal and general engineering. The announcement that the partnership entered into between Messrs. Chipman and Power had been dissolved by mutual consent appeared in the November issue of *The Journal*.

Yves Lamontagne, A.M.E.I.C., of the Department of Trade and Commerce, Ottawa, sailed on the Montclare, on November seventh, for Europe, to assume the position of assistant Canadian trade commissioner at Brussels. Mr. Lamontagne, on calling at headquarters, assured the secretary that he would be glad to hear from members of *The Institute* at any time, and to be of any service that may be required. His address is 98 Boulevard Adolphe, Max, Brussels.

L. H. Cole, M.E.I.C., who, as guest of the Society of Chemical Industry, Montreal branch, addressed their regular meeting on November 18th, on the Sodium and Magnesium Salts of Western Canada, visited headquarters and in the course of conversation stated that approximately 100,000,000 tons of hydrous sodium and magnesium salts had been proven to exist by the drilling operations carried on during the last four years by the Mines Branch, Department of Mines, Ottawa.

W. G. Mitchell, M.E.I.C., of Price Bros., and Company, Limited, and chairman of the Saguenay Branch of *The Institute* had an extremely narrow escape from asphyxiation on November eighth, when with the doors of his garage closed, Mr. Mitchell had the engine of his automobile running and was quickly overcome by the gas fumes. Fortunately, a messenger with a telegram for Mr. Mitchell was sent to the garage to deliver the message, and upon seeing Mr. Mitchell unconscious quickly secured assistance.

W. J. Boulton, A.M.E.I.C., of the Natural Resources Intelligence Service, Department of the Interior, has returned to Ottawa from western Ontario, where he has been conducting an investigation in co-operation with the Board of Trade, as to the source and supply of basic raw materials imported by the manufacturers, with the idea of finding out the possibilities of replacing them with Canadian raw products. His investigations during the past season covered the urban centres in Perth, Bruce, Huron, Grey and Wellington counties.

F. H. Farmer, M.E.I.C., of the Canadian Westinghouse Company, is located at Pittsburgh, Pa., with the Westinghouse Electric and Manufacturing Company. Mr. Farmer's connection with the Westinghouse Company dates back to 1905 when he spent a year taking the company's apprenticeship course. From 1907 to 1910 he was on outside construction for the Canadian Westinghouse Company at Hamilton. He was later located with the company at Winnipeg for some eight years and during the season of 1916-17 he lectured in electrical engineering at the University of Manitoba.

F. H. Kitto, M.E.I.C., has returned to Ottawa from Nova Scotia where he has been conducting an economic survey of the natural resources of the province and the possibilities of their greater development. During a six months' period spent in the field he covered the entire fourteen mainland and four Cape Breton Island counties. This work is being carried on by the Natural Resources Intelligence Service, Department of the Interior and was conducted in co-operation with the Nova Scotia Department of Industries and Immigration and the various Boards of Trade and Development Associations of the province.

G. H. Herriot, M.E.I.C., has been appointed assistant professor in the department of civil engineering, at the University of Manitoba. Mr. Herriot graduated from the school of mining, Queen's University with the degree of Bachelor of Science in 1907. He is a Dominion, Manitoba, and Alberta land surveyor. In addition to extensive experience in topographical surveying, Mr. Herriot lectured in applied mathematics at Queen's University during the seasons of 1909-10, and 1910-11, and in applied mathematics and astronomy at the University of Manitoba during the seasons of 1917 and 1918. During the season of 1918-19 he was assistant professor in civil engineering at the University of Manitoba.

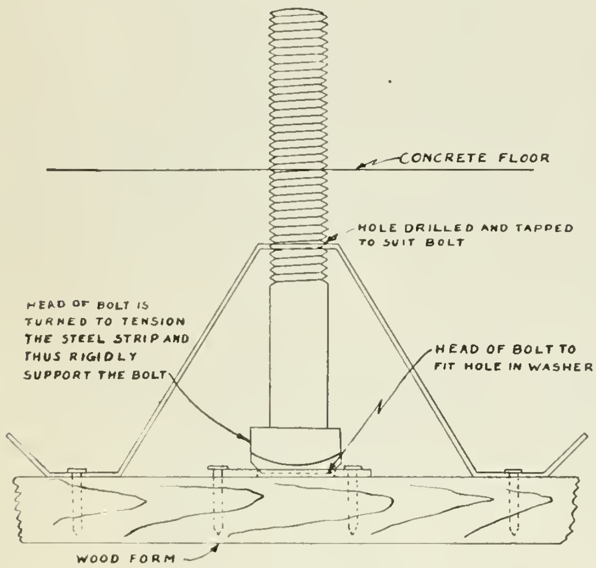
Chief Engineer Appointed for Quebec Roads Department

Alex. Fraser, A.M.E.I.C., who for the past two years has been in charge of district number four of the Quebec Department of Roads has been appointed chief engineer, of that department, succeeding the late Gabriel Henry, A.M.E.I.C.

Mr. Fraser has been connected with the roads department of the Province of Quebec since 1911 when he was appointed assistant chief engineer of the Department of Highways and during that time he has been in charge of the construction of a number of the principal highways of the province. Mr. Fraser is a native of Cap St. Ignace, Que., and is a graduate of the Ecole Polytechnique, the class of 1909. In addition to his new duties, Mr. Fraser will continue in his former position, engineer in charge of the Montreal district.

President of American Gas Association

H. C. Abell, M.E.I.C., who has recently been elected president of the American Gas Association, was born in Winnipeg, in which city he received his early education. His first work was with the Canadian Pacific Railway as apprentice engineer and after considerable experience in connection with the operation of public utilities he took a course at the Armour Institute of Technology of Chicago, where he obtained the degree of B.S. in electrical engineering and later the degree of Electrical Engineer. For the past six years he has devoted his entire time to the public utilities industry, being connected with the design, construction and operation departments. Mr. Abell is a member of the executive committee and chairman of the organization committee of the Public Utility Information Bureau, and vice-chairman of the Public Relations Section. He is chairman of the committee on Gas Appliance Testing Laboratory. In addition Mr. Abell is vice-president of the Electric Bond and Share Company of New York, and president of the National Power and Light Company, and is a director and an official in many public utility undertakings.



Bennet Anchor Bolt Holder

G. A. Bennet, Jr.E.I.C., has developed a simple appliance for supporting bolts in concrete floors and ceilings for machinery, hangers, etc. This support, for which Mr. Bennet has made application for patents in Canada and the United States, is known as the Bennet Anchor Bolt Holder and is designed to support any bolt rigidly, withstanding ordinary knocks without shifting its position. These holders eliminate the old-fashioned wood templates, are inexpensive and result in the saving of time and labour. Mr. Bennet is a graduate of McGill University of the class of 1911, and during the late war spent three years overseas with the 3rd Field Company, Canadian Engineers.

ELECTIONS AND TRANSFERS

At the meeting of Council held on November 25th, 1924, the following elections and transfers were effected:

Associate Members

ANDERSON, Norman Russell, Squadron Leader, Officer in/c training section, Royal Canadian Air Force, Camp Borden, Ont.

ANDERSON, William, in charge of power apparatus divn., Northern Electric Co. Ltd., Calgary, Alta.

BARKER, William George, Wing Commander, V.C., D.S.O., D.F.C., M.C., Royal Canadian Air Force, Ottawa, Ont.

BONUS, William Harold, B.A.Sc. (Univ. of Tor.), asst. supt. of bldgs. and grounds, University of Toronto, Toronto, Ont.

BREADNER, Lloyd Samuel, Wing Commander, in command of R.C.A.F. Station, Camp Borden, Ont.

CROIL, George Mitchell, Squadron Leader, Staff Officer, Royal Canadian Air Force Headquarters, Ottawa, Ont.

CUFFE, Albert Lawson, Squadron Leader, Officer Commanding R.C.A.F. Station, High River, Alta.

GORDON, James Lindsay, Wing Commander, Royal Canadian Air Force, Ottawa, Ont.

HENDERSON, John Alexander, B.A., B.A.I., (Trinity College, Dublin), Major, R.E., sole official, Oyama Irrigation District, Vernon, B.C.

HOBBS, Basil Deacon, Squadron Leader, commanding R.C.A.F. Station, Winnipeg, Man.

JOHNSON, George Owen, Squadron Leader, Royal Canadian Air Force, Ottawa, Ont.

KENNY, Walter Robert, Squadron Leader, Royal Canadian Air Force, Ottawa, Ont.

KILBOURN, Frederick Binns, gen. supt., Canada Cement Company, Montreal, Que.

MORTON, Guy H., B.A.Sc. (Univ. of Tor.), manager and principal owner, Electrical Engineers, Limited, Calgary, Alta.

RITCHIE, Alexander, tech. engr., power plant dept., City of Edmonton, Alta.

TUDHOPE, John Henry, Squadron Leader, commanding R.C.A.F. Station, Dartmouth, N.S.

Juniors

DAWSON, Gerald Stewart, B.Sc. (Univ. of Alta.), of Calgary Alta.

LEA, Harry Windsor, asst. engr. on constrn. of streets, etc., Dept. of Technical Service, City of Montreal, Que.

Transferred from the class of Associate Member to that of Member

INGRAHAM, Harry Alexander, in charge of concrete design and constrn. for H. Ingraham, Calgary, Alta. Also consulting engineer.

Transferred from the class of Junior to that of Associate Member

BADGLEY, Leonard Amey, B.A.Sc. (Univ. of Tor.), plan examiner and structural engr., city architect's dept., City of Toronto, Ont.

CRYSLER, Roy Alan, B.A.Sc. (Univ. of Tor.), structural and reinforced concrete engr., city architect's dept., City of Toronto, Ont.

EDMONDS, Charles William, B.A.Sc. (Univ. of Tor.), asst. designer, sewer section, dept. of works, City of Toronto, Ont.

Transferred from the class of Student to that of Junior

ROOT, Stephen Eastman, engr. in charge of construction, Canadian Explosives Limited, McMasterville, Que.

The following students were admitted:—

AKINS, Ernest Joseph William, 113 Cauchon Street, Fort Rouge, Winnipeg, Man.

ALLISON, Jesse Graham, 619 Belgium Avenue, Westmount, Que.

ARCHAMBAULT, Jean Jules Albert, B.A. (Loyola College), 443 Durocher Avenue, Outremont, Que.

BAXTER, Gordon Bruce, 707 Shuter Street, Montreal, Que.

DAWSON, Randolph, Central Y.M.C.A., Montreal, Que.

DILWORTH, Edwin Leslie, Queen's University, Kingston, Ont.

DONNELLY, William David, 24 Main Street, Kingston, Ont.

FOX, Maurice, B.Sc. (London Univ.), 217 Stewart Street, Peterborough, Ont.

GILLETT, George Herbert, B.Sc. (McGill Univ.), 360 Stewart Street, Peterborough, Ont.
HAINES, Benjamin Willard, B.Sc. (Univ. of N.B.), 369 Brock Street, Peterborough, Ont.
HARDY, Albert Elwin. 170 Furby Street, Winnipeg, Man.
HINCHCLIFFE, Joseph Edward, 2249 Waverley Street, Montreal, Que.
KATZ, Morris, 1103 St. Urbain Street, Montreal, Que.
LEE, Frank Spencer, Queen's University, Kingston, Ont.
LISTER, Arthur, 119-7th Avenue, Ville St. Pierre, Que.
McCLUNG, Joseph Eldon, 3584 Park Avenue, Montreal, Que.
MULES, Nathan Ernest, 1539 Hutchison, Street, Montreal, Que.
PIGOT, Charles Hugh, 198 Milton Street, Montreal, Que.
PRICE, Frederick Avery, 377 Mountain Street, Montreal, Que.
REEKIE, William George, 319 Vaughan Street, Winnipeg, Man.
ROBERTSON, Frederick Thomas, 10 Dawson Court, Furby Street, Winnipeg, Man.
SHARPE, James MacDonald, 126 Lewis Avenue, Westmount, Que.
SMITH, Gerald Augustine Vincent, 332½ Gottingen Street, Halifax, N. S.
STOCK, Sydney Wallace, B.Sc. (Univ. of Alta.), 516 Charlotte Street, Peterborough, Ont.
SWITZER, Ralph Hubbs, B.A.Sc. (Univ. of Tor.), 315 Margaret Avenue, Peterborough, Ont.
THWAITES, Joseph Taylor, 64 Victoria Street, Kingston, Ont.
WEAMES, Albert J., 2378 Jeanne Mance Street, Montreal, Que.
WEBSTER, James Stewart, Strathcona Hall, Montreal, Que.
WINTER, Francis Edward, 4684 Westmount Avenue, Westmount, Que.
YOUNG, Dudley Stewart, 4 Academy Road, Winnipeg, Man.

EMPLOYMENT BUREAU

Situations Wanted

Mechanical and Designing Engineer

Mechanical and Designing Engineer, A.M.E.I.C. with considerable experience in plant installations, employing heavy machinery. Holding position at present with large concern. Desires executive position with a large corporation. Married — age 38 yrs. Future prospects for advancement essential. Apply Box 159-W

Civil Engineer

University graduate 1918, general construction and cost experience, draughting and estimating. Very best references. Available for immediate engagement. Can speak English and French fluently. Apply box No. 160-W.

Construction or Manufacturing

Engineer with construction and manufacturing experience is willing to invest in going engineering business with a view to expansion and taking an active interest therein. Apply box No. 161-W.

Civil and Sales Engineer

McGill graduate, age 30, desires permanent connection with engineering, contracting or industrial concern. Four years sales experience. Would consider investment in sound proposition where services could be used advantageously. Apply box No. 162-W.

Situations Vacant

Electrical Engineer

A large public service corporation requires an electrical engineering graduate with a few years experience since graduation. Must be prepared to start at the bottom with a view to obtaining responsible position within two years. Probable location Toronto. Apply box No. 121-V.

Mechanical or Electrical Graduate

There is an opening for either an electrical or mechanical graduate, between the ages of twenty-two to twenty-eight years, on design work with a large equipment manufacturing organization. Apply box No. 122-V.

Graduate With Radio Experience

Manufacturing firm desires the services of a young graduate engineer who has had actual experience in radio work. Apply box No. 123-V.

Transportation as Related to National Development*

By J. G. Sullivan, M.E.I.C.,
Consulting Engineer, Winnipeg, Man.

The world in which we live travels in a definitely fixed path as the result of the balancing of opposing forces. This conflict of opposing forces appears to be a general law of Nature.

The naturalist would doubtless state that the object of our lives is to propagate that the human race may continue to exist. If we take this philosophic view, the speaker thinks we must admit that everything that tends to make life safe, easy, and comfortable, is working in the direction desired.

As an argument in proof of the theory that our object in life is to make a living rather than to create riches, the speaker would call attention to the fact that the estimated wealth of the world for the present population is less than $600 per capita. How is it possible easily to make a comfortable living for all? By increasing the production of the individual. How can this result be obtained? The natural instinct of self-preservation instilled in every man (if not stultified by false doctrines and theories) will result in his making a little more than a living, and this surplus or capital will buy plant and machinery that, in many instances, will increase the production of the individual a thousand-fold.

The most intellectual man, if entirely isolated without tools, would have little advantage over the savage in making a living, but place improved tools and machinery in the hands of the ordinary man, and he will produce sufficient of one or more articles to supply the requirements of hundreds or even thousands. This brings us to the subject of this paper, namely, Transportation.

Without means of transportation to convey economically the products to the consumers, it would be senseless for the miners of a coal district to produce a thousand times more coal than they require for themselves, or for the wheat growers to produce five or six hundred times the quantity they require for themselves. It is not necessary to make out a case for the need of transportation. It is scarcely worth while to discuss transportation by human beings or by animals, it is a matter of ancient history, as far as National development is concerned. There remains to be discussed waterways, railroads (steam and electric), motor cars, and aeroplanes. There is no question but that each has its particular function in the development of a nation, but as far as inland waterways are concerned, it must be borne in mind that they are not as susceptible of general development as the railways; in fact, large areas of the world have been developed by railways, that would have been impossible to develop by waterways, to say nothing of the impracticability on account of the excessive cost of constructing inland waterways as compared with that of building railways. In the speaker's opinion, the inland canal (other than short canals connecting open waterways) is no longer a factor in National development on the Western Hemisphere. It is realized that there are those who will not agree with this idea.

The speaker was born about sixty years ago in western New York in the shadow of a high embankment which carried the Erie canal over a deep ravine. Fifty years ago, he well remembers seeing scores of farmers' teams lined up waiting their turn to unload farm produce into the warehouses on the banks and slips of this canal. Thirty years ago, this business had almost vanished. The farmers in that district were hauling to the freight shed, and the through traffic in grain from Buffalo to New York City was declining. Since that time, the state has spent more than $100,000,000 in the hope of reviving that business, and in the face of all this pampering, one will find men who will state that the railroads killed the canal.

If a corporation can pay for its own thoroughfare and still be able to put out of business the traffic on a free thoroughfare that cost ten to fifteen times as much per mile, the speaker's conclusion is that there is something wrong with that mode of transportation. The motor bus, truck, and car are recent developments. They are performing a very valuable service, but the speaker cannot agree with those who predict that motor-driven vehicles will supplant the street car for short haul or the railroad for freight service of less than 100-mile hauls. The reasons for this opinion are: First, in general, the ratio of dead to live load is in favor of the rail car; second, the necessary tractive force is much in favor of the rail car; and, third, the cost of the roadway is far greater than that for the rail car. Although, at present, the motor trucks have practically free use of these expensive highways, the speaker believes that when the tax-payers realize the damage that heavy trucks cause to pavements and highways, this unfair competition at the expense of the general tax-payer will not be tolerated. It would appear, therefore, that, as far as can be predicted, no form of transportation is likely to compete with rail transportation in future National development.

In Canada and the United States, engineers have witnessed the greatest National development in the history of the world and the greatest and most essential factor in that development has been the

*Paper read before American Society of Civil Engineers as part of a symposium on Railroad Transportation and Railroad Terminals.

railroad. As a reminder, the speaker would call attention to Table No. 2, which gives a comparison between the railroad mileage and the population of the United States in the past 100 years.

TABLE No. 2.—RAILROAD MILEAGE AND POPULATION OF THE UNITED STATES

Year.	Railway mileage.	Population.
1830	23	13 000 000
1840	2 818	17 000 000
1850	9 021	23 000 000
1860	30 626	31 000 000
1870	52 922	39 000 000
1880	93 262	50 000 000
1890	166 703	63 000 000
1900	194 262	76 000 000
1910	240 438	92 000 000
1920	252 845	106 000 000

Canadian statistics show a similar growth except for a shorter period. The most striking example of rapid development is in the three prairie provinces of western Canada. Forty-five years ago, there were no railways and very little or no export. At present, these provinces are exporting between 200,000,000 and 300,000,000 bushels of wheat annually, to say nothing of the other grains and farm products. The extent of railway growth and increase in population is given in Table No. 3.

TABLE No. 3.—RAILWAY MILEAGE AND POPULATION IN MANITOBA, SASKATCHEWAN, AND ALBERTA.

Year.	Railway mileage.	Population.
1871	None	50 000
1881	Constr'n started	102 000
1891	3 443 (1894)	232 000
1901	......	419 000
1906	6 422 (1907)	809 000
1911	8 061	1 323 000
1916	13 581	1 693 000
1921	15 270	1 956 000

A statement has been published* giving the railway mileage of the world in 1917 as 706,730. This means an average increase per year of about 9,000 miles since the beginning of this form of transportation and must have required the expenditure for construction and equipment of not less than $50,000,000,000 or $60,000,000,000, of which a large proportion was financed by private corporations. In Canada, the cash subsidies to railways amount to $282,000,000, of which the Dominion supplied $220,000,000, the various provinces about $44,000,000, and the municipalities about $16,000,000. The land grants to railway companies amount to about 46,500,000 acres, of which the Dominion granted 31,500,000 acres and the various provinces about 15,000,000 acres. Of this land, the Canadian Pacific Railroad Company, the pioneer railroad company in the West, received 25,000,000 acres. The general Subsidy Act that was in force for a number of years prior to 1914, provided a bonus for colonization railways of $3,200 per mile for roads costing less than $15,000 per mile to construct and a further bonus of one-half the cost for roads costing more than $15,000 per mile, up to a point where the total bonus would be $6,400 per mile; that is, a subsidized railway costing $22,400 or more per mile would receive a bonus of $6,400 per mile.

This form of assistance in either cash or land grants resulted in a fairly sound and ample development, but the radical element of the country began a crusade against the alienation of the natural resources or, as they termed it, the people's inheritance. The clamor for railway extensions was general and the politician was in a dilemma; the result was that Canadian legislators pledged the credit of the government, in the form of guaranteed bonds and railway construction boomed, but when these roads failed to make expenses there was no alternative for them except to be taken over by the government. To-day, we are burdened with an annual deficit of between $60,000,000 and $80,000,000. In two cases, at least, where provincial governments could not induce organized railway companies to build the lines they had projected, they persuaded railway contractors to organize railway companies. In these two cases, the roads are in the hands of the Provincial Governments and are not earning operating expenses, to say nothing of fixed charges which, in one case, amount to more than $5,000 per mile. These are not pleasant statements, but they are truths known to the public, and the speaker is only repeating them to emphasize the fact that no matter how good the cause or the work, it can be turned into an evil by being carried to extremes.

*Railway Age, February 11, 1921.

Addresses Wanted

The work of compiling the revised edition of the Charter, By-laws and List of Members of *The Institute* is about to commence and for this purpose, as well as for general record, it is important that addresses should be brought up to date as soon as possible. The following is a list of members whose addresses are not known and any information that may be supplied as to the addresses of these members will be greatly appreciated by the Secretary.

Members

Albertson, D.
Brown, L. L.
DeLamere, C. T.
Edwards, H.
Ferguson, H. B.
Hawkins, E. E.
Holliday, J. H.
Leslie, R. F.
Macdonald, Chas.
Scott, W. L.
Walker, Miles
Welch, Arch.
Wright, J. A.

Associate Members

Ames, F. T.
Amiot, S.
Augustine, A. P.
Barnes, H. E. R.
Black, J. R.
Bolger, E. J.
Borland, V. J.
Bourgoing, S.
Bowie, Jas.
Butler, J. K.
Calder, J. W.
Campbell, Neil
Chown, R. C. F.
Clarke, Frederick
Corbett, C. F.
Cuthbert, A. D. W.
Davis, C. H.
Drowley, A.
Earl, E. A.
Elliott, G. R.
Girouard, E. C.
Gorrie, D. F.
Grange, E. R.
Gray, E. D. A.
Hamilton, G. M.
Hawkins, S. H.
Herren, P. H.
Ireland, W. J.
Kearney, Thos.
Lepage, J. S.
Lillico, R. S. B.
Luscombe, H.
Mackenzie, C. M.
Matthews, F. E.
McCrady, M.
McKenzie, J. E.
Menard, J. P.
Mercieca, A. L.
Millard, C. S.
Mulock, Col. R. H.
Murphy, C. J.
Newton, C. A.
O'Connor, J. F.
Orr, F. O.
Perrin, A. T.
Pinch, H. H.
Purvis, F. R.
Putnam, A. A.
Rhodes, J. F.
Rodd, B. T.
Saunders, Walter, L.
Scarnegie, D. A.
Schuster, K. R.
Shenstone, F. R.
Snodgrass, R.
Sprenger, H.
Suttie, J. P.
Tom, J. A.
Wallis, N. J.
Weir, F. E.
Wilkins, Sidney
Williams, C. W.
Yandall, B. A.
Zverina, J.

Juniors

Ardagh, S. V.
Betourney, J. N.
Bryant, E.
Burton, E. C.
Ells, J. C.
Grupp, C. A.
Igoe, F. J.
Junkin, R. L.
MacKenzie, Norman
Mayes, F. L.
Merton, H.
Morrison, H. K.
Pearson, Chas.
Roberts, H. A.
Shepherd, H. W. R.
Smith, H. S.

Students

Allen, A. J.
Allen, Wilfred
Bell, W. T. A.
Bickell, W. A. B.
Bishop, E. G.
Brodeur, J. C.
Bronstein, S.
Brown, E. C.
Brown, Leo. B.
Buckingham, E. J.
Burshell, G. H.
Campbell, A. J. G.
Carp, M.
Circle, J.
Clark, W. J.
Cooper, J. R.
Coulter, W. D.
Davison, J. L.
Deamude, F. V.
DeLormier, J. A.
Desmaisons, O.
Durham, J. B.
Foster, M. G.
Gagnon, A.
Gannon, L. J.
Garret, A. R.
Goldie, J. E.
Graham, H. J.
Grant, W. R.
Haley, J. P.
Hart, L. F. C.
Heurtley, E. S.
Hovey, L. M.
Hubbard, E. B.
Jones, G. L.
Kerr, G. E.
Kirby, A. R.
Larin, L.
Leger, A.
Lewis, B. W.
MacDonald, W. D.
MacLean, C. H.
MacKenzie, B. H. T.
MacLeod, C. H.
Martin, B. E.
McCallum, F. L.
McLeish, R. G. A.
McRae, J. A.
Munroe, K. A.
Oakley, R. D.
Pearse, H. A.
Philip, L.
Porter, J. B.
Porter, W. J.
Read, G. W.
Roy, E. W.
Rumble, Geo. R.
Sims, T. A.
Stewart, M. G.
Tallon, J. A.
Townsend, J. H.
Vanier, G.
Whitlock, W. H.
Wilson, D.
Wilson, F. E.
Wright, H. S.
Young, J. P.

BRANCH NEWS

Border Cities Branch

F. Jas. Bridges, A.M.E.I.C., Secretary-Treasurer.

President Surveyer Presents Charter

A special meeting of the Border Cities Branch was held as a dinner meeting at 6.30 p.m., November 8th, in the Prince Edward hotel, Windsor. This was an important occasion for the members of the local branch inasmuch as they had as their guest, Dr. Arthur Surveyer, M.E.I.C., president of *The Institute.* Dr. Surveyer was met at the train by Dr. Geo. Porter, M.E.I.C., former councillor for the branch, W. H. Baltzell, M.E.I.C., and J. E. Porter, A.M.E.I.C., present councillors for the branch and E. J. McIntire, A.M.E.I.C. Dr. Surveyer was conducted on a trip around the Border Cities, visiting most of the large manufacturing plants.

During the dinner several solos were rendered by Mr. Robt. Pryor. At the conclusion of the dinner and after disposing of a few items of business the chairman, J. E. Porter, A.M.E.I.C., introduced Dr. Surveyer. In his quiet, courteous and unassuming manner the president expressed his pleasure at being a guest of the Border Cities Branch and also at a strictly family gathering. He then proceeded with a short resumé of the history of *The Institute,* showing its extensive growth, both in regard to members and financially. He spoke of the formation of the branches and made special mention of the Journal which he said had played a very important part in the advancement of *The Institute.* The president also generalized on the engineering profession, its ethics etc. In closing his remarks Dr. Surveyer presented the charter to the Border Cities Branch.

The chairman, J. E. Porter, A.M.E.I.C., in accepting the charter touched briefly on the history of the branch since its formation, showing its growth from the twenty-three original petitioners to the present membership of one hundred and twenty. He remarked that, although only five years had elapsed since the petition had been forwarded to Montreal, there were already five who had passed on to the Great Beyond. He then read from the charter the names of the petitioners, these being, F. C. McMath, Willard Pope, Geo. E. Roehm, F. H. Kester, G. C. Williams, F. A. W. Brown, A. J. Riddell, Owen McKay, Morris Knowles, J. S. Nelles, H. Thorne, R. A. Carlyle, A. E. Eastman, David Molitor, E. C. Kerrigan, V. R. Heftler, A. H. Aldinger, L. T. Bray, E. C. Henderson, M. E. Brian, A. J. Stevens, F. J. Bridges, J. E. Porter.

F. J. Bridges, A.M.E.I.C., referred to the five deceased charter members, namely E. G. Henderson, Owen McKay, L. T. Bray, G. C. Williams and A. J. Riddell and asked the chairman if it would not be fitting and appropriate if a silent toast should be drunk to these members who were now on the other side of the veil. A silent toast was then drunk by all members.

For the remainder of the evening a social time was spent with informal discussions in which nearly all members present took part.

Regular Meeting

Although a special meeting was held only a week before, the members were equal to another meeting which was held Friday evening November 14th, at the Prince Edward hotel, Windsor.

Dinner completed, the chairman, J. E. Porter, A.M.E.I.C., brought up the matter of whether a ball should be given by the branch again this year. After much discussion it was referred to the Entertainment Committee to get the opinion of the members of the branch.

Notice was also given of the annual meeting of the branch which is to be held December 12th.

Civic Management

Mr. Porter then introduced the speaker for the evening, C. H. R. Fuller, city engineer and manager of the city of Chatham who chose as his subject "Civic Management".

In opening his remarks, Mr. Fuller emphasized the large new field which has opened to engineers in town management and he felt that engineers had not yet realized this. He said that he had found out from his experience that there was much to learn in this new field which was not in the curriculum of the engineering schools.

The number of towns and cities in Canada and the United States which now have this form of management is 344, and only 40 per cent of these have as their managers engineers, the majority or balance being filled by contractors, builders and members of other trades. He stated that since taking this position he had given much study to the most efficient system of issuing debentures and bonds and was using the serial method instead of the old system of the sinking fund. His office had charge of all the purchasing for the different departments of the city and thereby made a considerable saving. Besides looking after the usual work of the city engineer, that is of pavements, sidewalks, sewers, water, etc., he also had charge of the parks, playgrounds, city market, bond and debenture issuing, traffic problems and preparing a budget for the expenditures of the next year. Mr. Fuller went on to show how after the budget was prepared, it was presented to the council for consideration, additions and parings. The whole paper was most interesting as was evidenced by the discussion which took place after, in which nearly all members present took part.

Peterborough Branch

Paul Manning, A.M.E.I.C., Secretary.
W. E. Ross, A.M.E.I.C., Branch News Editor.

The first regular meeting of the season was held on Thursday October, 9th, when a paper was presented by D. V. Canning, Jr.E.I.C., on "Automatic Stations."

Automatic Stations

Mr. Canning, who is a graduate of McGill University, and is now a member of the engineering staff of the Canadian General Electric Company, Peterborough, had prepared a most interesting and comprehensive address on the subject, which lost nothing in the delivery. Commencing with the reasons for the development of automatic stations, Mr. Canning briefly sketched their history and development up to the present time and indicated the various advantages both from the economic and engineering standpoint. He then proceeded to give the main types into which automatic stations are divided and gave some interesting figures regarding actual installations.

Since, as Mr. Canning remarked, the two most general applications, at least in Canada, are the hydro-electric stations and the synchronous converter railway substation, he devoted more time to these two types, and with the aid of one or two lantern slide diagrams described their main features and method of operation. During this part of the address he pointed out the general possibilities of automatic stations, stressing the point that by their use the development of isolated and relatively small water powers is made economically possible.

Mr. Canning's address, included a brief but explicit description of each important piece of apparatus in the scheme. At the conclusion of Mr. Canning's address two reels of motion pictures of automatic stations and substations, and one reel of the general arrangement and operation of a supervisory control system were shown. These reels, which are the property of the General Electric Company were of very high order and served to further emphasize the various points brought out by Mr. Canning in his address.

The meeting was well attended, and the fact that both speaker and paper were well chosen was shown by the number of questions asked by the members and friends at the conclusion of the paper. Chairman E. R. Shirley, M.E.I.C., congratulated Mr. Canning on his paper and D. L. McLaren, A.M.E.I.C., moved a hearty vote of thanks which was unanimously approved by those present.

Meeting at Lindsay

As a compliment to the large number of Peterborough Branch members resident in Lindsay and district, the second meeting of the season was held in Lindsay on October 16th. The Peterborough contingent travelled to Lindsay by automobile in time to attend dinner at the Rotary Headquarters, which was a preliminary to the regular meeting. F. R. Wilford, M.E.I.C., occupied the chair and on behalf of the Lindsay members welcomed the Peterborough members. E. R. Shirley, M.E.I.C., chairman of the branch spoke briefly on the constitution, motto, and ethics of *The Institute* and gave a short historical sketch of the branch.

The speaker of the evening was R. O. Wynne-Roberts, M.E.I.C., who was introduced by Mr. Wilford, and who gave a paper on "The History and Development of Sewage Disposal." This paper was of great interest as the subject of sewage disposal is a live topic in Lindsay at the moment. Mr. Wynne-Roberts' paper is published elsewhere in this issue.

Supplementing the paper, moving pictures were shown by F. A. Dallyn, M.E.I.C., director of sanitary engineering division, Department of Health, Toronto. The meeting was attended by some forty members from Peterborough, Mayor Graham and the town council of Lindsay, members of the Board of Health and a number of others.

At the conclusion of the meeting Mayor Graham moved a vote of thanks to Mr. Wynne-Roberts for his very able address, which vote was seconded by Dr. Blanchard, Lindsay and Victoria health officer. The Peterborough members all united in expressing their appreciation of the good time prepared for them by their Lindsay brethren.

The Annual Dinner

Although five years ago the Peterborough Branch was inaugurated with a banquet that set a high standard for future years, the sixth banquet of the branch, held on Tuesday, November eighteenth, proved that not only was that high standard being well maintained but that due to the fellowship resulting from being better acquainted the last banquet was one of the most enjoyable yet held.

The annual dinner of the branch is recognized locally as one of the biggest affairs of the winter season, and an invitation to attend is considered an honour to the recipient in any part of Canada. The gathering was also notable for the presentation and reception of the Peterborough Branch charter.

The initial part of the programme consisted of a farce introduced by the chairman, who protested against the absence of programmes. The semblance of protest was maintained by other members of the branch, giving the impression that a good-sized row had developed more or less spontaneously. The hoax was disclosed when the programmes were distributed showing the "Tempest in a Soup-bowl", word for word as given by the following cast:—

The Grouch....................G. R. LANGLEY,
The Apologist..................B. L. BARNS,
The Indignant One............A. L. KILLALY,
The Injured One..............BILL ROSS,
The Goat......................PAUL MANNING,
The Pacifist....................P. P. WESTBYE,
The Gogetter..................MAURICE CRUTHERS.

The effect was dramatic in the extreme.

Presentation of the Charter

J. B. Challies, M.E.I.C., vice-president of *The Institute*, made the presentation of the branch charter while the charter itself was handed over by O. O. Lefebvre, M.E.I.C., chairman of the Montreal Branch. In making the presentation Mr. Challies expressed his pleasure in representing the Council on this historic occasion. He pointed out that the charter was a material evidence of faith in the Peterborough Branch and an expression of appreciation of the high standard maintained in branch activities. The charter was a visible expression of authority to carry out the activities of the branch and considered a warrant from the Grand Council that the branch was legally established and in due form. He expressed the hope that they would treasure the charter as their authority to represent the engineering profession in their district and to maintain its highest traditions. In asking the branch to accept the charter from the chairman of the Montreal Branch, he stated that the charter was not only an emblem of authority but an emblem of responsibility and an opportunity for service afforded to each and every individual member.

Mr. Lefebvre, in a brief address, marked by extreme courtesy, handed the charter to the chairman of the branch, expressing the hope that it would carry with it good luck and prosperity.

World Power Conference

In a vivid picturization of the World Power Conference, Mr. Challies showed the extent of Canada's participation and the great good it did in advertising to the world the unbounded resources of this country. The result of the World Power Conference was to put Canada on the map in a new way. It showed the engineers and financiers of the world that Canada is, if not the leading power producing country in the world, at least not far behind. One point that was interesting to the Europeans was the way our International Joint Commission functions. It is the only body of its kind in the world to-day, acting as a safety valve so far as the two countries are concerned. European countries with their complex problems arising out of joint water rights, asked an explanation, and we told them that all along the 3,000-mile frontier there is no fort, but only hydro development stations. The commission, watching the interests of both nations, makes it impossible for any real difference to occur between Canada and the United States. In concluding, Mr. Challies made the startling statement that we if, in working out our great water power developments along the St. Lawrence and at Niagara, ever let our share of this power go into the United States, we are ruined.

The Engineering Institute from outside the branch was represented by Professor Haultain and Professor Gillespie of Toronto, F. S. Lazier, chairman of the Niagara Peninsula Branch O. O. Lefebvre, chairman of the Montreal Branch and Vice-President Challies, all of whom took an active part in the function.

As is the custom at the Peterborough Branch functions, the sister professions were well represented. Speaking for the legal profession J. R. Corkery, stated that the Peterborough Branch had been a credit to the city and to the engineers. Representing one hundred and fifty teachers J. E. R. Munroe, stated that the teaching profession in Peterborough leaned on such a strong organization as the E.I.C., for protection from destructive criticism. Dr. J. A. Morgan was one of several who, during the evening made reference to the personal loss and the loss to the profession in the death of President Walter J. Francis during the past year. Rev. Doctor R. C. Blagrave, carrying the greetings of the ministerial profession, said the advancement of the Dominion depends in large measure upon the success of the engineering profession. Representing the profession of dentistry, Dr. S. J. Graham complimented his hosts upon the achievement of an ideal and conveyed in happy fashion the grettings of the dentists of the city. Another speaker was F. H. Dobbin, introduced as a good friend of the local branch.

Visitors to the Peterborough Branch functions have always taken away happy recollections of the inspiring music with original songs and parodies contributed by the famous sextette, W. E. Ross, A. B. Gates, A. L. Dickinson, W. M. Cruthers, P. Manning, and Ian Mackenzie, who played the accompaniments throughout.

All who had the pleasure of attending this enjoyable function felt that they had added one more happy evening to those already enjoyed on the occasion of the well established annual dinner of the Peterborough Branch.

Victoria Branch

E. P. Girdwood, M.E.I.C., Secretary-Treasurer.

Visit to Dominion Drydock at Esquimalt, B.C.

The Victoria Branch together with visiting engineers and friends, a number of over one hundred, paid a visit of inspection to the Dominion Drydock at Skinner's Cove, Esquimalt, B.C., on October 18th, and were shown over the undertaking by the district engineer of the Department of Public Works, J. P. Forde, M.E.I.C., the resident engineer, W. A. Gourlay and the vice-chairman of the Victoria Branch, G. B. Mitchell, M.E.I.C.

All parts of the work were explained and the visitors were surprised at the immensity of the project which, when finished, will rank as one of the largest in the British Empire. At the time of the visit several gangs of men were working on the construction of the pumphouse at the new $6,000,000 drydock now being built for the Dominion Government at Skinner's Cove, Esquimalt, and this part of the undertaking will soon be completed.

It was also stated that the contract for the floating caissons to close the docking chambers had been called for. The caissons will be floated into position across the entrance and intermediate sills, where their keels will rest after the valves are opened and sufficient water is admitted to the centre compartments to sink them to a position of rest on the sills. To remove them from this position the water ballast will be pumped overboard, bringing them back to light draft condition when they can be floated out of the dock entrance.

Extent of the Huge Basin

The basin which, when completed will be 1,150 feet long, 149 feet wide at the top and 129 feet wide at the bottom, will be emptied by pumping machinery at a rate of 198,000 gallons per minute, emptying the dock in four hours and five minutes.

The pumping plant will consist of three main pumps with a capacity of 60,000 gallons per minute each. There will be two auxiliary pumps with a capacity of 9,000 gallons per minute each. A six inch pump for removing seepage water surface drainage, etc., when a vessel is in dock, has also been provided. All the mechanical equipment, which will include main, auxiliary and fire pumps, valves, sluice gates, machine shop equipment, capstans, travelling cranes, etc., will be electrically operated.

The dock is divided into three sections, each of which can be used independent of the other. They are provided with culverts five feet wide and five feet six inches high connected with the dock by openings in the floor around the sections, and with the pump chamber.

Major Walkem Presents Charter

The Victoria Branch held a very successful and well attended luncheon meeting on November 5th, in Spencer's private dining room at which the branch charter was presented by Major George A. Walkem, M.E.I.C., vice-president of *The Institute* The charter was prepared under the authority of the Institute council, and was received on behalf of the Victoria branch members by Patrick Philip, M.E.I.C., deputy minister of Public Works Department of British Columbia, who replied suitably.

The Vancouver and Victoria Branches of *The Engineering Institute of Canada* are making a presentation of an enlargement of a photograph which appeared in *The Engineering Journal*, in February 1924, to the Provincial Library, of Merssrs. H. J. Cambie, M.E.I.C., T. H. White, M.E.I.C. and J. H. Kennedy, M.E.I.C., pioneer railway builders, three of Canada's railway engineers whose record embodies much of the history of railway construction in Canada.

Through the kindness of Messrs. Mitchell & Duncan, it was arranged that the picture was on exhibit in their window on Government street.

Ottawa Branch

F. C. C. Lynch, A.M.E.I.C., Secretary-Treasurer.

Making of Bank Notes

That more prosperous times for Canada would arrive within a few months was the prediction made yesterday by J. A. Machado, president of the Canadian Bank Note Company in his lecture on the "Making of Bank Notes" to the members of the Ottawa Branch of *The Engineering Institute* at a luncheon at the Château Laurier on November 6th. Mr. Machado based his prediction on the fact that there was an increasing demand for notes for circulation as well as more demand for postage stamps and for cigar wrappers. In his 23 years connection with the bank note business in the Dominion, he had never seen these signs fail as indications of a revival of trade.

Mr. Machado, prior to the showing of lantern views of the actual processes of making notes and stamps, dealt in a general way with some interesting features of the business. The oldest bank note in the possession of his company was one of Chinese denomination issued in the year 1200 A. D. On it was written the warning that attempts to counterfeit the bill would be punished with death. The oldest Canadian paper money which was manufactured in 1815, was of a very crude quality compared with present day issues. On account of the extensive use of paper money in Canada and the United States, steel plate engraving was more highly developed in these countries than in any other part of the world.

In referring to attempts to counterfeit Mr. Machado stated that Canada was freer of this evil than any other country and that the whole losses of his company in the past 20 years either through this means or in thefts of stamps did not exceed the tiny sum of $30.

Mr. Machado then gave the engineers an outline of the technical processes of fine steel engraving and the making of notes which was illustrated by lantern slides.

A number of prominent citizens, including several bank managers, were present at the lecture and took seats at the head table.

Toronto Branch

J. H. Curzon, A.M.E.I.C., Secretary-Treasurer.
J. A. Knight, A.M.E.I.C., Branch News Editor.

November finds the Toronto Branch well launched on its winter programme. On October 16th, Chairman J. M. Oxley, M.E.I.C., delivered his opening address, being a history of the use of Portland cement in the engineering industry of the world. Mr. Oxley showed how even as hard and practical a material as concrete was quite shrouded in romance.

Budgeting for Management

On the evening of Thursday, October, 23rd, the Toronto Branch joined with the other technical societies of the city in a joint meeting, the subject being "Budgeting for Management". Papers were read by H. Michell, professor of political economy, McMaster University, and R. L. Wright of the Wahl Company of Canada. Professor Michell demonstrated by the aid of charts that seasons of depression and inflation followed each other in cycles, and also showed how different phases of business were affected in succession. He expressed the hope that in time economists would be able to forecast periods of depression and thus enable business men to arrange their business so that they would be able to meet these slumps when they came, as it were, to iron off the excessive peaks both positive and negative. Mr. Wright then addressed the meeting, his angle of the subject being a discussion on why the slump came and how a business might be budgeted in order to discount bad times.

Aerial Surveying

On Thursday, October 30th, the branch was favoured with two papers on a subject of very great interest to all of its members. Ellwood Wilson, M.E.I.C., of the Laurentide Company of Grand Mere, Que., gave an illustrated address on the work being done and contemplated by the aerial service in mapping, reconnaissance and forest patrol. After he had spoken, H. K. Wicksteed, M.E.I.C., enlarged on the value of the aeroplane in railroad location. Having located railroads by every known method previously Mr. Wicksteed could not refrain from trying out the latest method and his personal experience of the past summer enabled him to point out very clearly the great advantages and also the points where at present at least the aeroplane has not ousted the old method of the use of ground parties for final location.

The Resurrection of Europe

The meeting of Thursday November 6th, was addressed by Vincent Massey, his subject being "The Resurrection of Europe". Mr. Massey is a great student of economic conditions and was able to hold the meeting quite enthralled by his intimate knowledge and sympathetic understanding of the various peoples of that land of ancient hates, fears, memories and aspirations which we vaguely refer to as Europe.

Vertical Transportation

On Thursday evening, November 13th, the branch returned to a topic nearer home, from an engineering standpoint as well as geographically, the subject being "Vertical Transportation", and the speaker, A. G. McLaughlin, general sales manager of the Otis Fensom Elevator Company of Canada. Mr. McLaughlin traced the history and development of the elevator, both passenger and freight, from the time of Caesar to the present day. Members of the branch present greatly appreciated the care and labour Mr. McLaughlin had expended on his paper.

Winnipeg Branch

P. Burke-Gaffney, A.M.E.I.C., Secretary-Treasurer.
James Quail, A.M.E.I.C., Branch News Editor.

Smoking Concert

The Programme Committee excelled itself in the idea that inspired the item of a smoking concert on its list. The smoking concert was held in the Marlborough hotel on the evening of October 2nd. The rollicking good time that all the members and the guests had at it must have amply repaid the committee for the time and effort it spent in preparing for the occasion. Refreshments began early and ended late. Students and professors, the older members of the profession and the younger vied with each other in feeling at home.

Under the able leadership of "Art" McFadyen voices that hadn't seen the light for years were roused into competition with the enthusiastic hilarity of those others. One is tempted to remember the reason and forget the excuse; to remember "Alouette" as rendered by the impromptu choir of a dozen students that "Art" coaxed and persuaded on to the platform, and to forget that its Charter was presented to the branch.

Charlie Attwood, A.M.E.I.C., the convener of the Golf Tournament Committee, was called upon by E. V. Caton, M.E.I.C., the acting chairman, to make his report and present "Sam" Kennedy, A.M.E.I.C., with something as a token of the recognition of Mr. Kennedy's golfing prowess. Mr. Attwood handled his end perfectly urging all members and friends to be happy, without provocation, at all times, and suggesting that a gathering or gatherings at Kenora and Minaki for week ends of golf next year should provide future occasions where Sam Kennedy might win more trophies. Mr. Kennedy replied fittingly in the happy vein of Mr. Attwood, accepting the encomium with grace.

Professor Wallace of Manitoba University, T. R. Deacon, M.E.I.C., and Theo. Kipp, M.E.I.C., talked to the meeting about Wembley Exhibition. They all, each from his own angle of individual interest used the British Empire Exhibition as a basic scale from which Canada and things Canadian, Manitoba and things of Manitoba, could obtain a relative measuring. Professor Wallace told that the promotion of mining enterprises and the actual development of mines was being considered now on a very sound financial footing; that to as great an extent as possible, greater than ever before, the 'speculative' was being eliminated. Canadian mining propositions were receiving proportionate attention to those of other world mining fields though not the attention they deserved. In the latter respect he had in mind, particularly, Manitoba.

Mr. Deacon compared world business conditions with those of Canada and Manitoba. He dwelt on the relatively fortunate position in which Canada and Manitoba finds itself; 'plant' idleness in the British Isles and its concomitant unemployment was pitifully wasteful. He said that production costs in the British Isles interfered with production for consumption in available world markets.

Mr. Kipp emphasized the importance of Canada as a unit of the British Empire as evidenced by its display at the exhibition. He, with the other speakers, referred to the fact that an exhibition of the immensity of that at Wembley left one the only alternative of confining himself to becoming familiar with the activities, in the British Empire, that embraced those in which he himself was interested. Mr. Kipp found machinery manufacturers and financial men wide awake to the field of Canada provided by its natural resources and its inherent ability to produce cereals.

Presentation of Charter

Major Geo. A. Walkem, M.E.I.C., vice-president of *The Institute* presented the branch with its charter. In making the presentation Major Walkem reviewed the history of the branch. He mentioned especially the debt that *The Institute* as a whole owed to the members who founded the branch. General H. N. Ruttan, M.E.I.C., H. A. Bowman, A.M.E.I.C., chief engineer of the Manitoba Provincial Reclamation Branch, C. A. Millican, A.M.E.I.C., consulting engineer, land reclamation, and John Woodman, M.E.I.C., architect, were named in that connection.

Major Walkem enlarged on the opportunities aside from the pursuit of the strictly technical avenues open to them, that existed for engineers. He stressed public life as a duty which engineers should not shirk even though it be irksome. Members who had taken up that duty were instanced.

Mr. Bowman and Mr. Millican replied to Major Walkem and accepted the charter on behalf of the branch. Both Mr. Bowman and Mr. Millican recalled the days when three or four of them used to meet, more frequently than not in General Ruttan's office. The meetings took place at irregular intervals and were characterized by a friendly informality that was pleasant to remember. Those friendly informal meetings were the nucleus around which the branch had formed. Some of the informality had disappeared as the membership increased but none of the friendliness.

D. A. Ross, M.E.I.C., presented a report of the 'Quarters' Committee, which was received. The report advised of the concurrence of the Manitoba Electrical Association and the Architects Association in the idea that joint quarters for the two associations with the branch was a practicable one.

J. G. Sullivan, M.E.I.C., T. H. Kirby, A.M.E.I.C., M. Calkwell, J. Lyon and W. Faulkner should be mentioned as contributing to the pleasure of the evening; Mr. Sullivan's Irish wit scintillated in a short speech; Mr. Kirby with original cartoons, illustrated the peculiar abilities of some of the members; Mr. Calkwell, the professional from Southwood Golf Club showed how and how not to play golf; Mr. Lyon at the piano; and Mr. Faulkner who gave two solos delightfully. Mr. A. McFadyen, beside leading the choruses frivolously, sang seriously, and very enjoyably, in solos.

St. John Branch

W. J. Johnston, A.M.E.I.C., Secretary-Treasurer.

Visitors Welcome

"The St. John Branch of The Engineering Institute of Canada welcomes all members of The Institute and visiting engineers to the city. You are invited to attend all meetings and social functions of the Branch."

— So reads a framed notice at the desk of the local hotels. This notice is framed with slot at side so details of time, place and speaker of the different meetings may be inserted.

Thus the St. John Branch Executive welcomes the transient engineer to St. John. In the past the branch members have met fellow engineers in town on the day following a meeting of the branch and have been informed the visitors did not attend the meeting because they did not know of it. From now on we hope to inform the visitor of a branch meeting before and not after the meeting occurs.

St. John Branch Dinner

On the evening of November 12th, the members of the St. John Branch participated in an event which happens once only in the lifetime of a branch. The occasion was the presentation of the charter to the branch by F. A. Bowman, M.E.I.C., of Halifax, vice-president of *The Institute.* Another feature of the evening was the honour bestowed on the branch as a whole, and on G. G. Hare, M.E.I.C., in particular, when a life membership was presented to Mr. Hare in recognition of his position as chairman of the branch and for having completed thirty years of active membership in Canadian Society and Institute affairs. In a neat speech Fraser S. Keith, M.E.I.C., general secretary of *The Institute* made the presentation to Mr. Hare.

Forty-six persons enjoyed a dinner served in the Union Club, St. John. G. G. Hare, M.E.I.C., presided over the gathering.

Wembley and the World Power Conference

An illustrated lecture on Wembley and the World Power Conference was delivered by Mr. Keith. By upwards of sixty slides and the accompanying remarks of the speaker, those present gained an idea of the resources of the British Empire so splendidly portrayed at Wembley. The general lay-out of the grounds of the exhibition; the splendid effects of the landscape gardening in evidence; the lavish use of concrete in buildings giving the idea of permanence; the products of Canada, Australia, New Zealand; East, West and South Africa, India, and other parts of the British Empire on display, each in separate buildings; the Doll's House; the Palace of Engineering, — these and other views with the accompanying explanations gave one an idea of the scope of the exhibition and could only be rivalled by a visit to Wembley itself.

The impression one gained from the lecture was that Wembley was in itself an engineering achievement. The Palace of Engineering, covering a larger area than any other reinforced concrete building in the world, showed countless working models of mechanical devices of every description and gave one a bird's-eye view of progress to date.

It was interesting to learn that Evan Owen Williams, engineer, and John William Simpson, architect, had recently been knighted for distinguished services in connection with work on grounds and buildings at Wembley.

The World Power Conference in session between June 29 and July 12, 1924, in one of the buildings at Wembley was attended by several hundred delegates representing forty-one countries, and generally had as many as three meetings in session at the same time. About 425 papers were presented and after the Conference small groups of the delegates visited the power plants of continental Europe.

Presentation of Branch Charter

The charter was formally presented to the St. John Branch by F. A. Bowman, M.E.I.C., Mr. Bowman sketched the growth of *The Institute* and touched on its possibilities for continued good work in the future. Replying on behalf of the charter members of the St. John Branch, C. C. Kirby, M.E.I.C., spoke of the events leading up to the formation of the St. John Branch in 1918, of a luncheon attended by the general secretary and a few men in St. John when the idea took form, and of its climax in the presentation of the charter.

Replying as a charter member of the Canadian Society of Civil Engineers, C. E. W. Dodwell, Hon. M.E.I.C., of Halifax delivered an address packed with humor and good advice. In a reminiscent mood the speaker traced the early efforts at organization among the engineers in Nova Scotia of the simultaneous growth of the Canadian Society and later of *The Engineering Institute of Canada.* The speaker declared the formation of branches was the underlying source of strength of the association.

D. F. Maxwell, M.E.I.C., of St. Stephen was called on as one of the branch district members and replied briefly.

A vote of thanks was extended to Mr. Keith for his address on motion of C. C. Kirby, M.E.I.C., and F. P. Vaughan, M.E.I.C.

Someone suggested a vote of thanks to the Entertainment Committee for their work, in providing the dinner but as everyone present seemed so well disposed toward the committee and all appeared to want to talk at the same time the chairman diplomatically tendered his thanks on behalf of all assembled.

Wembley will be repeated again next year, — let's all go! But in the meantime **plan on visiting The Annual and Professional Meeting at Montreal, January 27th, 28th, 29th, 1925.**

Saskatchewan Branch

J. W. D. Farrell, A.M.E.I.C., Secretary-Treasurer.

Presentation of Branch Charter

On Monday, October 20th, the Saskatchewan Branch held a special meeting in the dining room at the parliament buildings, at which Major Geo. A. Walkem, M.E.I.C., of Vancouver, presented the branch charter. Following the dinner Mr. J. Smith, a guest of the branch, favored the audience with a piano solo so skillfully rendered that he was obliged to give an encore. H. S. Carpenter, M.E.I.C., then expressed regrets on behalf of Prof. C. J. Mackenzie, M.E.I.C., and R. N. Blackburn, M.E.I.C., on their not being able to be present and after welcoming Major Walkem, called on him to address the branch.

Major Walkem gave a brief historical outline of *The Institute* and strongly recommended to the members a visit to Institute headquarters whenever and as often as possible. The speaker then described the meetings at various points at which he had already presented the charters, telling of some humorous incidents that had happened. Major Walkem thought that at present engineers were not receiving the recognition to which they are entitled. He thought this condition would continue until engineers took a more active part in public life and were able to influence and control enterprises employing engineers. He considered that engineers needed more training and practice in speaking and writing to the public. Public meetings are monopolized by members of other professions. A man is often taken at his own apparent valuation so that modesty does not pay. Major Walkem's advice to the profession was to serve the public and thereby gain further recognition.

Speaking of legislation, Major Walkem thought the engineer was entitled to protection as much as the doctor or lawyer. He touched on the relationship between *The Institute* and the Associations of Professional Engineers in various provinces. He also spoke of the value of engineering training to men going into commercial activities and estimated that of the graduates from schools of engineering only 25 to 30 per cent were still practising. Major Walkem then presented the branch charter, expressing the wish personally and on behalf of *The Institute* that the branch would continue in prosperity and progress.

Mr. Carpenter received the charter on behalf of the branch and made a fitting response, expressed the gratitude of the branch to the Parent Institute and to Major Walkem. R. H. Murray, A.M.E.I.C., being called on as a charter member, referred humourously to the *birth certificate* of the nine year old child for whose existence he held some responsibility. Mr. Murray recalled some features of the meetings in the earlier days of the branch. A. P. Linton, A.M.E.I.C., and J. N. deStein, M.E.I.C., two other charter members present, spoke reminiscently of the activities of the branch, Mr. deStein suggesting a special tenth anniversary meeting. The appreciation of the branch to the Parent Institute for the Charter and also to Major Walkem, M.E.I.C., for his kindness was voted unanimously.

The members were then favored by a vocal solo by L. A. Thornton, M.E.I.C., Mr. deStein playing the accompaniment.

Ladies' Night

On Thursday, November 13th, the branch putting aside dull professional matters proceeded to that higher branch of engineering known as the art of entertaining. A specification-invitation was skillfully devised by R. W. Allen, A.M.E.I.C., and J. G. Schaeffer, S.E.I.C. About twenty-five "Contractors" each accompanied by a "Consulting Engineer" and attracted no doubt by the anticipation "extras" were present and proceeded with the work as specified. The first item took the form of a dinner at the dining room of the parliament buildings. After receiving a "progress certificate" for the satisfactory completion of this item, work was commenced on item No. 2. Strangely enough this work proceeded satisfactorily without supervision from the "Executive Officers of the Street Railway". Contract No. 3 provided by the Permanent Players at the Regina theatre was the subject of much favorable comment. It is safe to say that anticipated profits were more than realized.

Moncton Branch

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

A. C. D. Blanchard, M.E.I.C., was the guest of the Moncton Branch on Thursday evening, October 23rd, 1924, at a meeting over which F. O. Condon, M.E.I.C., chairman of the Moncton Branch, presided. Mr. Blanchard has recently taken up his duties as hydraulic engineer of the New Brunswick Power Commission, and by way of introducing some of the pending power questions to the people of New Brunswick, in a public meeting under the auspices of the Moncton Branch, outlined the growth of the Niagara power companies, with particular reference to the Queenston-Chippawa project, as developed by the Ontario Hydro-Electric Power Commission.

Of deep significance to this province, he said, was the fact that the companies which started the Niagara developments had originally no market at hand for their product. They had, however, vision and faith in the growth of Canada. New Brunswick had not yet come to her place as a power producing province, but there was no reason why she should not, and the settlement of questions now before the New Brunswick Commission would doubtless place her in her merited place.

The Queenston-Chippawa project was traced from its initial stages to its present status and splendidly descriptive pictures were thrown upon the screen to illustrate the speaker's address.

J. D. McBeath, M.E.I.C., gave expression to the gratitude of the Moncton Branch, and his motion of thanks was seconded by A. S. Gunn, A.M.E.I.C.

F. P. Shearwood, M.E.I.C., vice-president of *The Institute* and chief engineer of the Dominion Bridge Company Limited, was a recent and welcome visitor in Moncton. It was regretted that his visit was of such a temporary nature that the branch as a body were unable to meet him.

Address on Wembley and the World Power Conference

A regular meeting of the Moncton Branch of *The Engineering Institute of Canada* was held in the Council Chambers, City Hall, on November 13th, the speaker for the evening was our general secretary, Fraser S. Keith, M.E.I.C.

He gave a very interesting, illustrated address on the Wembley Empire Exhibition. Mr. Keith was one of the official delegates from Canada to the World Power Conference which met at Wembley during the exhibition, and had improved his opportunity while there by collecting a great deal of data and photographs of the various buildings and exhibits.

Mr. Keith said in part, that this was not only an *empire* exhibition, but in reality, in every meaning and sense of the word a *world* exhibition, as everything known of in the world was represented at the exhibition, although the exhibits were confined to the empire, which only went to show how vast the British Empire is, and how many different races and industries were to be found within it.

The exhibition was not put on for show only, although that formed a very important part of it, but to get the people from the different parts of this far flung empire together and be able to show to each other the possibilities of each different part of the empire, and thereby cement the people of the British Empire into closer relationship. It was the first time in history that a great empire had joined together to visualize to the world the wonderful achievements and resources contained within its boundaries.

Moncton Branch felt greatly honoured in having Mr. Keith address them on so important a subject, especially when it was presented in such a pleasing manner, which the genial Fraser has the happy faculty of doing. The general secretary's visits and addresses were always looked forward to with a great deal of interest in the past, but he surely excelled himself in his address on the Wembley exhibition.

Presentation of Charter

Before Mr. Keith began his address, F. A. Bowman, M.E.I.C., vice-president of *The Institute*, in a few well chosen words, presented the charter to Moncton Branch.

Calgary Branch

G. P. F. Boese, A.M.E.I.C., Secretary-Treasurer.
W. St. J. Miller, A.M.E.I.C., Branch News Editor.

Presentation of Branch Charter

At a well attended gathering of members held on October 22nd, the branch was honoured by the presence of Major Geo. A. Walkem, M.E.I.C., as its guest. Dinner was immediately succeeded by a few enjoyable musical selections interspersed with community songs, following which Major Walkem made a few preliminary remarks in connection with the principal object of his visit which was the presentation of the branch charter. He held the attention of his hearers whilst leading up to this important duty by relating much of the history of *The Institute*. He referred to the early progress up to the change by Act of Parliament of the name in 1918 and remarked how a steady growth was apparent since that date.

Having read the charter to the assembly, he presented it in the name of *The Institute* to the only charter member of the branch present, namely, A. S. Dawson, M.E.I.C. Mr. Dawson in his reply suitably expressed the sentiments of all present in thanking Major Walkem, and accepted the charter with full realization of the responsibility attached thereto. Continuing his address Major Walkem pointed out his belief that engineering is a thorough training for most walks of life. He was insistent in expounding the theory that engineers should take a more active part in the affairs of the nation, the province and the municipality. Boom expansion in cities was due largely to lack of engineering representation on city councils he believed.

Referring to affairs in Vancouver, he emphasized the extraordinary rapid progress of the wheat shipping business, and stated that Vancouver was blessed with a safe harbour area of twenty-two square miles. He was most emphatic as regards the future of this industry at the coast in particular, stating a few statistics to substantiate his remarks which certainly showed an enormous trade expansion during the last few years. The Panama route, he said, has proved its worth over and over again, and we can look forward to a still greater quantity of prairie wheat and farm produce finding its way to Great Britain and Europe through this passage. In reference to the far East he despaired of any trade improvement in that direction for some time to come.

In conclusion, he wished to convey the felicitations of the various branches that he had visited during his eastern tour, to the Calgary Branch, and took the opportunity of stating how increasingly valuable affiliate members of branches were becoming in strengthening our position in the eyes of the public in general. He announced that President Surveyer had sent greetings and that he hoped to be present in person some day to meet all members.

At the invitation of Chairman R. S. Trowsdale A.M.E.I.C., to those present to "reminisce" for a while on past experiences, William Pearce, M.E.I.C., rose to say a few words. He recollected that the name Walkem appeared in the very early annals of British Columbia history. He referred to a visit he paid to the coast in 1881, and how in 1904 he read a paper advocating Vancouver as the most logical coast port. "Bill" Pearce is at his very best when in a reminiscent mood, and one feels like making a verbatim report when he speaks historically.

Mayor Webster, a recent Branch Affiliate, also reminisced, (where's that dictionary?). His sole claim as an engineer was an early connection with railroad field work in the contracting business. It was due to his peculiar familiarity with mother earth and yardage that he carried the title "Classification Webster". He heartily supported the speaker's idea and sound advice that engineers should appear more prominently in the public services, and looked for such a man to come forward either this year or next in Calgary. Had there been an engineer on the city councils in the early days he felt convinced that such unwarranted boom expansion would have been largely avoided, especially as regards the futility of laying pipe lines, street car tracks etc., into outlying subdivisions. He declared that the development of Vancouver, which the speaker had so much at heart, meant also the steady development of Calgary.

The following parody was especially composed for the presentation of the charter and was heartily sung by everyone:—

OUR CHARTER

(*To the tune of Rule Britannia*)

When Branches first at heaven's command
Were formed, the main idea was this,—
To spread, to spread, to spread our influence
o'er the land.

CHORUS.

Here's to our CHARTER, the Charter we obey.
No one shall ever, ever, ever rue this day.
Tell the Majaar, the Majaar from the west,
We'll never, never, never, never forget our guest.
Hail the Charter of our Branch of the E.I.C.
Whose members never, never, never disagree!

The sarcasm of the last line called forth a remark from the Mayor that things must be very different at the city hall!

An enjoyable evening's entertainment was concluded with a few words from the chair thanking the speaker, followed by a round of applause for "our guest".

The Oil Industry at Calgary

The Calgary refinery of the Imperial Oil Company Ltd., has handled an average of 6,000 barrels of crude oil per day for several months past. This is far in excess of the amount anticipated when the plant was completed. As a result the number of employees has been increased to keep up with this greater output and the annual payroll now amounts to half a million dollars. It is apparent that the peak supply of crude oil has been passed in the States and a steady supply from the Alberta fields is eagerly looked for.

The Royalite well No. 4 situated some thirty miles southwest of Calgary became unmanageable this week with twenty million feet of gas escaping daily. This unfortunately caught fire and has been blazing for several days, the glare being visible from Calgary. At the present time the Northwest Drilling Company is combatting the flames with a battery of six boilers in an endeavour to steam it out. There are two flames, one at the end of the casing about thirty feet above the ground, and the other streaming from the pit some twenty feet below the surface. It will be necessary to extinguish both flames simultaneously. Prior to the accident arrangements had just been made to pipe the gas to the extraction plant.

Niagara Peninsula Branch

R. W. Downie, A.M.E.I.C., Secretary-Treasurer.
R. Hogg, Jr. E.I.C., Branch News Editor.

The fall outing of the branch, which took place on Wednesday, October 22nd, was one of the most interesting and enjoyable that has been held in the Peninsula for some time.

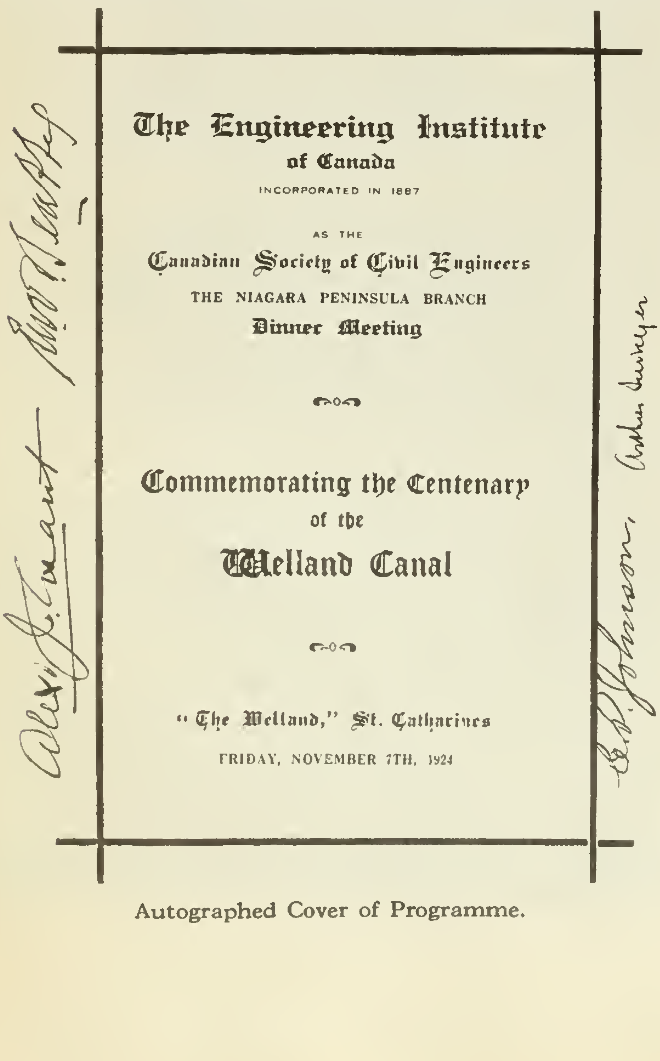
Visit to the Horton Steel Works

As guests of the Horton Steel Works, of Bridgeburg, Ontario, about sixty of the members inspected the company's new $300,000 plate mill. This mill is splendidly equipped to handle heavy steel plate. At the time of the visit, two large sulphite-pulp digesters were being built. The ease with which the modern equipment of the mill handled heavy sheets of 1¼ foot steel, bending to the required arc the side pieces, dishing the parts that form the cone-shaped ends, the 'squishing', as one spectator expressed it, of large rivets heated to white heat in an electric rivet heater, and above all the small staff of workmen required to handle such heavy work, was a revelation to many and a source of interest to all. An hour or more was spent in the mill. The members then faced the camera, after which they re-assembled in the office.

Carl H. Scheman C.E., A.M.E.I.C., general manager of the Horton Steel Works, is a capable executive and as a host he has few equals. His plans for the entertainment of his guests were carefully laid in the minutest detail. Before leaving the office tickets were issued to one of Buffalo's leading theatres, and instructions given how to find the way to the Buffalo Athletic Club. The party crossed the river to Buffalo on the car ferry and drove to the club building, and in the club's beautifully appointed dining-room, to the strains of orchestral music, a sumptuous dinner was served. S. R. Frost, A.M.E.I.C., past chairman, was called on by Chairman E. P. Johnson, A.M.E.I.C. to propose a vote of thanks to our host. In responding he suggested that Mr. Scheman should be made Honorary Member of the "Order of Davy Dick". For the information of those unfortunates who live outside the pale of Davy's acquaintances, it may be explained that this is a way of saying that Mr. Scheman is a host 'de luxe'. The theatre party to the Teck rounded out a very pleasant day.

Welland Canal Centenary

In the month of November, 1824, an event of unusual and far reaching importance took place in the Niagara Peninsula; an event which went a long way towards making this entire district, and has had its influence on Canadian life from the Atlantic to the prairies. In that year and month the first sod was turned for the first Welland canal. This district furnishes examples of the progress wrought in one hundred years by the ever-increasing skill of the engineer that few parts of the world can rival. Little remains to-day of the first canal, merely sufficient to show its form. Two or three of the old oak locks still remain, however, along the line of the second canal; the latter, now known as the Old Welland canal and containing larger masonry locks, was opened in 1850. This in turn was superseded in 1881 by a third and still larger canal, the New Welland canal, which is now in use. To-day the fourth, the Welland ship canal, is under construction. It marks the highest point to which engineering skill has yet attained in this type of work.


The Engineering Institute
of Canada
INCORPORATED IN 1887
AS THE
Canadian Society of Civil Engineers
THE NIAGARA PENINSULA BRANCH
Dinner Meeting

Commemorating the Centenary
of the
Welland Canal

"The Welland," St. Catharines
FRIDAY, NOVEMBER 7TH, 1924

Autographed Cover of Programme.

To commemorate the centenary of the Welland canal, Niagara Peninsula Branch, on November 7th, held a semi-public dinner meeting, to which were invited members of Chambers of Commerce, Canadian, Rotary and other clubs, from the towns and cities of the district. Two hundred men of whom ninety were members of the branch, sat down to dinner. Among the distinguished guests of the evening were Dr. Arthur Surveyer, M.E.I.C., our president and E. W. Beatty, K.C., president of the Canadian Pacific Railway, while in the gathering was Prescott Merritt, grandson of Hon. Wm. Hamilton Merritt, to whose efforts are attributed the building of the first Welland canal. The two former were speakers of the evening.

Early History of Welland Canal

Dinner over, and the diners having reached their respective elastic limits, the chairman, E. P. Johnson, A.M.E.I.C., gave a concise history of the events leading up to the digging of the Welland canal in 1824. To the Hon. Wm. Hamilton Merritt belonged the credit for conceiving the idea of a waterway to connect lake Ontario with lake Erie. In 1812 the idea was first mooted. In 1816 a joint committee from the two houses of Upper Canada secured a report on the feasibility of the project. In 1818 an appropriation was passed for the purpose of making surveys of a route along the Grand river, with the lake Ontario outlet at a point near Hamilton. This route did not conform with Merritt's idea. Borrowing a water level, and in company with George Keefer, who later became president of the Welland Canal Company, he made a survey of a route crossing the Niagara escarpment at Thorold. Here the canal was eventually located, and the succeeding canals did not vary greatly in location from his first survey line.

The greatest difficulty confronting the builders was encountered in the deep cut at Port Robinson. All work had to be done by manual or animal labour. Excavating machinery was unknown. When these methods failed, and it seemed as though the scheme should fail too, a prize of £125 was offered to anyone who devised an apparatus to raise the material up the steep bank and deposit it out of the cut. It must have been an ancestor of Heath Robinson, of By-stander fame, who secured the £125. The machine was in the form of a large wheel around which passed a rope with hooks on each end. The mule team descending the bank empty was, by means of this device, made to assist the loaded ascending team, and all loads were as though being drawn on level ground. The device worked, and in 1829 the first boats passed up the canal to Port Robinson.

The Welland Canal Company, incorporated in 1824, was bought out by the government of Canada for the sum of $1,850,000. In stressing the importance and growth of the canals the chairman quoted the following figures:—In 1850, the tonnage through the canal was 216,000; in 1923 the tonnage was 3,756,000; while this year it is expected that the four million mark will be passed.

Mayor Jacob Smith, of St. Catharines, extended to Dr. Surveyer and to Mr. Beatty an official welcome, and offered them the freedom of the city.

Address by President Surveyer

H. L. Bucke, M.E.I.C., vice-chairman of the branch, introduced Dr. Surveyer, president of *The Institute*. Dr. Surveyer said that he did not take credit to himself for the degree that had been conferred on him by the Rensselaer Polytechnic Institute. The degree, he felt, was conferred on the president of *The Engineering Institute* rather than on Arthur Surveyer. He felt very proud of the honour. His address, touching as it did on the growth of *The Institute* in the last six years, on the relations existing between the engineer and the public and other matters of interest to the members, was inspiring to a degree. He was given prolonged applause when, before sitting down, he presented the branch with its charter. The charter was received by the chairman.

A. J. Grant, M.E.I.C., engineer in charge, Welland ship canal, in introducing Mr. Beatty, spoke of the important part played by the C.P.R., in making Canada a nation. It was peculiarly fitting, he thought, that Mr. Beatty, a son of the Welland canal district, born in Thorold, one who had grown up, as it were, in an atmosphere of transportation, should return to his native district and assist in paying tribute to those courageous men who conceived and built the first Welland canal.

Some Transportation Problems

Mr. Beatty spoke on 'Transportation', later reducing the subject to 'Some Transportation Problems'. As a boy, he said, he had regarded the Welland canal as a means rather of recreation than of transportation. It was well worth the money that a wise government spent to bring this summer and winter playground to his door. He spoke of the difficulties which confronted the early pioneers in Canada; of the wretched clay wagon-roads then existing, and of the immense boon to the farmer as the clay road gave way to the railway. The cost of hauling produce to markets was greatly reduced and the markets of the world were opened to Canadian trade.

The speaker made an earnest plea for a better understanding of the problems of, and greater co-operation with the transportation interests. They are continuing the pioneer task of building up the country, striving to revive its abundant prosperity. The Canadian National, though publicly owned, faced the same problems and difficulties as the Canadian Pacific. Each were competitors. Their competition was conducted in such a way as to reflect credit on the the transportation ethics and efficiency of both. He knew of no problem concerning transportation which he could not or would not discuss almost as freely with the distinguished president of the National lines as with one of his own officers or directors. In the relations between the companies, healthy strong competition though there was, there was nothing which changed or affected their common interests or the fundamental principles upon which both must be operated.

The services rendered by the railways was equal in quality and extent to the exacting demands of the Canadian people. The question of paramount importance to the country to-day was what the people of Canada should pay for those services; and if as a result of agitation the roads were compelled to carry the traffic of the country at a loss would the country gain or lose thereby.

The C.P.R., the only system for which he had power to speak, in its many fields of activity touched the different phases of Canadian life perhaps more than did any other corporation. In its conception and execution it was a national enterprise. It had extended on land and sea, at home and abroad, until it now did business in every civilized country in the world. That expansion would not have been possible had not Canadian development taken the C.P.R. with it. The most conspicuous result following its success was the great benefit accruing to Canadian development and credit. Every enterprise in Canada was based on confidence in the future, and in a belief that Canada will support those undertakings that are wisely conceived, honestly financed and efficiently administered.

The transportation interests deserved well of the country. During the last year the C.P.R., disbursed in Canada for wages and materials the sum of $202,000,000, and in taxes of all kinds $7,000,000. If the railway systems which contribute so substantially to the country's progress can grow and become stronger with the country's development the people are insuring their own future. If they become weak and anaemic through inadequate rates, larger deficits must be faced on the one hand and on the other insufficient services and weakened credit. Fairness to the transportation systems was asked for on their past record of service, on the important part they are playing in the national life, and the factors they are bound to be in its progress.

On the question of immigration, the speaker referred to appeals made by the late Lord Shaughnessy and others for the adoption of a definite and aggressive immigration policy, under the direction of a minister whose time would be given exclusively to that work. The present situation did not indicate that these representations had been given the consideration he thought they deserved. This apparent lack of confidence in themselves and their country had not helped the Canadian people. It is contended that so long as unemployment exists no immigration should be permitted. The two problems are not inter-related. Seasonal unemployment should not have a direct influence on a national question such as immigration. One of the surest ways to reduce or avoid unemployment was to people the empty spaces with more productive units whose necessities would mean greater consumption, more activity and therefore more employment.

Mr. Beatty's address was an eloquent and sincere appeal to the Canadian people to place greater confidence in themselves and their country, and to show fairness to the systems which have brought and will bring prosperity to the nation. It was a fighting speech, yet tinged throughout with humor and optimism.

T. S. Scott, M.E.I.C., rising to move a vote of thanks to the speakers mentioned the difficulties in the way of placing the Anglo Saxon on the land. His women, he claimed, will not stay there. In B.C. the Swedes and French-Canadians did the lumbering, the Hindu piled the material in the yards, the Japs fished, and the Chinese did the market gardening, while all the Anglo Saxon people did was to trade houses with one another. A. Milne A.M.E.I.C. seconded the vote of thanks.

In the intervals between speakers during the evening, the gathering was entertained by instrumental music excellently rendered by the Welland Ship Canal Instrumental Trio. A treat was also offered in the form of vocal solos by W. H. Thornton, winner of the Gold Medal for tenor singing at this year's Canadian National Exhibition.

Kingston Branch

G. J. Smith, A.M.E.I.C., Secretary-Treasurer.

A special meeting of the Kingston Branch was held on Tuesday evening November 4th, in Convocation Hall, Queen's University, when the branch was able to co-operate on very short notice with the Kingston Historical Society to hear a lecture by Hammett P. Hill, K. C. of Ottawa on "The Story of The Rideau Canal".* Major General Sir Archibald Macdonell of the Royal Military College acted as chairman of the meeting and Mr. Hill was very ably introduced by Col. W. P. Wilgar M.E.I.C., who paid tribute to Mr. Hill, and stated that although he had already heard the lecture, he was very eager to do so again.

The paper covered the history of the Rideau scheme from its inception, through its many difficulties of construction and finance, to its completion; the indefatigable efforts of Col. John By, after whom the present city of Ottawa received its original name of Bytown, being the whole secret of the success of the tremendous undertaking. The lecture was intensely interesting and showed a vast amount of research and original investigation on Mr. Hill's part. The speaker was given great applause at the close of his address and a vote of thanks moved and seconded received the hearty approval of the large audience present.

*An abstract of this paper appears on page 746 of this issue.

Montreal Branch

E. A. Ryan, A.M.E.I.C., Secretary-Treasurer.
Ed. Prevost, Jr., E.I.C., Branch News Editor.

Steel Rails

A technical paper was read before the branch on October 30th, by C. B. Bronson, assistant inspecting engineer of the New York Central lines on the "Evolution in the Design and Manufacture of Steel Rails." J. M. R. Fairbairn, M.E.I.C., chief engineer of the Canadian Pacific Railway occupied the chair.

Many prominent railway engineers and representatives of steel manufacturers were in attendance and took part in the discussion. Technical points were ably dealt with by J. E. Armstrong, A.M.E.I.C., of the C.P.R., M. S. Blaiklock, M.E.I.C., W. A. Duff, M.E.I.C.; and F.L.C. Bond, M.E.I.C., of the C.N.R. Operating and maintenance points of view were discussed by Chas. Warnock, A.M.E.I.C., Robert W. Hunt & Company; N. B. Greensted and J. D. Jones, M.E.I.C., of the Algoma Steel Corporation and F. W. Gray, M.E.I.C., of the British Empire Steel Corporation. Mr. Bronson's paper is published in this issue of the Journal.

Previous to the lecture, the branch held a business meeting for the election of the nominating committee. Messrs W. Walker, A.M.E.I.C., John T. Farmer, M.E.I.C., and D. C. Tennant, M.E.I.C., were duly proposed and elected. O. O. Lefebvre, M.E.I.C., chairman of the branch presided.

Recent Advances in Construction and Operation of Grain Elevators

On November 6th, a very interesting lecture was given by L. Coke Hill, M.E.I.C., chief engineer and director of the John S. Metcalf and Co. entitled "Recent Advancement in the Construction and Operation of Grain Elevators". The lecturer made an extensive and historic review of that important adjunct in the handling of grain; — illustrating his address with numerous lantern slides. Mr. Hill outlined the history of grain elevators going as far back as ancient Egypt. Up to quite recent years they were built of wood; then came the heavy concrete elevators, and now the accepted design calls for a structure as light as possible as a result of investigations prompted by the study of dust explosion especially that of the Chicago Northwestern elevator in Chicago. In his opinion, an explosion-proof elevator is about on a par with an unsinkable ship. Starting from this analogy, it has been found logical that if ships have their hulls divided into compartments for the sake of safety, grain elevators might also be dealt with along the same principles.

The East End Elevator No. 3 in Montreal Harbour was described as a typical building erected along the lines of latest practice. The new Marine Tower Jetty recently completed by the Atlas Construction Co., Ltd, was also referred to. All these commodities are now doing their share in receiving and shipping grain at an astounding rate.

Quite a lively discussion followed the paper during which, E. G. M. Cape, M.E.I.C., P. Leclaire, A.M.E.I.C., H. Rolph, M.E.I.C., A. D. Swan, M.E.I.C., J. H. Hunter, M.E.I.C., J. A. Jamieson, M.E.I.C., and Martin Peterson, were called to give their opinions.

Colonel C. N. Monsarrat, M.E.I.C. moved a vote of thanks which was conveyed to the lecturer, in well chosen words, by T. W. Harvie, M.E.I.C., manager of the Harbour Commission, acting as chairman.

The Work of the Quebec Public Service Commission

F. C. Laberge, M.E.I.C., one of the oldest members of the branch, spoke at the regular meeting of November 13th, on the "Work of the Quebec Public Service Commission." The lecturer, who has been connected with this commission since its foundation in 1910, was in a good position to give a complete history of this important link between the public utilities and the different municipalities.

Of the three members who were originally appointed he is the only one to remain. Mr. Laberge took advantage of this fact only as an opportunity to praise the untiring activity of his two former colleagues, Messrs. Hibbard and N. Garneau. The object of this commission is to safeguard the interests and rights of individuals and communities and at the same time ensure that the public utilities corporations are not impeded in their progress by unfair price cutting, etc.

Its powers are not inconsistent with municipal autonomy, and yet wide enough to reach decisions and to enforce them. Claims originating within this province from or against public utilities come before this board. It has also to deal with disputes between companies on right of ways, etc., It is also responsible for the appointment of city managers if interests concerned do not agree.

The address was delivered first in French and then in English. This practice found favour with the audience who endorsed Mr. Hunter in his plea for a better knowledge of both languages as a most important step towards "la bonne entente". Mr. Hunter moved a vote of thanks to Mr. Laberge in french and he was seconded by Mr. Brown who spoke briefly in english. Geo. R. MacLeod, M.E.I.C., occupied the chair.

CORRESPONDENCE

Railway Location in Northern Nigeria

Regina, Sask.,
November 11th, 1924

The Editor,
The Engineering Journal,
Dear Sir:

I was greatly interested to see on page 699 of the November issue of your magazine a picture of the Kaduna bridge on the main line Lagos to Kano railway, Northern Nigeria. This picture was apparently taken by Mr. B. H. Hughes.

Eighteen years ago, I was on the original survey for this line and was amongst the first white men to pass through this country when it was dense African forest.

I remember on one occasion being detached from the regular duties as assistant engineer of construction to take a party north into the immediate vicinity of this bridge. Like most young fellows I seized the opportunity to go further north to the capital of the Protectorate, which is Zungurue. I crossed the Kaduna in a dugout log, which passed for a native canoe. Halfway across the canoe, carrying my baggage, was capsized and all in it was spilled into the river. After great difficulty my boxes were retrieved and we continued our journey to Zungurue, which was made in those days in a meat safe on four wheels pulled by an engine on a two-foot tramway. This so-called railroad went from the river landing station inland to Zungurue—some 20 miles. However, I made the trip safely to Zungurue and had several very pleasant days there with the Garrison—The West African Frontier Forces.

In those days Sir Percy C. Girouard, a well known Canadian, was Governor-General of Northern Nigeria; and on the day I decided to return to my station in the safe, Sir Percy also had arranged to go on an official journey. I remember watching the Governor, with all of the pomp and glory of our Native Protectorates, go on his way to the station. There were bands, horses and troops and numerous high officials; but in the rear of all this pomp and glory were two little native niggers about eight year's old, clad in a pair of No. 10 boots and a white collar aping the soldiers in front of them. This sticks strongly in my memory and recurred to me when I saw your present picture "Across the Kaduna". I am afraid Mr. Hughes has many luxuries that were denied us in those early days; and here is wishing him all luck.

I could write an endless letter on this country as I knew it in those times; but I am afraid of taking too much of the stenographer's time.

Yours sincerely,
J. C. MEADE, A.M.E.I.C.

Construction of Reinforced Concrete Grain Elevators

Winnipeg, Man.,
November 8th, 1924

The Editor,
The Engineering Journal,
Dear Sir:

In the November issue of *The Engineering Journal*, under the Winnipeg Branch news, I find that I have been somewhat misquoted in the reporting of an address I gave before the branch, on the Construction of Reinforced Concrete Grain Elevators, with regard to details of the speed of construction of the new Canadian Government Elevator, erected at Edmonton this summer.

The part of the article;—"Ground was broken on the 2nd of May this year and on Monday, September 15th, the first car of grain passed through the elevator. The storage annex capable of holding 2,000,000 bushels of grain was completely poured in eleven days. Four of these days were used in the hopper bottoms", should have read;—"*Concreting was commenced* on the *3rd* of May this year and on Monday, September 15th, the first car of grain passed through the elevator. The *bins of the* storage annex capable of holding 2,000,000 bushels of grain, were completely poured in *sixteen* days. *Three* of these days were used in the hopper bottoms."

These storage bins were 90 feet in height. Concreting and jacking of forms, for the bins, commenced at noon, July 2nd, and ceased at noon, July 18th. Three days between these dates were used for the hopper fills. An average lift of 7 feet per day was made with the jacks. The best day's jacking was a lift of 10 feet 7 inches, which, I believe to be a record for movable form work of this type. The working house bins took 13 days to erect, using the same type of moving forms. These latter were 70 feet in height. The form work used in both cases was a special sliding type, about 4 feet high, made of wood.

Hoping that the above information may correct any wrong impressions that may have arisen, I remain,

Sincerely yours,
Albert E. Macdonald, Jr.E.I.C.
Asst.-Prof. of Civil Engineering, University of Manitoba.

Concrete in Sea Water

Barrie, November 7th, 1924

The Editor,
The Engineering Journal,
Dear Sir:

So much interest is at present taken in the subject of "Concrete in Sea Water" by both the Canadian Institute and the American Society of Civil Engineers that I would like to make a suggestion based on a couple of quotations that have recently come to my attention, the first is in regard to the construction of the Cherbourg, France, breakwater from "Laws Civil Engineering—1869" in which he says "The top of the sea slope is covered with large loose blocks and at the extremities of the wings it is further protected by immense artificial blocks, of about 40 tons weight each formed of rubble set in Roman or Portland cement" this work was done between 1820 and 1840. Then in the last volume of the American Society transactions, page 275 will be found the following remark: "The fact that some of the oldest structures built with "Natural cements" or Portland cement made by processes which have become obsolete are at present in better condition than some other structures of more recent date, raises the question as to whether there has been much real improvement in the durability of the product in the last forty years."

My idea is that if one of these blocks could be retrieved that it would answer the questions under discussion.

Possibly some of the French Engineering Societies might be interested in the matter.

Yours very truly,
Frank MOBERLY, M.E.I.C.

Shawinigan Company's New Power Development

Work has already commenced on the new power development which is being constructed by the Shawinigan Water and Power Company, on the Batiscan river, St. Narcisse, Que., where the new insulation of 20,000 horse power with provision for an additional 10,000 horse power, will replace the old development of 1,200 horse power which was owned and operated by the North Shore Power Company, a subsidiary of the Shawinigan company.

It is of interest to the engineering profession that the power plant which is being replaced was installed in 1893 and was the first plant to install a long distance high-tension transmission line in the British Empire. This line was approximately eighteen miles long and was erected to transmit power to Three Rivers, Que. In connection with the present development, a tunnel approximately three-quarters of a mile in length with a net diameter of thirteen feet, lined with reinforced concrete, will extend from the dam to be constructed above the Grand Chute on the Batiscan, to Chute des Cheminées, about 3,500 feet below.

Organization of Foundation Company of Canada, Limited.

A new company known as the Foundation Company of Canada, Limited, has been formed to take over the business and assets in Canada of the Foundation Company of New York which has been operating here for the past fourteen years. The new company has taken over all contracts from January first last. The directors and officers of the company are: President, John W. Doty, M.E.I.C., president of the Foundation Company, New York; vice-president and general manager, R. E. Chadwick, M.E.I.C.; vice-president, V. M. Drury; directors, A. J. Brown, K.C.; Franklin Remington, chairman of the New York Company; H. A. Timmins, president, Hollinger Consolidated Gold Mines; the Hon. F. H. Phippen, K.C., Toronto; E. R. Decary, W. F. Angus, M.E.I.C., Frank Quilter, vice-president of the New York Company; and C. B. McNaught, Toronto.

OTHER SOCIETIES NEWS

Toronto Engineering Alumni Reunion

The fifth annual reunion of the Engineering Alumni of the University of Toronto, held in Toronto on November 7th, 8th, and 9th, stands as one of the most successful gatherings of "School Men" since the Alumni Association was organized. Five principal events constituted the main features of the programme,—the class luncheons at noon on Friday; the dinner dance, Friday evening; the Queen's-Varsity football game, Saturday afternoon; the banquet, Saturday night, and the memorial service on Sunday morning.

Following the usual custom the class luncheons, by means of which the members of each graduating year are brought together as a unit, were held on the first day of the reunion in various parts of the city. Only those who have attended these luncheons can appreciate their value as a means of renewing that school spirit of the undergraduate days.

The Annual Dinner-Dance

The dinner-dance at the King Edward hotel proved to be a most delightful affair, and was attended by more than 350 couples. Held under the patronage of Mrs. C. H. Mitchell, Mrs. W. A. Bucke, Mrs. T. H. Hogg, Mrs. R. J. Marshall, Mrs. A. E. K. Bunnell and Mrs. B. N. Simpson, the dance proved an admirable means of bringing together the men of the various years.

Business Session

The business session of the reunion was held in the Mining Building on Saturday morning when various reports were presented. The meeting was addressed by Sir Robert Falconer and Dean Mitchell. Dr. R. A. Ross, M.E.I.C., in the course of a few brief remarks paid particular tribute to the late Walter J. Francis, M.E.I.C., whose untiring efforts in the interests of the Alumni Association are well known to all. At this meeting the officers of the association for the coming year were announced as follows:—Hon. President, W. A. Bucke, M.E.I.C.; president, T. H. Hogg, M.E.I.C.; vice-president, H. W. Fairlie, A.M.E.I.C.; second vice-president, A. V. Trimble, M.E.I.C.; third vice-president, F. A. Dallyn, M.E.I.C.; secretary, R. J. Marshall, M.E.I.C.; treasurer, W. P. Dobson, M.E.I.C.; representatives, R. A. Bryce, W. A. Black, H. W. Tate, A.M.E.I.C., and F. W. Thorold, M.E.I.C.

Queen's—Varsity Game

During the past few years the Queen's-Varsity football game in Toronto has become an event looked forward to each year with the keenest anticipation, and in planning for the school reunion, arrangements were made so that visiting graduates would have an opportunity of witnessing this annual struggle for the intercollegiate football championship. Provision was made in the seating arrangements so that the engineering graduates were allotted a special section reserved for them.

The game proved one of the most interesting that has been witnessed for many years, and the intense excitement of the last minutes of play may be judged from the final score, which was Queens' 14 Varsity 13.

Annual Banquet

At the annual dinner on Saturday night nearly five hundred graduates filled to capacity the Crystal ballroom of the King Edward hotel. With T. H. Hogg, M.E.I.C., in the chair, the dinner was admirably handled in every detail. The guests of honour of the evening were, — E. W. Beatty, K.C., president of the Canadian Pacific Railway, and Professor Sandwell, of Queen's University.

Mingling humor with an underlying note of serious advice, Mr. Beatty, who was introduced by Sir Robert Falconer, dealt generally with the problem which faces the college man in the world of business. Mr. Beatty's speach is referred to editorially in this issue.

Speaking brilliantly and with such a constant flow of humor that his audience interrupted with many a gale of laughter, Prof. Sandwell proved himself in the front rank of after-dinner speakers. While leadership was important, he told the gathering, in his opinion Canadians needed to acquire the capacity for following,—the ability to gain achievements through concerted effort.

Throughout the dinner splendid entertainment was provided and combined with the reunion spirit of undergraduates days made the event both intensely inspiring and enjoyable.

Memorial Service

On Sunday morning, Convocation hall was filled for the final event of the 1924 reunion, when a special memorial service for "School Men" was conducted by Archdeacon Fotheringham of Brantford.

American Society of Mechanical Engineers, Ontario Section

A meeting of the Ontario section of the American Society of Mechanical Engineers will be held in Toronto on December 17th, when Mr. A. J. T. Taylor, president of the Combustion Engineering Corporation, Limited, will present a paper on "Swedish Engineering Developments," dealing particularly with steam storage and accumulators.

Toronto graduates Annual Dinner in Montreal

One of the most successful and most enjoyable dinner-meetings of the Montreal Branch of the University of Toronto Alumni Association was held in the Windsor hotel, Montreal, on Saturday evening, November 15th, when 94 members of the association met for their annual reunion. The principal speakers of the occasion were, — Prof. Alfred Baker, professor emeritus of mathematics and former dean of the Faculty of Arts; Provost C. A. Seager of Trinity; Angus MacMurchy, K.C., president of the Alumni Federation of the University of Toronto; Prof. T. R. Loudon, M.E.I.C.; E. W. Beatty, K.C., president, Canadian Pacific Railway; Prof. John Macnaughton, professor of Latin, University of Toronto.

Following the announcement of the election of officers, J. M. R. Fairbairn, D.Sc., M.E.I.C., chief engineer of the C.P.R., who has been chairman of the association during the past year, handed over the meeting to H. M. Little, M.D., who is the chairman for the ensuing year. W. C. Chisholm, K.C., who has been second vice-president becomes first vice-president, and R. A. Ross, D.Sc., M.E.I.C., second vice-president. The most general regret was expressed at the announcement that Roy Campbell who has been secretary of the association for five years was about to retire. The present development and strength of the Montreal branch of the association is in no small measure due to Mr. Campbell's efforts.

Highway Research Board, Washington, D.C.

The Highway Research Board of the United States is holding its fourth annual meeting, December 4th, and 5th, 1924 at the National Research Building, B and Twenty-First Streets, Washington, D. C.

A.S.T.M. Tentative Standards

The 1923 edition of the American Society for Testing Materials tentative standards which is issued annually, has recently been completed and copies may be purchased upon application to the Secretary of the society. This volume contains one hundred and eighty-five tentative standards as follows:—11 — Steel and Wrought Iron; 18—Non-ferrous Metals; 28—Cement, Lime, Gypsum and Clay Products; 10—Preservative Coatings; 17—Petroleum Products and Lubricants; 45—Road Materials; 3—Coal and Coke; 5—Timber; 16—Waterproofing; 7—Insulating Materials; 4—Shipping Containers; 3—Rubber Products; 10—Textile Materials; 3—Thermometers; 5—Miscellaneous.

National Highway Traffic Association Annual Meeting

The date of the 1924 annual meeting of the National Highway Traffic Association, which is being held in New York City, has been changed from December 3rd, to Tuesday, December 2nd, 1924.

Trade Publications

The Taylor Stoker Company, Limited, have recently issued an attractive booklet describing the installation of this company's manufactures. The booklet contains fifty-four pages and is well illustrated with photographs and diagrams throughout.

The Canadian Ingersoll-Rand Company, Limited, have published a new handbook entitled, "101 Ways to Save Money with Portable Air Power." In this handbook the company has gathered together photographs, reports, cost data, descriptive of the many operations at which portable air power may be employed. The handbook contains seventy-two pages with a large number of illustrations and should be of interest to roadbuilders, building contractors, public service companies, municipal officials and consulting engineers.

The Illinois Stoker Company, of Alton, Illinois, are distributing a catalogue descriptive of their products. This is the third edition of catalogue L, and in addition to the interesting descriptive matter and illustrations, it contains thirty pages of blue print drawings illustrating the use of both forced and natural draft stokers manufactured by the Illinois Stoker Company in connection with all the principal types and makes of boilers.

The Story of the Rideau Canal

Abstract of paper by Hammett P. Hill, K. C., read before the Kingston Branch, November 4th, 1924.

It is necessary to go back well over one hundred years to get to the origin of the scheme of the Rideau canal. The war of 1812-15 showed the difficulties of defending the western part of Upper Canada. What is now eastern Ontario was practically a wilderness, the only means of transport from the seaboard being up the St. Lawrence river. Due to its many rapids, this was a very difficult waterway, and a possible blockade of it by the Americans on the south would mean a complete cutting off of the west. The cost of transport from Montreal to Kingston was at that time about 54 shillings per hundred weight.

After the war, one, Capt. Jebbs, was given the task of exploring the two sides of the triangle from Montreal to Ottawa and Ottawa to Kingston. Through the unbroken forest of the latter part, the Rideau river ran towards the Ottawa, and the Great Cataraqui found its way to the St. Lawrence at Kingston. Jebbs reported in 1815 that, as the waterways stood at the time, they were impassable but could be made navigable at a comparatively small expense. The area lying between the Ottawa and the St. Lawrence was being colonized by the authorities with retired British officers and men whose loyalty could be absolutely depended upon, so that there was an additional necessity for some series of roads or canals.

In 1821 the government of Upper Canada passed an act to provide for the improvement of internal navigation, and appointed an engineer, Samuel Clowes, to report on the matter. By 1824, Clowes had made his investigation, and advised the improvement of the Rideau and Cataraqui rivers at an estimated cost of £145,800. The report was very thorough and detailed all the surveys, and costs of the different types of marine and masonry work involved. The report of a joint commission of the Legislative Assembly and Legislative Council in 1825 unhesitatingly advised proceeding with the work, not only for reasons of military protection and defense, since Kingston was the key to lake Ontario and the waterways to the west, but also as a means of transportation to and from the settlements of the district, containing at the time more than 10,000 people. Earl Dalhousie, the Governor-General gave the proposal his strong support and forwarded the Clowes report to the War Office at London, and the British government offered to pay £70,000, or about one half the cost if the Upper Canada government would undertake the work. The legislature then did a "right-about-face" and refused to participate, making many excuses and taking an exactly opposite stand to its former one at the time of the Clowes report.

The Duke of Wellington then appointed a commission of military engineers to investigate the matter and report to him. This commission visited Canada, and after careful study, advised building the canal for military purposes, — "to permit gunboats to pass". They increased Clowes estimate to £169,000. and also reported that no assistance whatever could be expected from the Colonial government which claimed that the settlers were absolutely opposed to the work, and were unable to shoulder any further taxes.

At this time there were in Canada five small canals; Coteau du Lac, built 1780; Cascades, built 1782; Sault Ste Marie, built by the Northwest Company 1801; Lachine, built 1825; Welland commenced 1829. All these were built by private corporations except the Lachine, which was constructed by the government of Lower Canada, the Imperial government paying one-ninth of the cost.

The War Department decided to go ahead with the work and Lt.-Col. John By was selected by the Board of Ordnance to construct the canal. Col. By was born in 1781, had passed through the R.M.C. at Woolwich, and prior to 1826, when he was sent out to take charge of the Rideau canal, had already spent some years in Canada on construction work.

Col. By was instructed to complete a water communication from what is now the city of Ottawa to Kingston, having a uniform depth of 5 feet along the line recommended and surveyed by Clowes. The locks were to be 20 feet wide by 100 feet long, the same size as those at Lachine. An attempt was made to have the canal go through to Cornwall instead of Kingston but this proposal was discarded.

The Ordnance Department decided that the work was to be done by contract and Col. By was given absolute instructions to continue once the work was started without waiting each year for the parliamentary grant. A small estimate of £5,000. had been put through parliament for preliminary work on the undertaking and the authorities argued, even as far back as then, that the project had thus been endorsed and went on to let "the tail wag the dog" in thorough fashion.

The War Office instructed the Lieutenant Governor of Upper Canada to afford all possible aid and assistance, and Col. By reached Montreal in August 1826. His first communication to the Department was that the canal would cost at least £400,000, although he had not as yet even been on the ground. He arrived at Hull in September, 1826 and work commenced. The small village of Hull on the north side of the river was at the time the only settlement within miles.

The legislature had previously passed an act which was supposed to give Col. By complete powers to do all work and make all necessary expropriations for the construction of the canal, but the act absolutely refused him expropriatory powers for lands for military purposes or for the defence of the waterway.

During the winter of 1826-27, Col. By rushed the work and surveys and estimates were completed. Contracts were let in the late spring and two companies of engineers were sent from England for construction. The estimates had by this time climbed to £475,000., — over three times the original estimate, — which amount Col. By reported to the department stating that the length of the canal would be 132 miles, the rise from the Ottawa river to the height of land 283 feet and from thence to lake Ontario a drop of 154 feet. Forty-seven locks would be required of a recommended size of 150 by 50 feet and many dams for raising the water.

There was consternation in the Ordnance Department over the increased estimates and some very drastic criticism. A further commission was appointed to investigate the matter and reported that all Col. By's estimates were above question. Amongst other statements the commission stated that Col. By's plans for dams at Hog's Back and Jones' Falls of 45 and 48 feet respectively were for far higher works than any yet constructed.

Another commission was sent out under Sir James Kempt for a further investigation and it also reported that Col. By had done nothing but what was right, had been economical and had followed all instructions with very laudable zeal throughout. It recommended locks 33 feet by 134 feet and sent in Col. By's latest estimate of £576,757, which it advised reducing to £558,000, feeling the latter would be ample for every possible contingency.

The final arrangement was, 47 locks, total lockage 446¼ feet, dimensions of locks 134 by 33 feet, canal breadth at bottom 60 feet in earth, 54 feet in rock, at surface 80 feet in earth, 24 dams, 11 of which are in cut stone.

During the actual construction many difficulties were encountered, not the least amongst which was malaria, which carried off hundreds of Irish immigrants while working in the swamps of what is now Cranberry lake. Soldiers were required to keep order and Col. By himself almost died. There were many suits for damages, etc., in one instance Col. By being accused of killing the fish. The tremendous height of the spring floods was unknown to English engineers and caused great trouble, the huge Hog's Back dam being completely carried out in the spring of 1829. In addition many of the contractors threw up their jobs or sublet them to parties whom col. By claimed were impossible of description.

In the spring of 1830 the estimates had increased to £762,679, but Col. By seems to have been absolved from all blame in this regard, those in authority stating that they felt it was merely circumstances and the many unforseen difficulties, which were much greater than ever expected.

A parliamentary enquiry was demanded in the spring of 1831, when the pros and cons were thoroughly gone into. The military authorities were blamed for a vote of £5,000 being responsible for such a tremendous outlay of funds without further consultation with parliament. Col. By stood his ground and claimed he had neither accepted the original estimate nor given as positive any of his own figures; those submitted, being in each case only tentative, as anything in the way of a positive statement was both absurd and impossible. The contracts had all been made by the Commissariat Department at Quebec, and he (By) had to pay the bills. He consequently could not interfere with the contractors themselves.

In February 1832, Col. By reported the expenditure as £715,408, which was £22,700. more than parliament had agreed to after the enquiry, and that £60,615 more would be needed. The final figure was £30,134 over this last estimate, this last item being the cost of additional work which experience showed was absolutely necessary, such as the adoption of waste weirs, enlargement of dams, embankments, etc., to take care of the spring floods, as shown by the disaster at Hog's Back.

Col. By stated in conclusion that more accurate original plans and estimates were impossible due to the uncleared and impenetrable nature of the country, necessitating all surveys being made in the winter, and to the extremely unhealthy climate during the summer months. He said the surprise should be, not so much that the estimates had proved too meagre but rather that so few errors had taken place in the work itself.

The great work of the Rideau canal was completed early in 1832 and on May 29th, of that year the first steamboat, "The Bumper", with a party of officers and citizens passed through from what is now the capital of the Dominion to Kingston, the military centre of the province.

Four days prior to this, on May 25th, the Lords of the Treasury requested the war office to recall Col. By from the work, and order him to return to England to explain the whole matter. A third committee was appointed before which Col. By appeared. This great engineer had expected commendation and at least a knighthood on the completion of such a magnificent piece of work, in so short a time, under so many difficulties and at a cost by no means extravagant. Instead he was severely criticized, it would seem unwarrantedly, and never recovered from his chagrin. He died at his home in Sussex in 1836, worn out by hardship and disappointment. Every commission had reported favorably, every engineer had approved, there was not a word of disapproval from the Ordnance Board, but Col. By seemed to be the only one to whom the political "buck could be passed".

For years the Rideau was a very important artery for transportation to western Ontario, and it developed the country to a great extent. The building of the St. Lawrence canals and the railways, together with extensive motor traffic on improved highways have now rendered this charming, romantic and historical waterway obsolete for practically all except pleasure craft.

Preliminary Notice

of Applications for Admission and for Transfer

November 19th, 1924.

The By-laws now provide that the Council of the Institute shall approve, classify and elect candidates to membership and transfer from one grade of membership to a higher.

It is also provided that there shall be issued to all corporate members a list of the new applicants for admission and for transfer, containing a concise statement of the record of each applicant and the names of his references.

In order that the Council may determine justly the eligibility of each candidate, every member is asked to read carefully the list submitted herewith and to report promptly to the Secretary any facts which may affect the classification and election of any of the candidates. In cases where the professional career of an applicant is known to any member, such member is specially invited to make a definite recommendation as to the proper classification of the candidate.*

If to your knowledge facts exist which are derogatory to the personal reputation of any applicant, should be promptly communicated.

Communications relating to applicants are considered by the Council as strictly confidential.

The Council will consider the applications herein described in December 1924.

FRASER S. KEITH, Secretary.

*The professional requirements are as follows:—

A **Member** shall be at least thirty-five years of age, and shall have been engaged in some branch of engineering for at least twelve years, which period may include apprenticeship or pupilage in a qualified engineer's office, or a term of instruction in a school of engineering recognized by the council. The term of twelve years may, at the discretion of the council, be reduced to ten years in the case of a candidate for election who has graduated from a school of engineering recognized by the council. In every case the candidate shall have held a position in which he had responsible charge for at least five years as an engineer qualified to design, direct or report on engineering projects. The occupancy of a chair as a professor in a faculty of applied science or engineering, after the candidate has attained the age of thirty years, shall be considered as responsible charge.

An **Associate Member** shall be at least twenty-seven years of age, and shall have been engaged in some branch of engineering for at least six years, which period may include apprenticeship or pupilage in a qualified engineer's office or a term of instruction in a school of engineering recognized by the council. In every case a candidate for election shall have held a position of professional responsibility, in charge of work as principal or assistant, for at least two years. The occupancy of a chair as an assistant professor or associate professor in a faculty of applied science of engineering, after the candidate has attained the age of twenty-seven years, shall be considered as professional responsibility.

Every candidate who has not graduated from a school of engineering recognized by the council, shall be required to pass an examination before a board of examiners appointed by the council. The candidate shall be examined on the theory and practice of engineering with special reference to the branch of engineering in which he has been engaged. This examination may be waived at the discretion of the council if the candidate has held a position of professional responsibility for five or more years.

A **Junior** shall be at least twenty-one years of age, and shall have been engaged in some branch of engineering for at least four years. This period may be reduced to one year, at the discretion of the council, if the candidate for election has graduated from a school of engineering recognized by the council. He shall not remain in the class of Junior after he has attained the age of thirty-three years.

Every candidate who has not graduated from a school of engineering recognized by the council, or has not passed the examinations of the first year in such a course, shall be required to pass an examination in the following subjects: geography, history, (that of Canada in particular), arithmetic, geometry, euclid (books I, IV and VI), trigonometry, algebra up to and including quadratic equations.

A **Student** shall be at least seventeen years of age, and shall present a certificate of having passed successfully an examination equivalent to the final examination of a high school or the matriculation of an arts or science course. He shall either be pursuing a course of instruction in a school of engineering recognized by the council, in which case he shall not remain in the class of student for more than two years after graduation; or he shall be receiving a practical training in the profession, in which case he shall pass an examination equal to that prescribed for admission to the grade of Junior in the foregoing section and he shall not remain in the class of Student after he has attained the age of twenty-seven years.

An **Affiliate** shall be one who is not an engineer by profession but whose pursuits, scientific attainments or practical experience, qualify him to co-operate with engineers in the advancement of professional knowledge.

The fact that candidates give the names of certain members as references does not necessarily mean that their applications are endorsed by such members.

FOR ADMISSION

BAIRD—EARLE MEHARG, of Scarboro Jct., Ont. Born at Scarboro, Ont., Feb. 18th, 1901; Educ., B.A.Sc. Univ. of Tor., 1923; Summers 1920 and 1921, with R. R. Grant & Co., Toronto, Land Surveyors; Summer 1922 and from May 1923 to date, with Scarboro Township Engrg. Dept. on sidewalk and bridge constrn., dfting, surveying, etc., at present asst. engr.

References: S. W. Johnston, W. L. Dobbin, C. E. Fraser, J. H. Curzon, C. H. Mitchell.

BIGGAR—OLIVER MOWAT, of 239 Wellington Street, Ottawa, Ont. Born at Toronto, Ont., Oct. 11, 1876; Educ., B.A., Univ. of Toronto, 1898; Barrister and Solicitor — Ontario, 1901; N.W.T. 1903; Alberta and Sask. 1907; K.C. (Alberta) 1913, (Canada) 1920; Counsel in a number of cases involving engineering problems on behalf, among other clients, of the C.P.R., the city of Calgary, and R. S. Lea, 1901-17; 1919-22, vice-chairman, Canadian Air Board, on organization and during the whole time the Air Board remained a separate department of government; 1924, chairman, Interdepartmental Committee on the St. Lawrence Waterway constituted to inquire into the technical problems presented by the project; At present, chief electoral officer for Canada and Government Counsel.

References: C. R. Coutlee, D. W. McLachlan, C. H. Mitchell, J. T. Johnston, K. M. Cameron, A. G. L. McNaughton.

BURGE—WILLIAM ROBERT, of 63 Ernescliffe Apts., Toronto, Ont. Born at Lennoxville, Que., June 27th, 1880; In 1898 engaged with Jenckes Machine Co. Ltd., Sherbrooke, Que., practical experience in office, dfting room and shop, and was sales manager for prov. of Quebec until 1916; 1916 to date, sales manager for Ontario for Canadian Allis-Chalmers Co. Ltd., Toronto, Ont.

References: T. H. Hogg, O. Holden, H. G. Acres, E. T. J. Brandon, F. A. Gaby, A. E. Nourse.

CREASE—CHARLES EDWARD, of Amherst, N.S. Born at Amherst, March 24th, 1902; Educ., Engrg. Diploma, Dalhousie Univ. 1923. One year N.S.T.C.; 1916-18 (summers), ap'tice., Robb Engrg. Works, Amherst; 1920-23 (summers), truck driver, Prov. Highways; 1924, timekeeper, H.E.P.C. of Ont. on constrn. work throughout Ontario; At present, 4th year, elect'l. student, Nova Scotia Technical College.

References: W. P. Copp, F. R. Faulkner, W. F. McKnight, K. L. Dawson, R. W. McColough.

deHART—JOSEPH BERTRAM, of Lethbridge, Alta. Born at Newcastle-on-Tyne, England, August 9th, 1890; Educ., B.Sc. (C.E.), 1910, B.Sc. (M.E.), 1911, M.Sc., 1912, McGill Univ.; 1908, constrn. work, Canadian Copper Co., Copper Cliff, Ont.; 1909, prospecting, Gowganda; 1910, underground work, International Coal & Coke Co., Coleman, Alta.; 1911, Dom. Govt. coal tests under Dr. J. B. Porter; 1912-13, underground work, Canadian Coal & Coke Co., Kipp, Alta.; 1913-14, firehoss and pit boss, International Coal & Coke Co., Coleman, Alta.; 1914-15, mine manager, Twin City Coal Company, Edmonton; 1915-18, mine manager, North American Collieries Limited, Coalhurst; 1918-19, supt. of mines, North American Collieries Ltd., Edmonton; 1920-23, mine manager, Monarch Colliery, Drumheller; 1923, mine manager and engr., Cadomin Coal Co., Cadomin; 1923 to date, district inspector of mines, Lethbridge District, Government of Alberta.

References: J. B. Porter, R. S. L. Wilson, H. P. Keith, V. M. Meek, R. Livingstone.

EAGER—NORMAN HERBERT ALDWYN, of 4628 St. Catherine Street West, Westmount, Que. Born at Montreal, July 18th, 1900; Educ., B.Sc. (C.E.), McGill Univ. 1922. M.C.E., Cornell Univ., 1923; dftsman., Northern Elec. Co.; 1923, dftsman. and engr., dept. of highways, Pennsylvania. Res. engr., divn. of highways, Illinois; At present designer and estimator, Canadian Vickers, Ltd., Montreal, Que.

References: C. K. McLeod, H. M. MacKay, E. Brown, E. S. Mattice, C. M. McKergow.

LAMARCHE—JOSEPH CHARLES, of 2053 Blvd. Gouin East, Montreal North, Que. Born at Montreal, April 30th, 1893; 1910-16, dftsman., estimator and bldg. inspr. for various architects as follows: 1910-11, with J. E. A. Benoit; 1911-14, with Theo. Daoust; 1914-15, with Casimir St. Jean; 1915-16, with Simeon Bergeron; 1916 to date, designer with John S. Metcalf Co. Ltd., Montreal.

References: H. Rolph, F. W. Cowie, L. C. Hill, T. P. Hamel, J. B. O. Saint Laurent, C. D. Norton.

LAVOIE—ALPHONSE JOSEPH, of 294 Wilson Avenue, Montreal, Que. Born at Longueuil, Que., August 22nd, 1876; Educ., Longueuil College; Private course, mech. engrg. under Professor Hebert, and learned trade as pattern maker, moulder, and machinist, in father's work at Longueuil; At 21 years of age applicant left father's shops to take responsible position with James Cooper Mfg. Co. St. Henry, and two years later appointed engr. in charge. Shortly after this firm built the new plant at Rockfield, now the Allis Chalmers Bullock plant. On Mr. Cooper's death accepted position of chief engr. of the Rand Drill, Tarrytown, N.Y., and two years later came back to Canada to organize the pneumatic and mining machinery depts. for the Canada Foundry Co. Ltd., of Toronto and in charge of these depts. In 1908, (due to family sickness) returned to Montreal and for several years designed and built special machinery, also appraised and reorganized manufacturing establishments, specializing in the automobile line; In summer of 1913 went to Europe to compete for the British Aeroplane Engine Competition, after preliminary tests was allowed to enter engine in competition. Outbreak of war stopped testing of engines; In spring of 1914, invited by "La Presse" to prepare plans and suggestions for the decongestion of the Tramway Systems, over 98% of suggestions now in use; After that appointed by M. N. Hebert, city controller, to prepare a general plan for transportation and the replanning of Montreal. Made elaborate studies for that project but the Mayor of that time opposed bitterly such a move; During the last 2½ years of the war was chief mech. engr. of the P. Lyall & Sons Construction Co., Montreal, pertaining to all shell and mechanical activities. Also chairman of the U.S. 4.7 and 155 m/m Shell Committee, Washington, D.C.; Since the war produced a complete automobile embodying all his patents in Automotive Industries, car has covered over 40,000 miles, now ready to produce it in quantities; At present, president, Lavoie Automotive Devices Ltd., and president, Lavoie 4 Limited (Motor Cars). Now installing and testing patented 4 wheel brakes, etc., for the General Motors Corpn. of Detroit and several other auto companies. Replanning Transportation System for Montreal, including South Shore Bridge and City Railway, Harbor and other transportation connections.

References: J. M. R. Fairbairn, G. R. MacLeod, H. Holgate, C. N. Monsarrat, P. L. Pratley, F. B. Brown, L. E. F. Fusey, J. Ewing.

McGIE—WILLIAM ROBERTSON, of Walkerville, Ont. Born at Belleville, Ont., Jan. 16th, 1893; Educ., B.A.Sc. Univ. of Toronto, 1915; From 1917 to date, with Ford Motor Company of Canada, in capacity of plant engr., organized present engrg. dept., and at present chief engr., responsible for all engrg. and constrn. work.

References: W. H. Baltzell, L. M. Allan, R. W. Angus, J. E. Porter, A. J. M. Bowman.

McINTOSH—DUNCAN NEIL, of Simcoe, Ont. Born at Simcoe, Ont., Feb. 18th, 1900; Educ., B.A.Sc. Univ. of Toronto, 1924; 1917 (June-Sept.), rodman, geol. survey, Dominion Natural Gas Co.; 1919 (June-Sept.), and summer 1920, constrn. at Macadam Roads, Norfolk County; 1921 (May-Oct.), timekeeper and asst. foreman, Webster Construction Co., London, Ont.; 1922 (May-Sept.), dftsman., rodman, and instr'man., for G. R. Marston, A.M.E.I.C., county road supt., Norfolk County; 1923 (May-July), inspr. of culverts and grading for Dept. Public Highways, Ont.; 1923 (July-Sept.), asst. foreman, Paving and Mastic Co. Ltd. on paving in Simcoe; At present, instr'man., dftsman, etc., for G. R. Marston, A.M.E.I.C., county road supt., County of Norfolk.

References: G. R. Marston, T. R. Loudon, P. Gillespie, C. R. Young, C. Robertson, A. L. S. Nash.

FOR TRANSFER FROM CLASS OF JUNIOR TO HIGHER GRADE

COWLEY—ARTHUR THOMAS NOEL, of Ottawa, Ont. Born at Winnipeg, Man., Dec. 20th, 1888; Educ., B.Sc. McGill Univ. 1910; Study and Practice leading to commission as B.C. Land Surveyor; 1906-07 (summers), land survey parties, Manitoba; 1908-09, rly. location and constrn., Can. Nor. Rly., G.T.P.; 1910, res. engr. Can. Nor. Rly.; 1910-11, transitman, C.P.R. high level bridge, Edmonton; 1911-12, res. engr., Can. Nor. Rly., main line, Alberta; 1913-14, articled pupil, B.C. Land Surveyor; 1915-19, Royal Naval Air Service and Royal Air Force; 1919-21, res. engr., bridge constrn., C.N.R., Vancouver Island; 1922-23, Royal Canadian Air Force, Vancouver; Feb. 1924 to date, acting controller of civil aviation, Dept. National Defence, Ottawa.

References: R. Fowler, D' O. Lewis, D. C. M. Hume, J. A. Wilson. J. E. Daubney, E. F. Cooke, A. M. Narroway.

FOR TRANSFER FROM CLASS OF STUDENT TO HIGHER GRADE

BOWN—CHARLES ROY, of Welland, Ont. Born at Sydney, N.S., Dec. 10th, 1900; Educ., B.Sc. McGill Univ. 1923; With the British Empire Steel Co. as follows: 1918-19, foundry helper, ap'tice pattern shop, tracer; Summers: 1920, stock chaser, mills dept.; 1921, pattern maker; 1922, helper and lathe hand, mach. shop; May 1923 to date, dftsman., Canadian Mead Morrison Co. Ltd., Welland, Ont.

References: K. G. Cameron, A. W. McMaster, C. M. McKergow, A. R. Roberts, A. Sutherland, S. C. Mifflen, J. H. Fraser.

BUNTING—WILLIAM RUSSELL, of 828 Lorne Crescent, Montreal, Que. Born at Township of Grantham, Lincoln County, Ont., Dec. 14th, 1897; Educ., B.A.Sc. Univ. of Tor. 1923; 1916-19, overseas. Signal Corps, C.E.F.; College vacations, with H.E.P.C. Niagara Falls, as operator, dftsman., testman, and on elect'l. inspection, 15 months in all; May 1923 to May 1924, testman with General Electric Co., Schenectady and Pittsburg works; At present power apparatus specialist, Montreal district sales office, Northern Electric Co., Montreal.

References: A. H. Harkness, R. H. Mather, P. S. Gregory, C. V. Christie, W. C. Adams, W. S. Vipond, A. L. S. Nash.

MARLATT—CHARLES EWART, of Bonnington, B.C. Born at Fort William Ont., Nov. 4th, 1896; Educ., B.Sc. Queen's Univ., 1923; One year, C.P.R.; One year, coal mines branch, D.N.R., C.P.R.; Consolidated Mining & Smelting Co., research, etc.; With Field Artillery during war; 1923 (3 mos.), topographer, highways dept., B.C. Govt.; March 1924 to date, instr'man., West Kootenay Power & Light Co., Bonnington, B.C.

References: W. P. Wilgar, A. Macphail, D. S. Ellis, W. K. Gwyer, B. L. Thorne.

WONHAM—WALTER RICHARD, of 336 Wood Avenue, Westmount, Que. Born at Dorval, Que., June 26th, 1899; Educ., B.Sc. McGill Univ. 1922. Govt. Cert. in radio-telegraphy; 1922-24, ap'ticeship, Canadian Westinghouse Company, Hamilton, Ont.; At present asst. to K. B. Thornton, M.E.I.C., Shawinigan Water & Power Company, Montreal, Que.

References: K. B. Thornton, W. F. McLaren, C. A. Price, C. V. Christie, L. A. Herdt.

Recent Additions to the Library

Transactions, Proceedings, etc.

Presented by the Societies.

Transactions of the Liverpool Engineering Society, volume XLIV, 49th Session.

Transactions of the American Society of Civil Engineers, volume LXXXVII, 1924.

The Society of Naval Architects and Marine Engineers, Year Book, August 1924.

American Society for Testing Materials, Year Book, August 1924.

Transactions of North-East Coast Institution of Engineers and Shipbuilders, volume XL, session 1923-24.

Proceedings of the American Society of Civil Engineers, November 1924.

Transactions of the Institution of Mining and Metallurgy, 32nd Session, 1922-1923.

Proceedings of The New Zealand Society of Civil Engineers, 1923-24. Volume No. X.

Transactions of the Institution of Civil Engineers of Ireland, Volume XLIX.

Transactions of the American Institute of Electrical Engineers, January to December, 1923. Vol. XLII.

Reports, etc.

Presented by The Institution of Civil Engineers.

Selected Engineering Papers:

No. 10, The Principle of Virtual Velocities, and its Application to the Theory of Elastic Structures; No. 11, The Analytical Determination of the Voltage-Steps in the Starter of a Single-Phase Series Motor; No. 12, The Stresses in a Circular Ring; No. 13, Graphical Calculation of Overhead Electric Power Transmission-Lines; No. 14, Reinforced Gypsum; No. 15, Some Bridge Foundations of Moderate Depth; No. 16, Notes on the Drainage of Country Towns in the Plains of India; No. 17, Flying-Stations, Construction and Maintenance; No. 18, Levelling in the Sudd Region; No. 19, Length, Tension and Sag of Stay-Ropes.

Presented by Comptroller of Water Rights, Victoria, B.C.

Water Powers of British Columbia.

Presented by American Society for Testing Materials.

A.S.T.M. Tentative Standards, 1924.

Presented by Structural Materials Research Laboratory, Lewis Institute, Chicago.

Tests of Impure Water for Mixing Concrete, by Duff A. Abrams, M.E.I.C., Professor in Charge of Laboratory.

Presented by Dept. of the Interior, U.S. Geological Survey:—

Geology and Possible Oil and Gas Resources of the Faulted Area South of the Bearpaw Mountains, Montana, Bulletin 751-C; Zinc in 1923, I: 6; Bismuth, Selenium, and Tellurium in 1923; I: 8; Clay in 1923, II: 9; Barytes and Barium Products in 1923, II: 10; Graphite in 1923, II: 12; Fuller's Earth in 1923, II: 13; Mica in 1923, II: 17; Coal in 1922, II: 33; Water Powers of the Great Salt Lake Basin, Water Supply Paper 517; Surface Water Supply of the United States, 1921, Water Supply Paper 521.

Technical Books.

Presented by The Ronald Press Company, New York, U.S.A.

Management's Handbook, by a staff of Specialists, L. P. Alford, M.E., Editor-In-Chief.

Presented by John Wiley & Sons, Incorporated.

Problems to Accompany "Engineering Drawing" by Jordan and Hoelscher.

Presented by Chapman & Hall.

Practical Microscopical Metallography, by Richard Henry Greaves. and Harold Wrighton.

Presented by Rensselaer Polytechnic Institute;

A Chapter in American Education, by Ray Palmer Baker, Ph. D.

Office transferred to Toronto

G. G. Mills, A.M.E.I.C., vice-president of the Riley Engineering Company of Canada, Limited, announces that Mr. S. A. Armstrong, vice-president and general counsel of the Sanford Riley Stoker Company of Worcester, Mass., has transferred his offices from Detroit to Toronto in order that he may give more active direction to the Canadian interests of that company. The Canadian subsidiary companies are the Riley Engineering Company of Canada, Limited, and the Under-Feed Stoker Company of Canada, Limited, of which Mr. Armstrong is president and vice-president respectively.

Mr. Armstrong is a Canadian and was for a number of years assistant provincial secretary of Ontario, resigning from that position to become director, military hospitals commission, and later, deputy minister, Department Soldiers Civil Re-establishment of Canada. In 1918 he moved to the United States to become vice-president and managing director of the Under-Feed Stoker Company of America, which consolidated with the Sanford Riley Stoker Company in 1922. During his connection with the stoker industry, he has been a very active member of the Stoker Manufacturers Association, and in 1922 was elected president of it.

The president of the parent company, Mr. Sanford Riley is also a former Canadian and is the son of Mr. R. T. Riley, the well-known Winnipeg financier.

Engineering Index

This Index is prepared by the American Society of Mechanical Engineers.

In this department will be published from month to month the titles of current engineering papers with the authors and source and a brief extract of the more important. It is designed to give the members of The Institute a survey of all important articles relating to every branch of engineering profession.

PHOTOSTATIC PRINTS

Photostatic copies of the articles listed in this section, or others on engineering subjects, may be obtained from the Engineering Societies Library.

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The Library is also prepared to translate articles, to compile lists of references on engineering subjects and render assistance in similar ways. Charges are made, sufficient to cover the cost of this work. Correspondence is invited. Information concerning the charge for any specific service will be given those interested. In asking for information please be definite, so that the investigator may understand clearly what is desired.

The Engineering Societies Library is under the management of the United Engineering Society, which administers it as a public reference library of engineering. It is maintained jointly by the American Society of Civil Engineers; the American Institute of Mining and Metallurgical Engineers; the American Society of Mechanical Engineers and the American Institute of Electrical Engineers. It contains 150,000 volumes on engineering and allied subjects, and receives currently most of the important periodicals in its field.

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Harrison W. Craver, Director

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A

ABRASIVE WHEELS

Manufacture of. Making Vitrified Abrasive Wheels. Chem. & Met. Eng., vol. 31, no. 14, Oct. 6, 1924, pp. 531-533, 6 figs. Describes some of the problems in production of abrasive wheels from carborundum grains.

Surface Grinding in Stone Work (Der Flächenschliff in der Gesteinsbearbeitung), C. Krug. Tonindustrie-Zeitung, vol. 48, no. 73, Sept. 10, 1924, pp. 791-795, 14 figs. A series of articles on grinding wheels, grain and hardness, production, evaluation of abrasives, grinding in grinding machines, safety regulations, roller grinding machines, natural and artificial abrasives, etc.

AIR

Pollution of. The Automatic Measurement of Atmospheric Pollution, J. S. Owens. Chem. & Industry, vol. 43, no. 35, Aug. 29, 1924, pp. 866-871, 7 figs. Describes automatic recording apparatus developed by author primarily designed for measurement of smoke pollution in city air; comparison between automatic filter and jet dust counter; results obtained with automatic filter.

AIR CONDITIONING

Humidifying Plants. Air-Conditioning Plant in Textile Works. Sulzer Tech. Rev., no. 2, 1924, pp. 8-14, 8 figs. Describes Sulzer system of air-humidifying plants.

AIRPLANE ENGINES

Power Measurements, Correction of. Correcting Horsepower Measurements to a Standard Temperature, S. W. Sparrow. Nat. Advisory Committee for Aeronautics—Report, no. 190, 1924, 14 pp., 16 figs. Discusses relation between temperature of air at entrance to carburetor and power developed by engine; consideration of range of temperatures likely to result from changes of season, locality, or altitude.

AIRPLANE PROPELLERS

Airfoil Theory and. Comparison of Model Propeller Tests with Airfoil Theory, Wm. F. Durand and E. P. Lesley. Nat. Advisory Committee for Aeronautics—Report, no. 196, 1924, 26 pp., 61 figs. Examination of degree of approach which may be anticipated between laboratory tests on model airplane propellers and results computed by airfoil theory, based on tests of airfoils representative or successive blade sections.

AIRPLANES

Flying Boats. *See Flying Boats.*

Performance Predetermination. The Logarithmic Polar Curve—Its Theory and Application to the Predetermination of Airplane Performance, V. Cronstedt. Nat. Advisory Committee for Aeronautics—Tech. Notes, no. 205, Oct. 1924, 34 pp., 14 figs. Outlines theory and shows some of possibilities of Rith method, generally known as logarithmic polar curve for predetermination of airplane performance and also shows modifications required by more recent conceptions of performance.

Pilotless. Latest Progress in Telemechanics. Pilotless Airplanes. (Les derniers progrès de la télémécanique. L'avion sans pilote), E. Marcotte. Arts et Métiers, vol. 77, no. 45, June, 1924, pp. 201-204. Discusses progress in distance control by means of Hertzian waves, Sperry stabilizers, pilotless mail carriers, etc.

ALCOHOL

Production. Absolute Alcohol, Its History, Production and Control (L'alcool Absolu. Son histoire, sa fabrication, son contrôle), B. Pique. Association des Chimistes—Bul., vol. 61, no. 10, Apr. 1924, pp. 386-414, 7 figs. Discusses various precesses of production, including Deroy, Mariller, Verley, Coppee, Neste, Ricard, Barbet, etc.

ALIGNMENT CHARTS

Construction. Nomographic Solutions for Engineering Formulae, H. B. Muckleston. Can. Engr., vol. 47, no. 12, Sept. 16, 1924, pp. 329-333, 8 figs. Describes simplified method of constructing nomographic or alignment diagrams, with explanation of principles involved; alignment nomograms merit more attention than better known Cartesian nomogram; various arrangements of scales.

ALLOYS

Aluminum. *See Aluminum Alloys.*
Lead. *See Lead Alloys.*
Monel Metal. *See Monel Metal.*

ALUMINUM

Analysis. Aluminum in Alloys, D. H. Brophy. Indus. & Eng. Chem., vol. 16, no. 9, Sept. 1924, p. 963. Simple and rapid method for analysis of aluminum.

Uses. Aluminum and Its Applications (L'Aluminium et ses applications), M. L. Guillet. Société Industrielle de Mulhouse—Bul., vol. 90, no. 6, June-Aug., 1924, pp. 454-470. Discusses method of manufacture from bauxite, properties and impurities of aluminum, its uses and alloys; duraluminum; alpax.

ALUMINUM ALLOYS

Aluminum-Copper-Tellurium. Properties and Structure of Some Alloys of Aluminum-Copper-Tellurium, F. T. Sisco and M. R. Whitmore. Indus. & Eng. Chem., vol. 16, no. 8, Aug., 1924, pp. 838-841, 11 figs. Result of exploratory investigation on alloys of aluminum containing 5 per cent copper to which tellurium has been added in amounts from 0.25 to 5 per cent; physical properties of these alloys, and effect of tellurium on microstructure of aluminum; method of analysis for alloys.

Aluminum-Silicon. The New Aluminum-Silicon Alloys, J. D. Edwards and R. S. Archer. Chem. & Met. Eng., vol. 31, no. 13, Sept. 29, 1924, pp. 504-508, 8 figs. Pacz' process of "modification" and remarkable improvement in properties it brings about.

Duralumin. *See Duralumin.*

AMMONIA

Catalysts. Increasing Ammonia Production with Improved Catalysts, A. T. Larson. Indus. & Eng. Chem., vol. 16, no. 10, Oct. 1924, pp. 1002-1004. Review of important practical developments.

AMMONIA COMPRESSORS

Bernat System. A New French Ammonia Compressor. Refrig. Eng., vol. 11, no. 3, Sept. 1924, pp. 117-118, 1 fig. Description, characteristics and operation of Bernat system of compressor. Translated from Revue Générale du Froid.

APPRENTICES, TRAINING OF

Foundry. Recent Developments in Foundry Education and Training in France, J. G. Pearce. Foundry Trade, Jl., vol. 30, no. 422, Sept. 18, 1924, pp. 248-249. Particulars regarding scheme recently put into operation by French Foundry Employers' Assn. to encourage entry of suitable youths to foundries by providing systematic apprenticeship and training courses for all, and means whereby any young man of capacity and intelligence may obtain knowledge and experience necessary to fit him for any position in the industry to which he may be promoted. Extracted from Bul. of Brit. Cast Iron Research Assn.

Solves Training of Apprentices. Iron Trade Rev., vol. 75, no. 16, Oct. 16, 1924, pp. 1018-1022, 6 figs. Wisconsin law requiring employed persons under 18 to spend one-half day each week in some school has enabled many workers to obtain trade training; foundry practice popular.

Wisconsin Solves Apprentice Puzzle. Foundry, vol. 52, no. 19, Oct. 1, 1924, pp. 752-757, 5 figs. Describes plan, successful over a number of years trial, evolved by state of Wisconsin, its industrial leaders, its educators and its great army of workmen. Outline of how plan works at plant of Falk Corp.

Railways. Apprenticeship Methods on the Santa Fe. Ry. Mech. Engr., vol. 98, nos. 6, 7, 8 and 9, June, July, Aug. and Sept., 1924, pp. 355-359, 415-418, 467-472 and 527-531, 28 figs. Description of apprenticeship methods followed on Atchison, Topeka & Santa Fe. How and why work was started; selection of apprentices; equipment; instructions given in shop schools, methods and schedule of shop work followed in the various departments of shops, tools furnished, qualifications of instructors, and source of their supply, records maintained regarding work and qualifications of each apprentice, apprentice boards, instructors' conventions, moral training and discipline of apprentices, apprentice clubs, special apprentices, apprentice graduates, etc. Direct and indirect results derived from this apprentice training system.

ASBESTOS

Development of Industry. The Development of the Asbestos Industry 1871-1924. India-Rubber Jl., vol. 68, no. 5, Aug. 2, 1924, pp. 109-113. Review of progress and growth of industry.

AUTOMOBILE ENGINES

Balancing. Engine Balancing Calculations, M. Platt. Automobile Engr., vol. 14, nos. 192 and 193, Aug. and Sept. 1924, pp. 243-249 and 275-281, 42 figs. Discusses balance of rotating masses; crank-shafts; engine balancing calculations. Appendices. Bibliography.

Fuels and Oils, Effects of. Laboratory Tests Show Effects of Different Fuels and Oils on Engine Performance. Automotive Industries, vol. 51, no. 14, Oct. 2, 1924, pp. 608-610, 3 figs. Dynamometer laboratory of The Texas Co. in Long Island City given over to research on performance and engine wear. Nature and arrangement of testing equipment.

AUTOMOBILE FUELS

Anti-knock Compounds. A Suggested Mechanism for Antiknock Action, G. L. Wendt and F. V. Grimm. Indus. & Eng. Chem., vol. 16, no. 9, Sept. 1924, pp. 890-893, 1 fig. Experiments show that tetraethyl lead and other anti-knock compounds actually have marked effect in recombining gaseous ions at ordinary pressures and temperatures while knock inducers similarly tested have no effect.

Gasoline. *See Gasoline.*

TETRALIN. Tetralin, Fred. Nathan. Fuel, vol. 3, no. 10, Oct. 1924, pp. 346-349. Its history, manufacture and use as fuel for internal-combustion engines; produced by process of hydrogenating naphthalene.

AUTOMOBILES

GARAGES. *See Garages.*
HEADLIGHTS. Desirable Road-Illumination, C. A. Michel. Soc. Automotive Engrs. – Jl., vol. 14, no. 5, May 1924, pp. 511-515, 10 figs. Laboratory approval-test specifications; specifications for desirable illumination; specially designed reflector and lens; parabolic-reflector disadvantages; photometric-test values.
REAR-AXLE SHAFTS. Hot-Swaging of Rear-Axle Shafts, R. A. DeVlieg. Soc. Automotive Engrs.—Jl., vol. 14, no. 5, May 1924, pp. 507-510, 4 figs. Description of machines used and their mode of operation, and difficulties attendant upon their development.
STARTING AND LIGHTING APPARATUS, ELECTRICAL. Electrical Manufacturers and Service Men Adjust Differences. C. P. Shattuck. Automotive Industries vol. 51, no. 13, Sept. 25, 1924, pp. 563-566, 4 figs. Report of standards committee of Automotive Elec. Assn., on classification of standard lighting generators, starting motor and recommended practice in wiring.

AVIATION

COMMERCIAL. Adequate Landing-Fields Will Develop a Commercial-Aviation Industry, A. A. G. Fokker, Soc. Automotive Engrs.—Jl., vol. 14, no. 5, May 1924, pp. 504-506 and 510. Shows that great progress in commercial aviation has been made in America during last three years, especially with reference to Air-Mail Service. Gives instances where additional airplane routes are feasible even now in United States. European aviation development. Urges necessity for attaining ability for aircraft to fly at night and specifies advantages secured in Europe now by combined over-night railroad-and-airplane service. "Wild" flying; classification of aerial transport. Provision of landing fields throughout United States urged as a present necessity. Future aviation probabilities and development of aerial traffic.

B

BEAMS

LINES OF INFLUENCE. Lines of Influence (Lignes d'Influence), P. J. Rullens. Assn. des Ingénieurs sortis de l'Ecole Polytechnique de Bruxelles—Bul. Technique, vol. 19, nos. 4 and 5, 1923, and vol. 20, no. 1, 1924, pp. 117-170, 179-196 and 6-38, 63 figs. partly on supp. plates. Detailed study of this method of calculation, as follows: Part. I: Lines of influence in statically determinate systems. Part II: Lines of influence in statically indeterminate systems. Part III: Applications, Bascule bridges, vierendeel beams. Part IV: Fixed beams, bridges, etc.

BEARINGS, BALL

Formulas for and Properties of Ball and Roller Bearings (Alcune formole e proprieta notevoli nella cinematica dei cuscinetti protanti a sfere e a rulli), S. R. Treves. Industria, vol. 38, no. 9, May 15, 1924, pp. 242-245, 5 figs. Develops formulas for calculating peripheral speed, coefficient of resistance, etc.

BELT DRIVE

ARC OF CONTACT, INCREASING. Methods That May be Applied for Increasing Arc of Contact With Low Belt Tension, F. E. Gooding. Indus. Engr., vol. 82, no. 9, Sept. 1924, pp. 417-422 and 455, 16 figs. Describes special mechanical means whereby distance between shafts may be shortened and pulley ratios increased over usual recommended practice.
GROUP VS. INDIVIDUAL DRIVE. A Comparison of Froup and Individual Drive, R. W. Drake. Indus. Mgt. (N. Y.), vol. 68, no. 3, Sept. 1924, pp. 178-183, 6 figs. Analysis of factors which govern a choice.

BELTING

LUMBER INDUSTRY. Transmission and Conveyor Belts in New Long-Bell Lumber Mill, W. A. Scott. Belting, vol. 25, no. 3, Sept. 1924, pp. 21-24, 9 figs. Large new plant of Long-Bell Lumber Co., Longview Wash., contains latest improved design of modern equipment; belting installations highly efficient.
RUBBER. How Much Power Is That Rubber Belt Transmitting? W. F. Schaphorst. Belting, vol. 25, no. 3, Sept. 1924, pp. 29-30, 1 fig. Gives table for determining horsepower being transmitted by rubber belt.
Rubber Belting, G. A. Frenkel. Machy. (N. Y.), vol. 31, no. 2, Oct. 1924, pp. 122-124. Data and formulas required in designing rubber-belt transmissions.
TYPES. Characteristics and Attributes of Certain Classes of Belting, W. Staniar. Belting, vol. 25, no. 3, Sept. 1924, pp. 17-20, 2 figs. Combination of oak and special tannage declared "last word" in leather belting; other types also show improvement; discusses leather rubber, metallic stitched fabric, and solid woven hair belting.

BLAST-FURNACE GAS

CLEANING. Electrical Cleaning of Blast Furnace Gases, N. H. Gellert. Blast Furnace & Steel Plant, vol. 12, no. 9, Sept. 1924, pp. 423-426. Discussion of different methods.
ECONOMICAL USE. Blast-Furnace Gas Economy in German Iron Works, K. Rummel Iron & Coal Trades Rev., vol. 109, no. 2943, July 25, 1924, pp. 156-157, 6 figs. Discusses economic uses of gases, gas-fired vs. coal-fired boilers, gas-engine power stations vs. steam-turbine power stations with gas-fired boilers, waste-heat boilers behind gas engines, etc. Abstract of paper read before World Power Conference.

BLAST FURNACES

PRACTICE ALABAMA. Blast-Furnace Practice in Alabama, H. E. Mussey. Am. Inst. Min. & Met. Engrs.—Trans., no. 1376-S, Oct. 1924, 15 pp., 8 figs. In summarizing practice of district it may be stated that Southern practice is disposed to carry higher stove temperatures than Northern plants, also blast volume for given size of stack is higher; increased production may be expected as result of even larger furnaces than those now classified as large.
TUYERES. Number, Form, Diameter and Position of Blast-Furnace Tuyeres. Effect of Their Number on the Efficiency of Blast Furnaces (Nombre, Forme, diamètre et position des tuyères de hauts fourneaux. Influence du nombre des tuyères sur la marche du fournean), M. M. Derclaye. Revue de Métallurgie, vol. 21, nos. 6, 7 and 8, June, July and Aug., 1924, pp. 315-337, 396-421 and 450-461, 14 figs. Calculation of tuyeres for any blast furnace; considerations limiting number of tuyeres, position of tuyeres round crucible, etc. Determination of total and partial heat balances. New theory of Mathesius and its application to heat balances.

BOILER EXPLOSIONS

BRITISH LEGISLATION. Steam Boiler Explosions. Colliery Guardian, vol. 128, no. 3324, Sept. 12, 1924, pp. 674-675. Abstract of memorandum prepared by C. E. Stromeyer, chief engineer of Manchester Steam Users' Assn. for Prevention of Steam Boiler Explosions, dealing exclusively with steam-boilers clauses of new British Factories Bill.

BOILER FEEDWATER

CONCENTRATION CONTROL. Systematic Control of Boiler-Water Concentration, C. M. Ware. Power, vol. 60, no. 17, Oct. 21, 1924, pp. 650-651, 2 figs. Describes three methods, any one of which can be applied according to its relative merit for plant concerned.

BOILER OPERATION

COSTS AND ECONOMIES. Boilers—Operation Cost and Economies, J. A. Whitlow. Elec. Light & Power, vol. 2, no. 10, Oct. 1924, pp. 18-19, 80, 82 and 84. Notes on grate area; kinds of grates and furnaces; feedwater heaters; economizers; superheat; and operating data.
COMBUSTION CONTROL. Combustion Control for Boilers, R. J. S. Pigott. Mech. Eng., vol. 46, no. 10, Oct. 1924, pp. 590-592, 1 fig. Functions involved in operation; possibilities and methods of regulation; design, insulation; human factor in system.

BOILERMAKING

FRENCH SHOPS. Important Boiler Construction in French Shops, G. L. Carden. Boiler Maker, vol. 23, no. 9, Sept. 1924, pp. 249-251, 5 figs. Describes Fives-Lille boiler works which have been enlarged since war and improvements made in Delaunay-Belleville boiler.

BOILERS

AUTOGENOUS WELDING. Proposed Code of Rules to Govern Autogenous Welding on Steam Pressure Boilers. Boiler Maker, vol. 23, no. 9, Sept. 1924, pp. 257-262, 27 figs. Gives results obtained from tests and recommendations covering use of autogenous welding in steam boilers.
HEAT-BALANCE CALCULATION. Calculation of the Boiler Heat Balance. Power Plant Eng., vol. 28, no. 19, Oct. 1, 1924, pp. 991-995, 9 figs. Solution of a problem and an analysis of conditions which affect boiler economy over various periods of operation.
LOADING FOR MAXIMUM EFFICIENCY. Loading the Boilers to Obtain Maximum Efficiency, Chas. E. Coburn. Power, vol. 60, no. 17, Oct. 21, 1924, pp. 642-643, 3 figs. Points out that by properly dividing load among boilers in service and by strict attention to keeping controllable losses at their lowest, boiler load may always be maintained at its reasonably highest efficiency.
LOCOMOTIVE. *See Locomotive Boilers.*
MULTITUBULAR. Results of Tests of Multitubular Boilers with Direct Flow (Résultats d'essai de chaudières multitubulaires à flux direct), M. P. Pourchot. Outillage, vol. 8, no. 8, Aug. 1924, pp. 276-281, 5 figs. Describes recent installation at Louire Mines and Houillères de Montrambert Mines, where special difficulties had to be met; gives evaporation tests with low-grade fuels, etc.
RATINGS. Progress in the Rating of Heating Boilers-Heating & Vent. Mag., vol. 21, no. 10, Oct. 1924, pp. 46-48, 1 table. Comparison of three methods, including that announced by Chicago Master Steamfitters' Assn.
SPECIFICATIONS. Technical Specifications for the Supply of Forged or Stamped Pieces of Extra-Soft Rolled Steel for Boilers and Other Steam Vessels (Spécification technique pour la fourniture de pièces forgées ou embouties, en acier laminé extra-doux pour chaudières et autres appareils à vapeur). Associations Françaises de Propriétaires d'Appareils à Vapeur—Bul., vol. 5, no. 17, July 1924, pp. 171-176. Rules established by French Steam Boiler Users' Assn.

BOILERS, WATER-TUBE

TEMPERATURE VARIATION. Temperatures in Water-Tube Boilers. Power, vol. 60, no. 16, Oct. 14, 1924, p. 604, 1 fig. Investigations at Rensselaer Inst. show little variation throughout boiler.

BRAKES

POWER. Power Brakes on British Railway, W. E. Symons. Ry. & Locomotive Eng., vol. 37, no. 9, Sept. 1924, pp. 281-282, 2 figs. Reviews power-brake situation in Great Britain; vacuum and air brakes.

BREATHING APPARATUS

SELF-CONTAINED. The Practical Use of Self-Contained Breathing Apparatus, A. McEarchern. Can. Min. Jl., vol. 45, no. 38, Sept. 19, 1924, pp. 922-924, 1 fig. Describes various methods of using rescue breathing apparatus. Abstract of paper read before meeting of Min. Soc. of Nova Scotia.

BRIDGES, CONCRETE

ARCH. California Begins Construction of Douglas Memorial Bridge, H. D. Miller. Eng. News-Rec., vol. 93, no. 13, Sept. 25, 1924, pp. 506-507, 1 fig. Design considerations, physical features, pier design, and loading of half-million-dollar memorial bridge to be constructed over Klamath River in northern California; will consist of five 210-ft. open-spandrel reinforced-concrete arch spans, supported on a wood-pile foundation.

BRIDGE ERECTION

FALSEWORK, WITHOUT. Erecting Seven Simple Spans Without Falsework. Ry. Age, vol. 77, no. 15, Oct. 11, 1924, pp. 630-632, 4 figs. Describes how Union Pacific replaces Howe trusses in Columbia River Bridge; new bridge consists of three 192-ft. through trusses, three 242-ft. through trusses, three 90-ft. through plate girders, 280-ft. center bearing swing span, 304-ft. and 418-ft. trestles approaches.

BUILDINGS

STEEL FRAMEWORK, STRESSES IN. Measured Stresses in Columns of 18-Story Building. Eng. News-Rec., vol. 94, no. 14, Oct. 2, 1924, pp. 540-542, 5 figs. Results of series of strain-gage measurements carried out of dead-load stresses in steel frame-work of Equitable Life Insurance Co. of Iowa Building, Des Moines. Readings taken during erection show close check with computed loads and moderate bending effects. Abstract from Eng. Experiment Station of Iowa State College, Bul. 71.

C

CABLES, ELECTRIC

UNDERGROUND, LOCATING FAULTS IN. Locating Faults in Underground Cables, V. Truant. Elec. Wld., vol. 84, no. 13, Sept. 27, 1924, pp. 687-688, 4 figs. Application of Wheatstone bridge arrangement to complex networks. Description of apparatus required and general layout. Usefulness of method shown by practical examples.

CAR HEATING

PENNSYLVANIA RAILROAD. The Heating, Ventilating and Lighting of Passenger Cars on the Pennsylvania Railroad, G. L. Fowler. Ry. & Locomotive Eng., vol. 37, no. 9, Sept. 1924, pp. 284-285. Gives outline of work of railroad in development of systems used.

CARS, COAL

20-TON. 20-Ton Coal Wagons on the Great Western Railway. Ry. Engr., vol. 45, no. 537, Oct. 1924, pp. 351-353, 5 figs. On each 500 tons of coal conveyed in these cars there is nearly 400 ft. saving in length of trains; their use increases capacity of private owners' sidings by 30 per cent.

CARS, FREIGHT

MANUFACTURE. Economical Manufacture of Goods Trucks. Werner. Eng. Progress, vol. 5, no. 9, Sept. 1924, pp. 189-190, 1 fig. Deals with interchangeability of parts and successful introduction of principles in German shops.

CARS, PASSENGER

DINING. New Rolling-Stock for Day East Coast Trains, L. N. E. R. Ry. Gaz., vol. 41, no. 41, Oct. 3, 1924, pp. 439-445, 10 figs. Describes new vehicles, including all-electric "triplet" restaurant-car sets.

SIDE GIRDERS, SHEARING STRESS IN. Shearing Stress in Passenger Car Side Girders, W. J. Meyer. Ry. Mech. Engr., vol. 98, no. 10, Oct. 1924, pp. 604-608, 12 figs. Analysis of procedure necessary in order to reduce weight without sacrificing strength.

CASE-HARDENING

LOCOMOTIVE PARTS. The Case-Hardening of Locomotive Components. Ry. Engr., vol. 45, no. 537, Oct. 1924, pp. 337-338, 1 fig. Deals with alternative steels and case-hardening factors.

CAST IRON

TESTING. Mechanical Tests of Cast Iron. Metal Industry (Lond.), vol. 25, nos. 13 and 14, Sept. 26 and Oct. 3, 1924, pp. 307-309 and 331-332. Consideration of the various classes of tests for determining "strength" properties of the metal.

CEMENT, PORTLAND

MANUFACTURE. Some Facts about Portland Cement Manufacture, Chas. Wadsworth, 3d. Chem. & Met. Eng., vol. 31, no. 15, Oct. 13, 1924, pp. 570-573, 5 figs. Report of inspection of Petoskey Portland Cement Co.'s plant, with special reference to peculiarities of design and operation.

SOLUBILITY IN WEATHERING AGENTS. Solubility of Portland Cement in Weathering Agents, H. K. Benson, J. S. Herrick and T. Matsumoto. Indus. & Eng. Chem., vol. 16, no. 10, Oct. 1924, pp. 1063-1066, 6 figs. Solubility of anhydrous Portland cement in distilled water is shown to consist largely of calcium hydroxide; solubility of hydrated Portland cement is of same order of magnitude as anhydrous.

CENTRAL STATIONS

COMINES, FRANCE. Central Power Station at Comines, J. Gould Coutant. Combustion, vol. 11, no. 4, Oct. 1924, pp. 276-278, 4 figs. Initial installation consists of three 25,000-kw. turbo-generators, served by 10 boilers; details of pulverized-coal equipment; results of pulverized-coal firing have warranted placing of fourth repeat order for apparatus for extensions to station.

HEAT BALANCE. Heat Balance Study, F. H. Rosencrants. Combustion, vol. 11, no. 4, Oct. 1924, pp. 278-283, 2 figs. Analysis of relative merits of various means adopted for reducing loss of heat to condenser and to stack. (Abstract.) Report of Prime Movers Committee of Nat. Elec. Light Assn.

INTERCONNECTION WITH STEEL MILLS. The Steel Industry and The Electricity Utilities, M. Skinner and F. D. Mahoney. Iron & Steel Engr., vol. 1, no. 9, Sept. 1924, pp. 532-536, 3 figs. Discusses advantages of interconnection between electric power systems of larger steel companies and those of neighbouring electric utility companies, and difficulties to be overcome.

STEAM-TURBINE, DEVELOPMENTS IN. Modern Tendencies in Steam-Turbine Power Plants, E. Berg and F. V. Smith. Mech. Eng., vol. 46, no. 10, Oct. 1924, pp. 577-582, 10 figs. High pressure, superheat, reheating, and steam extraction as affecting power-plant economy, and advantages obtained in their adoption for marine propulsion. Calculated analysis of steam and fuel consumption of a 50,000-h.p. turbine-electric-drive passenger vessel.

CIRCUIT BREAKERS

HIGH SPEED. Thomson-Houston Extra-Rapid Circuit Breakers (Le disjoncteur extra-rapide Thomson-Houston), L. Vernier and M. Wilfart. Revue Générale de l'Électricité, vol. 16, nos. 9 and 10, Aug. 30 and Sept. 6, 1924, pp. 339-351 and 387-397, 39 figs. Detailed description of Thomson-Houston circuit breakers as satisfying all conditions required of high speed breakers.

OIL. Analysis of Oil Circuit Breaker Requirements for Large Steel Plants, M. J. Wohlgemuth. Elec. Jl., vol. 21, no. 9, Sept. 1924, pp. 411-413, 7 figs. Discusses conditions in typical plant which had badly mixed-up system; distribution system was entirely revamped and network installed which gives uninterrupted service at all substations.

CITY PLANNING

MONTREAL PROJECT. Considerations on a Project of Town Planning for the Island of Montreal, S. J. Fortin. Eng. Jl., vol. 7, no. 10, Oct. 1924, pp. 639-643. Outline of plan for establishment of town-planning commission to investigate and report on project.

COAL

GASIFICATION. Complete Gasification of Coal, H. Strache. Colliery Guardian, vol. 123, no. 3321, Aug. 22, 1924, p. 483, 1 fig. Describes process of complete gasification carried out according to double gas process resulting in highest yield of calories in gaseous condition. Abstract of paper read before World Power Conference.

HEATING VALUE AND AIR EXPOSURE. Loss of Heating Value of Bituminous Coal on Exposure to Air, J. F. Byrne and J. D. Davis. Indus. & Eng. Chem., vol. 16, no. 8, Aug. 1924, pp. 775-778, 5 figs. Method and results of determination of loss in heating value of coal on exposure to air.

IGNITION. The Ignition of Coal, R. V. Wheeler. Fuel, vol. 3, no. 10, Oct. 1924, pp. 366-370, 5 figs. Tests to determine what relationship, if any, there is between chemical composition of coal and its ignition temperature; it is concluded that reaction responsible for "self-heating" of coal is mainly one of attachment of oxygen to molecules of high carbon content.

MOISTURE IN. Moisture in Coal, W. S. Patterson. Power Engr., vol. 19, no. 222, Sept. 1924, pp. 329-330. Discusses boiler efficiency and wet coal, moisture and flue gas, moisture and economizer corrosion, moisture and spontaneous combustion, and appearance of wet coal.

SPECIFIC GRAVITY AND ASH CONTENT. The Specific Gravity and Ash Content of Coal, T. J. Drakeley and J. R. I. Hepburn. Chem. & Industry, vol. 43, no. 34, Aug. 22, 1924, pp. 277T-278T, 1 fig. Investigation to determine whether relation exists between specific gravity of sample of coal and its ash content; it is shown that no relation exist between true and apparent specific gravities and ash contents of samples of clean coal from same seam; relation exists between true and apparent specific gravities and ash contents of average samples and equation is given for calculating ash content of coal from specific gravity.

COAL DUST

TREATMENT WITH BITULOID. Experiments with Colloidal Oil (Bituloid) as a Medium for Laying Coal Dust, H. Briggs and N. H. Wales. Colliery Guardian, vol. 128, no. 3324, Sept. 12, 1924, pp. 673-674, 1 fig. Manner of application and cost of bituloid; tests at Eskmeals experimental station and at coal mines; ignition tests at Straiton mine; advantages and drawbacks. (Abstract.) Paper read before S. Wales Inst. Engrs. See also Iron & Coal Trades Rev., vol. 109, no. 2950, Sept. 12, 1924, pp. 432-433, 4 figs.; and discussion, in no. 2951, Sept. 19, pp. 477.

COAL GAS

ELIMINATION OF SULPHUR FROM. Elimination of Sulphur from Coal Gas. Gas Wld., vol. 81, no. 2094, Sept. 6, 1924, pp. 248-249, 7 figs. Discusses laboratory experiments carried out at Christiania municipal gas-works.

COAL HANDLING

BOILER HOUSE. Coal and Ash Handling Plant. Eng. & Boiler House Rev., vol. 38, no. 4, Oct. 1924, pp. 135-140, 143-144, 147-148 and 150, 20 figs. Review of principal methods in present-day use for handling of coal and ash in boiler house.

CONVEYOR, BELT. Use of Conveyor Belts in Modern Coal Storage. Belting, vol. 25, no. 3, Sept. 1924, pp. 36 and 38, 3 figs. Describes methods of handling fuel by American Hominy Co.; coal mechanically handled from freight cars to firebox.

SHIPPING PLANT. Coal-Shipping Plant at the Clarence Works of Messrs. Dorman, Long & Company, Limited. Iron & Coal Trades Rev., vol. 109, no. 2951, Sept. 19, 1924, pp. 469-470, 3 figs. Details of new wharf and loading plant.

COAL MINES

POWER PURCHASING. Making Power Contracts That Will Save Your Purse, W. H. Russell. Coal Age, vol. 26, no. 13, Sept. 25, 1924, pp. 437-438. Discusses schedule under which power should be purchased. Power schedules should be selected with care; large savings often can be made by buying under two schedules; contract must be based on intimate knowledge of conditions at mine to be supplied.

VENTILATION. Resistance of Mine Headings To the Flow of Air, J. W. Paul, G. E. McElroy and H. P. Greenwald. Coal Age, vol. 26, no. 13, Sept. 25, 1924, p. 441. Notes on tests made by U. S. Bur. Mines in connection with research on coal-mine ventilation factors. In smooth roadway coefficient only 0.000,-000,003,6; rough floor will add 10 per cent; cutting out crosscuts reduced friction 6 per cent.

COAL MINING

POWER CONSUMPTION, REDUCTION. How to Save Power and Thus Reduce Maintenance and Operating Costs of Mine Machinery, W. H. Russell. Coal Age, vol. 26, no. 15, Oct. 9, 1924, pp. 499-500, 2 figs. It is shown that reduction in power required by machines will make savings by decreasing wear and strain on every part of machine, but saving of power is in itself well worth while.

COAL STORAGE

SCIENTIFIC. Scientific Coal Storage. Blast Furnace & Steel Plant, vol. 12, no. 9, Sept. 1924, pp. 418-420, 1 fig. Summary of report of storage of coal committee of Am. Eng. Council.

COKE

CONVEYING AND QUENCHING. Conveying and Quenching of Coke in Gas Works, L. Rodde. Indus. Mgt. (Lond.), vol. 11, nos. 15 and 16, Sept. and Oct. 1924, pp. 421-422 and 448-450, 9 figs. Discusses quenching, conveying and storing; factors affecting quality of coke; hand labour versus mechanical handling; comparison of plants; arrangement of plant; conveying coke breeze; hygienic considerations. Abstract of paper read before German Soc. Gas & Water Engrs.

COLUMNS

ECCENTRIC LOADS. Eccentric Loads on Columns, T. H. Fallows. Concrete & Constr. Eng., vol. 19, no. 9, Sept. 1924, pp. 583-585, 3 figs. Gives quick and reasonably accurate method of determining point of zero stress experimentally, for case where load acts on axis of symmetry of section.

COMBUSTION

CONTROL. Automatic Combustion Control, J. Fred Weller. Combustion, vol. 11, no. 4, Oct. 1924, pp. 295-297. Deals with essential elements to be controlled, namely, fuel supply in proportion to steam demands, air supply, removal of gases, and maintaining negative furnace pressure.

Combustion Control, E. G. Bailey. Iron & Steel Engr., vol. 1, no. 9, Sept. 1924, pp. 483-487, 5 figs. Discusses problems of control.

CONCRETE

ELASTICITY. The Modulus of Elasticity in Compression of Concrete, W. D. Womersley. Concrete & Constr. Eng., vol. 19, no. 9, Sept. 1924, pp. 553-556, 2 figs. Experiments to determine elastic constants of concrete.

MIXING. Mixing Concrete for Power Plant Use. Power Plant Eng., vol. 28, no. 19, Oct. 1, 1924, pp. 1013-1014, 1 fig. Many uses arise around power plant where concrete, properly made, affords excellent construction. Fundamental principles of good construction.

PROPORTIONING. How the Big Four Proportions Concrete. Ry. Eng. & Maintenance, vol. 20, no. 10, Oct. 1924, pp. 387-392, 6 figs. Improved methods adopted by Big Four and applied on all concrete construction; instructions for designing concrete mixtures; specimen design of concrete mixture.

RESEARCH. How One Industry Concentrates Its Research, D. A. Abrams. Chem. & Met. Eng., vol. 31, no. 14, Oct. 6, 1924, pp. 539-542, 4 figs. Structural Materials Research Laboratory of Chicago working out important facts about portland cement and concrete; 45,000 tests are being made annually; describes some experiments and investigations made.

CONCRETE CONSTRUCTION, REINFORCED

GAS WORKS. Concrete Piles for Gas Works Foundations, J. F. Springer. Gas Age-Rec., vol. 54, no. 12, Sept. 20, 1924, pp. 385-388 and 390, 5 figs. General discussion of concrete as construction material for gas works purposes.

CONDENSERS, STEAM

TUBES. Chlorine Keeps Condenser Tubes Clean, C. H. S. Tupholme. Power Plant Eng., vol. 28, no. 20, Oct. 15, 1924, p. 1055, 1 fig. Process and apparatus, known as Chloronome, for continuous and automatic treatment of cooling water with measured trace of chlorine gas to prevent fouling of condenser tubes and other cooling surfaces with deposits of living organisms.

CONVERTERS

OPERATION. Operation of Converting Apparatus, V. E. Johnson. Power Plant Eng., vol. 28, nos. 16 and 18, Aug. 15 and Sept. 15, 1924, pp. 855-857 and 952-954, 16 figs. Preliminary considerations; methods of converting alternating to direct current; motor generators; rotary converters; methods of connecting; voltage regulation.

ROTARY. Operation of Converting Apparatus, V. E. Johnson. Power Plant Eng., vol. 28, no. 20, Oct. 15, 1924, pp. 1059-1061, 22 figs. Notes on operation of rotary converters; effects of power factor.

COPPER

COLD ROLLING AND HARDNESS. Effect of Progressive Cold-Rolling on the Brinne Hardness of Copper, H. Moore. Metal Industry (Lond.), vol. 25, no. 14, Oct. 3, 1924, pp. 326-327, 1 fig. Results of experiments; effect of initial cold rolling; time factor; thickness of specimens and hardness results.

COPPER METALLURGY

SMELTING. Smelting Copper Concentrates in a Converter, F. J. Longworth. Min. & Metallurgy, vol. 5, no. 214, Oct. 1924, pp. 485-486. Problem of treating flotation concentrates; successful charging of concentrates. Abstract of A.I.M.E. paper.

CORES

QUANTITY PRODUCTION. Producing Cores in Quantities, H. R. Simonds. Foundry, vol. 52, no. 20, Oct. 15, 1924, pp. 797-800, 6 figs. Practice at plant of New England Butt Co., Providence, R.I.; specially designed machine produces slender 3-in. cores for textile-machine castings at rate of from 8,000 to 10,000 per week; output equals that of six coremakers.

CORROSION

IRON AND STEEL. A Critical Résumé of Information on Corrosion of Iron and Steel, D. V. Onslow. World Power, vol. 2, no. 9, Sept. 1924, pp. 146-155, 4 figs. With special reference to cast iron to resist sea water.

COUPLINGS

SHAFT. Cast-iron Shrouded Shaft Couplings—Comment, W. Roland Needham. Machy. (Lond.), vol. 24, no. 626, Sept. 25, 1924, pp. 816-817, 1 fig. Corrolary to article in Machy., Aug. 7, 1924, p. 582.

CRANES

UNLOADING. Hoisting Apparatus. Electric Unloading Cranes. (Note sur l'étude des appareils de levage. Grues de déchargement à moteurs électriques), G. Catella. Arts et Métiers, vol. 77, no. 45, June 1924, pp. 220-227, 17 figs. Discusses choice of electric motor, calculation of power required, calculation of frame, and stability of crane.

Unloading Plant of the New United Sugar Company at Ham (Somme) (L'installation de déchargement de la Compagnie nouvelle de Sucreries réunies, à Ham (Somme), C. Dantin. Génie Civil, vol. 85, no. 9, Aug. 30, 1924, pp. 185-189, 7 figs. Details of design and operation of portal gantry and cranes for handling sugar beet; electric drive.

CRYSTALS

X-RAY ANALYSIS. Application of X-Ray Crystal Analysis to Metallurgy, W. P. Davey. Am. Soc. Steel Treating—Trans., vol. 6, no. 3, Sept. 1924, pp. 375-392, 6 figs. Outlines methods used in applying x-ray crystal analysis to metallurgy and gives outstanding results so far obtained; figures illustrating atom arrangements and diagram of method used in obtaining x-ray spectroscopic photographs.

CUTTING METALS

PROGRESS IN. Foreign Progress in Cutting Metals, C. A. Beckett. Mech. Eng., vol. 46, no. 10, Oct. 1924, pp. 618-624, 17 figs. Shows manner in which solutions of some of the problems presented have been attempted by foreign experimenters, referring more specifically to problems (1) development of a standard method for testing tool material and material to be cut, (2) development of a standard heat-treating method, and (3) development of methods for testing tool performance.

CUTTING TOOLS

STEEL FOR STANDARDIZATION OF. Standardization of Cutting Steels (Beitrag zur Normung der Schneidstähle), R. Nerrlich. Werkstattstechnik, vol. 18, no. 17, Sept. 1, 1924, pp. 463-466, 3 figs. Terminology of surfaces and angles of edge of cutting tools.

D

DAMS

CONSTRUCTION. Construction of Dams, A. P. Davis. Engineering, vol. 138, no. 3065, Sept. 26, 1924, pp. 466-468. Summary of current practice, especially its departure from, or development of, former practice. Paper, abridged, contributed to Sec. B of World Power Conference.

MASONRY. Lines of Pressure in Masonry Dams, A. Van der Meersch. Ry. Engr., vol. 45, no. 537, Oct. 1924, pp. 349-350, 6 figs. Proposes solution which aims at greater simplicity in obtaining lines of pressure.

SENNAR, AFRICA. The Sennar Dam and the Gezira Irrigation Scheme. Engineer, vol. 138, no. 3587, Sept. 26, 1924, pp. 348-350, 12 figs. partly on supp. plate and p. 352. Particulars regarding construction of Sennar Dam, which is being built on Blue Nile to provide water for irrigation of Gezira Plain, which lies south of Khartoum, on tongue of land formed by confluence of Blue and White Niles. Total length about 9,925 ft., and height from lowest point in foundations to top of parapet about 130 ft.

DIES

DROP-FORGING. Vital Factors in Design of Drop Forging Dies, W. Anslow. Can. Machy., vol. 32, no. 10, Sept. 4, 1924, pp. 27-29, 18 figs. Points out that parting line, contraction and balance are important considerations in layout; life of dies, to large extent, is dependent upon design.

FORGING-MACHINE. Steels for Forging Machine Dies, E. R. Frost. Forging—Stamping—Heat Treating, vol. 10, no. 10, Oct. 1924, pp. 368-371, 3 figs. Factors entering into choice of best die steel; points out that no definite formula or rule can be given which will cover many conditions encountered.

DIESEL ENGINES

DOUBLE-ACTING. Double Acting Diesels, Johnstone-Taylor. Mar. Eng., vol. 29, no. 10, Oct. 1924, pp. 605-606, 3 figs. Describes designs by two British firms, namely, North Eastern marine and North British design.

More on the Double-Acting Diesel Engine. Motorship, vol. 9, no. 9, Sept. 1924, pp. 659-660, 4 figs. Uniflow port scavenging system developed by M. A. N. (Maschinenfabrik Augsburg-Nürnburg) has given successful test results.

The Worthington Double Acting Diesel. Mar. Eng., vol. 29, no. 10, Oct. 1924, pp. 585-587, 9 figs. Details of new 2-cycle engine, with special reference to cylinder construction.

MEXICAN FUEL OIL. Burning Heavy Fuel Oil in Diesel Engines, R. Hildebrand. Eng. Wld., vol. 25, no. 3, Sept. 1924, pp. 167-168, 1 fig. Describes method employed by Fulton Iron Works Co. in solving problem of using heavy fuel oil in Diesel engines.

POWER PLANTS, USE IN. Use of Diesel Engines in Power Plants, L. R. Ford. Power Plant Eng., vol. 28, no. 19, Oct. 1, 1924, pp. 1003-1004. Considerations affecting adaptability of Diesel engine. Paper read before N. A. S. E. convention.

DRAWINGS

PREPARATION AND USE. Working Drawings, B. Moore. Elec. Jl., vol. 21, no. 10, Oct. 1924, pp. 483-486, 2 figs. Functions, classes, preparation, machining limits, and use of drawings.

DREDGES

SEA-GOING. All-Electric Sea-Going Hopper Dredges, H. C. Coleman. Elec. Jl., vol. 21, no. 9, Sept. 1924, pp. 438-442, 8 figs. Describes hydraulic-type hopper dredge which is self-propelled vessel with molded hull similar to that of ordinary ocean cargo ship; first of this type ever built, A. Mackenzie, is in active service in New York harbor.

DRYDOCKS

ESQUIMALT, B.C. The Canadian Government Drydock at Esquimalt, B.C. Engineering, vol. 138, no. 3065, Sept. 26, 1924, pp. 449-450, 33 figs. partly on supp. plate and p. 454. Description of new dock being constructed, which will accommodate largest class of ships, a depth over sill at high tide of 40 ft. being provided, while maximum usable length will be 1,150 ft.

DURALUMIN

TREATMENT. Duralumin, How It is Treated, Handled and Protected Against Corrosion, H. C. Knerr. Automotive Industries, vol. 51, no. 15, Oct. 9, 1924, pp. 648-650. Instructions for working cover—forming, bending, tube bending, spinning, forging, riveting, welding and soldering; condensed data given on composition, mechanical properties and heat treatment.

E

EARTH

DIATOMACEOUS. The Origin and Uses of Diatomaceous Earth, V. L. Eardley-Wilmot. Can. Min. Jl., vol. 45, no. 38, Sept. 19, 1924, pp. 918-920. Discusses composition, story of diatom, diatom theory for origin of oil, formation of diatomaceous earth, uses, etc.

ELECTRIC ARC

CARBON ARC. The Relation Between Current, Voltage, and the Length of Carbon Arcs, A. E. R. Westman and R. B. Walker. Am. Electrochem. Soc., Advance paper No. 24, for Mtg. Oct. 2-4, 1924, pp. 345-359, 8 figs. Results of investigation of relation between current, voltage and arc length for carbon arcs carrying alternating currents of from 100 to 700 amp. Gives also current and voltage wave forms and discusses their significance.

CHARACTERISTICS. Minimal Length Arc Characteristics, H. E. Ives. Franklin Inst.—Jl., vol. 198, no. 4, Oct. 1924, pp. 437-473, 28 figs. Investigation to see whether experimental test reveals phenomena in accord with conception of minimal or zero length arc; consequences to be investigated are specifically those to be drawn as to nature of discharge at separating contacts, or break arcs; evidence is presented that discharge occurring between spearating electrodes is, for large currents, an arc; for small currents, an atmospheric spark; method of isolating arc discharge for study.

ELECTRIC CIRCUITS, A.C.

PROTECTION, APPARATUS FOR. The Design of Apparatus for the Protection of Alternating-Current Circuits, A. S. Fitzgerald. Instn. Elec. Engrs.—Jl., vol. 62, no. 331, July 1924, pp. 561-598 and (discussion) 599-627, 58 figs. Description of differential protective systems, particularly those suitable for use where there is a neutral earthing resistance. Discusses operating conditions, and their influence on methods of design and construction, and describes improved means of practically applying the various protective circuits.

ELECTRIC DRIVE

COST COMPARISON OF STEAM, DIESEL, AND. Maximum Prices for Current Supply (Höchstpreise für Stromlieferung), W. Windel. Elektrotechnische Zeit., vol. 45, nos. 38 and 39, Sept. 18 and 25, 1924, pp. 995-1000 and 1027-1032, 9 figs. Theoretical and practical comparison of cost of electric, steam, and Diesel drive, for threshing machines and machine tools. Discussion of question of whether to buy current or produce it; cost of producing a kw-hr.

TRANSITION FROM STEAM TO. The Transition from Steam to Electric Drive, E. E. Thomas. Power House, vol. 17, no. 18, Sept. 20, 1924, pp. 21 and 42. Shows that continuity of operation of auxiliaries is often facilitated by house turbines, augmented by electrical ties to main bus, relay protection being included to assure service.

ELECTRIC FURNACES

HEAT-TREATING. Electric Furnace for Continuous Hardening and Tempering Wire, R. H. MacGillivray. Am. Electrochem. Soc., Advance paper No. 10, for Mtg. Oct. 2-4, 1924, pp. 149-151, 3 figs. on supp. plates. Description of furnace, consisting essentially of two units, one an electric-heated air-hardening furnace, approximately 5.48 m. in length, and other an electric-heated, lead drawing pan, quenching being done in oil.

Electric Furnace Installation, R. S. Sawdey. Iron & Steel Eng., vol. 1, no. 9, Sept. 1924, pp. 487-489, 4 figs. Describes electric furnaces installed at Van Dorn Iron Works Co., Cleveland, O.; installation consists of four double-end box-type furnaces.

MEDIUM- AND LOW-TEMPERATURE. Medium and Low Temperature Applications, E. A. Hurme. Iron & Steel Engr., vol. 1, no. 9, Sept. 1924, pp. 503-513, 24 figs. Application of small medium-temperature heat-treating furnaces; hearth-type tool-treating furnaces; tool-steel tempering furnace; large-size medium-temperature furnaces; furnaces for annealing castings; application of electric heat to annealing and hardening wire. applications of low-temperature heating: baking of motor armature; enameling; electric steam boilers; sheet-mill roll heaters.

Electric Furnaces for Medium Temperatures, C. F. Cone. Forging—Stamping—Heat Treating, vol. 10, no. 10, Oct. 1924, pp. 375-379, 8 figs. Points out that regenerative-car type of furnace has eliminated many troubles in preliminary annealing of wire used in manufacture of horse-shoe nails. Paper presented before Assn. Iron & Steel Elec. Engrs.

MELTING. Electric Melting Furnaces, J. A. Seede. Iron & Steel Engr., vol. 1, no. 9, Sept. 1924, pp. 490-494, 8 figs. Review of development; refinements in furnace design, accessories and operation; increasing productive capacity of furnace.

REFRACTORIES, EFFECT OF DEOXIDIZING SLAG ON. Fluorine in the Deoxidizing Slag, and Its Influence on Refractories in Basic Electric Furnace Practice, F. T. Sisco. Am. Electrochem. Soc., Advance paper No. 19, for Mtg. Oct. 2-4, 1924, pp. 257-272. Deoxidizing slag as first formed; analyses of electric-furnace deoxidizing of slags; advantages and disadvantages of fluorine in deoxidizing slag; temperature and fluidity of slag and their effect on roof and walls; etc.

RESISTANCE. An Electric Graphite Resistance Furnace, H. Bruan, A. L. Mehring and W. H. Ross. Indus. & Eng. Chem., vol. 16, no. 8, Aug. 1924, pp. 821-822, 2 figs. Describes furnace which combines features of both Arsem and Tucker furnaces with some new features, and which was designed for such special reactions as those involved in pyrolytic treatment of phosphate rock under non-oxidizing conditions.

WIRE-ANNEALING. Medium Temperature Furnace Installations, C. F. Cone. Iron & Steel Engr., vol. 1, no. 9, Sept. 1924, pp. 494-503, 18 figs. Describes regenerative car-type furnace for annealing of wire, installed in Buffalo plant of Fowler & Union Horse Nail Co.

ELECTRIC FUSES

SELECTION AND MAINTENANCE. Care in Choosing and Maintaining Fuse and Switches May Prevent Many Accidents, J. F. MacWilliams. Coal Age, vol. 26, no. 14, Oct. 2, 1924, pp. 468-471, 5 figs. Fuses should be kept in fireproof cabinets; automatic circuit breakers of 2,000-amp. capacity or over should be remotely controlled; each phase in a three-phase circuit should be provided with separate fuses. From paper read before Nat. Safety Council.

ELECTRIC GENERATORS

FIRES IN, EXTINCTION OF. Extinction of Fires in Generators by Means of Carbon Dioxide, C. L. Jones. Gen. Elec. Rev., vol. 27, no. 10, Oct. 1924, pp. 650-657, 4 figs. Details of a series of experiments made with carbon dioxide at Mellon Inst. Indus. Research. Tests were conducted on pieces of generator coil. Discusses effects of windage, gas composition, air temperature, copper temperature, and insulating materials.

OPERATING COSTS. Some Factors Affecting the Working Costs of Small Electric Generating Sets, E. G. Kennard. Instn. Elec. Engrs.—Jl., vol. 62, no. 332, Aug. 1924, pp. 713-719, 5 figs. Comparisons of costs for generating current, using various types of small internal-combustion engines under various working conditions. How working costs per unit of electricity are influenced by various factors, viz., type of engine, nature and magnitude of load, price and calorific value of fuels.

ELECTRIC GENERATORS, A.C.

EXCESSIVE VOLTAGE. Excessive Voltage in Generators, W. V. Lyon. Elec. World, vol. 84, no. 15, Oct. 11, 1924, pp. 784-785, 5 figs. Account of unusual test data brought to writer's attention; possible explanation of result obtained involves point in theory of a.c. generators about which little has been written.

HIGH-FREQUENCY. High-Frequency Alternators, C. M. Laffon. Elec. Jl., vol. 21, no. 9, Sept. 1924, pp. 416-420, 13 figs. General resume of high-frequency alternators; inductor-type alternator; cylindrical-type high-frequency generators; characteristic curves.

ELECTRIC LAMPS, INCANDESCENT

CANDLE-POWER MEASUREMENT. The Measurement of Candle-power by Means of the Photo-electric Cell, F. K. Moss. Gen. Elec. Rev., vol. 27, no. 9, Sept. 1924, pp. 592-601, 8 figs. Describes investigation made to determine serviceability of photo-electric cell to measure mean spherical candle-power of incandescent lamps. Photometric technique is outlined, limitations of application observed, and results are shown to be distinctly encouraging.

ELECTRIC LOCOMOTIVES

DEVELOPMENT. The Development of the Electric Locomotive, A. H. Armstrong. Mech. Eng., vol. 46, no. 10, Oct. 1924, pp. 608-617, 18 figs. General comparison of steam and electric locomotives; forms of motor drive; electric-locomotive rating; otheograph tests of locomotive impact on rails, etc.

PASSENGER-TRAIN. Electric Passenger Train Locomotive for the Railway Line Görlitz—Königsberg, Paul Müller. Eng. Progress, vol. 5, no. 9, Sept. 1924, pp. 173-174, 4 figs. Approved 2D1 locomotive with rod drive, for heavy gradients. Supplied by Bergmann Elec. Works, Berlin.

ELECTRIC METERS

RECORDING (GRAPHIC) FREQUENCY. A New Graphic Recording Frequency Meter. World Power, vol. 2, no. 9, Sept. 1924, pp. 182-183, 3 figs. Details of new Nalder-Lipman meter.

ELECTRIC MOTORS

REPULSION, ATKINSON TYPE. The Atkinson-Type Repulsion Machine as a Motor and Generator, F. J. Teago. Instn. Elec. Engrs.—Jl., vol. 62, no. 332, Aug. 1924, pp. 720-726, 12 figs. Results of experiments made by research students, under direction of author, on a 25-period single-phase Atkinson-type repulsion motor in Laboratories of Applied Electricity, Liverpool Univ.

STARTING. The Determination of Starting Torque for Motor Drives, P. B. Jackson. Power, vol. 60, no. 14, Sept. 30, 1924, pp. 527-528, 3 figs. Discusses a method for determining starting torque of a load. Contains table giving approximate starting characteristics of a.c. and d.c. motors.

ELECTRIC MOTORS, A.C.

INDUCTION. The Performance of Three-phase Induction Motors, T. F. Wall. World Power, vol. 2, no. 9, Sept. 1924, pp. 164-169, 10 figs. Discusses performance as influenced by change in supply pressure.

PARALLEL-CONNECTED SYNCHRONOUS. Oscillations and Resonance in Systems of Parallel Connected Synchronous Machines, H. V. Putman. Franklin Inst.—Jl., vol. 197, nos. 5 and 6, May and June 1924, pp. 603-621 and 787-820, 6 figs. Develops method for calculating resonance frequency of two synchronous machines electrically in parallel; theory for calculating actual power pulsations which occur in systems of two and three synchronous machines connected to reciprocating apparatus; with some approximation theory is extended to four machines and general method for n machines is suggested; simple methods of calculating correct sizes of flywheels necessary for successful parallel operation of engine-driven generators.

SYNCHRONOUS. Benefit of Synchronous Motors, B. L. J. Moore. Elec. Wld., vol. 84, no. 14, Oct. 4, 1924, pp. 733-734. Study shows that this equipment, installed in large sizes, effects saving without preferential rate. In case analyzed annual saving yielded return of 15 per cent on increased investment.

The Synchronous Motor in Steel-Mill Service, D. W. Dean. Elec. Jl., vol. 21, no. 9, Sept. 1924, pp. 428-433, 10 figs. Characteristics of synchronous motors; comparison to induction motors; customary applications; advantages and disadvantages.

ELECTRIC MOTORS, D.C.

TYPE DETERMINATION. Tests for Determining Type of Direct-Current Machines, B. A. Briggs. Power, vol. 60, no. 15, Oct. 7, 1924, pp. 573-576, 15 figs. Shows how to distinguish between different types of d.c. motors, also between d.c. machines and a.c. computation-type motors.

ELECTRIC POWER

DEVELOPMENT. New Fields of Research for Power Development, E. W. Rice, Jr. Gen. Elec. Rev., vol. 27, no. 9, Sept. 1924, pp. 572-579. Survey of what past and present research has accomplished and what trends of investigation appear to be most worthwhile in future. Abstract of paper read at Lond. Power Conference.

ELECTRIC SWITCHES

DISCONNECTING. Latches and Operating Sticks for Disconnecting Switches, H. J. Crabbs. Elec. Jl., vol. 21, no. 10, Oct. 1924, pp. 478-480, 9 figs. Gives characteristics of single-pole indoor switches, outdoor switches and operating sticks.

ELECTRIC TRANSMISSION LINES

CONSTRUCTION. Machine Building of Transmission Line, H. Cole. Elec. Wld., vol. 84, no. 13, Sept. 27, 1924, pp. 670-673, 7 figs. Description of methods pursued by Detroit Edison Co. in building 150 miles of 120-kv. double-circuit steel-tower transmission lines.

INDUCTIVE INTERFERENCE. Inductive Co-ordination as a Practical Problem, J. L. Clarke. Eng. Jl., vol. 7, no. 9, Sept. 1924, pp. 591-598, 7 figs. Review of subject of inductive interference. Co-ordinated transposition schemes; elimination of harmonics; residual voltages; effects produced by extraneous currents in communication circuits.

RURAL. Cost Data on a 6,600-Volt Rural Line, J. C. Robinson. Elec. Wld., vol. 84, no. 14, Oct. 4, 1924, pp. 730-733, 6 figs. Cost data of line running from Lincoln Water & Light Co.'s plant at Lincoln, Ill., to Atlanta, Ill., 12.25 miles. Aluminum conductors with 250-ft. spans used, expense averaging $1,215 per mile. Notes on construction of outdoor substation at Atlanta, which was built at a total expenditure of $4,940.48.

THREE PHASE. Unbalanced Three Phase Lines of Four Wires (Déséquilibrage des lignes triphasées à quatre fils), M. Marre. Électricien, vol. 40, no. 1355, Sept. 1, 1924, pp. 385-389, 6 figs. Discusses three phase lines with neutral wire and develops formulas for calculations.

ELECTRIC RAILWAYS

ARTICULATED TRAINS AND SELF-PROPELLED CARS. Articulated Trains and Self-Propelled Cars Ry. Age, vol. 77, no. 15, Oct. 11, 1924, pp. 641-643, 1 fig. Review of report by Committee on Heavy Electric Traction of Am. Elec. Ry. Assn., including study of light-weight equipment.

CAR MAINTENANCE. Equipment Maintenance, F. M. Brinckerhoff. Elec. Ry. Jl., vol. 64, no. 13, Sept. 27, 1924, pp. 509-514, 8 figs. Discusses important considerations for expediting inspection and overhaul work; deals with such practical features of shop design as proper areas of floors pace, use of lye tanks, provision for paint spraying and spray washing, adequate materials handling, and dipping and baking equipment.

OVERHEAD CONSTRUCTION, GERMANY. Overhead Construction for German Railway. Elec. Traction, vol. 20, no. 9, Sept. 1924, pp. 415-416, 1 fig. Details of unusual refinement in overhead construction on Mittenwaldbahn; overhead is sectionalized or separated into sections which can be disconnected in case of disturbance for return circuit running rails of track are used; special lighting protection.

SAFETY DEVICES. Automatic Safety Devices for A. C. Trains with Special Reference to the Hamburg Elevated (Selbsttätige Zugsicherungsanlagen mit Wechselstrom unter besonderer Berücksichtigung der Anlagen der Hamburger Hochbahn), C. Wolff. Zeit. des Vereines Deutscher Ingenieur, vol. 68, no. 37, Sept. 13, 1924, pp. 970-975, 11 figs. Application of Thullen (American) safety system in which a train automatically indicates a section is clear as soon as it has left it.

ELECTRIC WELDING

REPAIRING OIL-TANK BOTTOM. Electrically Welded Repairs to Oil Storage Tank Bottoms, L. F. Champion. Min. & Metallurgy, vol. 5, no. 214, Oct. 1924, pp. 493-494, 1 fig. Description of work in placing welded bottom in 55,000-bbl. tank of Pac. Oil Co.

ELECTRIC WELDING, ARC

HEAVY PLATE. Arc Welding Heavy Plate, H. P. Eagan. Welding Engr., vol. 9, no. 9, Sept. 1924, pp. 20-21, 3 figs. Arc welding of heavy plate can be successfully done if correct methods are used; three fundamental principles must be followed.

LOCOMOTIVE REPAIRS. Electric Arc Welding on the Steam Locomotive, W. W. M. Brady. Gen. Elec. Rev., vol. 27, no. 10, Oct. 1924, pp. 687-697, 26 figs. Superior economy and utility of electric arc welding for quickly making reliable repairs and building up worn surfaces.

THEORY. Theoretical Considerations on Electric Arc Welding (Considérations théoriques sur la soudure électrique à l'arc), M. Lebrun. Revue de Métallurgie, vol. 21, no. 8, Aug. 1924, pp. 484-495, 20 figs. Electric characteristics of a welding arc; effect of kind of current and of covering of electrodes; characteristics of electrodes.

ELECTRICAL MACHINERY

INSTALLATION. Preparing Electrical Machinery for Installation. Power Plant Eng., vol. 28, no. 20, Oct. 15, 1924, p. 1062. Extracts from instruction book of Elec. Power Club, containing valuable suggestions.

TEMPERATURE INDICATORS. Switchboard Type Temperature Indicators, D. M. Carswell. Gen. Elec. Rev., vol. 27, no. 7, July 1924, pp. 425-429, 10 figs. Describes equipments for a.c. generators and motors, thermo-couple indicator equipment, and equipment for transformer windings.

TEMPERATURE RISE AND DISTRIBUTION. The Rise and Distribution of Temperature in Small Electrical Machines, E. Hughes. Instn. Elec. Engrs.—Jl., vol. 62, no. 331, July 1924, pp. 628-648, 21 figs. Factors influencing shape of heating and cooling curves of coils and electrical machines. Calculation of thermal conductivity of insulation; effects of different temperature-rises and different air velocities upon thermal conductivity and temperature-rise per watt. New arrangement for measuring mean temperature-rise of field windings. Deduces temperature-rise of field windings in terms involving speed and armature loss for different machines, and compares temperature-rise as measured by resistance and by thermometer.

ELECTRICITY

DEVELOPMENT. Fifty Years in Retrospect. Elec. Wld., vol. 84, no. 12, Sept. 20, 1924, pp. 570-640, 70 figs. A number of articles by different authors briefly reviewing developments in telephony, electric railways, radio, electric lighting and illumination, frequency selection and standardization, hydro-electric engineering, power transmission, protection against lightning, electric motor control, etc.

ELECTRICITY SUPPLY

ANALYSES. Electricity Supply Analyzed, C. H. Merz. Electrician, vol. 93, no. 2416, Sept. 5, 1924, pp. 254-255. Discusses transmission and distribution of electrical energy. Abstract of paper read before First World Power Conference.

ELECTROLYSIS

BRINE, ANODE MATERIAL FOR. Insoluble Anodes for Electrolysis of Brine. The Lead-Silver Series, C. G. Fink and L. C. Pan. Am. Electrochem. Soc., Advance paper no. 8, for Mtg. Oct. 2-4, 1924, pp. 129-135, 2 figs. Presents anodic corrosion tests for alloys of system silver-lead, and shows that corrosion loss in brine drops very abruptly upon addition of small percentages of silver to lead, or vice versa. Voltage curve is similar to corrosion loss curve.

ELEVATORS

DRUM-TYPE MACHINE. Operation of Electric Elevator Machines—Drum-Type Equipment, F. A. Annett. Power, vol. 60, no. 16, Oct. 14, 1924, pp. 609-612, 5 figs. Describes different classes of elevator machines in use and operation of drum-type machine both for overhead and basement installations.

SWINGING-CRADLE TYPE. Swing- or Finger-tray Elevator for Handling Fresh Fruit in Crates, Barrels and Cases, G. F. Zimmer. Indus. Mgt. (Lond.), vol. 11, no. 16, Oct. 1924, pp. 445-447, 3 figs. Describes swinging-cradle type of elevator, great size of which is necessary in order to accommodate largest crates and barrels in which fruit is imported; consists of five parts, viz., main steel structure, two endless chains, cradles, feeding-on and delivering-off gear.

EMPLOYMENT MANAGEMENT

Employee's Industrial Past. The Employee's Past, D. A. Laird. Indus. Mgt. (N. Y.), vol. 68, no. 3, Sept. 1924, pp. 152-160, 11 figs. Value of dispassionate records in employment work.

ENGINEERS

Ethics Code. Advance in Engineering Ethics, C. E. Drayer. Professional Engr., vol. 9, no. 10, Oct. 1924, pp. 13-15. Code of ethics drafted by national technical societies; case method of engineers' applied ethics; specific principles of good professional conduct; relations of engineers to employees and to other engineers.

EVAPORATION

Air-Current. The Effect of a Current of Air on the Rate of Evaporation of Water Below the Boiling Point, G. W. Himus and J. W. Hinchley. Chem. & Industry, vol. 43, no. 34, Aug. 22, 1924, pp. 840-845, 11 figs. Deals with certain aspects of evaporation of water in currents of air and treats of evaporation from water surfaces at different temperatures under varying conditions of draft.

EVAPORATORS

Vacuum. Calculation of Heating Surface for Vacuum Evaporators (Calcul des surfaces de chauffe dans appareils d'évaporation sous le vide), Dessin. Arts et Métiers, vol. 77, no. 47, Aug. 1924, pp. 287-302, 8 figs. Principle of multiple-effect vacuum evaporators; determination of heating surface and coefficient of evaporation; temperature drop; apparatus of single, triple, and quadruple effect.

F

FACTORIES

Equipment Maintenance. Maintenance of Plant Equipment, W. L. Hitt. Mgt. & Administration, vol. 8, no. 1, July 1924, pp. 43-45, 1 fig. Maintenance of plant equipment at East Pittsburgh plant of Westinghouse Elec. & Mfg. Co. Describes organization of maintenance department, doors and windows, cleaning electric-light globes and reflectors, upkeep of fire equipment, and care of belting.

FERROMAGNETISM

Theoretical Study. Ferromagnetism and Its Dependence Upon Chemical, Thermal and Mechanical Conditions, L. W. McKeehan. Franklin Inst.—Jl., vol. 197, nos. 5 and 6, May and June 1924, pp. 583-601 and 757-786, 28 figs. Review of experimental work and survey of existing state of knowledge in regard to magnetism; review of magnetic properties of known ferromagnetics, and principal agents which vary these properties. Bibliography.

FERROPHOSPHORUS

Electric-Furnace Production. Production of Ferrophosphorus in the Electric Furnace, Th. Swann. Am. Inst. Min. & Met. Engrs.—Trans., no. 1383-S, Oct. 1924, 3 pp. In ordinary operation of electric furnace in production of ferrophosphorus, alloy may be produced containing 26 per cent phosphorus, which is said to be the limit.

Manufacture. Manufacture of Ferrophosphorus at Rockdale, Tenn. Am. Inst. Min. & Met. Engrs.—Trans., no. 1360-M, Oct. 1924, 5 pp., 1 fig. Points out that process of manufacturing ferrophosphorus lies not alone in smelting mixture of phosphates, silica, iron ore, with coke as fuel, but upon smelting this mixture with coke and air as chemical agents as well as heat producers and in conjunction with extraordinary procedures and manipulations making process continuous and profitable; conditions for best results.

FILTERS, SAND

Slow. Operation of Slow Sand Water Filters at Hartford, Conn., C. M. Saville. Eng. News-Rec., vol. 93, no. 13, Sept. 25, 1924, pp. 508-509, 3 figs. Stored surface water filtered at rates averaging 4.54 m.g.d. in 1923 with maximum of 20 m.g.d. and at average operating cost of $4.61. Color removal 41.7 per cent for 1922 and 1923.

FIRE PROTECTION

Alarm System. The "Gravity" Fire Alarm System. Colliery Guardian, vol. 128, no. 3226, Sept. 26, 1924, p. 811, 3 figs. Describes automatic fire-alarm system, dependent solely upon gravity for its motive power.

FIREBRICK

Porosity. Determination of Porosity of Firebrick (Porositätsbestimmungen an feuerfesten Steinen), E. Steinhoff and M. Mell. Berichte der Fachausschüsse des Vereins deutscher Eisenhüttenleute (Werkstoffausschuss), no. 44, Apr. 4, 1924, 6 pp., 3 figs. Examines six processes. Advantages of mercury displacement process. Describes new apparatus for its application.

FITS

British Standards. German Locomotive Works Uses British Limits and Fits (Masznahmen einer deutschen Lokomotivfabrik zur Anwendung der englischen Passungsnormen), T. Damm. Werkstattstechnik, vol. 18, no. 18, Sept. 15, 1924, pp. 481-484, 6 figs. Details of limits and fits of British Eng. Standards Assn. and interchangeable parts adopted by Hanover Machine Works.

FLIGHT

Fuel Economy in. Fuel Economy in Flight, H. T. Tizard. Roy. Aeronautical Soc.—Jl., vol. 28, no. 166, Oct. 1924, pp. 604-624, 7 figs. Author discusses following questions into which he divides problem: (1) What are principles governing most economical use of airplane in flight, having regard to weather conditions; (2) What are principles underlying design of airplanes to secure maximum efficiency of operation.

FLOW OF CASES

Pipes. Flow of Gas or Air in Pipes, Franklin H. Smith. Blast Furnace & Steel Plant, vol. 12, no. 10, Oct. 1924, pp. 448-449, and 451. By using formulas given both high- and low-pressure flows may be estimated.

FLOW OF STEAM

Supersaturation Losses. Losses Due to Supersaturation in the Efflux of Steam (Su le perdite per soprasaturazione nell'efflusso del vapore d'acqua), E. Foa. Industria, vol. 38, no. 9, May 15, 1924, pp. 245-250, 2 figs. Develops formulas for calculating losses and velocity from degree of undercooling of condensation, and variation of undercooling in successive expansion.

FLOW OF WATER

Closed Conduits. Hydraulic Efficiency Tests on 43,000-h.p. Unit by the Gibson Method and the Allen Method, W. R. Way. Eng. Jl., vol. 7, no. 10, Oct. 1924, pp. 625-633, 9 figs. Tests carried on under operating conditions; Gibson method for measuring flow of water in closed conduits; test by salt-velocity method for measurement in large conduits, developed by Prof. Chas. M. Allen.

FORGINGS

Steel, Brittleness of. Brittleness of Steel Due to Tempering After Being Forged Cold (Om anlöpningsspródhet), G. Wazau. Jernkontorets Annaler, no. 7, 1924, pp. 343-360, 19 figs. Examples where steel parts, which have been drawn after having been worked in cold condition, have become very brittle, and investigation of such breaks by means of etching of sections according to Fry's method.

FOUNDRIES

American Decrease. Decrease in Foundries Noted. Foundry, vol. 52, no. 20, Oct. 15, 1924, pp. 801-805, 7 figs. Statistics indicate less number of castings plants in operation in 1924 than in 1922.

European and American, Comparison of. European and American Foundries Compared, H. M. Lane. Foundry Trade Jl., vol. 30, no. 422, Sept. 18, 1924, p. 245. Extract from paper presented to South Metal Trades Assn.

Gray-Iron. Tunnels Facilitate Handling of Material in New Foundry, P. Dwyer. Iron Trade Rev., vol. 75, no. 14, Oct. 2, 1924, pp. 879-883 and 897, 11 figs. Also Foundry, vol. 52, no. 20, Oct. 15, 1924, pp. 806-812, 10 figs. Description of new foundry of Studebaker Corp., at South Bend, Ind., and notes on methods employed. Designed and equipped for a potential melting capacity of 400 tons of gray-iron castings per day.

FREIGHT HANDLING

Monorail Overhead Carrying System. Relieving Railway Terminal Freight Congestion, J. L. Miller. Can. Machy., vol. 32, no. 12, Sept. 18, 1924, pp. 34-36, 2 figs. In author's opinion, overhead carrying system of monorail type offers greatest degree of flexibility and economy in handling goods in freight sheds.

FUEL ECONOMY

High Temperatures and. Fuel Economy and the Measurement of High Temperatures, R. Hadfield. Iron & Coal Trades Rev., vol. 109, no. 2946, Aug. 15, 1924, pp. 273-274. Discusses steam boilers, forge furnaces and furnaces for heat treatment of steel, temperature measurement in furnace, flame temperature, and furnace efficiency, regenerators and recuperators, heat transmission and heat balance in furnaces and melting furnaces. Abstract of paper read before First World Power Conference.

Railway Service. Heat Economy and Railway Service, Landsberg. Eng. Progress, vol. 5, no. 9, Sept. 1924, pp. 170-172. Points out that German state railways consume 9 to 12 per cent of total German coal production; economic efficiency of locomotives; influence of load; other fuel consumers.

FUELS

Coal. *See Coal; Pulverized Coal.*
Lignite. *See Lignite.*
Oil. *See Oil Fuel.*
Peat. *See Peat.*
Producer Gas. *See Producer Gas.*
Pulverized Coal. *See Pulverized Coal.*

Recovery from Ashes. Recovering the Unburned Fuel from Ashes, S. H. Bunnell. Combustion, vol. 11, no. 4, Oct. 1924, pp. 287-288, 2 figs. Describes three German inventions in practical use for recovering usable coke from common ashes, namely, magnetic ash separator produced by Krupp Works, Weber system, and Schilde system.

Technology. Notes on Recent Developments in Fuel Technology, R. Wigginton. Fuel, vol. 3, no. 10, Oct. 1924, pp. 343-345. Utilization of coal in America; steam accumulator; pulverized fuel; cracking of oils; purification of coal gas; atomic energy as source of power; coking power of coal.

FURNACES, ANNEALING

Fisher. New Annealing Equipment for Strip Steel. Iron Age, vol. 114, no. 15, Oct. 9, 1924, pp. 907-909, 5 figs. Notes on new annealing equipment of Worcester Pressed Steel Co., Worcester, Mass. Electric mule on rack for charging; ample combustion space in furnaces; arrangement for cooling boxes and quick charging of furnaces.

FURNACES, ROASTING

Zinc. A New Roasting Furnace for Zinc Flotation Concentrate, Chas. H. Fulton and J. Burns Read. Am. Inst. Min. & Met. Engrs.—Trans., no. 1362-D, Oct. 1924, 22 pp., 7 figs. Experiments carried on at Case School of Applied Science, together with their results; their success led to design of larger furnace herein described, but which has not been built.

G

GARAGES

Construction. New Large-Scale Garage (Eine neue Massengarage), H. Luckbardt. Motorwagen, vol. 27, no. 23, Aug. 20, 1924, pp. 411-413, 6 figs. Details of patented arrangement in which stalls are placed at angle of 45 deg. instead of 90 deg., giving greater accommodation.

GARBAGE DISPOSAL

Methods. Notes on Garbage Disposal Methods in Pacific Coast Cities. Eng. New-Rec., vol. 93, no. 15, Oct. 9, 1924, pp. 591-592. Resume of methods used in San Francisco, Sacramento, Los Angeles, Spokane, Portland, and Seattle. Some sell garbage, others pay for disposal; fills, destructors and hog farms all in use.

GAS MANUFACTURE

Different Grades. The Production of Different Grades of Gas. Gas Wld., vol. 81, no. 2094, Sept. 6, 1924, pp. 240-246. Discusses horizontal retorts, steaming in continuous vertical retorts, summary of results from steaming verticals, precautions to be observed, flow of steam through nozzles, blue water gas, carburetted water gas, yields of different grades by different methods, complete gasification, distribution of different grades of gas, etc. See also Gas Jl., vol. 167, no. 3200, Sept. 10, 1924, pp. 816-821.

GAS PRODUCERS

Slagging. The Slagging Producer in Steel Works, K. Huessener. Iron & Steel Engr., vol. 1, no. 9, Sept. 1924, pp. 457-464, 3 figs. History, description, uses and advantages.

GASOLINE

Natural-Gas. Application of Refrigeration Processes to the Production of Natural Gasoline, E. F. Burton. Refrig. Eng., vol. 11, no. 3, Sept. 1924, pp. 83-90, 8 figs. Notes based upon experience and observation of author and information obtained through publications of Bur. of Mines and other publications; author believes that more attention should be given to utilization of waste residue gas for production of low temperatures through expander, and that further investigation be made of possibilities of using more volatile parts of plant product, especially propane, for cooling gases.

GASOLINE ENGINES

Water Condensation from Exhaust Gas. Heat Transfer in the Condensation of Water from Engine Exhaust Gas, Rob. F. Kohr and L. Butler. Indus. & Eng. Chem., vol. 16, no. 9, Sept. 1924, pp. 885-889, 8 figs. Describes apparatus devised by Bur. of Standards for condensing large part of water contained in exhaust, thus making it possible continually to compensate during flight of gas-filled airships for weight of fuel burned.

GAS WORKS

Vertical Retort Plant. Five Years Operation of a Vertical Retort Gas Plant, M. H. Frank. Gas Age-Rec., vol. 54, nos. 11 and 12, Sept. 13 and 20, 1924, pp. 355-356 and 364, and 397-400, 10 figs. Gives outline and discusses results obtained from 5½ years' operation of vertical-retort gas plant comprised of two benches of nine retorts each operating under normal and abnormal conditions as experienced before, during and after war period; describes plant and conditions under which it operates; gives details of operation and results which have been obtained. Abstract of paper read before Mich. Gas Assn.

GEAR CUTTING

Tooth-Section Generator. Am Improved Photomechanical Tooth-section Generator, H. E. Merritt. Machy. (Lond.), vol. 24, no. 625, Sept. 18, 1924, pp. 777-779, 6 figs. Describes improved form of apparatus for obtaining a large-scale profile of any generated gear-tooth section by a photographic process. Gives a tooth section in white on a black ground.
Truck Drive. Machining Gears for an Electric-Truck Driving Mechanism, F. H. Colvin. Am. Mach., vol. 61, no. 14, Oct. 2, 1924, pp. 355-537, 11 figs. Describes machining of gears for drive of trucks built by Commercial Truck Co., Phila., Pa. Special tools for undercutting; fixtures for hardening bore of gear; overcoming distortion in large internal gears.

GEARS

Design. Gear Designing Tables, L. S. Burbank. Machy. (N. Y.), vol. 31, no. 2, Oct. 1924, pp. 141-143. Gives four tables which provide a simple and direct method of determining relation between pitch and power-transmitting capacity of either spur gearing or bevel gearing.
Helical, Calculation of. Helical Gear Problems Simplified, O. M. Burkhardt. Am. Mach., vol. 61, no. 14, Oct. 2, 1924, pp. 529-530. Method of calculation which will render graphical solutions far more accurate than before.
Pinions, Dynamic Stresses in Rotating. Mathematical Theory of Dynamic Stresses in Rotating Gear Pinions, P. Heymans. Mech. Eng., vol. 46, no. 10, Oct. 1924, pp. 583-587 and (discussion) 587-589, 3 figs. Theoretical study of dynamic stresses in rotating gear pinions developed in course of investigation by photoelastic method of stresses in gear pinions undertaken by Research Laboratories and Ry. Motor Eng. Dept. of Gen. Elec. Co., Schenectady, N.Y., conducted at Mass. Inst. Technology Shows that in all disturbed elastic media a force applied cyclically along any closed contour results in oscillatory deformations and corresponding dynamic stresses. Likewise in rotating gear pinions a torque acting on perfectly formed and spaced gear teeth sets up similar dynamic stresses.
Quiet, Production of. Quiet Gears and Their Production. Soc. Automotive Engrs.—Jl., vol. 14, no. 5, May 1924, pp. 545-557, 14 figs. Symposium regarding advantages of the various production methods that have been adopted by several of the leading automobile companies for reducing noise of gears and results that have been obtained by use of these methods, containing following papers: Some Sidelights on the Gear Problem, W. R. Griswold; Need of Grinding Carburized and Hardened Gears, O. H. Schafer; Oil-Treated Steel and Ground Gears, L. A. Danse; Polishing and Burnishing of Gear Teeth, R. E. Linn; Checking Tooth-Forms by the Comparator, W. G. Hildorf; and Importance of Accuracy of Tooth-Form, A. H. Frauenthal.
Spur, Strength of. The Strength of Spur Gears. Automobile Engr., vol. 14, no. 193, Sept. 1924, pp. 262-264, 6 figs. Gives method of accurately estimating stresses involved.

GRINDING

Regrinding Practice. Regrinding Methods Outlined, B. K. Price. Abrasive Industry, vol. 5, no. 9, Sept. 1924, pp. 226-230, 7 figs. Practice at plant of Houpert Machine Co., Long Island City, N. Y., in regrinding cylinders.

GYPSUM

Canada. Gypsum Situation in Canada. Can. Min. Jl., vol. 45, no. 37, Sept. 12, 1924, pp. 908-909. Résumé of conditions.

H

HARDNESS

Ball Hardness Testing. The Ball Indentation Hardness Test, S. L. Hoyt. Am. Soc. Steel Treating—Trans., vol. 6, no. 3, Sept. 1924, pp. 396-420, 4 figs. Refers to Eugen Meyer's investigation of Brinell's ball indentation hardness test first published in 1908 in which he showed that hardness of metal cannot truly be represented by one figure, or, in other words, resistance to penetration varies with degree of penetration of ball; author of present paper discuss Meyer's analysis to throw light on our present methods of hardness testing.

HEAT TRANSMISSION

Pipes. Heat Transfer in Small Pipes, F. C. Blake and W. A. Peters, Jr. Indus. & Eng. Chem., vol. 16, no. 8, Aug. 1924, pp. 845-846, 2 figs. Method developed by authors of measuring water temperature by drawing off portion.
Research. Research in Heat Transmission, E. Buckingham. Refrig. Eng., vol. 11, no. 3, Sept. 1924, pp. 91-94. Conduction, relation and convection; conduct of research in heat transmission; employment of dimensional analysis; variables involved in complete mathematical theory of heat transmission; suggestions in regard to planning of research programs.

HEATING AND VENTILATION

Radiation, Standard Formula. The Movement Towards a Standard Radiation Formula. Heating & Vent. Mag., vol. 21, no. 10, Oct. 1924, pp. 49-51, 1 fig. Principal features of rules compiled by Heating & Piping Contractors' Nat. Assn.

HEATING, ELECTRIC

Industrial. Electric Heating with Special Reference to Central Stations, E. D. Sibley. Iron & Steel Engr., vol. 1, no. 9, Sept. 1924, pp. 513-515, 1 fig. Shows present development of electric heating.

HEATING, HOT WATER

Central Stations. Use of Mechanical Devices in Central Hot-Water and Steam Heating Plants (Emploi d'organes mécaniques dans les installations de chauffage central par l'eau et la vapeur), A. Nessi. Chaleur & Industrie, vol. 5, no. 52, Aug. 1924, pp. 389-396, 9 figs. Discusses use of centrifugal pumps, vacuum pumps, fans, and their operation in connection with heating plants; reduction of fuel consumption.

HIGHWAYS

Construction and Design. Consideration in the Design and Construction of Highways, P. Philip. Eng. Jl., vol. 7, no. 9, Sept. 1924, pp. 602-603. Relation of design of highways and limitations imposed on motors using them.

HYDRAULIC TURBINES

Discharge Losses. Energy Losses of Hydraulic Turbines at Discharge (Énergie perdue par les organes de décharge des turbines hydrauliques), J. Calame. Bulletin Technique de la Suisse Romande, vol. 50, nos. 16, 18 and 19, Aug. 2, 30 and Sept. 13, pp. 197-201, 228-232, and 237-241, 15 figs. Discusses calculation of water losses due to frequent and extreme variation of load; compensating errors of evaluation of water losses; gives numerical calculation for various plants.
High-Speed. High-Speed Hydraulic Turbines (Turbine hydraulique extra-rapide), F. Prasil. Revue Générale de l'Électricité, vol. 16, nos. 7 and 8, Aug. 16 and 23, 1924, pp. 274-280, and 311-321, 35 figs. Discusses tendencies in turbine construction and describes improvements made by Th. Bell & Co., Switzerland, in their type of high-speed turbine; details of tests carried out at Bell shops.
Pelton. Units of Pelton Wheels Under Varying Conditions (Die Einheitsgrössen der Becherturbinen unter wechselnden Bedingungen), G. Karrass. Zeit. des Vereines deutscher Ingenieure, vol. 68, no. 35, Aug. 30, 1924, pp. 902-904, 9 figs. Discusses peripheral velocity, friction, hydraulic efficiency, torque, and specific r.p.m., and makes calculations.

HYDRO-ELECTRIC DEVELOPMENTS

Big Creek, California. Progress on the Big Creek Hydro-Electric Project, D. H. Redinger. Compressed Air Mag., vol. 28, no. 12, Dec. 1923, vol. 29, nos. 1, 3, 4, 9 and 10, Jan., Mar., Apr., Sept. and Oct. 1924, pp. 720-724, 747-750, 803-808, 837-842, 989-992 and 1013-1017, 76 figs. Outline of part of undertaking being pushed forward by Southern Cal. Edison Co.; details of work in connection with power houses nos. 1, 2, 3 and 8, Shaver Lake tunnel, dams, etc.
Ontario. Power Generation on the Kaministiquia River. Power House, vol. 17, no. 18, Sept. 20, 1924, pp. 19-20, 3 figs. Development at Kakabeka Falls, Ont., operating under 180-ft. head; main source of electricity supply for cities of Port Arthur and Fort William.

HYDRO-ELECTRIC PLANTS

Ice Troubles. Measures Taken in Sweden Against Ice Troubles at Water Power Plants, A. F. Samsioe. Engineering, vol. 138, no. 3065, Sept. 26, 1924, pp. 463. Paper, abridged, contributed to Sec. B of World Power Conference.
Protective Rack. Construction and Upkeep of Racks for the Protection of Hydraulic Turbines (La construction et l'entretien des grilles pour la protection des turbines hydrauliques). Génie Civil, vol. 85, no. 11, Sept. 13, 1924, pp. 225-230, 5 figs. Details of various types of racks, and mechanical rakes for cleaning them, as installed at Wynau and Beznau, Switzerland, and Chevres.
Spain. High-Voltage Power Supply in Spain. Elec. Rev., vol. 95, no. 2438, Aug. 15, 1924, pp. 253-255, 8 figs. Gives notes on Riegos y Fuerza del Ebro undertaking; describes equipment of various plants.
Whitingham, Vt. The Davis Bridge Power Plant Development of the New England Power Company, E. B. Collins and H. R. Wilson. Gen. Elec. Rev., vol. 27, no. 10, Oct. 1924, pp. 665-672, 11 figs. Located at Whittingham, Vt.; consists of two (ultimately three) 20,000-hp. hydro-electric units. Describes diversion tunnel and spillway, intake structure, pressure tunnel, turbines and generators, low-tension switching equipment, high-voltage equipment, transformers, etc.; is enabled to transmit at 66,000 and 110,000 volts simultaneously.

I

ICE PLANTS

Developments. Developments in Ice-Making Plants, H. P. Hill. Power Plant Eng., vol. 28, no. 19, Oct. 1, 1924, pp. 1015-1016. Outline of present practice and probable development as presented to N.A.S.E. convention.

INDUSTRIAL MANAGEMENT

Budgeting. Budgeting Advertising Expense, J. L. Palmer. Mgt. & Administration, vol. 8, no. 4, Oct. 1924, pp. 394-395, 3 figs. Develops, by assuming a typical case, a possible method of planning and controlling advertising expenditures.
Cost Control. Quality Manufacturing at Predetermined Costs, E. F. Roberts. Factory, vol. 33, no. 4, Oct. 1924, pp. 495-497, 544, 548, 552, 556, 560, 564 and 568, 3 figs. Describes how Packard Motor Car Co. established time standards and how workmen are paid so that variations in time and in cost of labour are kept at minimum; advantages of payment method which is integral part of cost-control system.
Graphic Control. Graphic Control in a Small Hosiery Mill, W. E. Haseltine. Mgt. & Administration, vol. 8, no. 2, Aug. 1924, pp. 161-166, 20 figs. How charts are employed in a small hosiery mill to give control of all factors entering into operation, to show just where enterprise is at a given time and whither it is headed.
Maintenance Division Organization. Organization of Maintenance Division, F. A. Waldron. Mgt. & Administration, vol. 8, no. 1, July 1924, pp. 39-42, 4 figs. Planning its duties for economy of operation.
Maintenance Work. Managing Maintenance Work with Economy, T. Clark. Mgt. & Administration, vol. 8, nos. 2 and 3, Aug. and Sept. 1924, pp. 191-196 and 299-302, 11 figs. Describes application to a construction and maintenance department of a manufacturing plant, of a complete system of planning and routing work, and payment of bonuses based on times determined by accurate time study. Methods of determining and using standard times for repair work.
Prague Conference. Scientific Management at Prague Conference. Mech. Eng., vol. 46, no. 10, Oct. 1924, pp. 624-625. Brief abstracts of papers by American authors presented at First International Management Congress held at Prague, July 20-24, 1924, treating of management problems including industrial relations, budgetary control and education.
Production-Costs Reduction. The Reduction of Production Costs, H. Varley. Indus. Management (Lond.), vol. 11, nos. 2 and 16, Jan. 24, and Oct. 1924, pp. 41 and 437-440. Jan. 24: General observations. Oct.: Cost of machine idleness; justification for new machine; saving of handling time; relative cost of operation; replacing machinery every year.
Pulp and Paper Industry. Paper and Pulp Manufacturing, S. E. Thompson and W. E. Freeland. Mgt. & Administration, vol. 8, no. 4, Oct. 1924, pp. 397-402, 6 figs. Job standardization, wage incentives and bonus plans of general application.
Time Study. *See Time Study.*
Tool System. A Well-Planned Tool System. Eng. Production, vol. 7, nos. 143 and 144, Aug. and Sept. 1924, pp. 229-232 and 268-271, 26 figs. Details of comprehensive scheme; discusses tools department, stores, depots, receipt, identification and class identification, shortages, issue, replacement, etc.
Waste Elimination. *See Waste Elimination.*

INDUSTRIAL PLANTS

RAILWAYS SWITCHING EQUIPMENT. Modern Switching Devices for Factory Railways (Ueher moderne Rangiermittel für Werkbahnen), M. Schulz. Glasers Annalen, vol. 95, no. 3, Aug. 1, 1924, pp. 41-46, 13 figs. Details of locomotive driven by gasoline or henzol, with and without capstan; battery locomotives and tractors and their operation.

INDUSTRIAL RELATIONS

EMPLOYEES-MANAGEMENT CO-OPERATION. Co-operation in Industry, S. Rea. Min. Congress Jl., vol. 10, no. 9, Sept. 1924, pp. 421-423. Enlightened industrial management recognizes need for direct negotiation and mutual understanding. Principles underlying Pennsylvania Railroad system plan of employee-management relationship.

IMPROVEMENT. Industrial Relations, Rob. E. Tally. Min. & Metallurgy, vol. 5, no. 214, Oct. 1924, pp. 478-480. Industry created by capital and labour; duties of employer; duties of organization heads and hosses; other factors of influence hetween employer and employee.

INDUSTRIAL TRUCKS

EFFICIENCY MEASUREMENT. Measuring the Efficiency of Shop Trucks, S. M. Lowry. Mgt. & Administration, vol. 8, no. 3, Sept. 1924, pp. 279-284, 3 figs. Methods used at plant of Westinghouse Elec. & Mfg. Co. at East Pittsburgh, Pa.

INSULATING MATERIALS, ELECTRIC

DIELECTRIC STRENGTH. Dielectric Strength of Insulation, V. M. Montsinger. Elec. Wld., vol. 84, no. 14, Oct. 4, 1924, pp. 723-727, 19 figs. Describes determination of influence exerted by time and frequency tests made on individual insulation materials for transformers.

INSULATORS, ELECTRIC

HIGH TENSION. Transmission Lines Mounted on Insulator Chains (Lignes de transmission d'énergie montées sur chaînes d'isolateurs), H. Carpentier. Revue Générale de l'Électricité, vol. 16, nos. 8 and 9, Aug. 23 and 30, 1924, pp. 303-311 and 352-356, 12 figs. Discusses necessity for studying mechanical equilibrium of projected lines, tension of conductors adjacent spans, break of conductors; methods of calculation.

INSULATORS, HEAT

HEAT LOSSES THROUGH. Heat Losses through Insulating Materials, R. H. Heilman. Mech. Eng., vol. 46, no. 10, Oct. 1924, pp. 593-602 and (discussion) 602-606, 18 figs. A rational method for their determination by means of conductibity coefficients of materials. Results of 94 tests on commercial pipe coverings and insulating cements conducted at Mellon Inst. Indus. Research of Univ. of Pittsburgh. Describes experimental methods. Discusses from a physical and mathematical standpoint exact character of thermal conductivity and its relation to temperature gradients and differences.

INTERNAL-COMBUSTION ENGINES

CATALYSIS APPLIED TO. Catalysis and the Internal Combustion Engine, E. Sokal. Chem. & Industry, vol. 43, no. 35, Aug. 29, 1924, pp. 283T-284T. Points out that so far catalytic coating called "Katalite" has been used in engines without any change in engine; it is considered possible and even probable that with certain changes much greater effects could he produced which might have hearing on utilization of low-grade fuels, running of engines at constant compression pressure, and various other questions of design and operation.

DETONATION. Relative Effects of Some Nitrogen Compounds upon Detonation in Engines, T. A. Boyd. Indus. & Eng. Chem., vol. 16, no. 9, Sept. 1924, pp. 893-895, 3 figs. Data show that in general nitrogen compounds which are most effective for suppressing detonations are the primary and secondary amines.

See also Airplane Engines; Automobile Engines; Diesel Engines; Gasoline Engines; Ignition; Oil Engines; Semi-Diesel Engines.

IRON

CORROSION. The Influence of Emulsoids Upon the Rate of Solution of Iron, J. N. Friend, D. W. Hammond and G. W. Trobridge. Am. Electrochem. Soc., Advance paper No. 14, for Mtg. Oct. 2-4, 1924, pp. 197-207, 6 figs. A possible method is suggested of treating natural and other waters, to render them less corrosive towards ferrous and non-ferrous metals in practice. Results of experiments on corrosion of iron in lead-acetate solution and in copper-sulphate solution; rate of solution of iron in dilute sulphuric acid.

MOLTEN, SPECIFIC GRAVITY OF. Method of Determination of the Specific Gravity of Molten Iron and of Other Metals of High Melting Temperature (Metod för bestämning av spec. vikt hos flytande järn och andra svarsmälta metaller), C. Benedicks, D. W. Berlin and G. Phragmén. Jernkontorets Annaler, vol. 108, no. 6, 1924, pp. 308-333, 9 figs. Molten metal is contained in U-shaped tube of very high melting point and difference of levels in two legs of tube is measured hy electrical methods; said difference is produced by pressures of inert gas and difference of said pressures is measured by means of mercury column. Report from Swedish Metallographical Inst.

IRON AND STEEL

HISTORY. Notes on the History of Iron and Steel, G. E. Trackary. Am. Soc. Steel Treating—Trans., vol. 6, no. 4, Oct. 1924, pp. 443-490. Compilation of some of salient points of history; notes were selected from various records, writings, researches, investigations by archaeologists, and others.

PICKLING, BIBLIOGRAPHY ON. Pickling of Iron and Steel; A. Bibliography, V. S. Polansky. Blast Furnace & Steel Plant, vol. 12, nos. 7, 8 and 9, July, Aug., and Sept., 1924, pp. 326-328, 368-371, and 431-434. Contains articles on machines and equipment, pickling in acid solutions, pickling in salt solutions, electrolytic pickling, inhibitors and accelerators, effect of pickling, recovery of spent liquor, etc. See also Forging—Stamping—Heat Treating, vol. 10, nos. 7, 8 and 9, July, Aug. and Sept. 1924, pp. 267-269, 298-301 and 350-354.

IRON INDUSTRY

CANADA. Iron and Steel Industry in Canada, C. S. Cameron. Iron & Steel of Canada, vol. 7, no. 10, Oct. 1924, pp. 195-204, 3 figs. Gives progress of iron and steel industry in Canada. Abstract of paper read before Empire Min. & Metallurgy Congress, London.

POWER IN. Power in the Iron and Steel Industry, B. R. Shover. Iron & Steel Engr., vol. 1, no. 9, Sept. 1924, pp. 452-456. Data and estimates from which deductions are made as to present and probable future tendency of power generation and application in iron and steel industry.

IRON, PIG

GRADING AND MIXING. Grading and Mixing of Pig Irons. Metal Industry (Lond.), vol. 25, nos. 7 and 8, Aug. 15 and 22, 1924, pp. 155-156 and 179-180. Discusses American method of grading by analysis; noteworthy changes in American opinion as to complete chemical grading; difficulties of complete chemical limits influence of melting conditions difficult of complete explanation on chemical basis accuracy of analyses, scope of analytical control, scope of control by fracture, graphite condition and thermal influences, and chilling.

L

LABOUR

EIGHT-HOUR DAY. Eight-Hour-Day Application in Continuous Running (Applications simples de la journée de huit heures dans les entreprises à service continu). J. Schwarz. Schweizerische Bauzeitung, vol. 84, no. 10, Sept. 6, 1924, pp. 115-117, 8 figs. Mathematical treatment of on-time and off time for continuous operations (In French.).

LABORATORIES

HIGH-VOLTAGE. California's Million-Volt Laboratory, R. W. Sorensen. Elec. Wld., vol. 84, no. 14, Oct. 4, 1924, pp. 735-737, 4 figs. Method of obtaining this high voltage and description of equipment installed at California Inst. of Technology at Pasadena.

HYDRAULIC. The Hydraulic Laboratory of the Instituto Católico de Artes é Industrias (Spain) (Laboratorio hidraulico del I.C.A.I.), J. M. F. de Castro. Anales de la Sociacion de Ingenieros del Instituto Católico de Artes é Industrias, vol. 3, no. 4, 1924, pp. 350-358, 9 figs. Details of mechanical and electrical equipment, and activities of laboratory.

LATHES

BENCH. Vidal Precision Bench Lathe. Machy. (Lond.), vol. 24, no. 626, Sept. 25, 1924, pp. 841-843, 6 figs. Describes lathe made by Vidal Eng. Co., Croydon, England; is of 3—in. centers, bed heing 33 in. in length; bed is of flat type with sloping edges.

TURRET. New Turret Lathe has Greater Power and Range of Feed. Automotive Industries, vol. 51, no. 15, Oct. 9, 1924, pp. 652-653, 4 figs. No. 1—A universal hollow hexagon turret lathe of Warner & Swasey Co. is featured by all-Steel geared head, increased number and range of feeds and feed control in carriage aprons.

LEAD ALLOYS

LEAD-ANTIMONY. Grain Growth in Lead Containing One Per Cent of Antimony, R. S. Dean and W. E. Hudson. Am. Chem. Soc.—Jl., vol. 46, no. 8, Aug. 1924, pp. 1778-1786, 5 figs. Discussion of mechanism of grain growth as indicated hy results of investigation of relations of time, temperature and amount of deformation to grain size.

LIGHT

REFLECTION. Law of Reflection from Moving Mirrors (Les lois de la réflexion sur des miroirs en mouvement), F. Guery. Revue Générale de l'Électricité, vol. 16, no. 10, Sept. 6, 1924, pp. 371-376. Discusses optics of bodies in motion, interpretation of Michelson experiment, Sagnac experiment, theory of Lorentz and Ritz, relativity, ether, etc.

LIGHTING

REQUIREMENTS. Physiological Requirements of Good Illumination and Their Realization in Practice (Die physiologischen Forderungen an eine gute Beleuchtung und ihre Verwirklichung in der Praxis), Schenider. Elektrotechnik u. Maschinenhau, vol. 42, no. 37, Sept. 14, 1924, pp. 277-283 (Die Lichttechnik), 18 figs. Structure and function of eye as affected by illumination; direct and indirect lighting; glare; projection of light; etc.

LIME

HYDRATED. Hydrated Lime in Concrete. Contract Rec. & Eng. Rev., vol. 38, nos. 30 and 31, July 23 and 30, 1924, pp. 743-745 and 761-762, 1 fig. Experimental investigations confirm practical experience that lime in mix facilitates handling and placing of concrete.

LOCOMOTIVE BOILERS

BOILER-SHEET FLANGING MACHINE. Cold Flanging of Locomotive Boiler Sheets. Boiler Maker, vol. 24, no. 8, Aug. 1924, pp. 232-233, 9 figs. Outline of work of pneumatic flanging machine developed to speed up sheet-metal production.

LOCOMOTIVES

CABS, TEMPERATURES IN. Temperatures in Cabs of Freight Locomotives Passing Through Tunnels of the Chesapeake & Ohio Railroad, S. H. Katz and E. G. Meiter. Ry. & Locomotive Eng., vol. 37, no. 9, Sept. 1924, pp. 264-268, 3 figs. Gives results of tests and investigations conducted by Bur. of Mines in tunnels of Chesapeake & Ohio Ry. to improve conditions of temperatures in cabs of freight locomotives.

DECAPOD. Tests of Decapod Show 14 Per Cent Fuel Saving. Ry. Age, vol. 77, no. 15, Oct. 11, 1924, pp. 635-638, 12 figs. Abstract of report in Bul. No. 32 (copyright 1924 hy Pa. R. R.), giving results of test plan trials; latest Pennsylvania class I1 locomotives show expected economy with short cut off.

DESIGN. New Locomotive Construction (Neue Wege im Lokomotivhau), F. Meineke. Zeit. des Vereines Deutscher Ingenieure, vol. 68, no. 37, Sept. 13, 1924, pp. 937-942, 13 figs. Discusses increased pressure and temperature for more economic working, Krupp turbo-locomotives, Diesel locomotives, 1200-hp. Diesel-electric locomotives of Russian State Railways, operating Diesel locomotives with hydrogen, etc.

DIESEL-ENGINED. German Diesel Locomotives, F. Meineke. Eng. Progress, vol. 5, no. 9, Sept. 1924, pp. 167-170, 8 figs. States that several locomotives with Diesel engines are heing built in Germany, representing very remarkable solutions of problem; describes different types.

ELECTRIC. *See Electric Locomotives.*

GARRATT. The Latest Garratt Locomotive Development. Ry. Gaz., vol. 41, no. 19, Sept. 26, 1924, pp. 408-409, 2 figs. Engine, constructed for Burma railways, is first of its kind to he constructed with eight coupled wheels, and is reputed to be largest locomotive yet constructed for meter gage.

LUBRICATION. Lubrication and its Effect on Locomotive Service. Ry. Age, vol. 77, no. 13, Sept. 27, 1924, pp. 558-561. Value of specific gravity and viscosity tests questioned; cylinder oil must be atomized; direct feed to cylinders unnecessary; friction and temperature tests with different oils; etc. Paper read at Traveling Engrs.' Assn.

MIXED-TRAFFIC. New Mixed-Traffic Locomotives for the Great Southern & Western Railway, Ireland. Ry. Engr., vol. 45, no. 537, Oct. 1924, pp. 345-348, 8 figs. Tests made with first of series have proved adaptability of class for handling fast passenger trains, although primarily built for freight traffic.

MOUNTAIN TYPE. Central of Georgia Ry. Mountain Type Passenger Locomotives. Ry. Rev., vol. 75, no. 13, Sept. 27, 1924, pp. 457-460, 4 figs. New 4-8-2 type passenger locomotive constructed hy Am. Locomotive Co. for handling heavy passenger trains; equipped with Nicholson thermic siphons.

SANTA FE. Santa Fe Locomotives, Canadian National Railway. Can. Ry. & Mar. World, no. 320, Oct. 1924, pp. 487-489, 4 figs. Built for heavy transfer service at Toronto, to operate between Mimico and Danforth; designated as T-t-a class; total weight, without tender, 409,000 lb.

STEAM-TURBINE. The First German Turbine Locomotive, R. Lorenz. Eng. Progress, vol. 5, no. 9, Sept. 1924, pp. 165-166, 5 figs. Describes condensing turbine locomotive built in Germany by firm of F. Krupp, Essen; author states that introduction of steam turbines to drive locomotives would save railways 20 to 30 per cent of coal now consumed.

SUPERHEATERS FOR. *See Superheaters.*

SWITCHING. Light-Weight Locomotive for Shunting Purposes. Indian & Eastern Engr., vol. 55, no. 1, July 1924, pp. 18-19, 3 figs. Discusses extended use of gasoline locomotive in classification yards; engine is of four-cycle internal-combustion type, having four water-jacketed cylinders (bore, 120 mm., stroke 140 mm.) and developing 40 hp. at 1,000 r.p.m.

UNIFLOW. A Uniflow Locomotive is Built for Russia, J. Stumpf. Ry. Mech. Engr., vol. 98, no. 9, Sept. 1924, pp. 517-521, 8 figs. Describes 0-10-0 type locomotive built by Nydquist & Holm, Trollhättan, Sweden, for Russian government; equipped with a Walschaert valve gear. A remarkably high vacuum has been obtained by redesigning cylinder exhaust pipes. See also Ry. Age, vol. 77, no. 8, Aug. 23, 1924, pp. 327-331, 8 figs.

VALVE-GEAR SETTING. Helpful Suggestions for Setting Valve Gear, H. W. Stowell. Ry. Mech. Engr., vol. 98, no. 10, Oct. 1924, pp. 596-597, 1 fig. Simple formulas used to obtain correct alterations for eccentric rods and valve rods.

LUBRICATING OILS

MANUFACTURE. How Oil Companies Manufacture Industrial Lubricants, W. Miller. Eng. Wld., vol. 25, no. 3, Sept. 1924, pp. 169-171, 3 figs. Outlines modern processes of manufacturing lubricating oils; Abstract of paper read before Nat. Assn. Purchasing Agents.

TESTING. Testing Lubricating Oils (Ueber die Prüfung von Schmierölen), G. Spettmann. Praktische Maschinen-Konstrukteur, vol. 57, no. 28, July 29, 1924, pp. 399-400. Discusses importance of testing; describes methods of testing; chemico-physical tests for classification of oils, mechanical for determining lubricating value; temperature measurement of bearings.

LUBRICATION

ESSENTIALS. The Essentials of Lubricating Engineering, A. F. Brewer. Indus. Mgt. (N. Y.), vol. 68, no. 3, Sept. 1924, pp. 145-151, 9 figs. How to minimize depreciation of expensive machinery.

RAILWAY MOTORS. The Importance of Efficient Lubrication of Railway Motors, C. Bethel. Elec. Jl., vol. 21, no. 10, Oct. 1924, pp. 467-472, 9 figs. Outlines results of recent tests made to determine main factors affecting operation of waste packed bearings; tests were conducted both in laboratory and in service.

M

MACHINE TOOLS

WEMBLEY EXHIBITION. The Machine Tool Exhibition. Eng. Production, vol. 7, no. 144, Sept. 1924, pp. 257-267, 24 figs. Describes and illustrates important exhibits; high speed side-planing machine, girder radial drilling machine, vertical drilling machine, high-power universal milling machine, turret lathe with covered bed, slot milling machine, bench drill, etc.

MALLEABLE CASTINGS

MANUFACTURE AND PROPERTIES. Malleable Castings. Eng. Production, vol. 7, no. 145, Oct. 1924, pp. 311-312, 1 fig. Notes on their properties and manufacture.

MALLEABLE IRON

PRODUCTION IN SHORT ANNEALING PERIODS. Possibilities of Producing Malleable Iron and Intermediate Products of Value in Short Annealing Periods, A. Hayes and W. J. Diederichs. Am. Soc. Steel Treating—Trans., vol. 6, no. 4, Oct. 1924, pp. 491-498, 5 figs. Outlines laboratory methods for producing malleable iron in 31 hours or less and for producing intermediate products of desirable physical properties; relations between method of treatment, microscopic structures and physical properties. Photomicrographs.

MAPPING

PHOTOGRAPHIC. Photographic Surveying for Mining Engineers, L. A. Woodworth. Eng. & Min. Jl.-Press, vol. 118, no. 13, Sept. 27, 1924, pp. 485-490, 8 figs. Describes author's experience in photographic mapping. Bibliography.

MATERIALS HANDLING

AUTOMOBILE MANUFACTURING PLANTS. Material Handling as Our Key to Many Savings, M. R. Denison. Factory, vol. 33, nos. 1 and 2, July and Aug., 1924, pp. 31-33, 60, 62, 64, 66, 68, 70, 72, 74, 76, 78, 80, 82, 84 and 86; and 190-193 and 242-246, 27 figs. Important economies in labour, in inventory, and in floor space that have come out of material-handling methods at Studebaker plant. Details of methods.

CEMENT INDUSTRY. Handling 42,000,000 Tons of Raw Material a Year, L. N. Duryea. Mgt. & Administration, vol. 8, no. 1, July 1924, pp. 155-160, 11 figs. Mechanical conveying methods in cement industry.

METAL-WORKING PLANTS. Handling Materials in Metal Working Plants. Can. Machy., vol. 32, no. 12, Sept. 18, 1924, pp. 29-33, 8 figs. Types of equipment; moving cars and materials; type of cranes.

MEASURING INSTRUMENTS

FLUIDS. Fluid Measuring Devices, D. H. Killeffer. Indus. & Eng. Chem., vol. 16, no. 8, Aug. 1924, pp. 785-788, 8 figs. Devices for discontinuous and for continuous measurements; measurement without loss head; indicating mechanisms; recording meters; formulas applicable to flowmeters; measurement of static volume; specific-gravity records.

METALS

CLEANING. Modern Methods of Cleaning Metals. Metal Industry (N. Y.), vol. 22, no. 10, Oct. 1924, pp. 402-404, 5 figs. How application of modern machinery and volume-production methods has lowered costs in metal-cleaning department and insured uniformly thorough work.

CORROSION. Notes on Corrosion Testing by Different Immersion Methods, H. S. Rawdon and A. I. Krynitsky. Am. Electrochem. Soc., Advance paper No. 20, for Mtg. Oct. 2-4, 1924, pp. 273-286, 5 figs. Need for choosing a corrosion test which shall in some measure approximate service conditions is emphasized and illustrated by reference to an unusual case of corrosion in a submarine cable. Describes general types of immersion tests. Comparative results of immersion tests on chromium steels. Pub. by permission U. S. Bur. Standards.

The Micro-Chemistry of Corrosion, C. H. Desch. Am. Electrochem. Soc., Advance paper No. 18, for Mtg. Oct. 2-4, 1924, pp. 251-256. Description of apparatus employed in a microscopical study of early stages of corrosion and of method of testing alloys.

ENDURANCE. Correlation of Endurance Properties of Metals, D. J. McAdam, Jr. Am. Soc. Steel Treating—Trans., vol. 6, no. 3, Sept. 1924, pp. 393-395. Summary of paper presented by permission of Secretary of Navy.

PROTECTION. Metal Protection (Metallschutz), E. Maass. Zeit. des Vereines deutscher Ingenieure, vol. 68, no. 34, Aug. 23, 1924, pp. 880-883. Reviews theories on corrosion of metals; corrosion of aluminum; processes for protecting metals; corrosion of condenser tubes.

USES. The First Use of Metals, T. A. Rickard, Eng. & Min. Jl.—Press, vol. 117, nos. 13, 15 and 19, Mar. 29, Apr. 12 and May 10, 1924, pp. 528-530, 602-604 and 759-762. Early mining and metallurgical practice and uses of metals. Mar. 29: Gold and silver. Apr. 12: Copper and bronze. May 10: Iron, lead and zinc.

WORK, HARDNESS, EFFECT OF TEMPERATURE ON. Effect of Temperature on Work Hardening Metal, E. G. Herbert. Can. Machy., vol. 32, no. 8, Aug. 21, 1924, pp. 19-21, 12 figs. Experiments prove heat essential in some stamping operations, and that cutting tools increase durability at speeds which raise work to its critical temperature.

MINERAL RESOURCES

CANADA. Mineral Wealth of the Pre-Cambrian in Canada, C. V. Corless. Roy. Soc. Arts—Jl., vol. 72, no. 3743, Aug. 15, 1924, pp. 607-683 and (discussion) 683-687. Outline, form and extent of pre-Cambrian; fundamental principles necessary in estimating mineral wealth; mineral discoveries and mining developments in pre-Cambrian area in Canada.

MOLDING MACHINES

TYPES. Types of Molding Machines, R. E. Search. Metal Industry (N. Y.), vol. 22, no. 10, Oct. 1924, pp. 397-398, 4 figs. Describes representative machines made in United States and abroad.

MONEL METAL

WELDING. Welding Monel Metal. Can. Machy., vol. 32, no. 12, Sept. 18, 1924, pp. 39-40, 2 figs. Discusses precautions to be observed in welding of monel metal which are not ordinary followed in welding steel.

MOTOR BUSES

PUBLIC-UTILITY OPERATION. Public-Utility Experience with the Motorcoach, V. E. Keenan. Soc. Automotive Engrs.—Jl., vol. 15, no. 4, Oct. 1924, pp. 320-323, 6 figs. Experience of United Elec. Rys. Co., Providence, O. About 16 per cent of electric-railway mileage in Providence to be abandoned because it does not pay cost of electric operation. Comparison of earning power of motor bus and street-railway car.

SIX-WHEEL. New Six-Wheel, Double-Deck Bus Brakes on All Wheels. Automotive Industries, vol. 51, no. 14, Oct. 2, 1924, pp. 613-614, 6 figs. Brief description of latest product of Moreland Motor Truck Co. of Los Angeles, Cal. Seats 60; air-operated Lockheed hydraulic brakes.

MOTOR TRUCKS

FLEET-OPERATING COSTS. An Analysis of Costs for 10 Years of Fleet Operation, R. E. Plimpton. Soc. Automotive Engrs.—Jl., vol. 14, no. 5, May 1924, pp. 539-544, 7 figs. Discusses operating costs and their relation to age of vehicle. Comparison of costs.

Observations of a Superintendent of Motor-Truck Fleet-Operation, J. F. Winchester. Soc. Automotive Engrs.—Jl., vol. 14, no. 5, May 1924, pp. 496-503, 16 figs. Methods of mechanical upkeep; special tools and fixtures used, and details of maintenance practice; engineering factors that affect fleet operation; tire selection; advocates a magazine system of chassis lubrication; treats brakes, wheels and accessories from standpoint of design, simplicity and accessibility being keynote; operating costs, records and record forms.

TESTING. Modern Methods of Truck Testing, W. L. Day. Mgt. & Administration, vol. 8, no. 3, Sept. 1924, pp. 285-287, 6 figs. Notes on new method of testing employed at plant of Gen. Motors Truck Co. and recording instruments used.

N

NITROGEN

FIXATION. Do Green Plants Have the Power of Fixing Elementary Nitrogen from the Atmosphere? C. B. Lipman and J. K. Taylor. Franklin Inst.—Jl., vol. 198, no. 4, Oct. 1924, pp. 475-506. Experiments carried out with wheat and barley in culture solutions proved conclusively that cultures gained nitrogen at expense of elementary nitrogen of atmosphere; results of experiments with other plants. Bibliography.

NON-FERROUS METALS

COLD ROLLING VS DRAWING. Cold Rolling Compared with Drawing, C. E. Davies. Metal Industry (Lond.), vol. 25. nos. 6 and 7, Aug. 8 and 15, 1924, pp. 121-123 and 149-152, 13 figs. Discusses cases in which colh rolling can wholly or partly be substituted for drawing in production of many sections, comparing respective advantages and disadvantages.

O

OIL ENGINES

HEAVY-OIL. The Polar Heavy-Oil Engine. Gas & Oil Power, vol. 20, no. 229, Oct. 2, 1924, pp. 3-4, 3 figs. Its evolution into the "H" type.

HIGH-COMPRESSION. The Functioning of High Compression Oil Engines, Johnstone Taylor. Gas & Oil Power, vol. 20, no. 229, Oct. 2, 1924, pp. 1-2. With special reference to injection and combustion of fuel.

LIGHT-OIL TYPES. High-Speed Petrol and Paraffin Engines, J. Okill. Gas & Oil Power, vols. 19 and 20, nos. 223, 224, 225, 226, 227, 228 and 229, Apr. 3, May 1, June 5, July 3, Aug. 7, Sept. 4 and Oct. 2, 1924, pp. 127-128, 147-148, 167-168, 190-191, 212-213 and 216, 235-236 and 13-14, 20 figs. Features and management of lighter-fuel types of oil engine.

OIL FUEL

BOILER PREPARATION FOR. Preparing Boiler for Oil Burning, G. Spencer. Plumbers Trade Jl., vol. 77, no. 6, Sept. 15, 1924, pp. 492-493, 4 figs. Discusses arranging and setting refractory linings and baffles, etc.

CENTRAL HEATING WITH. Oil Fuel for Central Heating, A. F. Baillie. Domestic Eng. (Lond.), vol. 44, no. 8, Aug. 1924, pp. 167-171. Advantages and disadvantages of oil fuel, relative costs compared with coke, amount and different methods of storage, specific heat of oil and amount of heating surface required, frictional loss in pumping through pipes, etc.

FIRE PREVENTION. Petroleum (Il petrolio), C. E. Della Chiesa. Industria, vol. 38, no. 15, Aug. 15, 1924, pp. 422-424. Discusses its use as substitute for coal in steam boilers, its advantages, means for preventing oil from taking fire and for extinguishing fires.

FLASH POINT. The Flash Point of Fuel Oil. Mar. Eng., vol. 29, no. 10, Oct. 1924, pp. 596-598. Résumé of U.S. Navy's investigations; heating and pumping tests; temperatures at which inflammable gases form; conclusions.

USES. Liquid Fuels (Combustibili liquidi). Elettricista, vol. 3, no. 14 (series 4), July 15, 1924, pp. 106-108. Discuss petroleum and its application; evolution of heavy-oil engines; Diesel engines; shale-oil industry; lignite and peat; benzol; alcohol; vegetable oils, etc.

OILS

Viscosity. The Viscosity of Oils at High Temperatures, A. R. Fortsch and Rob. E. Wilson. Indus. & Eng. Chem., vol. 16, no. 8, Aug. 1924, pp. 789-792, 3 figs. Data and curves covering viscosity determinations on wide variety of oils from Mid-continental and similar crudes up to temperature of 495 deg. fahr.; outline of method of interpolation.

Viscosity-Temperature Curves. Viscosity-Temperature Curves of Fractions of Typical American Crude Oils, F. W. Lane and E. W. Dean. Indus. & Eng. Chem., vol. 16, no. 9, Sept. 1924, pp. 905-911, 6 figs. Results of investigation made by Bur. of Mines; discusses method of rectifying temperature-viscosity curves, and possibility of its practical utilization.

OPEN-HEARTH FURNACES

Design. Some Recent Developments in Open-Hearth Steel Practice, G. A. V. Russell. Iron & Coal Trades Rev., vol. 109, no. 2944, Aug. 1, 1924, pp. 197-198. Discuss limitations of furnace charges; furnace hearths, coke-oven gas; mixed gases, thermal efficiency, furnace regenerators, furnace construction, etc. Abstract of paper read before Yorkshire Assn. of Instn. Civil Engrs.

OXY-ACETYLENE CUTTING

Cutting Tips, Manufacture of. Making Oxy-acetylene Cutting Tips. Machy. (Lond.), vol. 24, no. 626, Sept. 25, 1924, pp. 838-840, 6 figs. Cost-reducing methods used in manufacturing cutting tips for oxy-acetylene outfits.

OXY-ACETYLENE WELDING

Plumbing and Heating Work. Welding in Plumbing and Heating, H. E. Wetzell. Welding Engr., vol. 9, no. 8, Aug. 1924, pp. 17-18, 3 figs. Work done in place with oxy-acetylene cutting and welding; joints, connections and special fittings economically welded.

P

PACKING

Crate Design. Eleven Packing Problems and How They Were Solved, H. N. Knowlton. Factory, vol. 33, no. 4, Oct. 1924, pp. 515-519, 590 and 592, 15 figs. Author gives his experience in redesigning crates for forge-manufacturing company.

PAPER MANUFACTURE

Pulp Manufacture. Calcium Polysulphide Pulping Process, A. Tingle. Paper, vol. 34, no. 22, Sept. 18, 1924, pp. 1000-1002. Mechanism of pulping by alkaline treatments and chemical changes involved with summary of polysulphide process.

PATENTS

Enforcement of Rights. Rights of Inventor and Patentees — How Enforced, W. G. Carr. Elec. Jl., vol. 21, no. 9, Sept. 1924, pp. 434-438. Notes on testing validity; equity and law suits; injunctions; infringements; interpretation of claims; defenses in suits for infringement; etc.

PEAT

Drying. Drying Peat with High Percentages of Moisture, J. W. Brassington. Power House, vol. 17, no. 10, Oct. 5, 1924, pp. 21-23, 1 fig. Modified type of paper-drying machine advocated as practical and fool-proof equipment to enable peat to be sold in successful competition with other fuels.

The Drying of Peat for Power Production, G. K. Fletcher. World Power, vol. 2, no. 9, Sept. 1924, pp. 156-163. Considers possibilities of using peat for purposes of power production.

Preparation and Briquetting. New Process of Preparing and Briquetting Peat, R. Schade. Iron & Coal Trades Rev., vol. 109, no. 2952, Sept. 26, 1924, p. 520. Outlines new German method of peat preparation, by which not only water in peat, but also sugar contained in it, are separated.

PHOTOELASTICITY

Gear Stresses, Analysis of. The Photoelastic Method for the Determination of Causes of Failure of Metal Structures, P. Heymans, G. R. Brophy and A. L. Kimball, Jr. Am. Soc. Steel Treating—Trans., vol. 6, no. 4, Oct. 1924, pp. 506-514, 12 figs. Results obtained through scientific study of stresses set up in metal structures, resulting from design and method of installation or assembly; investigation applied specifically to study of pinion gears; as result of photoelastic method of analysis, predictions as to form of failures were made and then substantiated by actual tests with steel gears.

PHOTOGRAPHY

Fundamental Principles. Certain Fundamental Problems in Photography, T. L. Price. Roy. Soc. Arts—Jl., vol. 72, nos. 3746, 3747 and 3748, Sept. 5, 12 and 19, 1924, pp. 725-736, 739-750 and 753-763, 20 figs. Sept. 5: Discusses question of what particular properties possessed by gelatin make it particularly suitable as emulsion medium. Sept. 12: Method of drying coated plate; prevention of swelling; hardening action of alum; action of acid-fixing bath; part that gelatin plays in process of development. Sept. 19: Visible and latent images. (Cobb Lectures.)

Photographic Sensitivity. Studies in Photographic Sensitivity, S. E. Sheppard, E. P. Wightman and A. P. H. Trivelli. Franklin Inst.—Jl., vol. 198, no. 4, Oct. 1924, pp. 507-515, 1 fig. Effect or oxidizers on sensitivity and on latent image.

PIPE

Fittings, Specifications for. Specifications for Pipe Fittings, H. E. Collins. Mgt. & Administration, vol. 8, no. 1, July 1924, pp. 83-87, 1 fig. Notes on American standard for flanged fittings; kind and quality; valves. Tables giving dimensions for standard weight fittings and extra-heavy fittings.

Stresses in. Stresses in Thin Circular Pipes, etc., Under Symmetrical Loads, G. P. Manning. Concrete & Constructional Eng., vol. 19, nos. 7 and 8, July and Aug. 1924, pp. 437-442 and 491-495, 6 figs. Develops formulas and makes calculations.

PIPE, CAST-IRON

Centrifugally Cast. Manufacture of Cast-Iron Pipe in the South, R. Moldenke. Min. & Metallurgy, vol. 5, no. 214, Oct. 1924, pp. 472-474. Centrifugally cast pipe; difficulties in casting sand-spun pipe. Abstract of A.I.M.E. paper.

Modern Methods of Pipe Manufacture by the Centrifugal Process, E. J. Fox and P. H. Wilson. Iron & Coal Trades Rev., vol. 109, no. 2948, Aug. 29, 1924, pp. 344-346, 8 figs. Discusses process details, process of centrifugally casting, and output of centrifugal machines, giving comparative data.

PIPING

Compressed-Air, Calculation of. Application of Nomography to Calculation of Compressed-Air Conduits (Application de la nomographie au calcul des conduites d'air comprimé), J. Ponset. Arts et Métiers, vol. 77, no. 45, June 1924, pp. 204-219, 2 figs. Formulas available; construction of graphic charts and their application; examples.

PISTON RINGS

Manufacture. Piston-rings and their Production, J. McIntosh. Machy. (N. Y.), vol. 31, no. 2, Oct. 1924, pp. 93-94, 1 fig. Methods of machining, finishing, testing, facing sides, and grinding outside diameter.

POLES, CONCRETE

Centrifugally Cast. Resistance Test of Centrifugally Cast Poles for Traction Equipment (Prove di resistenza su pali centrifugati per elettrotrazione), M. Manerha. Ingegneria, vol. 3, no. 9, Sept. 1, 1924, pp. 317-319, 5 figs. Discusses testing of new poles of Brescia-Tavernole street car line, showing their efficiency.

POTASH

Recovery from Cement Dust. Potash from Cement Dust, E. J. Fox and C. W. Whitaker. Indus. & Eng. Chem., vol. 16, no. 10, Oct. 1924, pp. 1044-1046. Deals with concentration by elutriation; fractions of cement dusts, potash contents of which are approximately double those of original materials, were obtained by air separation; in no instance was all the potash obtained in one fraction of material, regardless of size of fraction; in all fractions of given sample, potash content decreased as size of particles increased.

POWER FACTOR

Improvement. Examples of Power Factor Improvement, M. C. Farrell. Power Plant Eng., vol. 28, no. 19, Oct. 1, 1924, pp. 1005-1008, 2 figs. Describes three practical ways of strengthening power factor in industrial plants.

PRECIPITATION

Electrical. Electrical Precipitation in Retrospect, W. A. Schmidt. Indus. & Eng. Chem., vol. 16, no. 10, Oct. 1924, pp. 1038-1041, 5 figs. Discussion, with especial reference to service which has been performed by some of older installations; investigations at plant of Riverside Portland Cement Co.; other developments.

PRESSES

Hydraulic. Hydraulic Presses in the Rubber Industry (Hydraulische Pressen in der Gummi verarbeitenden Industrie), C. Walther. Gummi-Zeitung, vol. 38, no. 43, July 25, 1924, pp. 878-881, 10 figs. Design and construction of presses used in production of hollow bodies.

PRODUCER GAS

Analysis. Producer Gas, R. T. Haslam. Indus. & Eng. Chem., vol. 16, no. 8, Aug. 1924, pp. 782-784, 2 figs. Apparent equilibrium between its constituents and influence of depth of fuel bed.

Utility of. Producer Gas as an Industrial Fuel, D. J. Demorest. Chem. & Met. Eng., vol. 31, no. 15, Oct. 13, 1924, pp. 578-581, 3 figs. Consideration of its utility and economies obtained through its proper use.

PULVERIZED COAL

Advantages. Advantages in Burning Pulverized Coal, F. L. Wolf. Steam Coal Buyer, vol. 2, no. 2, Sept. 1924, pp. 22 and 24, 1 fig. Practical description showing why pulverized coal gives more perfect combustion, with figures on comparative costs.

Boiler Firing. Powdered Coal for Small Boiler Plants, T. W. Atterbury. Power Plant Eng., vol. 28, nos. 18, 19 and 20, Sept. 15, Oct. 1 and 15, 1924, pp. 937-939, 996-999 and 1048-1050, 12 figs. Describes unit pulverizer method of pulverizing and firing; system makes powdered coal an economical fuel for plant with few boilers. Analysis of operating costs. Comparative advantages and desirable characteristics of unit pulverizer.

Boiler Performance. Pulverized-Coal Boiler Performance, Brunot Island Power Station, L. W. Heller. Power, vol. 60, no. 16, Oct. 14, 1924, pp. 600-603, 9 figs. States that 22 months of operation has shown that this method of burning Pittsburgh coal has operating characteristics that are desirable and will be dominating factors in selection of furnace equipment in future; general arrangement and operating performance.

Locomotive Firing. Pulverized Fuel for Canadian Locomotives, A. J. T. Taylor. Eng. Jl., vol. 7, no. 10, Oct. 1924, pp. 633-635, 2 figs. Review of possibilities of economy in use of fuel for railway purposes.

Propagation of Combustion Zone. The Propagation of a Zone of Combustion in Powdered Coal, F. S. Sinnatt and L. Slater. Fuel, vol. 3, no. 10, Oct. 1924, pp. 350-355, 4 figs. Determination of minimum temperature for combustion.

Steam Power Plants. Steam Generation with Pulverized Fuel, D. Brownlie. Can. Engr., vol. 47, no. 12, Sept. 16, 1924, pp. 343-344. Development of system of low-temperature carbonization of coal with reference to important installations in Great Britain, on Continent and in United States; efficiencies obtained by system. Abstract of paper read before Inst. Elec. Engrs.

PUMPS

Characteristics, Determination of. Determining Pump Characteristics, R. T. Livingston. Power Plant Eng., vol. 28, no. 20, Oct. 15, 1924, pp. 1063-1065, 3 figs. Approximate pump characteristics can be determined graphically from given data.

Circulating, Motor-Driven. Motor-Driven Circulating Pumps, H. B. Seeley. Elec. Wld., vol. 84, no. 13, Sept. 27, 1924, pp. 689-691, 3 figs. Characteristics of circulating system, applications of various pump combinations, desirable speed requirements and economical operation.

PUMPS, CENTRIFUGAL

Boiler-Feed, Turbo. Sulzer Turbo Boiler Feed Pumps. Sulzer Tech. Rev., no. 1, 1924, pp. 3-7, 4 figs. Advantage of steam-turbine drive; types of turbines used for drive; how turbo boiler-feed pumps are governed.

PYROMETERS

Optical. An Optical Pyrometer. Metal Industry (Lond.), vol. 25, no. 14, Oct. 3, 1924, pp. 329-330, 2 figs. Construction and technical features of "Pyro" pyrometer.

R

RADIOTELEPHONY

Short Wave. Results Obtained Over Long Distances by Means of Directed Radiotelegraphy with Short Waves (Risultati ottenuti su lunghissime distanze mediante la radiotelegrafia direzionale ad onde corte, piu' genericamente nota come "il sistema a fascio"), G. Marconi. Telegrafi e Telefoni, vol. 5, no. 4, July-Aug. 1924, pp. 179-184. Discusses short wave developments and successful radiotelephony between England and Australia.

Transmission. Faithful Reproduction in Radio-Telephony, L. C. Pocock. Instn. Elec. Engrs.—Jl., vol. 62, no. 333, Sept. 1924, pp. 791-807 and (discussion) 807-815, 14 figs. Defines terms suitable to scientific study of faithful reproduction, analyzes into separate constituents types of distortion occurring, and lays down general principles and gives them as far as possible a mathematical form. Principal types of apparatus employed in radiotelephony. Bibliography.

RADIATORS

HEAT EMISSION AND COSTS. Comparative Costs and Heat Emission for Cast-Iron Direct Radiation, T. W. Reynolds. Heating & Vent. Mag., vol. 21, no. 10, Oct. 1924, pp. 41-45 and 57, 7 figs. With detailed data for eight different radiator heights and wall and window radiators.

RAILWAY ELECTRIFICATION

BRITISH RAILWAYS. The Future of Main-Line Electrification on British Railways, H. E. O'Brien. Instn. Elec. Engrs.—Jl., vol. 62, no. 333, Sept. 1924, pp. 729-755 and (discussion) 755-781, 9 figs. Shows that probable density of traffic in ton-miles on main railway arteries is so great that cost of energy, including all capital charges, will not be prohibitive, also that cost of electric locomotives will not be a capital charge, and that when reductions in cost of locomotive operation and maintenance (due to simple construction of electric locomotive) are taken into account, total cost of locomotive operation is substantially less for electricity than for steam.

EUROPE. The Electrification of Foreign Railways, Including Recent Developments and Projects, S. P. Smith. World Power, vol. 2, nos. 1, 2 and 4, Jan., Feb. and Apr., 1924, pp. 44-51, 111-116 and 216-223, 4 figs. Jan.: Germany. Feb.: Austria and Hungary. Apr.: France and Holland.

SPAIN. The 3,000-volt Electrification of the Spanish Northern Railway, A. I. Totten and H. C. Hutchinson. Gen. Elec. Rev., vol. 27, no. 10, Oct. 1924, pp. 658-664, 11 figs. Section between Ujo and Busdongo now being electrified as initial step of extensive program. Describes this most recent substitution of electric locomotives for steam locomotives, locomotives themselves, motors, control, auxiliary equipment, substations, transformers, motor-generator sets, and over-head line construction.

UNITED STATES. The Electrification of Railways in United States, Including Recent Developments and Projects, S. P. Smith. World Power, vol. 2, nos. 6 and 7, June and July 1924, pp. 338-346 and 38-44, 6 figs. Deals with roads electrified in America.

RAILWAY MANAGEMENT

STORES DEPARTMENT. Stores Department Activities on M.-K.-T. Lines. Ry. Rev., vol. 75, no. 14, Oct. 4, 1924, pp. 495-500, 14 figs. Large reclamation plant at Parsons, Kan., and supply train with special oil-car features.

RAILWAY MOTOR CARS

GASOLINE. The Gasoline Railroad-Car for Branch Lines, W. L. Bean. Soc. Automotive Engrs.—Jl., vol. 15, no. 4, Oct. 1924, pp. 306-310, 7 figs. Discusses principal factors of design. Weight-space and weight-power ratios of prime importance. Transmission systems compared. See also Ry. Age, vol. 77, no. 13, Sept. 27, 1924, pp. 535-539, 6 figs.

GASOLINE-ELECTRIC. The Gasoline-Electric Car, A. H. Candee. Elec. Jl., vol. 21, no. 10, Oct. 1924, pp. 481-483, 4 figs. Discussed possibilities and developments.

OPERATION. Motor Rail-Cars, J. W. Cain. Soc. Automotive Engrs.—Jl., vol. 15, no. 4, Oct. 1924, pp. 317-319. Ascribes limited success of McKeen gasoline-driven car and one of the gasoline-electric type that were introduced in early part of present century and were pioneers among self-propelled cars for railway use, to their excessive weight and to engine and transmission troubles. Present state of industry. Advantages of motorization.

TYPES. Motor Coaches for Railways, G. Soberski. Eng. Progress, vol. 5, no. 9, Sept. 1924, pp. 175-182. 23 figs. Development of railway motor cars; modern types—their advantages and disadvantages.

RAILWAY OPERATION

CINDERS DISPOSAL. Report on the Handling and Disposing of Cinders. Ry. Eng. & Maintenance, vol. 20, no. 10, Oct. 1924, pp. 402-404. Discusses track layout and equipment for wasting; committee recommends more extensive use of cinders as ballast; equipment for handling direct from pit to point of use; storage of cinders. Committee report of Roadmasters & Maintenance of Way Assn.

FREIGHT-TRAIN LOADING. Maximum Loading of Freight Trains. Ry. & Locomotive Eng., vol. 37, no. 9, Sept. 1924, pp. 278-280. Method of computing adjusted tonnage ratings for maximum freight-train loads.

TRAIN CONTROL. A Continuous Conductive System of Train Control. Ry. Rev., vol. 75, no. 14, Oct. 4, 1924, pp. 501-504, 1 fig. Clifford system of automatic train control gives continuous indication two blocks in advance of danger condition.

Economic Advantages of Automatic Train Control, Jos. Beaumont. Ry. Rev., vol. 75, no. 14, Oct. 4, 1924, pp. 507-508. Information on direct saving which accrued by elimination of train stops on Chicago Rock Island & Pac. Ry.; analysis of economic value of automatic train control.

Pennsylvania's Experience with Automatic Stops. A. H. Rudd. Ry. Age, vol. 77, no. 15, Oct. 11, 1924, pp. 645-646. Value of cab signal; effect on track capacity; conclusions. (Abstract.) Paper read before Am. Ry. Assn. See also Ry. Signaling, vol. 17, no. 10, Oct. 1924, pp. 391-393.

Train Control Development on the C. & O., B. T. Anderson. Ry. Signaling, vol. 17, no. 10, Oct. 1924, pp. 394-397. Features of first installation; new features of a.c. system; failure of automatic-train-control devices; train-control organization; effect on track capacity; interchangeability.

RAILWAY SHOPS

LOCOMOTIVE CYLINDER SHOP. A Modern Locomotive Cylinder Shop, E. A. Custer. Baldwin Locomotives, vol. 3, no. 2, Oct. 1924, pp. 45-53, 10 figs. Describes method of machining locomotive cylinders; gives design and equipment of plant of Baldwin Locomotive Works, Eddystone plant.

MICROMETERS, APPLICATION OF. Application of Micrometers in Railway Shops, M. H. Williams. Ry. Mech. Engr., vol. 98, no. 10, Oct. 1924, pp. 615-618, 7 figs. Interchangeability of pins and bushings for valve motion is made possible by use of micrometers.

STORES METHODS IN. Store Methods on the Norfolk & Western, J. W. Wade. Ry. Age, vol. 77, no. 14, Oct. 4, 1924, pp. 605-608, 8 figs. Particulars of new stores-department methods which have brought about a large reduction in material investment.

RAILWAY SIGNALING

INTERLOCKING. New Low-Voltage Interlocking on the Delaware & Hudson, A. H. Rice. Ry. Signaling, vol. 17, no. 10, Oct. 1924, pp. 375-377, 6 figs. Points out that remote control of switches and signals, in connection with new coaling plant, permit high-speed movements.

RAILWAY TRACK

CROSSINGS. Grade Crossings as a Municipal Engineering Problem. Eng. News-Rec., vol. 93, no. 15, Oct. 9, 1924, pp. 579-581. Brief review of present and prospective conditions in a number of cities in United States. Track elevation usual method.

Standard Formulae for Calculating Point and Crossing Dimensions, R. D. Walker. Ry. Engr., vol. 45, no. 537, Oct. 1924, pp. 339-340, 4 figs. Problems illustrating use of standard formulas as given for four methods, and more difficult problems.

TURNTABLES. New 85-Ft. Diameter Locomotive Turntables for the Bombay Baroda & Central India Railway Company. Ry. Gaz., vol. 41, no. 10, Sept. 5, 1924, pp. 310-311, 4 figs. Turntable has diameter of 85 ft. and is designed for 5 ft. 6 in.-gage locomotives weighing up to 200 tons; deck type with central balance.

RECLAMATION

DREDGING AND. Dredging and Land Reclamation, E. Latham. Engineering, vol. 138, no. 3065, Sept. 26, 1924, pp. 437-438. Methods and calculations for combined dredging and land reclamation; discusses whether it is cheaper to take sludge to sea or dump it ashore; scale of pay should be based on quantity of solid in proportion to quantity of water raised; examples of successes and failures.

RECTIFIERS

WAVE FORMS. Rectifier Wave Forms, D. C. Prince. Gen. Elec. Rev., vol. 27, no. 9, Sept. 1924, pp. 608-615, 13 figs. Various factors influence output wave form of rectifiers, and a knowledge of how to adjust them properly is essential to obtain best service. Presents information to this end. Necessary fundamental formulas are supplemented by simple tables for convenience in calculation.

REFRACTORIES

CARBORUNDUM. Physical Characteristics of Specialized Refractories—Part V: Thermal Conductivity of Carborundum Refractories, M. L. Hartmann and O. B. Westmont. Am. Electrochem. Soc., Advance paper No. 21, for Mtg. Oct. 2-4, 1924, pp. 287-312, 13 figs. Details of tests made.

SILLIMANITE. Preparation of Artificial Sillimanite for Refractory Uses, C. E. Sims, H. Wilson and H. C. Fisher. Am. Electrochem. Soc., Advance paper No. 22, for Mtg. Oct. 2-4, 1924, pp. 327-343, 8 figs. partly on supp. plates. Describes experimental work leading to adoption of a furnace for preparation of artificial sillimanite. Raw materials, and characteristics.

TESTS. The Relative Value of Tests on Refractory Materials. Gas Wld., vol. 81, no. 2094, Sept. 6, 1924, pp. 12-13. Summarizes what is learnt from several methods of testing and compares their relative values.

REFRIGERANTS

ORGANIC BRINES. Organic Refrigerating Brines, H. F. Zoller. Indus. & Eng. Chem., vol. 16, no. 10, Oct. 1924, pp. 1073-1075, 1 fig. Deals with non-aqueous and aqueous brines; factors affecting choice of brine; advantages of alcohol-water mixture; summarizes advantages of certain organic refrigerating brines of methyl-ethyl alcohol or glycerol type over inorganic chloride brines.

PROPERTIES. Properties of Refrigerants, H. D. Edwards. Refrig. Eng., vol. 11, no. 3, Sept. 1924, pp. 95-116, 20 figs. Report containing data on physical properties, effect on various lubricants, effect on human life or health, inflammability, explosive qualities, method of testing purity, precautions essential in handling, etc.

REFRIGERATING MACHINES

ABSORPTION. The Absorption Ice Machine, H. A. Cranford. Southern Engr., vol. 41, no. 2, Apr. 1924, pp. 57-59, 1 fig. What to do when overhauling the system and how to handle the various apparatus.

REFRIGERATION

BRITISH EXHIBITION. Refrigeration at Wembley. Power Engr., vol. 19, nos. 221 and 222, Aug. and Sept., 1924, pp. 308-311 and 346-348, 11 figs. Illustrated description of refrigerating plant actually performing useful functions at British exhibition.

REFUSE DISPOSAL

FACTORY. Factory Refuse. Eng. & Boiler House Rev., vol. 38, no. 4, Oct. 1924, pp. 150 and 153-154, 2 figs. Author advocates systematic collection of factory refuse and burning it in steam boiler equipped on scientific lines, or in special refuse destructor so as to utilize all heat for some useful purpose.

RELAYS

PROTECTIVE. Application of Protective Relays, H. M. Rankin. Elec. Light & Power, vol. 2, no. 10, Oct. 1924, pp. 15-17 and 62, 5 figs. Review of modern practice.

RIVERS

GRAND, POWER DEVELOPMENT. Grand River Conservation and Power Development, W. H. Breithaupt. Eng. Jl., vol. 7, no. 9, Sept. 1924, pp. 604-606, 1 fig. Possibility of power development and its beneficial effect in preventing destructive floods.

RIVETING

MACHINES, ELECTRICALLY DRIVEN. Application of Work-Regulating Drive in Hydraulic Machines (Die Anwendung des Arbeitsreglerantriebes bei hydraulischen Maschinen), P. Hohnen. Maschinenbau, vol. 3, no. 23, Sept. 11, 1924, pp. 850-852, 3 figs. Describes A. E. G. automatically regulated electric motor and compares a riveting plant driven by such a motor with one having hydraulic drive.

ROAD CONSTRUCTION

LABOUR-SAVING MACHINERY. Labour Saving Machinery for Street Construction Work. Gas Age-Rec., vol. 54, no. 12, Sept. 20, 1924, pp. 391-393. Give brief description of types of machines, their record of performance and of savings which have been made. Abstract of paper read before Michigan Gas Assn. Convention.

ROCK DRILLS

CARE. Rock-Drill Troubles, E. H. Paull. Compressed Air Mag., vol. 29, no. 10, Oct. 1924, p. 1018, 1 fig. Points to be remembered in order to secure best service from rock drills; example of typical instruction wall hanger published by Ingersoll-Rand Co., manufacturers of rock drills.

ROLLING MILLS

ADJUSTABLE-SPEED DRIVES. Adjustable Speed Drives for Rolling Mills, L. A. Umansky. Iron & Steel Engr., vol. 1, no. 9, Sept. 1924, pp. 515-532, 27 figs. Discusses advantages to be derived from use of adjustable-speed drive, and necessary speed range and capacity; elementary cases of speed-regulation problems; comparison and selection of systems.

ELECTRIC DRIVE. The Bar Mill and Structural Mill Electrification of the Phoenix Iron Company, J. S. Erichson. Elec. Jl., vol. 21, no. 9, Sept. 1924, pp. 403-407, 9 figs. Details of conversion from steam to electric drive, which consists of 3,000-hp. 600-volt, compound-wound, compensated, adjustable-speed d.c. motor, driving through herringbone-gear unit.

HOT BEDS. New Type of Mechanical Hot Bed. Iron Age, vol. 114, no. 16, Oct. 16, 1924, pp. 990-991, 4 figs. Elliptical moving members insure proper advance of rails, billets, etc., with less direct transfer of heat, in hot bed developed by W. McKee, which represents radical change from present type. See also Iron Trade Rev., vol. 75, no. 16, Oct. 16, 1924, pp. 1016-1017, 4 figs.

S

SAND, MOLDING

BONDING SUBSTANCE OF. The Bonding Substance of Molding Sands, H. B. Hanley. Am. Foundrymen's Assn.—Bul., vol. 3, no. 2, Apr. 1924, pp. 6-10. Its composition, properties and tests.

SCALES

COMPUTING. The Development of the Modern Computing Scale. Can. Machy., vol. 32, no. 11, Sept. 11, 1924, pp. 19-22, 4 figs. Brief outline of evolution of methods of weighing from shekels of silver of 1,860 B. C. to products of Dayton Scale Works, Toronto, in 1924.

SCRAP

ELECTRIC BALING. Electric Scrap Baling. Blast Furnace & Steel Plant, vol. 12, no. 10, Oct. 1924, p. 450, 1 fig. New German method of simplifying production and meeting competition.

SEWAGE

ANALYSES. Analyzing Sewages and Sewage Effluents, C. B. O. Jones. Can. Engr., vol. 47, no. 12, Sept. 16, 1924, pp. 337-339. Discusses methods used in making analyses; need for great accuracy emphasized. Abstract of paper read before Assn. of Mgrs. of Sewage Disposal Works.

SEWAGE DISPOSAL

ACTIVATED SLUDGE. Activated-Sludge Process Has Come to Stay, T. C. Hatton. Eng. News-Rec., vol. 93, no. 14, Oct. 2, 1924, pp. 538-539. Impressions of American engineer after visit to England and talks with British engineers. Air economy being studied but sludge dewatering and utilization neglected.

DEVELOPMENT. Historical Development of Sewage Purification Processes, J. H. Garner. Surveyor & Mun. & County Engr., vol. 66, no. 1704, Sept. 12, 1924, pp. 213-216. Discusses land irrigation, intermittent filtration, artificial filters, rise of biological methods, contact beds, percolating filters, humus tanks, septic tank, travis hydrolytic tank, imhoff tank and recent developments.

IMHOFF TANKS, METHANE GAS RECOVERY FROM. New Design for Collecting Methane Gas From Imhoff Tanks, K. Imhoff. Eng. News-Rec., vol. 93, no. 15, Oct. 9, 1924, p. 585, 1 fig. How construction of early gas collectors used in two-story sewage sedimentation tanks in Ruhr District, in Germany, which were constructed so that scum could be removed from there, has been improved so that manual labour is no longer necessary. Translated from German.

SHAFTS

FLEXIBLE. Experimental Research on Flexible Shafting for Transmission (Ricerche sperimentali sugli alberi flessibili da trasmissione), A. Alpe. Industria, vol. 38, no. 10, May 31, 1924, pp. 269-274, 8 figs. Results of experiments; application of flexible shafting in operation of grinding wheels, dynamos, etc.

LINESHAFTING. Some Notes on Line Shafting, H. Seymour. World Power, vol. 2, no. 9, Sept. 1924, pp. 170-172. Discusses considerations in selecting lineshafting; erection of shafting; choice of couplings.

SHAPERS

TOOLING OF. Tooling Reciprocating Machine Tools. Eng. Production, vol. 7, no. 142, July 1924, pp. 197-198, 4 figs. Shaping machines.

SMOKE

ABATEMENT. Economy through Smoke Abatement, H. B. Meller. Indus. & Eng. Chem., vol. 16, no. 10, Oct. 1924, pp. 1049-1051. Present-day conditions respecting smoke abatement; results of investigation of smoke and dust problem of Pittsburgh.

SOUND

VELOCITY, RELATION TO HEIGHT. The Relation of Sound Velocity to Height, W. J. Humphreys. Franklin Inst.—Jl., vol. 197, no. 6, June 1924, pp. 821-824, 1 fig. Points out that, in general, velocity of sound in atmosphere decreases 4 meters per sec., roughly, per km. increase of height throughout troposphere, and is nearly constant, through given range of level, within stratosphere.

SPRINGS

RELEASE OF. Effect Produced by the Release of Springs (Les effets produits par la détente d'un ressort), C. Reynald. Arts et Métiers, vol. 77, no. 47, Aug. 1924, pp. 312-317, 6 figs. Discusses rectilinear and curvilinear motion of springs on release, velocity of release, and develops formulas for calculating forces exerted.

STANDARDS

GERMAN N. D. I. REPORTS. Report of the German Industrial Standards Committee (N. D. I. Mitteilungen). Maschinenbau, vol. 3, no. 23, Sept. 11, 1924, pp. 875-880, 6 figs. Details of proposals for screws with conical square head and with point and hexagonal head; size of letters and figures for making castings, etc.; colors for distinguishing pipe lines; forged flanges for shafts.

STEAM

DISCHARGE COMPUTATIONS. Simplifying Steam-Discharge Computations, S. D. Barclay. Power, vol. 60, no. 16, Oct. 14, 1924, pp. 613-614, 5 figs. Presents curves which have proved to be quick and convenient method for finding areas for given discharges or amount of steam discharged for given conditions when areas is known.

PHYSICAL PROPERTIES. Study of the Physical Properties of Steam (Étude sur les propriétés physiques de la vapeur d'eau), C. Roszak. Chaleur & Industrie, vol. 5, nos. 49, 50, and 52, May, June and Aug. 1924, pp. 213-223, 283-292, and 402-407, 25 figs. Part I: Saturated steam: determination of heating temperature of water, total heat of saturated steam and of heat of evaporation; specific heats; relation between temperature and pressure of water; volume and specific heat and condensity; conduction. Part II: Superheated steam: specific heat and constant pressure; total and superheated steam; specific volume and characteristic equation. Part III: Discussion of work at University of Munich. Part IV: Determination of heat of vaporization. Part V: Specific heat. Part VI: Relation between temperature and saturation pressure of water. Part VII: Volume and specific weight in saturated water-steam mixture. Part VIII: Conductivity. Part IX: Total heat of superheated steam. Knoblauch-Raisch-Hansen formulas.

PHYSICS OF. The Physics of Steam, C. L. Hubbard. Southern Engr., vol. 41, nos. 3 and 4, May and June 1924, pp. 50-51 and 59-65, 3 figs. Definitions of steam and their applications to practical problems. Action of steam in steam engine.

POWER AND PROCESS WORKS, USE FOR. Generating Mechanical Energy in Works Using Heating Steam. Sulzer Tech. Rev., no. 1, 1924, pp. 7-14, 10 figs. Discusses advantages of installing steam plant arranged for exhaust or extracted steam utilization in industrial plants; field of application of back-pressure engine; back-pressure engine working on conjunction with another power source; steam-extraction plant; Sulzer oil-operated steam-pressure regulator.

STEAM ENGINES

TRIPLE-EXPANSION. An Experimental Triple Expansion Engine. Power Engr., vol. 19, no. 222, Sept. 1924, pp. 351-352, 1 fig. Describes experimental steam engine and accessories which have recently been supplied to Corp. of City of Cardiff and installed at Technical College, by W. Sisson & Co., Ltd.

STEAM POWER PLANTS

ALIGNMENT OF EQUIPMENT. Procedure for Aligning Power Equipment. Power Plant Eng., vol. 28, no. 20, Oct. 15, 1924, pp. 1051-1054, 3 figs. Points out importance of proper alignment and discusses methods.

ECONOMIC OPERATION. Efficiency in Steam Power Plant Operation, L. M. Arkley. Eng. Jl., vol. 7, no. 10, Oct. 1924, pp. 635-638, 2 figs. Discusses possibility of effecting economy in operation of steam plants; preparations for boiler tests; heat losses; Orsat apparatus; causes of low percentage of CO_2; summary of procedure to ascertain causes of low boiler efficiency; CO_2 recorders.

HIGH-PRESSURE. High Pressure Steam at Weymouth, I. E. Moultrop. Stone & Webster Jl., vol. 35, no. 3, Sept. 1924, pp. 309-317, 3 figs. Gives detailed description of design and equipment of Weymouth power station of Edison Elec. Illuminating Co. of Boston, highest commercial steam power plant in world.

HIGH PRESSURE, SUPERHEAT, AND REHEATING IN. Pressure, Superheat, Steam Extraction and Reheating as Affecting Power Plant Economy. Eskill Berg. Franklin Inst.—Jl., vol. 197, no. 6, June 1924, pp. 727-739, 8 figs. Notes on gain by high steam pressure; gain by high superheat; gain by high steam pressure and superheat combined; steam extraction; reheating; capacity rating; high pressure and high steam temperature.

STEEL WORKS. Steel Company Builds New Power Plant. Power Plant Eng., vol. 28, no. 20, Oct. 15, 1924, pp. 1034-1041, 9 figs. Details of power plant of new blast furnace and coke plant of Columbia Steel Corp. at Provo, Utah; includes tabular data on equipment used.

STEAM TURBINES

DEVELOPMENTS. The Modern Steam Turbine on Land and Sea, C. A. Parsons. Power House, vol. 17, no. 16, Aug. 20, 1924, pp. 25-29, 4 figs. Turbo-electric generating units now being built up to 60,000-kw.; thermal efficiency over all, coal to electricity of 27.80 per cent expected in recent installations; mechanical gearing, reheating steam, etc.

The Steam Turbine, C. A. Parsons. Engineering, vol. 138, no. 3065, Sept. 26, 1924, pp. 469-470. Correlates certain well-known principles of thermodynamics with practical progress of steam turbine and with important advances that are being made at present time. Paper read at Int. Mathematical Congress.

DISK WHEELS, PROTECTION FROM AXIAL VIBRATION. The Protection of Steam Turbine Disk Wheels From Axial Vibration, W. Campbell. Gen. Elec. Rev., vol. 27, nos. 6, 7 and 8, June, July and Aug. 1924, pp. 352-360, 459-484 and 511-535, 99 figs. June: Troubles which gave rise to investigation made by Gen. Elec. Co., and preliminary work which led to discovery of cause of difficulty. July: Nature and theory of vibration in turbine wheels, and reasons for necessity of placing reliance on actual tests in addition to purely analytical methods. Aug.: Methods of design and testing for protection of turbine bucket wheels from axial vibration Paper read at A.S.M.E. spring mtg.

ECONOMY, CONDITIONS AFFECTING. Conditions Affecting Steam Turbine Economy, J. Y. Dahlstrand. Power Plant Eng., vol. 28, no. 20, Oct. 15, 1924, pp. 1041-1043, 1 fig. Outline of conditions which interfere with maintenance and high economy.

HIGH-PRESSURE. Steam Boilers at Very High Pressure (Les machines à vapeur à très haute pression), A. Troller. Nature (Paris), no. 2618, June 7, 1924, pp. 364-368, 5 figs. Discusses Gennevilliers 45,000-hp. equipment, Brown Boveri high-pressure turbines and data, Blomquist boilers, etc.

What the World Power Conference Showed About Modern Steam Turbines and Their Design. Elec. Wld., vol. 84, no. 14, Oct. 4, 1924, pp. 737-740. Abstracts of four authoritative papers on high pressure showing general lines of development in Great Britain, Holland, Sweden and United States.

INSTALLATION. Installing an 1,875-Kva. Impulse Steam Turbine, Claude C. Brown. Power, vol. 60, no. 17, Oct. 21, 1924, pp. 648-650, 1 fig. Résumé of details worked out in installation of each of four steam turbo-generators at plant of large Western sugar refinery.

LUBRICATION. Turbine Lubrication, N. E. Funk. Indus. & Eng. Chem., vol. 16, no. 10, Oct. 1924, pp. 1080-1084, 4 figs. Discusses difficulties experienced in applying many lubricating oils that are considered by refiners to be high-grade products; problems of turbine lubrication; action of oils as heat dissipating agent; destruction of oil in operation; effects produced by destructive agents; care of lubricant in service.

STEEL

DEPHOSPHORIZING. Dephosphorizing in the Martin Furnace and the Electric Furnace by Means of the Basic Process (Defosforazione al forno Martin ed ai forno elettrico col processo basico), E. De-Luisi. Rassegna Mineraria Metallurgica e Chimica, vol. 61, no. 2, Aug. 15, 1924, pp. 29-34. Details of oxidizing agents and reactions, composition of slag, etc.

LOCOMOTIVE. High-Manganese Steel for Locomotives, E. F. Cone. Iron Age, vol. 114, no. 14, Oct. 2, 1924, pp. 824-825, 4 figs. Its properties when incorporated in cast-steel engine frames and crossheads. Composition and heat treatment.

MACROSCOPIC EXAMINATION. The Macroscopic Examination of Steel, V. O. Homerberg. Am. Soc. Steel Treating—Trans., vol. 6, no. 3, Sept. 1924, pp. 295-314, 30 figs. Explains manner in which segregation takes place in steel; method of preparing specimens; formulas of etching reagents, together with directions for their use and necessary precautions to be taken; macrographs are included to illustrate results obtained from use of these different reagents.

OXY-ACETYLENE FLAME APPLIED TO. Steel under the Oxy-Acetylene Flame, A. S. Kinsey. Am. Soc. Steel Treating—Trans., vol. 6, no. 4, Oct. 1924, pp. 515-524, 2 figs. Points out that in burning of oxy-acetylene flame, which produces temperature of about 6,300 deg. fahr., border combustion occurs which makes it possible to melt steel without oxidizing it; odd shapes and sizes of steel to be hardened, tempered or annealed may easily be heated with oxy-acetylene torch, which has additional advantage of being adaptable to confined areas; economy and efficiency of oxy-acetylene flame is largely attributable to remarkable purity of 99.5-per cent oxygen, now commercially available.

RIVET. Effect of Sulfur on Endurance Properties of Rivet Steel. Am. Soc. for Testing Matls., Preprint No. 4a, for Mtg. June 24-27, 1924, 15 pp., 9 figs. Third preliminary report of Joint Committee on Investigation of Phosphorus and Sulphur in Steel. Describes endurance tests made at U. S. Naval Eng. Experiment Station, and results obtained.

Metallographic Investigation of Effect of Sulfur on Rivet Steel. Am. Soc. for Testing Matls., Preprint No. 4b, for Mtg. June 24-27, 1924, 75 pp., 85 figs. partly on supp. plates. Fourth preliminary report of Joint Committee on Investigation of Phosphorus and Sulphur in Steel. Results of microscopic investigation, investigation of non-metallic inclusions, and investigation of microstructure.

SPHEROIDIZED CEMENTITE IN HYPOEUTECTOID. Spheroidized Cementite in Hypoeutectoid Steel, R. S. MacPherran and J. F. Harper. Am. Soc. Steel Treating—Trans., vol. 6, no. 3, Sept. 1924, pp. 341-374, 20 figs. Results of authors' experience in method of heat treating large forgings; results obtained by spheroidization of cementite of pearlitic constituent seem to warrant treatment given; treatment applied to cast steel results in corresponding improvement of physical properties. Photomicrographs.

STAINLESS. Stainless Steel and Stainless Iron, O. K. Parmiter. Am. Soc. Steel Treating—Trans., vol. 6, no. 3, Sept. 1924, pp. 315-340. Reviews history and development of stainless steel and stainless iron of 13 per cent chromium type; problems involved in manufacture of this material, its composition and effect of various elements upon it; heat treatment, forging, normalizing, annealing and hardening; physical properties; general properties of stainless steel; applications and possibilities of stainless iron.

TEST RESULTS. What is Steel? A. Sauveur. Min. & Metallurgy, vol. 5, no. 214, Oct. 1924, pp. 465-468, 2 figs. Notes on thermic curves of blast furnaces; epochal contributions of Henry M. Howe; results of tests on Armco iron; electrolytic iron; Norway iron; low-carbon steel; steel containing 0.30 per cent carbon. (Abstract.)

STEEL CASTINGS

DEFECTS. Some Steel Foundry Experience, H. V. Fell. Foundry Trade Jl., vol. 30, no. 422, Sept. 18, 1924, pp. 239-240, 19 figs. Describes a few steel castings which have been made by author and indicates their defects and means by which they were overcome.

Sink Heads. Proportioning and Shaping of Sink Heads, J. H. Hall. Iron Age, vol. 114, no. 14, Oct. 2, 1924, pp. 822-823. How not only a saving of metal can be secured, but a lowering of cost of steel, if proportioning and shaping of risers is carefully studied. Advantages of use of a comparatively new kind of riser, which is cone shaped.

STEEL, HEAT TREATMENT OF

Annealing. Annealing of Plates Used in Electrical Construction (Le recuit des tôles utilisées dans la construction électrique), R. Cazaud. Revue de Métallurgie, vol. 21, no. 8, Aug. 1924, pp. 473-483, 18 figs. Requirements of thin sheets used in electric machines; effect of mechanical treatment on magnetic qualities; effect of temperature, silicon content, atmosphere, etc.

Quenching. Quenching Diagrams for Carbon Steels in Relation to Some Quenching Media for Heat Treatment, H. J. French and O. Z. Klopsch. Am. Soc. Steel Treating—Trans., vol. 6, no. 3, Sept. 1924, pp. 251-294, 22 figs. Gives quenching diagrams for carbon steels containing from 0.25 to 1.25 per cent carbon; in these are shown relations between Rockwell hardness, microstructure, thermal transformations and cooling velocity determined at 720 deg. cent.; general relations between quenching diagrams and various quenching media for heat treatment. Bibliography.

STEEL, HIGH-SPEED

Chromium in. The Nature of the Function of Chromium in High Speed Steel, E. C. Bain and M. A. Grossmann. Am. Soc. Steel Treatings—Tran., vol. 6, no. 4, Oct. 1924, pp. 430-442, 17 figs. Results of measurement of effect of heat treatment upon hardness, impact strength and volume change in case of four hightungsten steels; date, in some measure, reveal function of chromium in high-speed steel; photomicrographs show principal structural changes responsible for effect of heat treatment upon properties.

Hardness, Brinell and Rockwell. Comparison of Brinell and Rockwell Hardness of Hardened High Speed Steel, S. C. Spalding. Am. Soc. Steel Treating—Trans., vol. 6, no. 4, Oct. 1924, pp. 499-504, 6 figs. Steels were treated under varying temperatures and both Rockwell and Brinell hardness numbers were obtained; these are tabulated and shown in accompanying curves.

STEEL WORKS

Electrical Equipment, Application of. Electrical Engineering as a Leading Factor in the Development of Modern Steel works, W. Geyer. Iron & Coal Trades Rev., vol. 109, no. 2943, July 25, 1924, pp. 153-154. Discusses electric motors, cranes and transporters auxiliary machines, power production, compressed-air supply, rolling mills, steel production in electrical furnaces. Abstract of paper read before World Power Conference.

Machine Tools in. Machine Tools and Their Auxiliaries in the Steel Mills, J. F. Kelly. Iron & Steel Engr., vol. 1, no. 9, Sept. 1924, pp. 466-482 and 536-544, 30 figs. Notes on selection of machine tools; history and development of tools; modern practice; reversing planers; gear-cutting machines; grinding machines; boring mills; radial drills; automatic control of machine tools; lubrication.

STOKERS

Steam Engine as Drive. The Steam Engine as a Stoker Drive. Power Plant Eng., vol. 28, no. 19, Oct. 1, 1924, pp. 1000-1002, 4 figs. Slow speed, continuous range and automatic torque-speed adjustment are among desirable characteristics.

STREET RAILWAYS

Car Materials. New Materials in Car Body Construction, J. A. Dewhurst. Elec. Ry. Jl., vol. 64, no. 14, Oct. 4, 1924, pp. 549-552, 5 figs. Points out that development of steel-covered laminated wood panels has made possible construction of type of side girder which has strength and rigidity of steel and at same time gives better insulation, less noise and reduced weight.

Noise Elimination. Elimination of Noise, C. L. Van. Auken. Elec. Traction, vol. 20, no. 9, Sept. 1924, pp. 405-412, 13 figs. Deals with track, wheel, wheel and track, journal, brake, truck, gear, compressor, motor, body, roof, trolley and other noises in operation of street cars.

Three-Car Articulated Trains. Detroit Operates New Three-car Articulated Train, A. C. Colby. Gen. Elec. Rev., vol. 27, no. 7, July 1924, pp. 441-448, 10 figs. Describes three-car articulated unit place in operation on Woodward Ave. line by Dept. Street Rys., designed to handle heavy passenger traffic on this route.

SUBSTATIONS

Automatic. The Peebles-Reyrolle Automatic Substation. Engineering, vol. 138, no. 3062, Sept. 5, 1924, pp. 323-327, 7 figs. Describes completely automatic substation capable of performing all functions which usually demand intervention of a skilled operator, produced as result of collaboration of two firms of A. Reyrolle & Co., Ltd., Hebburn-on-Tyne, Eng., and Bruce, Peebles, & Co., Ltd. Reyrolle's metal-clad switchgear bas been applied in connection with standard motorconverting machinery of Bruce, Peebles, & Co.

SULPHUR

Industrial Uses. New Uses for Sulphur in Industry, W. H. Kobbé. Indus. & Eng. Chem., vol. 16, no. 10, Oct. 1924, pp. 1026-1028. Deals with materials which have been impregnated with molten sulphur by simple immersion in bath of this substance, such as diatomaceous earth, concrete, building brick, bifrous materials, various asbestos products, sandstone, fiber board, etc.

SUPERHEATERS

Locomotive. Locomotive Superheaters. Superheater Co. (Locomotive Superheaters)—Bul. 11. Description, operation and maintenance of Elesco type "A" locomotive superheater.

SURVEYING

Aerial. Aeroplane Surveying, H. L. Cooke. Eng. Jl., vol. 7, no. 9, Sept. 1924, pp. 599-602. Progress in preparation of contoured maps from air photographs.

T

TELEPHONY

Transmission Maintenance. Transmission Maintenance of Telephony Systems, P. E. Erikson and R. A. Mack. Instn. Elec. Engrs.—Jl., vol. 62, no. 332, Aug. 1924, pp. 653-679 and (discussion) 679-687, 19 figs. Deals with broad aspects of modern telephone transmission maintenance, economic justification for good maintenance, and general lines upon which it should be carried out. Theoretical considerations leading up to development of a series of testing instruments, by means of which transmission losses in any part of telephone system can easily be measured. Brief descriptions of instruments and their use.

TIME STUDY

Usefulness of. Making and Using Time Studies, H. K. Reed. Indus. Mgt. (N. Y.), vol. 68, no. 3, Sept. 1924, pp. 165-169, 2 figs. Problems of "maintenance" of time study, discussing those factors which, in final analysis, determine degree of concrete usefulness of time study in modern management.

TRANSFORMERS

High-Reactance. The Design of Small High-reactance Transformers, R. H. Chadwick and D. W. Merchant. Gen. Elec. Rev., vol. 27, no. 10, Oct. 1924, pp. 682-685, 3 figs. In small transformers it is frequently more economical to obtain high leakage reactance by use of magnetic shunts, or stacks of steel punchings between coils. Description of this departure from conventional transformer design, together with explanation and example of its method of calculation.

Oils, Effect of Halogenated Hydrocarbons on. Halogenated Hydrocarbons As Dielectrics, H. G. P. Weber and R. H. Wynne. Am. Electrochem. Soc., Advance paper No. 13, for Mtg. Oct. 2-4, 1924, pp. 189-195, 2 figs. Details of study made of change in flash and fire points produced by varying percentages of a series of compounds, in order to determine what regularities, if any, existed in effect of halogenated hydrocarbons upon combustible oils. Two transformer oils used.

Oils, Sludging Tests for. A New Sludging Test for Transformer Oils, W. H. Nuttall. World Power, vol. 2, no. 8, Aug. 1924, pp. 92-96, 4 figs. Discusses interfacial tension between oil and water as bearing a definite relation to sludging properties of oil, and develops a method of determining sludge by means of it.

Overloads. Hot Spots and Overload Indicators, H. Cole. Elec. Wld., vol. 84, nos. 7 and 8, Aug. 16 and 23, 1924, pp. 314-317 and 360-362, 6 figs. Results of studies made by Detroit Edison Co. to permit utilizing transformers more effectively without incurring serious overheating of insulation. Tests conducted to determine accuracy, time-lag, correct setting, etc.; limitation of overload indicators in practical operation.

Temperature Indicators for. Recent Developments in Alternating-Current Temperature Indicators for Transformers, V. M. Montsinger. Gen. Elec. Rev., vol. 27, no. 10, Oct. 1924, pp. 706-707, 4 figs. Describes briefly several new devices that bave been developed for a.c. temperature-indicator circuits.

Brass, Annealing of. Annealing of Brass Tubing in the Electric Furnace, R. M. Keeney. Am. Electrochem. Soc., Advance paper No. 9, for Mtg. Oct. 2-4, 1924, pp. 137-147, 3 figs. Methods and equipment at plant of French Mfg. Co., of Waterbury, Conn. Electric brass annealing proven to be more economical than annealing witb wood fuel.

Brass, Manufacture of. The Manufacture of Brass and Copper Tubes, G. Evans. Metal Industry (Lond.), vol. 25, nos. 10, 13 and 14, Sept. 5, 26, and Oct. 3, 1924, pp. 217-219, 297-299 and 321-325, 20 figs. Refinery or foundry for copper-billet casting. Deals with development of piercing machines, describing present type of machine in use, their operation and adjustment. Describes suitable heating furnace and gives a plan of typical modern piercing-mill layout.

TURBO-GENERATORS

Westport Station, Baltimore. Turbine Packing, Bleeding Arrangements and Other Features of Westport Station Addition. Power, vol. 60, no. 16, Oct. 14, 1924, pp. 605-608, 3 figs. Describes special type of high-pressure packing gland, use of vertical bairpin tube heaters with special check valves and d.c. ball-bearing electrical auxiliaries, which are features of two newly installed 20,000-kw. turbo-generators.

V

VACUUM

Research. The Vacuum—There's Something in It, W. R. Whitney. Gen. Elec., Rev., vol. 27, no. 7, July 1924, pp. 430-439, 11 figs. Summary of results of research in field of high vacuum. From address before Am. Assn. for Advancement of Sci.

VACUUM TUBES

Thermionic Valves. Thermionic Valves With Dull-Emitting Filaments. Instn. Elec. Engrs.—Jl., vol. 62, no. 332, Aug. 1924, pp. 689-696 and (discussion) 696-700, 6 figs. History of dull-emitting thoriated tungsten filament and development of thermionic valves containing these filaments. Describes and discusses intrinsic properties.

VALVES

Automatic-Machinery. Valve Mechanisms in Automatic Machinery, A. A. Dowd. Machy. (N. Y.) vol. 21, no. 2, Oct. 1924, pp. 126-129, 5 figs. Describes devices for handling semi-fluid, heavy-liquid, heavy-pasty, and heavy-sticky materials.

VAPORS

Pressures. Vapor Pressure Curves for System Containing Alcohol, Ether, and Water, E. A. Louder, T. R. Briggs and A. W. Browne. Indus. & Eng. Chem., vol. 16, no. 9, Sept. 1924, pp. 932-935, 4 figs. Describes apparatus for determining vapor pressure; determination of vapor pressures of certain mixtures; from data obtained pressure-temperature curves have been constructed.

W

WASTE ELIMINATION

Methods. Organizing to Prevent Materials Waste, C. B. Auel. Mgt. & Administration, vol. 7, nos. 6, 7 and 8, June, July and Aug. 1924, pp. 669-674, 65-70 and 185-190, 13 figs. Prevention and salvage of waste at Westinghouse plant. Standardization of parts; preparation of standards; purchasing specifications; manufacturing allowances and specifications; stores stocks control; quarterly "clean-up"; storing, boxing, and shipping: ;use of obsolete copper wire; etc.

WATER PIPE

Corrosion. Film Protection as a Factor in Corrosion, F. N. Speller. Am. Electrochem. Soc., Advance paper No. 22, for Mtg. Oct. 2-4, 1924, pp. 313-325, 3 figs. Factors influencing corrosion; natural protective coating; factors influencing character and deposition of protective films; artificial protective coatings formed in water; limitation of scale protection on water pipe.

WATER SOFTENING

Permutite. Note on a Permutite Water Purification Plant (Note sur une installation d'épuration d'eau à la "Permutite" au siège de Victor 3-4, à Rauxel), M. Stoeffler. Chaleur & Industrie, vol. 5, no. 52, Aug. 1924, pp. 383-385, 1 fig. Details of permutite tests and comparative cost of apparatus and operations.

WELDING

Automatic Welding Machines. Automatic Welding of Tank. Welding Engr., vol. 9, no. 9, Sept. 1924, pp. 17-19, 5 figs. Describes new machine which automatically welds circular end seams; revolves around work; flame oscillates; increases production.

Electric. *See Electric Welding; Electric Welding Arc; Electric Welding, Resistance.*

Monel Metal. *See Monel Metal.*

Oxy-Acetylene. *See Oxy-Acetylene Welding.*

Rails. Welding of Non-Imbedded Tracks (Schweissung freiliegender Gleise), Wattmann. Maschinenbau, vol. 3, no. 24, Sept. 22, 1924, pp. 902-904. Experiences in track welding and comparative cost of welded joints and fishjoints. See translation in Eng. Progress, vol. 5, no. 9, Sept. 1924, p. LIX, 1 fig.

WOOD

Cellulose Determination. Modified Method for Determining Cellulose in Wood, G. J. Bitter. Indus. & Eng. Chem., vol. 16, no. 9, Sent. 1924, pp. 947-948. Modification of present method of preparing cellulose, so as to minimize, if possible, troublesome features.

WOODWORKING PLANTS

Flooring Plants. A New Electrically Drvien Flooring Plant, E. B. Clemenc. Gen. Elec. Rev., vol. 27, no. 9, Sept. 1924, pp. 602-608, 12 figs. Describes plant of Mitchell Bros. Co., at Cadillac, Mich., including notes on substation.

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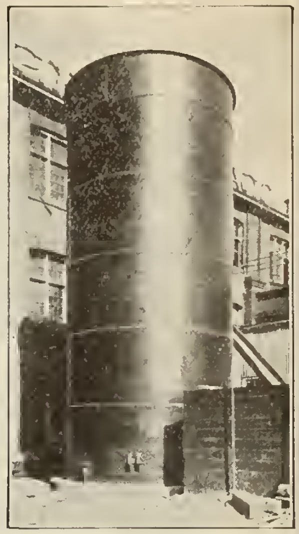

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TENDERS

DEPARTMENT OF RAILWAYS AND CANALS

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CORNWALL CANAL

NOTICE TO CONTRACTORS

SEALED TENDERS, addressed to the undersigned and marked "Tender for Raising Banks and Lock Walls on the Cornwall Canal" will be received at this office until 12 o'clock noon on Thursday, December 18, 1924.

Plans, specifications and form of contract to be entered into can be seen on and after this date at the office of the Chief Engineer of the Department of Railways and Canals, Ottawa, and at the office of the Superintending Engineer, Ontario-St. Lawrence Canals, Cornwall, Ont.

An accepted bank cheque on a chartered bank of Canada for the sum of $4,000.00, made payable to the order of the Minister of Railways and Canals, or Dominion of Canada Bonds, to the same amount, or Dominion of Canada Bonds and accepted cheques, if required to make up the amount, must accompany each tender, which sum will be forfeited if the party tendering declines entering into contract for the work at the rates stated in the offer submitted.

The cheque or bonds thus sent in will be returned to the respective contractors whose tenders are not accepted.

The cheque or the cheque and bonds of the successful tenderer will be held as security or part security for the fulfilment of the contract to be entered into.

The lowest or any tender not necessarily accepted.

By order,
J. W. PUGSLEY,
Secretary.

Department of Railways and Canals,
Ottawa, November 19, 1924.

DEPARTMENT OF RAILWAYS AND CANALS

WELLAND SHIP CANAL

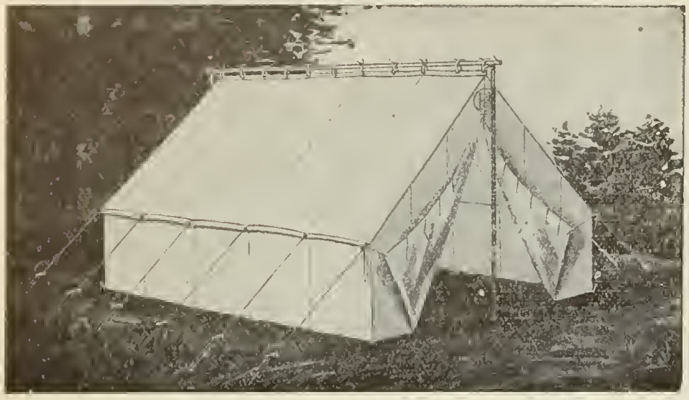
Section 7

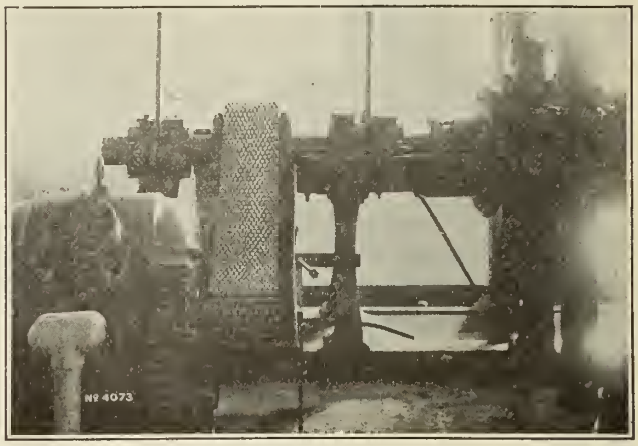
NOTICE TO CONTRACTORS

CONTRACTORS are hereby notified that the time for receiving tenders in connection with the construction of Section 7, Welland Ship Canal, has been extended to 12 o'clock, noon, Monday, December 1st, 1924.

By order,
J. W. PUGSLEY,
Secretary.

Department of Railways and Canals,
Ottawa, October 21, 1924.

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Link-Belt Ltd.
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Combustion Engineering Corp., Ltd.
Taylor Stoker Co., Ltd.

B

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Bates Valve Bag Co.
Bags, Paper:
Bates Valve Bag Co.
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C

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D

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Mussens Ltd.
Die Screw Plates:
Pratt & Whitney Company of Canada, Ltd.
Dies:
Pratt & Whitney Co., of Canada, Ltd.
N. Slater Co., Ltd.
Doors, Fireproof:
Mussens Limited.
N. Slater Co., Ltd.
Dredges:
Canadian Vickers Ltd.
Drills:
Pratt & Whitney Company of Canada, Ltd.
Drilling Machines, Metal:
John Bertram & Sons Co., Ltd.
Drill Sharpeners:
Lancashire Dynamo and Motor Co. of Can. Ltd.

Purchaser's Classified Directory

E

Economizers:
Babcock-Wilcox & Goldie-McCulloch Ltd.
Combustion Engineering Corp., Ltd.
General Supply Co., of Canada Ltd.
Electric Cranes, Locomotive, Pillar, Transfer, Wrecking:
Industrial Works.
Electric Motors:
Lincoln Electric Co., of Canada, Ltd.
Electric Welders:
Lincoln Electric Co., of Canada, Ltd.
Electrical Appliances:
Northern Electric Co. Ltd.
Electric Railway Car Couplers:
Dominion Insulator & Mfg. Co., Ltd.
Electrical Supplies:
Northern Electric Co., Ltd.
Enamels, Acid & Fume Resisting:
Dominion Paint Works, Ltd.
Enamels, Industrial Lighting:
Dominion Paint Works, Ltd.
End Mills:
Pratt & Whitney Company of Canada, Ltd.
Engines, Gas and Oil:
Canadian Fairbanks-Morse Co. Ltd.
Canadian Vickers Ltd.
Engines, Gas & Oil, Filters:
Midwest Canada Limited.
Engines, Steam:
Combustion Engineering Corp., Ltd.
Babcock-Wilcox & Goldie-McCulloch Ltd.
Laurie and Lamb.
E. Leonard & Sons, Ltd.
Excavators:
Mussens Limited.
Excavators, Dragline:
Link-Belt Ltd.
Exhaust Steam Injectors, Locomotive:
Superheater Co., Ltd.

F

Fan Engine Regulators:
Under-Feed Stoker Co., of Canada, Ltd.
Feed-Water Heaters, Locomotive:
Superheater Co., Ltd.
Fence Posts, Steel:
Burlington Steel Co., Ltd.
Fillers, Wood and Metal:
Dominion Paint Works, Ltd.
Filters, Air:
Midwest Canada, Ltd.
Fire Alarm Apparatus:
Northern Electric Co., Ltd.
Floor Stands:
Jenkins Bros., Ltd.
Flange Couplings:
Cumberland Steel Co.
Flanges, Companion:
Jenkins Bros., Ltd.
Files, Valve:
Jenkins Bros., Ltd.
Flooring, Fireproof:
Irving Iron Works Co.
Flooring, Open Steel:
Irving Iron Works Co.
Flooring, Steel:
Irving Iron Works Co.
Flooring, Non-Slipping:
Irving Iron Works Co.
Flooring, Ventilating:
Irving Iron Works Co.
Floors, Monolithic:
Canadian Johns-Manville Co., Ltd.
Forgings:
British Empire Steel Corp., Ltd.
Dominion Bridge Co., Ltd.
N. Slater Co., Ltd.
Friction Clutches:
Link-Belt Ltd.
Canadian Johns-Manville Co., Ltd.
Fuel, Oil:
Imperial Oil, Ltd.
Furnaces, Automatic:
Under-Feed Stoker Co., of Canada, Ltd.

G

Galvanizing, Hot Dip:
N. Slater Co., Ltd.
Gantry Cranes:
Industrial Works.
Gasoline:
Imperial Oil, Ltd.
Gauges:
Pratt & Whitney Co., of Canada, Ltd.
Gear Reductions:
Hamilton Gear & Machine Co.
Gears:
Canadian Vickers Ltd.
Hamilton Gear & Machine Co.
Link-Belt, Ltd.
Gears, Machine Cut:
Jones and Glassco, Regd.
Gears, Double Helical:
De Laval Steam Turbine Co.
Gears Reduction:
De Laval Steam Turbine Co.
Generators:
Canadian General Electric Co., Ltd.
Canadian Westinghouse Co. Ltd.
Griswold & Co., Ltd.
Lancashire Dynamo and Motor Co. of Can. Ltd.
Grab Buckets:
Link-Belt Ltd.
Mussens Limited.
Grating, Steel:
Irving Iron Works Co.
Gratings, Area, Sidewalk:
Irving Iron Works Co.
Ground Joints Unions:
Dart Union Co., Ltd.
Ground Pipe Caps & Points:
G. & W. Electric Specialty Co.
Ground Shafting:
Cumberland Steel Co.
Guards, Truck Radiator:
Irving Iron Works Co.

H

Hammers, Steam:
John Bertram & Sons Co., Ltd., Industrial Works.
Hangers:
Link-Belt Ltd.
Midwest Canada Limited.
Hangers, Door:
N. Slater Co., Ltd.
Hydraulic Turbines:
Boving Hydraulic & Engineering Co.
Canadian Vickers Ltd.
Dominion Engineering Works, Ltd.
General Supply Co., of Can. Ltd.
Headlights, Electric Railway:
Dominion Insulator & Mfg. Co., Ltd.
Heaters, Boiler Feed-Water:
Babcock-Wilcox & Goldie-McCulloch Ltd.
Combustion Engineering Corp., Ltd.
Heating Material:
Crane Ltd.
Hobs:
Pratt & Whitney Company of Canada Ltd.
Hoisting Engines:
Clare Osborn, Ltd.
F. H. Hopkins & Co., Ltd.
Lancashire Dynamo and Motor Co. of Can. Ltd.
Mussens Ltd.
Hoists, Electric:
Lancashire Dynamo and Motor Co. of Can. Ltd.
Link-Belt Ltd.
Taylor Stoker Co., Ltd.
Hoists, Hydraulic:
Canadian Vickers Ltd.
Hoists, Mono-Rail:
Link-Belt Ltd.
Taylor Stoker Co., Ltd.
Hydraulic Press Control Systems:
Taylor Stoker Co., Ltd.

I

Industrial Electric Control:
Canadian General Electric Co., Ltd.
Dominion Engineering Agency, Ltd.
Insulated Rail Joints, Continuous:
Rail Joint Co., of Canada, Ltd.
Insulation, Steam Pipe Casing:
Pacific Coast Pipe Co. Ltd.
Insulation, Underground Systems:
Canadian Johns-Manville Co. Ltd.
Insulators, Porcelain:
Dominion Insulator & Mfg., Co. Ltd.

J

Joints, Filler Paving:
Barrett Co., Ltd.

K

Kerosene:
Imperial Oil Ltd.

L

Ladder Steps, Steel:
ron Works Co.
Lathes:
John Bertram & Sons Co., Ltd.,
Leaders, Pile Drivers:
Industrial Works.
Lightning Arrestors:
Canadian General Electric Co., Ltd.
Dominion Engineering Agency, Ltd.
Lighting Equipment, Industrial and Street:
Canadian General Electric Co., Ltd.
Line Materials:
Dominion Insulator & Mfg. Co., Ltd.
N. Slater Co., Ltd.
Locomotives:
Clare Osborn, Ltd.
F. H Hopkins & Co., Ltd.
Mussens Ltd.
Locomotive Cranes:
Industrial Works.
Locomotives, Electric:
Canadian General Electric Co., Ltd.
Canadian Westinghouse Co., Ltd.
Lubricating Oils & Greases:
Imperial Oil Ltd.
Lumber, Asbestos:
Canadian Johns-Manville Co., Ltd.

M

Machine Tools:
John Bertram & Sons Co., Ltd.
Machinery:
Canadian Fairbanks-Morse Co., Ltd.
Dominion Engineering Works, Ltd.
Machinery, Bag Filling and Weighing:
Bates Valve Bag Co.
Mackinaw Clothing:
Grant-Holden-Graham, Ltd.
Mandrels:
Pratt & Whitney Company of Canada, Ltd.
Marine-Machinery:
William Kennedy & Sons, Ltd.
Material Handling Plants:
Canadian Vickers Ltd.
Link-Belt Ltd.
Mussens Limited.
Men's Furnishings:
Grant-Holden-Graham, Ltd.
Merchant Bars:
British Empire Steel Corp., Ltd.
Metal Lath:
Trussed Concrete Steel Co. of Canada, Ltd.
Milling Cutters:
Pratt & Whitney Co., of Canada, Ltd.
Milling Machines:
John Bertram & Sons Co., Ltd.
Mine Hoists, Steam and Electric:
Lancashire Dynamo and Motor Co. of Can. Ltd.
Mining Machinery:
William Kennedy & Sons, Ltd.
Motors:
Canadian Fairbanks-Morse Co., Ltd.
Dominion Engineering Agency Ltd.
Lancashire Dynamo and Motor Co. of Can. Ltd.
Motors, Electric:
Canadian General Electric Co., Ltd.
Canadian Westinghouse Co., Ltd
Lancashire Dynamo and Motor Co. of Can. Ltd.
Lincoln Electric Co., of Canada
Motor Oils:
Imperial Oil Ltd.

N

Nails:
British Empire Steel Corp., Ltd.
Nuts:
British Empire Steel Corp., Ltd,

O

Oil Burning Equipment:
Combustion Engineering Corp., Ltd.
Oil Purifiers, Centrifugal:
De Laval Steam Turbine Co.

P

Packings, Asbestos Sheet:
Canadian Johns-Manville Co., Ltd.
Packings, Rod and Plunger:
Canadian Johns-Manville Co., Ltd.
Paints, Metal Protectives:
Barrett Co., Ltd.
aper Bags:
Bates Valve Bag Co.
Paper Mill Machinery:
Dominion Engineering Works, Ltd.
Paving Contractors:
Standard Paving Ltd.
Pencils:
American Lead Pencil Co.
Penstocks:
Canadian Vickers Ltd.
Horton Steel Works, Ltd.
Pacific Coast Pipe Co., Ltd.
Pile Drivers:
Industrial Works.
Pinions:
Hamilton Gear & Machine Co.
Jones & Glassco, Reg'd.
Pipe Coils:
Superheater Co., Ltd.
Pipe, Concrete:
Jno. E. Russell Co., Ltd.
Pipe Couplings, Union:
Dart Union Co., Ltd.
Pipe Fittings:
Crane Ltd.
Pipe, Lead:
Steel Co. of Canada, Ltd.
Pipes, Cast Iron:
Canada Iron Foundries, Ltd.
Gartshore-Thomson Pipe and Foundry Co., Ltd.
General Supply Co., of Canada Ltd.
Kennedy & Company, Ltd.
National Iron Corp., Ltd.
Pipe Insulations:
Canadian Johns-Manville Co., Ltd.
Pipe Lock Bar:
General Supply Co., of Canada, Ltd.
Pipe, Wood Stave:
Pacific Coast Pipe Co., Ltd.
Pipes, Reinforced Concrete:
Jno. E. Russell Co., Ltd.
Pipes, Wrought Iron:
Crane Ltd.
Planing Machines, Metal:
John Bertram & Sons Co., Ltd.,
Plate Rolls:
John Bertram & Sons Co., Ltd.,
Plates, Brass and Copper:
Openshaw & Bennet, Ltd.
Plates, Steel:
British Empire Steel Corp., Ltd.
Canadian Vickers Ltd.
Hamilton Bridge Works Co., Ltd.
Vulcan Iron Works, Ltd.
Plumbing Material:
Crane Ltd.
Pole Line Hardware:
Canadian Line Materials, Ltd.
Posts, Indicator:
Jenkins Bros., Ltd.
Porcelain, Insulators:
Dominion Insulator & Mfg. Co., Ltd.
Pot Heads:
G. & W. Electric Specialty Co.
Power Apparatus:
Northern Electric Co., Ltd.
Power Plant Equipment:
Babcock-Wilcox & Goldie-McCulloch Ltd.
Combustion Engineering Corp., Ltd.
Canadian Vickers Ltd.
Midwest Canada Limited.
Presses, Hydraulic:
John Bertram & Sons Co., Ltd.
Propellor Wheels:
Canadian Vickers Ltd.
Wm. Kennedy & Sons, Ltd.
Pulp Mill Machinery:
Dominion Engineering Works, Ltd.
William Hamilton Co., Ltd.
Pulp Pumps:
De Laval Steam Turbine Co.
Pulpwood Machinery:
Canadian Vickers Ltd.
Pulverized Fuel Systems:
Combustion Engineering Corp., Ltd.
Under-Feed Stoker Co., of Canada, Ltd.
Pump Governors:
Under-Feed Stoker Co., of Canada, Ltd.
C. A. Dunham Co., Ltd.
Pump Valves:
Jenkins Bros., Ltd.
Pumps:
Canadian Fairbanks-Morse Co., Ltd.
Dominion Engineering Works, Ltd.
General Supply Co., of Canada, Ltd.
Jones & Glassco, Reg'd.
Mussens Limited.

Consult the advertiser, his information is valuable.

Purchaser's Classified Directory

Pumps and Condensers:
Babcock-Wilcox & Goldie-McCulloch Ltd.

Pumps, Centrifugal:
De Laval Steam Turbine Co.
Dominion Engineering Works, Ltd.
Laurie & Lamb.

Pumps, Hydraulic:
Taylor Stoker Co., Ltd.

Pumps Oil:
Taylor Stoker Co., Ltd.

Punches and Punch Dies:
Pratt & Whitney Company of Canada, Ltd.

Punches and Shears:
John Bertram & Sons Co., Ltd.

R

Radiator Traps:
Canadian Johns-Manville Co., Ltd.

Radiator Valves:
Jenkins Bros.. Ltd.

Radio Receiving Sets:
Northern Electric Co., Ltd.

Rail Bonds:
Dominion Insulator & Mfg., Co. Ltd.

Rail Joints:
Rail Joint Co., of Canada, Ltd.

Rail Saw (Portable):
Industrial Works.

Rails:
Algoma Steel Corp., Ltd.
British Empire Steel Corp., Ltd.
Burlington Steel Co., Ltd.
F. H. Hopkins & Co., Ltd.
Steel Co. of Canada, Ltd.

Railroad Spikes:
Steel Co., of Canada, Ltd.

Railway Equipment:
Canadian General Electric Co., Ltd.

Rawhide Pinions:
Hamilton Gear & Machine Co.

Rawlplugs:
Dominion Engineering Agency Ltd.

Reamers:
Pratt & Whitney Co., of Canada, Ltd.

Recording Instruments:
Combustion Engineering Corp., Ltd.

Refrigerating Machinery:
Taylor Stoker Co., Ltd.

Reinforcing Steel:
Burlington Steel Co., Ltd.
Midwest Canada Limited.
Trussed Concrete Steel Co., of Canada, Ltd.

Rivets:
British Empire Steel Corp., Ltd.

Road Oils & Preservatives:
Barrett Co., Ltd.

Road Rollers:
Dominion Insulator & Mfg. Co., Ltd.
Mussens Limited.

Rock Drills, Air and Steam:
Lancashire Dynamo and Motor Co., of Can. Ltd.

Rods, Steel:
British Empire Steel Corp., Ltd.

Roofing, Prepared:
Barrett Co., Ltd.

Rolling Mill Rolls:
Canadian Steel Foundries Ltd.

Roofs, Built up, Felt & Pitch:
Barrett Co., Ltd.

Roofing, Asbestos and Prepared:
Canadian Johns-Manville Co., Ltd.

Roofs, Asbestos Built up:
Canadian Johns-Manville Co., Ltd.

Roofing, Asbestos Ready-to-lay:
Canadian Johns-Manville Co., Ltd.

Roofing, Corrugated Asbestos:
Canadian Johns-Manville Co., Ltd.

Rope, Wire:
Dominion Wire Rope Co., Ltd.
Mussens Limited.

Rubber Goods, Mechanical:
Jenkins Bros., Ltd.

S

Safes:
Babcock-Wilcox & Goldie-McCulloch Co., Ltd.

Sash, Steel:
Trussed Concrete Steel Co., of Canada, Ltd.

Sawmill Chains:
Link-Belt Ltd.

Sawmill Machinery:
William Hamilton Co., Ltd.

Scales:
Canadian Fairbanks-Morse Co. Ltd.

Screening Equipment:
Canadian Vickers Ltd.
Link-Belt, Ltd.
Mussens Limited.

Screw Blanks, Lead:
Cumberland Steel Co.

Series Cut Outs:
G. & W. Electric Specialty Co.

Sewer Pipe:
Jno. E. Russell Co., Ltd.

Shaft Couplings, Flexible:
De Laval Steam Turbine Co.

Shafting, Anchorage:
Midwest Canada, Ltd.

Shafting, Cold Drawn:
Cumberland Steel Co.

Sheathing:
Barrett Co., Ltd.

Sheets:
Steel Co., of Canada Ltd.

Shingles, Asbestos:
Canadian Johns-Manville Co., Ltd.

Shingles, Prepared Asphalt:
Barrett Co., Ltd.

Skip Hoists:
Combustion Engineering Corp., Ltd.
Link-Belt Ltd.
Mussens Limited.

Sleeping Robes:
Grant-Holden-Graham, Ltd.

Smoke Stacks:
Canadian Vickers Ltd.
Combustion Engineering Corp., Ltd.
Horton Steel Works, Ltd.

Sodas:
Nichols Chemical Co., Ltd.

Speed Reducers, Gear:
Hamilton Gear & Machine, Co.

Spikes:
British Empire Steel Corp., Ltd.

Springs:
B. J. Coghlin Co., Ltd.

Sprinkler Tanks:
Horton Steel Works, Ltd.

Stair Steps, Safety:
Irving Iron Works Co.

Staples:
British Empire Steel Corp., Ltd.

Steam Heating Specialties:
C. A. Dunham Co., Ltd.

Steam Shovels:
F. H. Hopkins & Co., Ltd.
Mussens, Ltd.

Steam Traps:
C. A. Dunham Co., Ltd.
Canadian Johns-Manville Co., Ltd.

Steel, Ground Alloy:
Cumberland Steel Co.

Steel Head Frames:
Hamilton Bridge Works Co.,Ltd.

Steel Pipe:
Horton Steel Works, Ltd.

Steel Plate Construction:
Horton Steel Works, Ltd.

Steel Shafting:
Cumberland Steel Co.

Steel Stacks:
Midwest Canada Limited.

Stokers:
Combustion Engineering Corp Ltd.
Under-Feed Stoker Co., of Canada, Ltd.

Stokers, Side-feed:
Combustion Engineering Corp. Ltd.
Under-Feed Stoker Co., of Canada, Ltd.

Stokers, Under-feed:
Combustion Engineering Corp., Ltd.
Taylor Stoker Co., Ltd.
Under-Feed Stoker Co., of Canada, Ltd.

Stone Crushers:
General Supply Co., of Canada, Ltd.
Mussens Limited.

Structural Steel:
Algoma Steel Corporation, Ltd.
British Empire Steel Corp., Ltd.
Canadian Bridge Co., Ltd.
Canadian Vickers Ltd.
Hamilton Bridge Works Co.,Ltd.
Standard Steel Constrn.Co.,Ltd.
Steel Co. of Canada, Ltd.
Vulcan Iron Works, Ltd.

Superheaters:
General Supply Co., of Canada, Ltd.
Superheater Co., Ltd.

Switches, Disconnecting:
Canadian Line Materials, Ltd.

Switchboards, Power Lighting:
Canadian General Electric Co., Ltd.
Canadian Johns-Manville Co., Ltd.

Switchgears:
Lancashire Dynamo and Motor Co. of Can. Ltd.

T

Tanks, Cylindrical:
Horton Steel Works, Ltd.

Tanks, Oil:
Horton Steel Works, Ltd.

Tanks, Steel:
Canadian Vickers Ltd.
Horton Steel Works, Ltd.
E. Leonard & Sons, Ltd.

Tanks, Wood Stave:
Pacific Coast Pipe Co., Ltd.

Taps:
Pratt & Whitney Co., of Canada, Ltd

Tar:
Barrett .Co., Ltd.

Tents:
Grant-Holden-Graham, Ltd.

Tie Plates:
British Empire Steel Corp., Ltd.

Tools, Small:
Pratt & Whitney Co., of Canada. Ltd.
E. Leonard & Sons, Ltd.

Tools, Wrecking:
Industrial Works.

Track Tools:
B. J. Coghlin Co., Ltd.

Tractors:
Mussens Limited
F. H. Hopkins & Co., Ltd.

Transfer Tables:
Industrial Works.

Transformers, Lighting & Power:
Canadian General Electric Co., Ltd.

Transmission Machinery:
Link-Belt Ltd.

Trolley Materials:
Dominion Insulator & Mfg. Co., Ltd.

Tubing, Seamless Steel:
Openshaw & Bennet Ltd.

Turbines Hydraulic:
Boving Hydraulic & Engineering Co., Ltd.
Canadian Vickers Ltd.
Dominion Engineering Works, Ltd.
General Supply Co., of Canada, Ltd.

Turbines, Steam:
De Laval Steam Turbine Co.

Turbo Generators:
De Laval Steam Turbine Co.

U

Under-feed Stokers:
Combustion Engineering Corp., Ltd.
Taylor Stoker Co., Ltd.

Union Pipe Couplings:
Dart Union Co., Ltd.

V

Valve Boxes:
Jenkins Bros., Ltd.

Valve Files:
Jenkins Bros., Ltd.

Varnishes, Acid Resisting:
Dominion Paint Works, Ltd.

Varnishes, Insulating:
Dominion Paint Works, Ltd.

Valves:
Canadian Fairbanks-Morse Co., Ltd.
Crane Limited.
C. A. Dunham Co., Ltd.
Dominion Engineering Works, Ltd.
Jenkins Bros., Ltd.
Kerr Engine Co., Ltd.

Valves, Automatic Cut-off:
Under-Feed Stoker Co., of Canada, Ltd.

Valves, Penstock:
Dominion Engineering Works, Ltd.

Valves, Regulating:
C. A. Dunham Co., Ltd.
Under-Feed Stoker Co., of Canada, Ltd.

Valves, Relief:
Under-Feed Stoker Co., of Canada, Ltd.

Venturi Meters:
General Supply Co., of Canada, Ltd.

W

Washers:
British Empire Steel Corp., Ltd.

Water Meters:
Neptune Meter Co., Ltd.

Water Meters, Volumetric:
Canadian Johns-Manville Co., Ltd.

Water Power Plant Machinery:
Canadian Vickers Ltd.
Wm. Kennedy & Sons, Ltd.

Waterproofing:
Barrett Co., Ltd.
Canadian Johns-Manville Co., Ltd.

Water Softening Plants:
Laurie & Lamb.

Waterworks Constructional Articles:
Lincoln Electric Co., of Canada, Ltd.

Welding Machines, Electric and Accessories:
Canadian General Electric Co., Ltd.
Canadian Westinghouse Co., Ltd
Dominion Insulator & Mfg., Co., Ltd.
Lincoln Electric Co., of Canada, Ltd.

Wharf Cranes:
Industrial Works.

Wheelbarrows:
Bateman-Wilkinson.

Winches:
Taylor Stoker Co., Ltd.

Wire:
British Empire Steel Corp., Ltd.
Steel Co.,of Canada, Limited.

Wire Bag Ties:
Bates Valve Bag Co.

Wire Bar Ties:
Bates Valve Bag Co.

Wire Mesh:
Trussed Concrete Steel Co., of Canada, Ltd.

Wire Rope:
Dominion Wire Rope Co., Ltd.
F. H. Hopkins & Co., Ltd.

Wires and Cables:
Northern Electric Co., Ltd.

Wood Grapples:
Industrial Works.

Wood Preservations:
Barrett Co., Ltd.

Woodruff Key Cutters:
Pratt & Whitney Company of Canada, Ltd.

Worm Gear:
Hamilton Gear & Machine Co.
Link-Belt Ltd.

Worm Reduction Gears:
De Laval Steam Turbine Co.

Wrecking Cranes:
Industrial Works.

Wrecking Tools:
Industrial Works.

Members are urged to consult The Journal's advertising pages.

INDEX TO ADVERTISERS

PROFESSIONAL CARDS

Left — A fine stretch of highway.
Top — Showing the "Black Base" foundation.
Right — Near Allanburg.

Another "Black Base" Highway

Nearly six miles of this modern type of Asphalt pavement is rapidly nearing completion on the Provincial Highway from Allanburg to Niagara Falls. Utilizing the old macadam road for a foundation, the new construction consists of 3½" of Black Base topped by 1½" of stone-filled Sheet Asphalt.

This type of pavement has all the well-known advantages of Asphalt and in addition embodies increased flexibility, greater resiliency, complete waterproofing of the subgrade, quicker construction, the use of the same materials throughout, simple maintenance yet costs substantially less.

The work is being done by the Law Construction Co. Limited, under the supervision of Resident Engineer A. N. Fellowes, for the Department of Public Highways of Ontario.

IMPERIAL Asphalt PRODUCTS

Imperial Oil Limited

ROAD ENGINEERING DEPARTMENTS AT

Toronto Vancouver Montreal