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The Canadian Engineer

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Stream Regulation in Quebec Province

Lakes St. Francis and Aylmer Now Used as Storage Basins, Increasing Power by 7,450 H.P.—Total Fall of the St. Francis River is 900 Ft., Affording Important Possibilities For Development—From Annual Report Prepared Under Direction of

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Chief Engineer, Quebec Streams Commission

PARTIAL regulation of the flow of the St. Francis River by the storage of water in Lakes St. Francis and Aylmer has been completed. Lake St. Francis is located at the head of the St. Francis River, in the County of Frontenac, P.Q. Its watershed has an area of 472 square miles, and the lake has an area of 13 square miles

St. Francis Storage Dam

at natural high water. Lake Aylmer, located between the town of Disraeli at its head and the village of St. Gérard near its outlet, has a watershed of 135 square miles. Its area is 10 square miles.

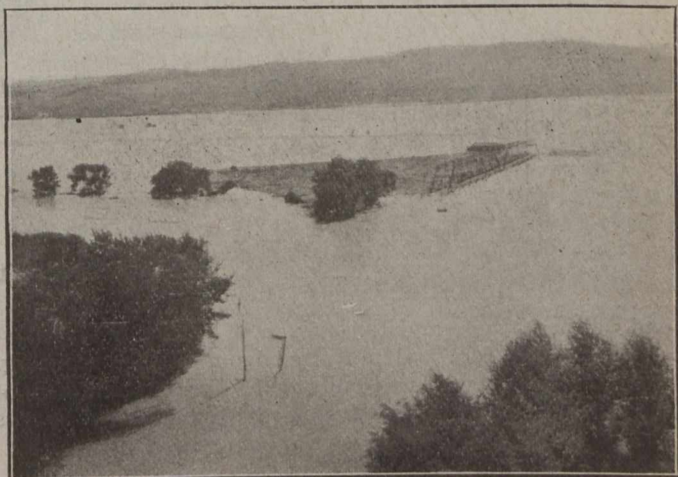
The water from these two lakes was partially stored by dams owned by the Brompton Pulp and Paper Co. Surveys made in 1914 have shown that it was possible to completely store the water from Lake St. Francis watershed by building a dam, the crest of which would be 15 feet higher than the company's dam. As to Lake Aylmer, its capacity under existing conditions was sufficient to store the water from its own watershed. But it would not be practicable to raise the water surface of this lake owing to considerable damage to the Quebec Central Railroad and the adjacent municipalities.

The Quebec Streams Commission was authorized to construct those works during the 1915 session of the Quebec Legislature. To avoid a double control of the storage in both lakes, it was advisable to acquire the rights of the Brompton Pulp and Paper Co to the existing improvements. It was the only sure way by which all the power users could be placed on the same basis. The value of the rights of the company and its improvements was submitted to arbitration.

The increase to the water-powers developed on the St. Francis River has been estimated at 7,450 horsepower-year, as follows:—

St. Francis Hydraulic Company	1,212 h.p.-year
Compagnie Champoux	606 "
Two Mile Falls (City of Sherbrooke	1,191 "
Brompton Pulp & Paper Co....	3,340 "
Canada Paper Company	630 "
Southern Canada Paper Company	471 "
Total	7,450 h.p.-year

The construction of the Lake St. Francis dam was completed in December, 1917. The work had to be stopped in the beginning of April, when it was found that it could not be completed before the spring floods, and it was necessary that sufficient openings be left to take care of



St. Joseph de Beauce Bridge During Chaudiere River Flood

the said floods. We had proposed to start work immediately after the driving of logs was finished, in the early part of June, but on account of the floods, which occurred in the month of June, it was possible to resume work in the latter part of the summer only.

The fact that we had to provide for a discharge of water sufficient for the requirements of the power users below, rendered the unwatering of the river quite difficult. For some time in October, the amount of water discharged had to be reduced below that required by the St. Francis Hydraulic Co. This company had to operate its auxiliary steam plant for a few weeks.

The dam is now in operation. The machinery for the lifting of the gates is working satisfactorily. It is likely that a shed will be built over that machinery to protect it against the weather. This construction could be done cheaply next summer.

During the floods in the spring and in the month of June, a large volume of water passed through the openings left in the dam for that purpose. Between piers 21-22, a width of 15 feet, there was on June 19th a discharge of 6,000 second-feet. The bed of the river downstream from this opening was scoured to a maximum depth of ten feet for a length of about ninety feet.

In October this hole was filled with concrete mixed in the proportions 1 :2½ :5, to which was added about 40% of boulders. A cut-off wall was built at the downstream end of this filling, and the bottom of the river was covered with boulders and protected from further scouring. A similar cut-off wall was built at the downstream edge of the apron. It is believed that these additional works will protect the river bottom from being washed out.

During construction it was thought advisable to build a concrete spillway deck in two spans of the spillway, so that the water let out from these two openings should not fall on the base of the dam but would be directed to the downstream apron, thus eliminating the impact due to the fall. Moreover, these two openings, which are adjacent to the log sluice, may be used to pass logs should an accident render the regular sluice not sufficient. The above drawing shows the construction details of these two decks.

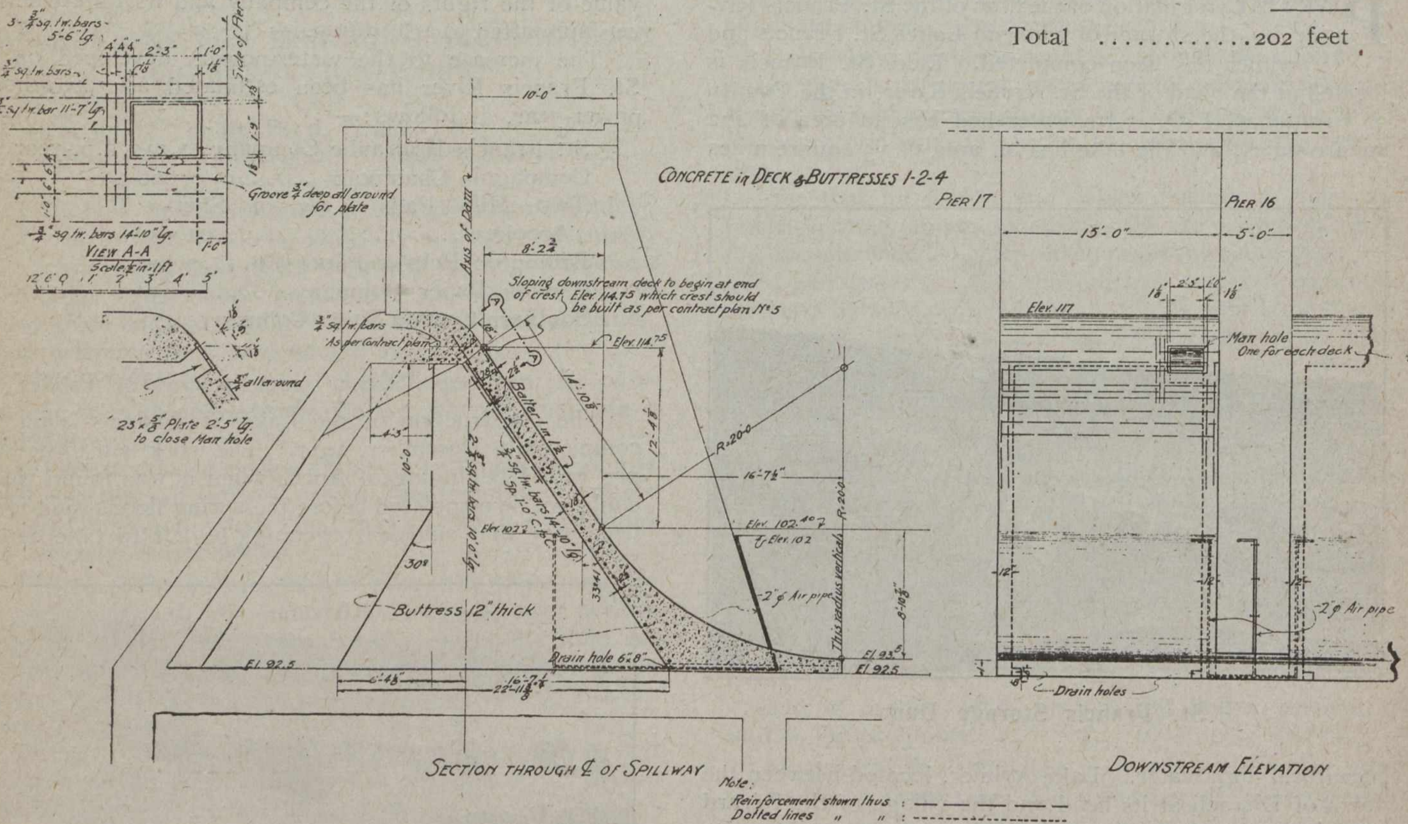
The work on the dam was carried out under the supervision of A. O. Bourbonnais, assisted by a small staff. There was at the site a small laboratory for the testing of cement and sand, under the charge of J. C. Legendre.

To guide the floating logs to the sluices in the dam will require booms and anchor piers. The timber required for the construction of the piers has been delivered at the dam. They will be built next summer. The booms will be supplied by the lumber companies.

Water Powers on St. Francis River

The total fall along the St. Francis River, from Lake St. Francis to the St. Lawrence, is about 900 feet. The water-powers due to this fall are very important. They have been developed for a total of 202 feet as follows:—

Disraeli	60 feet
Weedon	30 "
East Angus	55 "
Bromptonville	29 "
Windsor Mills	16 "
Drummondville	12 "
Total	202 feet



Spillway Deck, St. Francis Storage Dam

At the request of the Department of Lands and Forests, we have started to study the undeveloped water-powers on this river. P. E. Bourbonnais made a complete survey of three of these powers, namely: Westbury Rapid, the rapid above Ascot Corner and the Ulverton Rapid. A lay-out for a complete development of each of these water-powers will be made.

Following are extracts from the reports made by Mr. Bourbonnais:—

Westbury Rapids

"The Westbury Rapids are located on the St. Francis River, about three miles above the town of East Angus, in the townships Westbury and Dudswell, in the counties of Compton and Wolfe. They comprise Westbury Rapid proper, above the point called 'The Basin'; the rapid Ledge, the rapid Tardif and a small rapid where the river is crossed by the Maine Central Railroad.

"At the head of these rapids is a flat section of the river, called the dead waters, which extends a distance of four miles as far as the highway bridge at Bishop's Crossing. Along this latter part the shores of the river are low and would not be suitable for any power development. At the foot of the rapids, there is another flat section called 'The Basin'—the water surface of which is the same as that in the pond above the dam of the Brompton Pulp & Paper Co., located near the mouth of the Eaton River (near East Angus), two miles below the rapids herein described.

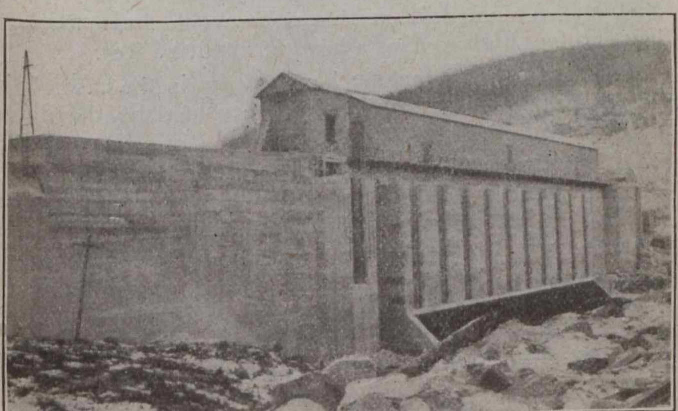
"We have made a survey of the St. Francis River between the Basin and the dead waters. Base lines were run on the two shores and connected by triangulations, checked and plotted by latitudes and departures. Special attention was paid to the location of the lands bordering the Quebec Central Railroad, and the lines dividing the lots bordering the river. Permanent stations were established at both ends of the survey and at all the triangulation points. The location of these stations have been referred to blazed trees, stumps or marked hubs.

Survey of St. Francis River

"A complete system of levels was run on these base lines, and the different elevations were referred to a benchmark located on a rock on the north shore, opposite the Westbury Rapid. The benchmark was assumed to be at elevation 100. Later on, Eloi Duval, C.E., making a precise levelling along this part of the river, called this point his benchmark No. 58, and found that our datum was 633.52 feet above mean sea level.

"Using our benchmark at elevation 100, it was found that on August 6th, 1917, the water surface at the Basin was 88.3, and the water surface at the dead waters above the bridge of the Maine Central Railroad was 115.6; the fall being, therefore, 27.3 feet in a distance of 22,500 feet or 4.25 miles.

"There is a possibility of using 25 feet of the fall between the head and the foot of the Westbury Rapids,



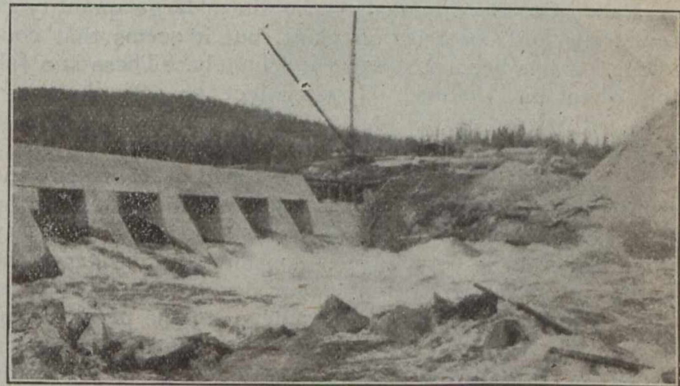
Upstream View of Sluice Gate Section, La Loutre Storage Dam

in building a dam that would back the water to the dead water part of the river. It is the most economical scheme possible. The idea of making three separate developments, namely, at Westbury, at the rapid Ledge and at rapid Tardif, is not practical. The heads would be low, and it is much better to construct the available fall in one single development.

"Records should be kept in the spring, so as to have more precise data regarding the water elevation of the Basin. It seems that the floor at the power-house should be built above elevation 95 and, in order to have the greatest possible head, use should be made of a penstock and draft-tube.

"The drainage area of the St. Francis River, above Westbury basin, has been measured on a map prepared by the Hydraulic Service of Quebec, to a scale of four miles to the inch. The area was found to be 1,240 square miles.

"But the dam which has been built by the Quebec Streams Commission at the outlet of Lake St. Francis, will store the run-off from a basin of 472 square miles, and



Temporary Sluices, La Loutre Storage Dam

will regulate this run-off to a minimum of 600 second-feet for every day of the year.

"The discharge at Westbury will thus be 600 second-feet, plus the run-off supplied by the drainage area between Westbury and the outlet of Lake St. Francis. That is, 1,240—472 = 768 square miles.

"From measurements made during the last four years, by the Commission, it was shown that the minimum run-off must be taken as being 0.25 second-foot per square mile, and the maximum run-off as being 20 second-feet per square mile. The minimum discharge at Westbury would thus be:—600 + 768 x 0.25 = 792 second-feet, say 800 second-feet.

"Over a head of 25 feet and assuming a wheel efficiency of 80% the minimum of water-power at Westbury will be 1,818 h.p. The maximum discharge will be the regulated flow let out plus the run-off supplied by 768 square miles multiplied by the run-off of 20 second-feet per square mile from the drainage area below the storage dam at Westbury. That is:—600 + 768 x 20 = 15,960 second feet, say 16,000 second-feet.

"Sufficient openings will have to be provided in the dam to make sure of the possible discharge at the rate of 16,000 second-feet during flood times, and to assure the regular sluicing of the logs.

Rapids Below East Angus

"From East Angus to Westbury Islands, the St. Francis River is not deep and contains a large percentage of boulders. At certain points, the bed of the river is made up entirely of boulders, which give the impression that the grade is high; but the profile shows a uniform grade, and none of these rapids can make the object of special study. From the Westbury Islands downstream, the river is flatter, the shores are nearer level and the valley is pretty large. From a water-power standpoint, the part of the river above the islands is the only one that can be used. A complete topographic survey was made from these islands as far as the dam of the Brompton Pulp & Paper Co. at East Angus.

"At about 1,000 feet above the Westbury Islands, the Brompton Pulp & Paper Co. has chosen a site for a dam and a hydro-electric power plant, which power would be transmitted to its mills at East Angus. Taking into consideration the development of the largest head possible between this point and the foot of the dam at East Angus, this site seems the most suitable.

"On the south shore the face of the rock may be seen for a distance of about ten feet, but I have been informed that borings were made to a great depth in the centre of the river and on the north shore, without finding the rock or impervious ground desired. The Brompton Pulp & Paper Co. have hauled to the site a large quantity of materials and construction plant, but it seems that construction has been postponed indefinitely. There is a fall of 40 feet in a distance of 25,300 feet, or 4.8 miles.

Minimum Power, 3,272 H.P.

"To use the maximum possible head of 40 feet by the construction of a dam which would back the waters to the tail race of the dam at East Angus, it would be necessary to provide in the dam sufficient openings to discharge the maximum flow and prevent the back water from decreasing the head at East Angus. Owing to the pervious nature of the ground, a considerable amount of protection work will have to be made on the north shore where the land, after reaching elevation 95.6 at the top of the bank, slopes down for a certain distance. The scheme may be realized, but precautionary measures will have to be taken.

"A dam could be built to raise the waters to less than 40 feet, and it would offer a larger measure of safety against infiltration. It would then be possible to discharge the water by a spillway, thereby rendering the construction much simpler. A development for a head of 35 feet would be more desirable.

"At the site of the proposed dam, the drainage area of the St. Francis River is 1,624 square miles. It was measured on a map prepared by the Hydraulic Service of Quebec.

"As in the case of the Westbury development, one must consider the regulation obtained from the storage dam at the outlet of Lake St. Francis, which will regulate the run-off from a drainage area of 472 square miles to a minimum uniform discharge of 600 cubic feet per second.

"The flow of the river at Westbury Islands will be 600 cubic feet per second plus the amount of water supplied by the drainage area between the lake and this point, that is: 1624—472 = 1152 square miles.

"Taking as a minimum, the run-off of 0.25 second-foot per square mile, and for a maximum of run-off of 20 second-feet per square mile, the minimum discharge would be:—600 + 1,152 x 0.25 = 888 second-feet, say 900 second-feet.

"And for maximum discharge:—600 + 1,152 x 20 = 23,640 second-feet, say 23,600 second-feet.

"In developing upon a total head of 40 feet, and assuming a wheel efficiency of 80%, the minimum power available will be 3,272 h.p. A development with a head of 35 feet would give under the same conditions a minimum of 2,846 h.p. It will be necessary to provide in the dams, sufficient openings to allow the discharge of a maximum of 23,600 second-feet. It is said that the Brompton Pulp & Paper Co. has under option most of the land that would be affected by this development.

Ulverton Rapid

"The Ulverton Rapid is located about seven miles below the town of Richmond and divides the townships of Durham and Kingsey, in the county of Drummond. It takes its name from the village of Ulverton located on the public highway about one mile west of the river.

"The rapid proper extends for a distance of 1,700 feet and has a total fall of 11 feet. The part of the river preceding the rapid has a good slope as far out as the mouth of the Black River,—part of which slope could be used to increase the head of a development. Above this point, the slope of the river is nearly uniform and at the rate of one and a half feet per mile.

"It was found on September 5th, 1917, that the water surface was 346.1 at the foot of Ulverton Rapid, 357.3 at the head of Ulverton Rapid, and 367.0 below the Grand Trunk Railway bridge.

"As to the possibility of development, the Ulverton Rapid offers one of the most suitable sites upon the whole course of the river. The shores are high and steep, and would permit the construction of a very high dam, if need be. The solid rock is exposed on both shores and no large amount of excavation would be required.

"It has appeared to us that the best site for a dam is in the rapid itself at the most important fall, and on a rock ledge extending almost completely across the river. The water surface was 348.20 and the current was so swift that we could not possibly take soundings.

Maximum Discharge, 60,000 Second-Feet

"Should a dam be built at this point, it would be necessary to locate the power-house at the foot of the rapid and bring the water to the turbines by a penstock, by raising the water at the head race to elevation 365, the mills operating under a head of 20 feet. There is a possibility of increasing this head by three or four feet by the building of a tail race canal, which would lead the water to the foot of the swift current below the rapid. This particular side of the scheme deserves to be studied from its financial standpoint.

"Another site for a dam was also examined at the foot of the rapid, and soundings were made about 35 feet downstream, giving a full idea of the depth of the water in the river. In the channel we have noted a depth of over 25 feet. A dam built at this point would have to be at least 50 feet high to give a head of about 20 feet.

"The cost of the penstock, necessary in the case of the first dam, would certainly be compensated by the difference in the cost of the two dams.

"The drainage area of the St. Francis River, at Ulverton Rapid, is 3,456 square miles, measured on the Hydraulic Service map. Taking the figures obtained by The Quebec Streams Commission for a minimum run-off of 0.25 second-foot per square mile, and for the maximum run-off of 20 second-feet per square mile, the minimum run-off at Ulverton Rapid would be:—600 second-feet plus (3456—472) 0.25 = 1346 second-feet, say 1350 second-feet.

"Or, assuming that the head of 20 feet is used and a wheel efficiency of 80%, the minimum power would be 2,454 h.p. The maximum discharge would be:—600 plus (3456—472) 20 = 60,380 second-feet."

Rainfall

The amount of rain and snow which has fallen in the valley of the St. Francis River was measured at Lambton, Disraeli, Sherbrooke and Drummondville.

The station at Lambton was established in 1915; that at Disraeli was established in 1907. The Sherbrooke station was established in 1904, at the Seminary, and is under the direction of Rev. P. A. Begin, who has kindly

(Concluded on page 411)

Letter to the Editor

INCRUSTATION IN VANCOUVER SEWER PIPE

Sir,—The City of Vancouver began to use machine-made concrete pipe in the year 1909, and up to the end of 1917 had laid probably over ten miles of this class of sewer pipe in sizes from 8 to 30 inches in diameter. The specification upon which the contract for the supply of this pipe was based was as follows:—

"All cement concrete pipe supplied under this contract shall be the very best of machine tamped pipe manufactured. They shall be composed of a mixture of portland cement and fine crushed granite, or portland cement and clean, coarse, sharp sand or fine gravel. Sufficient clean water is to be used in the mixture to insure its thorough hydration. The inside or the wearing surface of the pipe shall be trowelled by the use of a revolving metal core until it presents a polished or glazed appearance. The pipes must be capable of withstanding an inside hydraulic pressure of thirty pounds per square inch for fifteen minutes, and pipe when placed in an upright position and filled with water must be sufficiently non-porous to retain ninety-five per cent. of the water for twenty-four hours. Each pipe must not be less than two feet in length, and of not less than the following thicknesses: 4-inch, ¾-inch; 6-inch, ⅞-inch; 8-inch, 1-inch; 10-inch, 1⅛-inch; 12-inch, 1¼-inch; over 12-inch, not less than one-eighth of their diameter. Pipes 18 inches in diameter and under are to have spigot and socket joints, similar to those specified in Clause 11 for clay pipe; those over 18 inches in diameter, grooved and tongued joints of approved pattern."

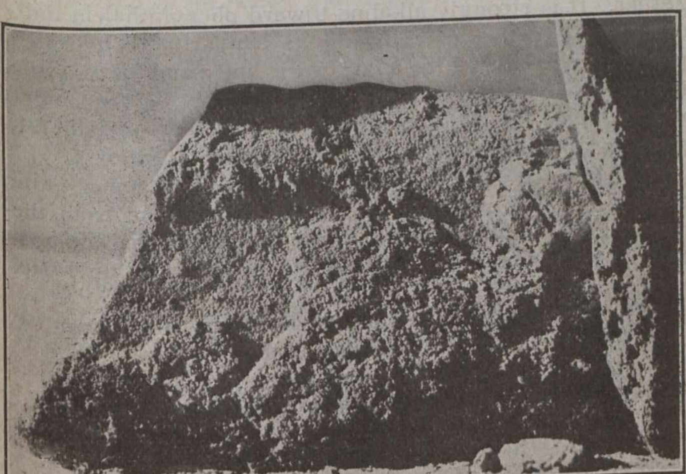


Fig. 1—Sample of Incrustation on Inner Surface of Vancouver Sewer Pipe—Natural Size

No stipulation was made as to the proportions of the materials entering into the construction of the pipe, as it was considered best that the manufacturers should be responsible for their product. It is however known that the proportion of cement in the pipes hereinafter described was not less than one of cement to three of aggregate, though the manufacturers afterwards made pipe which they claimed to be of superior quality, with the proportion of one of cement to five of aggregate.

In the year 1915 some pipe of 12 and 14 inches in diameter, which had been laid in 1913 as temporary outlets pending the construction of a trunk sewer, was taken up and found to be so fragile that it was impossible to use it for relaying elsewhere. This led to an examination of other sewers, but as the small sizes could only be looked into where they entered large trunk sewers, a more thorough examination was confined to sizes over 20 inches in diameter.

The conditions found in two sewers, one of 24 inches laid in 1910, and carrying combined sewage from a residential section, and one of 27 inches, laid in 1909, carrying storm water only, are here described.

For examination of the 24-inch sewer the sewage was blocked off and pumped from a manhole into an adjoining sewer on another system. Two lines of fire-hose were used to flush the sewer, which had a grade of one per cent., and a rope was floated down by which a small bogie carrying the observer was pulled through the sewer, the hose being kept running.

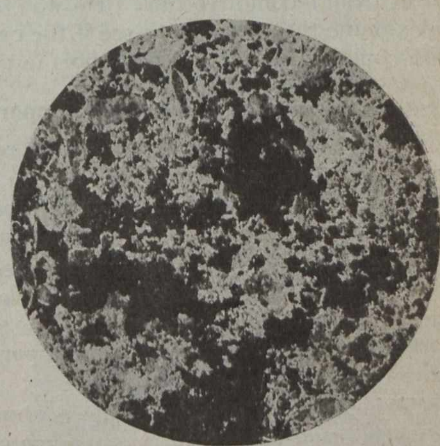


Fig. 2—Sample of Concrete from Vancouver Sewer Pipe, Magnified Two Diameters—Black Areas Indicate Voids

Previous observation on large defective pipe, and examination from the trunk sewers of some small sized pipe which showed a stalactitic deposit on the crown, caused attention to be directed at first to the crown of the sewer. It had only been entered a short distance when the bogie jammed through the piling up of material in front of the wheels, and the observer had to be pulled back.

The sewer maintenance foreman then volunteered to go through the sewer without keeping the hose running, so as to locate and remove the obstruction. In the dry sewer it was seen that the obstruction was not caused by sand or road debris left in it, but that on each side of the sewer at the level of the ordinary dry flow, about four inches above the invert, there was a thick incrustation of material which looked very much like lime mortar, and that the wheels of the bogie broke this material and formed the obstruction. It was also found that in spite of the prolonged flushing in the endeavor to cleanse the sewer for examination, paper and sewage still adhered to the rough edges of this incrustation.

A 27-inch sewer carrying storm water only was then examined, and similar conditions found; so that it was evident that the incrustation was not caused by sewage. Many other sewers of the same class of pipe were examined, and it was found that the presence of this incrustation was most marked where the pressure of ground water was most evident. In one sewer where the pipes had been laid in tunnel and covered with coarse concrete, incrustation was only found at one or two joints; and in sewers built of concrete in situ, the same thing applied, the continuous scale on the water line of the sewer being peculiar to the machine-made pipe.

The sewer maintenance foreman had often told the writer that the concrete pipe sewers took longer to flush clean than the vitrified pipe sewers; and if incrustation of the character herein described is general in the smaller sizes, the reason is obvious. In the 24-inch pipe carrying sewage, the obstruction to flow was most marked. This must tend to make a foul sewer and lead to the formation of sewer gas, which in itself is prejudicial to concrete and will tend to shorten the life of the sewer.

Charles A. Newhall, of the Charles A. Newhall Co., Inc., chemical and inspecting engineers, of Seattle and Vancouver, had described to the Pacific North-West Society of Engineers, in Seattle, the results of his investigation in several concrete-lined railway tunnels, and the effect on the concrete of the percolation of ground water and the gases from locomotive fuel. He was invited by the writer to examine these sewers to see if the cause of the incrustation could be found, and his report in part is as follows:—

Mr. Newhall's Report

"We herewith submit to you the result of our investigations on concrete sewer pipe laid in Georgia Street and Glen Drive, Vancouver. Concrete pipe in stock and samples removed from sewer were also examined.

The Georgia St. sewer was entered from a man-hole west of Jervis Street. With the aid of a rope and dollie the writer was pulled up through the sewer toward Jervis Street and thus was able to make a personal and thorough examination.

This sewer has been in place about eight years and has been used only to carry storm water. The pipe is 27" diameter inside, smooth finish; pipe said to be machine made, with mix of one volume cement to three of crushed granite, with enough water to give a semi-wet consistency. Judging from the inside appearance, the pipe was of good quality and made with care.

"We found that the lower side of the pipe, through practically the entire length of the sewer examined, was coated to a varying degree with a stiff, firmly adhering scale. (See Fig. 1). In places this scale had formed to a depth of three or four inches, these thick deposits being made up of several layers lying parallel to the surface of any water that would flow through the sewer. In places the thick scale would be cut through along the flow line of the sewer water, and only the edges and lower layer of the scale remained firmly adhering to the concrete pipe. In other places the scale had evidently just started to form or had been mostly scoured away, as only a slight roughness and coating was noticeable on the concrete bottom and sides of the pipe.

"In some sections, especially at the joints of the pipe, a thin scale or encrustation of somewhat different appearance than that just described was noted. This encrustation extended in streaks from the top or sides of the pipe down to the bottom, the surface of the encrustation being parallel to the inner surface of the sewer pipe. This encrustation in places was white in color and in others of a dirty grey color. It adhered very firmly to the surface of the concrete pipe. The concrete of the pipe was firm and hard on the inside surface. There was no softening noticeable under any of the encrustations or scales.

Examination of Glen Drive Sewer

"The Glen Drive sewer was entered by the man-hole at the intersection of 11th Ave. and the examination made on the section extending toward 12th Ave. The pipe carries the sewerage from a residence section and was in use at the time of our inspection. The sewer was rather foul and gassy hence we did not deem it wise to go up into it, but made our examination from the bottom of the man-hole into which the pipe opened. With the aid of a flash light and a long pole we were able to make a thorough examination of the surface for a distance of ten feet up the sewer. In this ten feet, encrustations and scale similar to those noted in the Georgia St. sewer were observed.

"This sewer has been in the ground about seven years; is 24" inside diameter; said to be machine made, of a one to three mix, but gravel and sand instead of crushed granite.

"A section of the Glen Drive sewer had previously been taken up for examination and one of the pipes removed was examined in the city yard. This pipe was 24" diam., 24" long and 3" wall.

"The inside of the pipe showed a thin coating of scale on the lower or flow side; this scale being similar to the scale noted in the two sewers examined. Also a white encrustation was noted in the pipe, this encrustation extending from the high side of the pipe down toward the flow side.

"The inside of the pipe, aside from the encrustations, showed a good smooth concrete finish. The outside surface of the pipe had been pitted in places and softened to a depth of ¼" to ½" below the original surface. In these soft places the remaining concrete was so loose that it could be quite easily scraped away from the surface.

"Samples were taken of the thick scale from the Georgia St. sewer, the scale from the bottom of the Glen Drive sewer, and the white encrustation from the Glen Drive sewer.

Scale from the Georgia St. Sewer

"A green-grey scale, quite firm and coherent when wet, but turning dirty white and chalky when dry. The scale when examined under the microscope is found to consist of quartz and rock sand, wood shreds, organic matter and a very fine amorphous material like the "laitance" or scum that forms when portland cement is hydrated with too much water.

"This amorphous material binds the sand grains together. It is strongly alkaline toward phenolpthalein indicator; this further establishing its similarity to hydrated portland cement. Fine clay, very fine sand or organic matter—all substances that might possibly be the binder which holds the sand of the scale together—would not give an alkaline reaction with the above indicator.

"When the scale is thoroughly dried, it becomes quite chalky and it is possible to rub the coarse sand from the amorphous binding material. An analysis of the fine portion (which comprises 53% of the weight of the scale) shows as follows:—

"Silica and sand (insoluble matter) 77.10 per cent.
"Iron and aluminium oxides, 2.48 per cent.
"Calcium oxide, 6.77 per cent.
"Water and carbon di-oxide, 10.52 per cent.

Scale from Glen Drive Sewer

"Similar in general appearance to No. 1227. It contained shreds of lint and paper in addition to the other substances noted above.

"Silica and sand (insoluble matter), 72.74 per cent.
"Iron and aluminium oxides, 5.30 per cent.
"Calcium oxide, 10.50 per cent.
"Water and carbon di-oxide, 11.40 per cent.

Encrustation from Glen Drive Sewer

"This material contained a small amount of very fine sand, together with wood and paper shreds, lint and organic matter.

"Silica and insoluble matter, 21.54 per cent.
"Iron and aluminium oxides, 2.48 per cent.
"Calcium oxide, 30.94 per cent.
"Water and carbon di-oxide, 41.02 per cent.

"In these three samples the point of interest is the calcium oxide content. The sand portion contains no soluble calcium compounds. Samples of soil along the line of this sewer had already been examined by a reputable firm of chemists. From a study of their report it is certain that the calcium compound could not have come from the soil or ground water. All this gives the clue to the origin and cause of the scale and encrustations.

"Now it can be easily demonstrated that as weak an acid as carbonic will decompose cement, provided enough fresh surface is exposed to the action of this acid. Hard, sound, neat cement pats can be dried and finely powdered. This powder can be exposed to the action of water containing carbonic acid. Eventually all the calcium oxide of the cement will go into solution as calcium bi-carbonate.

"All soil water contains organic acids, among which is carbonic acid. Thus if ground water should seep through the walls or joints of a sewer pipe the calcium oxide of the cement would gradually pass into solution and eventually the pipe would disintegrate.

"Just this thing is happening in all the concrete sewer pipe where the encrustations and scales are appearing. Ground water and sewer water gradually dissolves the cement and carries the calcium oxide into solution as calcium bi-carbonate. This water charged with the calcium bi-carbonate, and the scourings of the hydrated cement from the walls of the sewer, unite to form a normal calcium carbonate which binds the cement scourings, sand and other float in the sewer into a fairly hard scale.

"The cement pipe itself furnishes the binding medium whereby any sand and float is held in the sewer, i.e., the calcium bi-carbonate which is formed from the solution of the calcium oxide of the hydrated cement.

Can Obtain Non-Porosity

"In a large heavy wall sewer or a thick mass of concrete, even if quite porous, the dissolving action of ground water will take place, but this point should be noted: Disintegration will stop just as soon as the flow of ground water through the concrete is stopped. In any sewer pipe or a mass of concrete, this flow of water will depend strictly on the head of the water and of the porosity or void space of concrete. If the flow is rapid and the cement is dissolved and disintegrated before the silt and mud flowing along with the ground water plug up the pores, the concrete will go to pieces.

"This is the reason, we believe, why a porous drain tile will sometimes give good service when laid in clay soil, but a similar tile will go to pieces if laid in peat or sandy soil: The fine particles of clay plug up the pores of the concrete and keep the soil water away from the cement.

"Thus a thin walled cement pipe stands a far greater chance of being destroyed by ground waters than does a heavy walled pipe or a massive concrete wall. For this reason more trouble is to be expected with the small size pipe, say 30″ and under, where the wall is thin.

"It is entirely possible to make a concrete pipe that will meet this requirement of non-porosity if enough cement is used, or if a water-proofing medium is used, and if extreme care is taken in curing. A mixture of one part of cement with two and one-half parts of carefully graded sand would be none too rich. With a 1 to 5 mix, or a 1 to 3 mix, even if most carefully mixed and placed, it is absolutely impossible to get a moisture-proof concrete.

"Even with a well-made, dense concrete, there is, in the light of recent investigations and reports, a strong presumption that percolating waters will enter the concrete mass and eventually cause deterioration. In our investigations of concrete railway tunnel linings, we noted numerous cracks and fine fissures in the mass of dense, sound concrete. These cracks and fissures can only be formed by natural expansion and contraction due to temperature changes and to alternate wetting and drying of the concrete mass. Such movement is inherent in the nature of a substance like concrete, made up as it is of a mixture of crystalline fixed aggregates bound together with a glue-like colloidal substance.

"Once these cracks and fissures are formed, percolating waters gain entry and disintegration is bound to take place to some extent, the damage depending entirely on the amount of surface exposed by the cracks and fissures. Ordinarily in massive concrete the cracks quickly become plugged up by infiltering silts and by the products of disintegration and little or no damage is done. However, if the cracks or fissures occur in thin walls such as of small size sewer pipe, the concrete is likely to fail before disintegration can be checked by the natural causes.

"In two tunnels that we examined these disintegration cracks had not become noticeable till the concrete was over ten years old. Cracks subject to ordinary sulphate-free water became plugged up and disintegration stopped. On the other hand, sulphate waters caused the cement of the concrete to soften and swell to seven times the original volume, this causing a progressive disintegration that gradually eats into the concrete mass.

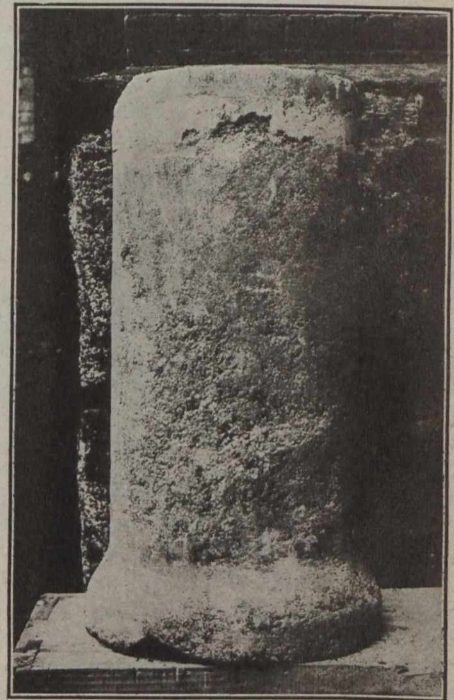


Fig. 3—Showing Disintegration on Outside of 12-inch Machine-Made Pipe Laid at Vancouver in 1913 and Taken Up in 1915

"Fig. 2 shows a magnified section of a piece of concrete taken from the wall of one of the sewer pipes in city yard—the pipe taken up from Glen Drive. This concrete, to the naked eye, appears very dense and of uniform texture, yet the microscope and magnifying glass show even more voids than shown in the print. This print makes it easy to see how readily ground water would pass through the walls of the pipe. This same sample from which the print was made gave an absorption of 8.8%, thus indicating a fairly dense concrete, as far as ordinary requirements go. In other words, a low absorption test is not always proof of density. A glazed surface may cause a low absorption test, while the interior of the pipe is full of voids. Once the glaze is scoured away or eaten off, the ground water has easy access to the body of the concrete.

Conclusions

"1.—A troublesome scale and encrustation is forming in the concrete sewers of Georgia Street and Glen Drive.

"2.—The concrete sewer pipe in these two sections is subject to conditions that will eventually cause its disintegration.

"3.—The scale and encrustation are caused by accumulations of sand, sewerage matter and scourings from the walls of the concrete pipes; these materials being held together by calcium compounds derived from the cement of the pipe itself.

"4.—Percolating ground water and sewerage water are gradually passing through the pores of the cement pipe: the carbonic acid contained in these waters dissolving and disintegrating the cement of the concrete."

It appears to the writer that this is a matter of grave concern and is worthy of investigation by the chemists of the cement industries, so that some remedy may be found or otherwise that pipes made by this process be used only for carrying surface water where incrustation is not of so serious a character. It will be interesting to know if similar conditions have been found in other cities where these pipes have been used.

A. G. DALZELL,
Formerly Assistant City Engineer,
Vancouver (1908-18).

Vancouver, B.C., October 17th, 1918.

POWER COMPANIES CONSOLIDATE

COMPLETE control of the power situation on the United States side at Niagara Falls has been obtained by the Niagara Falls Power Co. as a result of consolidation with the Hydraulic Power Co. Announcement is made under date of October 31st, 1918, of the merger of the Niagara Falls Power Co., the Hydraulic Power Co. and the Cliff Electrical Distributing Co. (a small subsidiary concern owned by the Hydraulic Power Co.) The merged concerns will be operated under the name of the Niagara Falls Power Co., although it is rumored that the Hydraulic Power Co. interests predominate in the merger.

The Hydraulic Power Co. is entitled to use 6,500 c.f.s. of the 20,000 c.f.s. allotted by treaty as the permissible diversion from the Falls by United States concerns, while the entire remaining 13,500 c.f.s. has been used by the Niagara Falls Power Co. The equipment of the Niagara Falls Power Co. is said to be very wasteful, as the head utilized is comparatively low. Although authorized to generate 200,000 h.p., it is stated that not much more than half of that amount has actually been developed. The Hydraulic Power Co. has a more efficient plant, and it is said to have developed more power than the Niagara Falls Power Co.

It is thought that the merger will mean the early scrapping of the Niagara Falls Power Company's plant and the construction of a modern plant for the utilization, probably, of the whole 20,000 c.f.s. It is possible that this new plant may pattern after the Chippawa-Queenston development now being constructed on the Canadian side, utilizing the whole of the available 300-foot head.

The outstanding stock of the Hydraulic Power Co. amounts to $12,000,000 and the bonded debt is $6,500,000. The capital stock of the Cliff Electrical Distributing Co., which was incorporated to handle the transmission lines of the Hydraulic Power Co., amounts to $500,000 and its bonded debt to $1,150,000, all owned by the Hydraulic Power Co. The capital stock of the Niagara Falls Power Co. before the amalgamation amounted to $5,757,700 and the funded debt was $18,246,000.

Additional Canadian interest in the amalgamation is caused by the fact that the Niagara Falls Power Co. owns 99.8% of the capital stock, and all of the outstanding debentures, of the Canadian Niagara Power Co., which latter concern operates one of the three plants on the Canadian side of the river. Only $2,500 capital stock of this Canadian concern is "in the hands of the public," and these twenty-five shares are owned by five directors of the company. The Canadian Niagara Power Co. has an installed capacity of about 125,000 h.p. and is entitled to use 8,225 c.f.s. of the 36,000 c.f.s. allotted to Canada. Its plant is linked electrically with the transmission lines of the Niagara Falls Power Co., but the amount of power that it can export to the United States has been limited by the Dominion Government.

THREE BIDS FOR BIG TURBINES

THREE tenders have been received by the Ontario Hydro-Electric Power Commission for the construction of the four 52,500 h.p. water turbines required for the Chippawa-Queenston development at Niagara Falls. While no official announcement has yet been made regarding the tenders, which were received up to November 1st, it is unofficially understood that preliminary proposals have been made by the I. P. Morris Co., of Philadelphia; the Allis-Chalmers Co., of Milwaukee; and the Wellman-Seaver-Morgan Co., of Cleveland.

The "Hydro" is negotiating with these concerns and discussing details of proposed plans, and it is thought that some announcement of a definite character will be made within the next month. Another American concern from which it was hoped to receive a tender,—the S. Morgan Smith Co., of York, Pa.,—could not make any proposition on such a big job just at present, unfortunately, on account of the large amount of United States Government work that it has on hand.

Enquiries were made by Escher-Wyss & Co., of Zurich, Switzerland, but it is thought unlikely that present conditions in that country, due to the war, will permit the firm to undertake the construction at this time of machines of such magnitude. The British Trade Commissioner for Ontario, F. W. Field, drew the attention of English manufacturers to the call for tenders, but no tender has been received from Great Britain, and it is thought unlikely that any will be received from there, as the English manufacturers have not had such extensive experience in the manufacture of extraordinarily large water turbines as have the American concerns.

No Canadian manufacturer entered a definite tender for the turbines, as larger machine tools are required than are at present installed in any Canadian plant manufacturing equipment of that nature. An informal proposal for the manufacture of the turbines in Canada under certain conditions is being carefully considered, however, and it is still too early to predict just where the big wheels will be built. As these four turbines will be the most powerful ever constructed, there is considerable interest in their design and keen competition for the honor of building them, although the competition is naturally much limited by the size of the work.

After the award of the contract for the turbines, tenders will be called for the generators, which will probably be built by the General Electric Co. and the Westinghouse Co. A resume of the specifications for the turbines appeared in the September 26th issue of *The Canadian Engineer.*

WATER POWERS OF THE EMPIRE*

(Concluded from last week's issue)

CANADA is exceptionally fortunate in the extent and distribution of its water-powers. Extending over a belt of several thousand miles in length, from Alaska to Labrador, and over a width of several hundred miles, there is an almost continuous network of lakes and rivers.

The Canadian Conservation Committee estimates that of the 3,730,000 square miles of the Dominion, 2,000,000 miles may be expected to be fairly thickly settled within the next few decades. The remaining area comprising the North-West Territories, the Northern and Eastern portions of Quebec, and the greater part of the Yukon is known to have thousands of water-powers, but the capacities of these are so imperfectly known, and they are so remote from any present market, that they are not included in any statistics.

Excluding these districts, it is estimated that 18,803,000 h.p. is available. This amount includes, in the case of Niagara, Fort Frances, and the St. Mary's River at Sault Ste. Marie, only the development permitted by International treaties, and does not take into account the possibilities of storage for the improvement of present capacities.

The power actually developed up to 1918 amounted to approximately 1,736,000 h.p. About 78 per cent. of this is used for electric light and electric railway and motive-power work, but some 250,000 h.p. is utilized in the manufacture of paper from wood pulp, and about 150,000 h.p. in electro-chemical and similar processes.

The Department of the Interior has recently (1917) prepared a summary of powers as yet undeveloped, but which are capable of rapid and easy development, and which aggregate 5,400,000 h.p. In addition to these, it is estimated that existing plants could be extended so as to develop an additional 280,000 h.p., so that an aggregate of 7,500,000 h.p. is readily available within range of present markets. At the present accelerated rate of development it appears more than probable that the whole of this energy will be utilized within the next twenty years or so.

On the Winnipeg River almost as much power is available as is now in use at Niagara. In addition to two plants now in operation, and supplying the city of Winnipeg and district, a further seven sites, aggregating 313,500 h.p. (24-hour power) have been exhaustively investigated, and detailed plans and estimates prepared by Government engineers show that these powers can be developed at from £9 2s. to £14 12s. per h.p. installed, equivalent to from 19s. to 29s. per h.p. year.

In Quebec, the Saguenay River alone offers three power sites which can be easily developed to give a total of 1,000,000 h.p. at tide water, with facilities for industrial sites and docks for ocean-going vessels of the largest type, and railroad connection with Quebec. On the Nelson River, Manitoba, there is available at a number of sites, with heads from 17 to 52 feet, some 2,000,000 24-hour continuous power, or 4,000,000 h.p. for eight months of the year. The river is fed by large lakes, and has very uniform flow, while, owing to the proximity of the Hudson Bay Railway, the power reach is readily accessible.

The following table shows how general is the distribution of water power throughout the Dominion:—

Province.	B. Horse-power. Available.	Developed.	Per cent.
Nova Scotia	100,000	21,412	21.4
New Brunswick	300,000	13,390	4.5
Prince Edward Island	3,000	500	16.7
Quebec	6,000,000	520,000	8.7
Ontario	5,800,000	789,466	13.6
Manitoba	3,500,000	76,250	3.1
Saskatchewan		100	
Alberta		32,860	
British Columbia	3,000,000	269,620	9.0
N.W. Territories, Yukon	100,000	12,000	12.0
	18,803,000	1,735,598	9.2

Shawinigan Falls, on the St. Maurice River, about 80 miles east of Montreal, form an interesting example of a case in which an industrial community has been brought into existence around a water-power. On completion of the storage works now under construction the river will have a capacity of 204,000 h.p. at the minimum flow period, and this is practically the present capacity of the installed machinery at the Falls. Water is used in the electric generating stations of the Shawinigan Water and Power Co., and is also sold to the Northern Aluminium Co., which generates 33,000 h.p. for use in reduction furnaces, and to the Belgo-Canadian Pulp and Paper Co., which utilizes 14,000 h.p. for pulp machinery. The Canadian Carbide Co. also absorbs 12,000 h.p., so that besides a miscellaneous local load, industries have been created using 60,000 h.p. at a site where only a few years ago no community existed, and transportation facilities were entirely absent.

To its wealth of water-power the Dominion adds the advantage of a great share in the world's forest and mineral resources. Coal, iron, copper, nickel, gold, silver, cobalt, lead, asbestos and mica are widely distributed, and the proximity of large hydraulic powers to the mineral deposits will prove a great stimulus to the development of both.

State Control

It has been fortunate that in Canada the water-power rights have mainly remained in the control of the Dominion or Provincial Governments. The Dominion Government controls navigable and floatable streams and their water-powers, and in addition, through the Water-Power Branch of the Department of the Interior, controls all water-power developments in the provinces of Manitoba, Saskatchewan, Alberta, the North-West Territories and the Yukon, and has now nearly completed a revision of the Dominion Water-Power Law and Regulations, designed to bring these in line with the best and most modern practice.

The policy of the government in respect to the control and administration of water-powers is that the title should be retained by the Crown, that the public should be protected by securing the maximum possible advantageous development of each river, by control of the rates, by reasonable rentals, etc., and that at the same time the inducements should be such as to encourage legitimate enterprise for the development of power resources.

In the province of Ontario the Department of Lands, Forests and Mines, in conjunction with the Hydro-Electric Commission of Ontario, controls the powers on other than navigable streams. This commission is virtually a Government Commission acting in trust for the various municipalities which have combined for the securing of cheap power.

In the province of Quebec the Department of Lands and Forests controls the power in provincial waters. In

*Report of the Water Power Committee of the Conjoint Board of Scientific Societies of Great Britain.

Nova Scotia many of the water-rights are privately owned outright, from eighteenth century land grants, but the remaining sites as in New Brunswick are under full provincial control.

Newfoundland

No estimate has been made of the water-powers of Newfoundland, but these are known to be of considerable importance. So far, about 6,000 h.p. has been developed for general industrial purposes and lighting. About 54,000 h.p. has been developed for use in the pulp and paper mills, and, in view of the extent of the forests available for pulp-making, it is probable that the future demand for power for this purpose will be very large.

Australasia

With the exception of New Zealand, the water-power resources of Australasia have never been systematically surveyed, and there is, in consequence, a lack of data on which to base any reliable estimate.

The exceptional richness of New Zealand in potential water-power happily caused the government in 1903 to prosecute an enquiry into its possibilities, and Mr. P. S. Hay, the New Zealand Government Engineer of Works, and Mr. L. M. Hancock were called upon to make investigations, the results of which were published in the New Zealand Parliamentary Papers of 1904.

While these reports set out in definite terms the case of New Zealand, no such investigation has been completed in any State of the Commonwealth. A beginning has been made, however, for recently the New South Wales Government has taken steps to ascertain the water-power possibilities of that State, and Mr. W. Corin, the chief electrical engineer, has already published an interim report. The chief engineer of the Tasmanian Hydro-Electric Department has also made a start in this direction.

The apparent apathy in the past regarding water-power resources of Australia is probably due to the fact that, in proportion to the size of the country, the probable available water-power is small, and is concentrated on the eastern coast, where is developed already an ample supply of coal. It is only in the islands of Tasmania and New Guinea that the prospects are notable in relation to their territorial extent.

The Commonwealth of Australia: Tasmania

Estimates have already been made of a few of the more promising hydraulic powers of Tasmania. The State Hydro-Electric Department has investigated the possibilities of the upper reaches of the Ouse, Arthur's Lakes, Lake St. Clair, the Dee, Franklin and King Rivers. No complete survey of the water-power of Tasmania has, however, yet been made. The agent-general (Sir John McCall) estimates the possibilities at about 400,000 h.p. He also reports that the State government proposes to utilize the water of the King River in the near future to supply some 40,000 h.p. to the mining districts in the west.

So far, only three hydraulic installations have been developed. These are the Great Lake scheme, at present developing something over 12,000 h.p.; the South Esk scheme, developing 1,350 h.p.; and the Lake Margaret scheme of the Mt. Lyell Mining Co., developing 4,000 h.p. The Great Lake is on the central plateau, and with a catchment area of only 216 square miles, and with a head of 1,120 ft., is capable of developing 70,000 h.p. The plant is now being enlarged. Part of the power is to be used for zinc reduction and calcium carbide production.

Tasmania certainly should be capable of developing a relatively large amount of hydraulic power, for the rainfall exceeds 100 ins. per annum over a large area of the mountainous region of the west, and there is no doubt that much of this area has a run-off of as much as 4 cubic ft. per second per square mile.

It is probable that Sir John McCall's rough estimate of power is well within the mark. In view of the shortage of water-powers in Australia, and of the future demand of the Commonwealth for nitrogen products, etc., there should be no difficulty in finding a market for the output of all the energy which can be developed in Tasmania. It would appear desirable that the survey of the more promising localities proposed by the Tasmanian Hydro-Eelectric Department should be made without further delay.

Australia

Though comparable in area with the United States, there has yet been no notable hydro-electric develop in Australia. Except on the east coast, the topography is too flat or the rainfall too low to provide the necessary conditions. Some of the large irrigation schemes are capable of being utilized for power production, but the aggregate of such possible power is small.

The only possibilities of considerable powers are to be found in the rivers draining the great dividing chain of the east coast. A large area of the district of the Australian Alps, situated partly in Victoria and partly in New South Wales, has a rainfall of 50 ins. per annum, and the run-off is probably as much as 18,000 cubic feet per second. The level is high, Mount Kosciusko attaining an elevation of 7,200 ft., and the sea is distant less than 100 miles. There are plenty of opportunities for damming back the rivers, so that a considerable aggregate fall might be secured. Probably the possibilities of this region lie between 300,000 and 500,000 h.p. Among others the following rivers appear to deserve careful inspection: The Snowy, Tambo, Dargo, Wonnangatta, Thompson, Goulburn, Ovens, Mitta Mitta, Indi, Tamut and Murrumbidgee. It is noteworthy that a single scheme which involves impounding the head-waters of the Snowy, operating with a head of 1,500 ft., has been reported by Mr. Corin as capable of developing 166,000 h.p.

In Victoria a scheme has been suggested to utilize the head-waters of the Kiewa River. From surveys it is estimated that about 40,000 e.h.p. may be developed from this source.

The Blue Mountains to the west of Sydney form an important high-level catchment. The altitudes attain about 4,000 ft., the rainfall is about 40 ins., and the run-off probably about 1.5 cubic ft. per second per square mile. The physical character of the region, as a plateau deeply cut up by canyons, suggests the possibility of efficient utilization of the run-off, and the available economic power is likely to be between 25,000 and 50,000 h.p. Already useful power schemes have been put forward for the Cataract and Warregamba Rivers.

The New England Range in New South Wales, and extending into Queensland, contains heights of over 5,000 ft., and descends steeply to the coastal lowlands. The rainfall averages about 50 ins. per annum, and the available catchment is about 6,000 square miles. The probable available power probably lies between 200,000 and 500,000 h.p. The State government has outlined a power scheme for the Clarence capable of producing 150,000 h.p.

In 1914 the government of New South Wales directed that a systematic preliminary investigation of the most important water-powers should be made, and some of these preliminary surveys have been carried out. Among the rivers already investigated or to be investigated are the Murray, Murrumbidgee, Tumut, Snowy, Shoalhaven, Hawkesbury, Warregamba, Hunter, Hastings, Macleay, Clarence and Richmond. Although the Water Conservation and Irrigation Commission has published the results of various river gaugings, these refer to such rivers as are suitable for water supply or irrigation rather than for power purposes. Certain new gauging stations have been and are being established in order to obtain data on which to base estimates of available power.

In Queensland, the Cairns District offers useful possibilities. The effective mountainous catchment areas of the rivers entering the sea between Lucinda Point and Cairns are, roughly, 3,000 square miles, and the rainfall ranges from 50 to 140 ins. The available horse-power probably lies between 150,000 and 400,000 h.p. The Barron River Falls, 19 miles from Cairns, are approximately 1,000 ft. in height, and it is probable that the river in their vicinity would yield at least 10,000 h.p. This district is favored in respect of shipping facilities and is rich in copper, tin and other minerals, so that a market could probably be found for any power likely to be developed.

The aggregate power suggested as being capable of economic development in the Great Dividing Chain is as follows:—

	Horse-power.
Australian Alps	300,000 to 500,000
Blue Mountains	25,000 to 50,000
New England Range	200,000 to 500,000
Cairns District	100,000 to 250,000
Total	625,000 1,300,000

As little in the nature of an actual hydrographical survey has been made, these estimates are of a very general nature. Sufficient, however, has been said to indicate that 1,000,000 h.p. may reasonably be expected from Australia.

In all cases the scheme would be somewhat expensive to develop, but in view of the general high cost of power in Australia, it would probably not be prohibitive. The possibilities are certainly sufficiently promising to justify a careful and extensive hydrographical survey.

New Guinea

The physical characteristics of New Guinea: its narrowness; its high mountain ranges; its large rainfall, ranging from 38 ins. to over 200 ins., and averaging probably 130 ins. per annum, offer exceptional facilities for developing water-power. There are numerous rivers of large volume and steep gradient, and, while there is a general absence of data as to the discharge of these rivers, there is evidence that in the aggregate the available power is enormous.

A study of the facts at present available shows that the rivers of Papua (British New Guinea) have a highland catchment area of at least 50,000 square miles, having an elevation of between 2,000 and 13,000 ft. The average rainfall over this area is almost certainly in excess of 130 ins. per annum. Were it possible to utilize 50 per cent. of this through a height of only 500 ft., a total power of 8,500,000 h.p. would be developed.

A rough gauging of the Fly River by Mr. Gibb Maitland, reported in the Queensland Parliamentary Papers of 1892, indicated a discharge of 327,000 cubic ft. per second, which speaks volumes for the power possibilities in the highlands further inland.

German New Guinea, the territory occupied by the Australian forces during the present war, has also great prospects. The salient feature of this territory is a great valley extending across from east to west, and occupied by three large rivers, the Kaiserin Augusta, the Ramu and the Markham. The first named is the largest, and is navigable by motor boats to a point 560 miles from the mouth. The three rivers drain about 40,000 square miles of high land. Assuming a run-off of six cubic ft. per second per square mile, the total volume would be 240,000 cubic ft. per second. This indicates possibly some 5,500,000 h.p.

Altogether, the potential water-power in the section of the island now under the British flag may amount to as much as 15,000,000 h.p. On the other hand, owing to the complete absence of a hydraulic survey, it is impossible to say what proportion of the power is capable of commercial development.

It is certain, however, that the islands will prove to be richly endowed with cheap water-power. Taken in conjunction with its great fertility, its prospect of coal and mineral oil, and its already partially developed metallic mineral resources, this augurs well for its future. Its great possibilities would appear to call for an immediate survey of the more promising localities.

Smaller Islands of the South Pacific Ocean

Some few of the islands of the South Pacific Ocean offer possibilities of hydraulic power on a fairly large scale in spite of their comparatively small size. The more promising are New Britain, New Ireland, Guadalcana, Ysabel, Bourgainville, Espiritu Santo, Viti Levu and Vanua Levu. These islands may be expected to produce a total of quite 500,000 h.p. On the other hand, the greater part of such power would be available only after considerable expenditure in retaining walls and dams, and, as the islands are subject to outbreaks of earthquake activity, the question of the maintenance of the necessary hydraulic works would be serious.

New Zealand

The physical characteristics of the two islands forming New Zealand render the country particularly well adapted for providing large stores of water-power and for facilitating their development. The backbone of high mountains leads to heavy precipitation from the moist westerly winds, giving a mean rainfall of some 50 ins. for the whole of the Dominion, while over a large portion of the south island the rainfall exceeds 100 ins. per annum. The mountain ranges are studded with extensive lakes, situated above a deeply indented coast line. The mountains of the Southern Alps attain a height of over 12,000 ft., and support many glaciers of large size which act beneficially in equalizing the run-off throughout the year.

Reports by Mr. P. S. Hay and Mr. L. M. Hancock, published in the New Zealand Parliamentary Papers of 1904, gave a list of seventy-two important and promising schemes, and placed the economically workable water-powers of the Dominion at 3,700,000 b.h.p. on the turbine shafts. Of this, 500,000 h.p. is found in North Island and 3,200,000 in South Island.

Since Mr. Hay's report of 1904, the Public Works Department has examined further schemes, adding to the original list. The latest and most complete statement is published in the New Zealand Government Year Book for 1914.

This table gives particulars of the more important available water-powers exceeding 1,000 h.p., showing also the nearest city or actual or potential port.

According to this report, the total available power is about 3,822,000 b.h.p. This is at the rate of about 37 h.p. per square mile of territory, or 3.5 h.p. per head of the population.

The power actually developed and in use in 1916 is given in the government returns as 42,600 b.h.p. Many other projects are, however, in course of construction or under consideration.

The mean figure suggested by Mr. Hay as the cost of development of the whole 3,800,000 b.h.p., including transmission costs to the nearest market, is at the rate of £31 per e.h.p. The figures for the various schemes range from £15 to £40 per e.h.p.

As regards State control, the Public Works Act of 1908 vests the sole right to use water-power in His Majesty, subject to any existing rights, and gives the government the right to develop, or to delegate such power to any local authority, or, outside a mining district, to any person or company, subject to conditions. Advantage has been taken of this in several cases, the right in the case of local authorities being issued free of royalty, and in the case of private individuals developing water-power for electrical distribution, subject to a royalty of 1/20d. per unit generated.

The outlook for New Zealand at the dawn of what promises to be an era of unexpectedly great electro-chemical and electro-metallurgical activity is most promising.

As a centre for the manufacture of nitrogen products, aluminium, calcium carbide, and the like, its situation is ideal. The fundamental requirement, a great excess of energy over the power needs of the country, is provided.* Further, that power is convenient to the coast; in some of the largest schemes the generating plant will be actually on the coast, on deep-water harbors.

To quote Mr. Hancock:—

"The manufacturing of all Australasia and a great portion of the Orient could be done here better and cheaper than anywhere else. Being so near these markets, with this unlimited power, and having a climate suited to a degree to manufacturing purposes, the possibilities of the colony are almost beyond the bounds of fancy."

South Africa

The committee has not as yet been able to elicit any definite information regarding the Union of South Africa. The government of the Union have recently instituted a Board of Enquiry to consider the potential resources of the country, and among the questions to be investigated is that of the utilization and conservation of water-power. Owing to the seasonal character of the rainfall throughout South Africa, the flow of the rivers either is greatly diminished or entirely ceases during a considerable period in each year, and their value as sources of power is correspondingly diminished. It is, however, known that a number of important falls occur, particularly on the eastern slopes of the Drakensberg Range, some of which are perennial and capable of development. Some energy may also be developed on the Vaal and Orange Rivers and the Mooi River of Natal and the Transvaal.

Rhodesia

In Rhodesia the rivers capable of developing large powers are in general very remote from present centres of industry, and few powers have as yet been developed.

*In 1904 the total developed boiler-power in the country, including all locomotives, was given as 250,000 h.p.

There are three great river systems in Southern Rhodesia, the Zambesi, the Sabi and the Limpopo. Of these, the Zambesi is the more important, and at the Victoria Falls alone offers a potential power of something like 750,000 h.p. At the Kariba and Mapata Gorges the river offers further possibilities, and units of 5,000 h.p. to 10,000 h.p. could probably be installed.

Of the rivers in the Zambesi system, only the Hunyani, Ruia, Mazoe, Inyagui and Nyagadzi offer any possibilities of power. The Hunyani cannot be relied upon for uniform flows of any magnitude.

The other rivers of this system have a more or less uniform flow. It is worthy of note that in this region not only does the uniformity of flow increase, but also in rivers of equal catchments the percentage of run-off increases as their directions bear round from west to east.

The Limpopo and its feeders offer practically no possibilities owing to the great variability of flow, the flatness of the gradients, the sandy nature of the bed and banks, and the large amount of silt carried in suspension.

The Sabi River system offers greater possibilities. Its feeders have a fairly uniform supply and steep gradients, with occasional falls, and it is estimated that it should be possible to develop some 90,000 h.p. from this system.

Assuming that 10 per cent. of the total power of the Victoria Falls can be usefully developed, the resources of Southern Rhodesia total about 220,000 e.h.p., made up as follows:—

	E.h.p.
Victoria Falls	75,000
Kariba Gorge	10,000
Mapata	10,000
Ruia River	5,000
Mazoe River	5,000
Inyagui	5,000
Nyagadzi	5,000
Sabi system	91,000
Plateau	13,000
Total	219,000

Large areas in the neighborhood of the Sabi Rivers consist of rich alluvial plateau land, which only requires irrigation to render it capable of bearing ample crops of sugar, cotton, rubber, etc., and, as water is plentiful and only requires pumping, there would appear to be an immediate use for any such power as could be developed in the irrigation and agricultural development of the region. The success of such a scheme would, however, depend on facilities for economical transport to Beira or the Union. The district is, moreover, rich in deposits of coal, copper and other minerals, which are at present not developed owing to the large cost of power and the lack of transport facilities.

The possibilities are sufficiently promising to warrant a thorough hydrographical survey being carried out.

East Africa, West Africa, Egypt

The committee has as yet been unable to obtain any definite information regarding the hydraulic possibilities of these countries. It is known, however, that in East Africa many promising waterfalls occur on the slopes of Mount Kenia, in the vicinity of Nairobi and elsewhere, and that, in particular, the possibilities of the Tana River will probably repay investigation. Some considerable amount of power might evidently be developed from the regulated flow of the Nile, and it is hoped to obtain information regarding this in the near future.

It is estimated that on the Gold Coast some 250,000 h.p. is available, and in Nigeria between 60,000 and

70,000 h.p. In Nigeria the Kwa River is said to be capable of developing between 60,000 and 70,000 h.p.; the Calabar at Uivet, probably between 30,000 and 40,000 h.p.; and the Niger, between Jebba and Lokoja, in the northern province, probably at least 150,000 h.p.

Malay States

The committee has not as yet been able to obtain any definite information as to the water-power possibilities of the Malay States.

Conclusions

The main conclusions to be drawn from the evidence available to the committee are:—

1. That the potential water-power of the Empire amounts in the aggregate to at least 50 to 70 million horse-power.

2. That much of this is capable of immediate economic development.

3. That except in Canada and New Zealand, and to a less extent in New South Wales and Tasmania, no systematic attempt has as yet been made by any government department to ascertain the true possibilities of the hydraulic resources of its territories, or to collect the relevant data.

4. That the development of the Empire's natural resources is inseparably connected with that of its water-powers.

5. That the development of such enormous possibilities should not be left to chance, but should be carried out under the guidance of some competent authority.

In view of these conclusions the committee would submit the following recommendations:—

Recommendations

1. That the British Government bring before the notice of the Indian Government, of the various Dominion Governments, and of the governing bodies of the Crown colonies the necessity for a close, systematic investigation of all reasonably promising water-powers, and of their economic possibilities.

2. That the British Government take steps to ascertain whether the governments concerned are prepared to undertake this work.

3. That where such an enquiry is beyond the powers of any governing body the British or Imperial Government place the work under the direct control of an "Imperial Water Power Board" or "Conservation Commission."

4. That the government take steps to initiate the formation of such an "Imperial Water Power Board" or "Imperial Conservation Commission," to include a representative from each of the Dominions and dependencies.

5. That this board act in an advisory capacity.

It should decide on the sequence of such investigation work as comes under its purview.

It is suggested that all schemes for the development of which local resources are inadequate should be submitted to the board by the governments concerned, and that the board should make recommendations on which the Imperial Government might take action.

Such a board would be able to take a broad and comprehensive view of the advantages to the Empire as a whole attending the development of any given scheme, and would be able to form a reasonable decision as to the relative advantages of such different schemes as might be brought forward from different parts of the Empire.

6. That since it is unlikely that private capital will be available for many years for hydraulic development on any large scale, powers should be obtained to enable the State to assist or to undertake such development if thought advisable.

It is suggested that much might be done to attract private capital if the State, after careful investigation, were to guarantee a suitable minimum interest on the necessary capital, sharing at the same time in any profits beyond the amount necessary to provide that interest. By this method of assistance private enterprise would be untrammelled, and the management of the concerns so assisted would remain in private hands.

STREAM REGULATION IN QUEBEC PROVINCE

(Continued from page 402)

supplied us with all the records. We may say that the records at this station are very well kept and, apparently, interest is shown in the work.

At Drummondville, the station was established in 1913 by the Hydraulic Service of Quebec Province. It was put under the direction of the college authorities.

We must say here that the Federal Service supplies freely the necessary instruments, the record forms, registers, etc., provided that at the end of each month the director of the station makes a report of his observations to their office. The salary of the recorders is paid by the provincial government.

Attention is called to the considerable rainfall registered at Lambton and Disraeli during the month of June, 1917, that is 9.21 inches and 9.28 inches respectively,—figures which are almost three times the monthly mean. The level of Lake St. Francis and that of Lake Aylmer, as well as that of the rivers tributary to these lakes, had reached a record height.

At Lake St. Francis, the river overflowed the south abutment of the old dam, which is built of cribs filled with stone and earth. There was a large wash-out on a distance of about 60 feet. It was feared that the old dam would be carried away. It was fortunate that the new concrete dam, which the Commission has just completed, was then in a condition to hold back part of the water at the foot of the old dam to a depth of twelve feet, thereby decreasing considerably the water pressure on the latter. It is sure that the new dam saved us from considerable damage. The old dam was repaired as soon as the water level of the lake had lowered a few feet.

Precise Levelling

During the summer there was established along the St. Francis River a series of benchmarks, the elevation of which is given above a datum or reference plane.

The work was done from the St. Lawrence to Sherbrooke by L. Bonhomme, and from Sherbrooke to Lake Aylmer by Eloi Duval. Owing to the importance of the Magog River, on account of the water-power developments thereon, benchmarks were established along this river from its mouth to Lake Memphremagog.

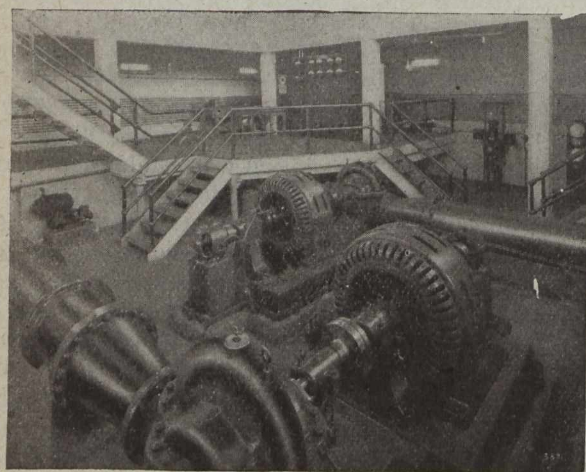
The datum or original plan, above which is given the height of each benchmark, is that of mean sea level. Our work was started from one of the benchmarks established by C. F. X. Chaloner, from Halifax to Rouses' Point, the heights of which are published in a report by the Department of Public Works of Canada, "Report of the Ottawa River Storage and Goedetic Levelling."

HIGH EFFICIENCIES SHOWN BY MOTOR-DRIVEN WATER WORKS PUMPS

By Geo. H. Gibson

MANY pumping problems are most conveniently solved by electric-driven pumps. Such pumps constitute a peculiarly desirable load for central stations, as they operate either at full load continuously, or in some cases are operated only during periods of light load, thus helping to fill up the "valleys" in the load curve.

Where centrifugal pumps are operated by power purchased through a meter, careful attention is likely to be given to efficiency, as a few per cent. in efficiency will in a short time amount to more than the cost of the pumps. The figures showing efficiency and other characteristics



Motor-Driven Centrifugal Pumps, 5,000 Gal. Per Min. Each Against 171 Ft.

of two 12-in. motor-driven centrifugal pumps herein given are taken from a report made by J. W. Kelsey, principal assistant engineer, to G. O. House, general superintendent, of the St. Paul Water Department, and relate to equipment recently installed at the McCarren Pumping Station.

The specifications required that each unit should be guaranteed to deliver not less than 5,000 U.S. gallons per minute against a total head of 171 ft., and not more than 5,500 gallons per minute against a total head of 158 ft., the overall efficiency from "wire to water" to be not less than 72 per cent. when pumping continuously at either of the heads and deliveries. It was further required that when delivering against a reduced head of 140 ft., the motor should not be over-loaded.

The bid of the Northwestern Electric Equipment Co., of St. Paul, which was accepted, offered pumps manufactured by the De Laval Steam Turbine Co., of Trenton, N.J., and synchronous motors of the rotating field type, manufactured by the Electric Machinery Co., of Minneapolis, and guaranteed an efficiency of 74.3 per cent. at heads of either 158 or 171 ft., and an overall efficiency of 73.7 at 140 ft.

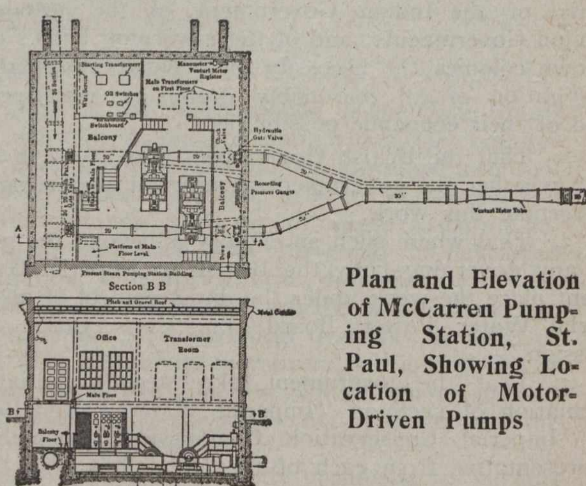
The motors receive three-phase, 60-cycle current at approximately 2,200 volts and drive the pumps at 1,200 r.p.m. They are so designed that they can be started by the application of alternating current to the armature windings. In normal operation they are supplied with exciting current by directly connected exciters of 1¾ kilowatt capacity. The pumps are of the De Laval single-stage double-suction volute type, having 12 in. suction and discharge nozzles. No diffusing vanes are used.

After installation both units were subjected to very complete tests to determine both efficiency and head-capacity characteristics. Before the official tests were run the impellers had been turned down slightly in diameter, due to the fact that the motors were operating at 20 r.p.m. above rated speed.

Before beginning the test, the pressure gauge of each pump was taken off and calibrated on a dead weight testing instrument, and then replaced, the pump stopped and the static head of water determined by finding the elevation of the centre of the gauges and the elevation of the water in the high service reservoir. The head determined from the elevations was found to agree with the calibration obtained with the dead weight testing instrument. The readings of the suction gauges were also checked against elevations in a similar manner, and found to be correct. As they registered zero with no pressure and as the variation in head was never more than 10 ft., it was assumed that readings of the gauges between zero and 10 ft. would be proportional.

The quantity of water delivered was measured by a 30 in. by 13 in. Venturi meter, supplied by the Builders' Iron Foundry Co., of Providence, R.I. The recording instrument supplied with this meter includes an indicating dial, a recording card and an integrating counter, but in order to verify the accuracy of its readings, an indicating mercury manometer was also connected to the pressure pipes of the Venturi tube. The electrical measuring instruments were checked and calibrated subsequently by comparison with standard instruments by representatives of the Northern States Power Company.

In running the test, the head against which the pumps worked was controlled by means of a hydraulic gate valve on the discharge side of the pumps. After throttling the gate valve, no readings were taken until all instruments had ceased fluctuating, after which two or three



Plan and Elevation of McCarren Pumping Station, St. Paul, Showing Location of Motor-Driven Pumps

readings were made and averaged, if any variations were found. Observations were made with the pumps operating under four different heads, covering a wide range of delivery.

The results obtained on the official test are shown in the following tabulations. In computing the efficiencies of the pumps alone, motor efficiencies, as obtained on tests of the motors by the University of Minnesota, were used. On motor No. 403115, the following efficiencies were obtained:—

Full load 95.5 per cent., ¾ load 94.9 per cent., ½ load 93 per cent.

Motor No. 403129 gave the following results:—

Full load 95.3 per cent., ¾ load 94.6 per cent., ½ load 92.5 per cent.

The test results of the units show the variations in head and capacity at constant speed together with electrical horse-power input and overall efficiencies.

The efficiencies obtained on these pumps are quite high, considering the comparatively small capacity and the high head. Many builders would advocate the use of diffusing vanes for such conditions, which, however, would make the pump more expensive and complicated without any gain in efficiency. The efficiencies are further very high over a considerable range in capacity. Take, for instance, pump No. 25651, which at a capacity of 6,527 g.p.m. shows an efficiency of 81.8 per cent., and at 4,097 g.p.m. an efficiency of 77.0 per cent., or for a reduction in capacity of about 37 per cent., there is a reduction in efficiency of only 5.9 per cent., which must be considered very good for a centrifugal pump.

Motor No. 403115—Pump No. 25650

Volt meter	2,230	2,230	2,240	2,240
Rec. watt hr. meter	234.0	225.0	210.0	165.0
A.C. ammeter	62	59.5	55.5	44.5
P.F. indicator %	100	100	100	100
Ind. wattmeter	233.3	226.2	210.1	165.3
Vent. manometer	9.75	8.50	7.25	4.60
Press. gauge ft.	147.25	165.25	179.25	195.75
Suc. gauge ft. press.	4.0	6.0	7.5	10.0
Total head feet	143.25	159.25	171.75	185.75
R.P.M.	1,220	1,220	1,220	1,220
G.P.M.	6,771	5,900	5,035	3,194
Water h.p.	245.1	237.5	218.4	150.0
Electrical h.p.	312.9	303.3	282	221.7
Overall efficiency	78.4	78.3	77.7	67.7
B.H.P.	298.5	289.6	269	209.9
Pump efficiency	82.2	82.1	81.2	71.5

The pumps deliver slightly more than 5,500 g.p.m. at 158 feet total head, but this was not at all objectionable, due to the fact that the efficiency was very high also at low heads, which in this particular case was of great advantage as can be seen from following quotation from the official report:

"As to the quantity of water pumped, it will be observed that it more than meets the requirements of our specifications. The clause in our specifications limiting the quantity of water to 5,500 gallons per minute when working against a head of 158 feet was inserted to insure a high efficiency at this pressure. It was our belief that the maximum efficiency would be obtained when pumps were working against a much higher head. Fortunately, however, the reverse is true, and our pumps are delivering a greater quantity of water, with a higher efficiency than was anticipated at the lower heads.

Motor No. 403129—Pump No. 25651

Volt meter	2,250	2,260	2,270	2,295
Rec. watt hr. meter	224	217.4	204.8	188.1
A.C. ammeter	57.6	56	52.4	47.8
P.F. indicator %	100	100	100	100
Ind. wattmeter	226.3	220.2	206.0	188.9
Vent. manometer	9.4	8.24	7.1	5.9
Press. gauge ft.	146.5	163.0	176.5	186.0
Suc. gauge ft. press.	3.2	5.0	6.5	8.0
Total head feet	143.3	158.0	170.0	178.0
R.P.M.	1,220	1,220	1,220	1,220
G.P.M.	6,527	5,722	4,930	4,097
Water h.p.	236.4	228.7	211.9	184.3
Electrical h.p.	303.4	295.2	276.1	253.1
Overall efficiency	78.0	77.5	76.4	72.8
B.H.P.	289.0	280.8	262.2	239.3
Pump efficiency	81.8	81.5	80.7	77.0

"As stated before, the friction loss in our force mains is less than computed, with the result that our operating head is somewhat lower than provided in our plans, which explains one of the main reasons for reducing the effective diameter of the impellers. The consequence is a greater quantity of water, at a higher efficiency against our prevailing dynamic heads."

The Engineer's Library

PETROLEUM REFINING.

By *Andrew Campbell*. Published by Charles Griffin & Co., Ltd., London, W.C. 2, England. 297 pages, 6x9 ins.; 11 tables and 138 illustrations, including 29 folded plates and 3 diagrams; cloth. Price $6.50 postpaid to Canada.

The refining of crude petroleum is an industry that has long been practiced, but unlike most other industries, the processes by all in the field have been learned in the hard school of experience, and an aspirant for knowledge in this branch of technology usually finds that there are few publications to assist him.

Technical publications are usually written for two classes of readers: those who desire detailed statistical information on a subject with which they are more or less familiar; and those who require a general idea of the process in which they may be interested. To the first class of reader, "Petroleum Refining" will offer a limited appeal, but to the second class the book is one of the few publications on this subject that are available.

There are two divisions in the petroleum industry that are not exemplified, namely: the cracking process, developed in the United States; and the extraction of oil from shales, which has reached its greatest development in Scotland. As the bulk of those engaged in the petroleum industry the world over use the natural crude, which is in liquid form, without special efforts to alter the natural yields, these two divisions may be considered as special applications of the general process.

The treatment of the subject occurs in logical order. In the first chapter is covered the laboratory work, which consists in ascertaining the manufacturing possibilities of crudes. The testing of the finished products, and all the apparatus and tests necessary for present day practice, are enumerated and described. There are evolutionary changes occurring in this industry similar to those occurring in other industries, but these are of special interest to individual refiners and could have no place in a book of this kind.

After describing the general principles considered in designing and building a refinery, the author covers, in order, the steps in the process of refining, and describes the various stills, condensers, agitators and filters, all of which are at present in use in more or less modified forms in all refineries. The still having internal flues that he describes is not now in general use in modern refineries in America, on account of the difficulty of cleaning it and the excessive cost of building it, as no adequate return in decreased fuel consumption results from its use.

In the chemical treatment of oils the author describes, besides the usual ones, a process for treating kerosene and burning oils with liquified sulphur dioxide, which process is not used in America.

The manufacture of containers, in which the finished products are shipped to the consuming public, is explained, and besides giving the customary sizes of the various barrels, cases and packages, the process of filling these in quantities is fully described.

Several specifications are given covering the construction of tanks, stills, agitators, etc., and these are about the same as present day practice on this continent except that the requirements—insofar as workmanship is concerned—are more severe than is the case here. About the only exception to this is that the practice of building tanks with trussed roofs and centre posts is not now in general use, principally on account of the greater cost.

In an appendix is given a comprehensive list of pamphlets and books on petroleum technology such as would be interesting to those wishing more detailed information on the subject than could possibly be given in a single volume.

ENGINEERING INSTITUTE OF CANADA, ELECTIONS AND TRANSFERS

At a meeting of the Council of the Engineering Institute of Canada, held on October 22nd, 1918, in Montreal, the following elections and transfers were announced:—

Armstrong, Harry Westropp, of Toronto, Ont., now on active service, elected associate member. Mr. Armstrong was born at Cobourg, Ont., and finished his education at the Collegiate Institute in 1902. He was for a time with the C.P. Ry., and in 1906 became resident engineer of that company. In 1915, prior to enlisting, he was engineer of bridges on the Toronto-Hamilton Highway Commission. Mr. Armstrong was for seventeen months with the Canadian Machine Gun Corps, and has been for the past year and a half with the Canadian Railway Troops.

Batemen, Edward Flemming, of Saskatoon, Sask., elected associate member. He was born at Mirfield, Eng., and received his education at Victoria College, Jersey, and at King's College, London, and Thames Marine Officers' Training Ship. He has had engineering experience covering a period of over forty years, and is at the present time engaged on the erection of structural steel and bunkers at the new power house, reconstruction of pumping station, etc., Saskatoon, Sask.

Belliveau, John Edmund, of Halifax, N.S., has been elected associate member. Born at Church Point, N.S., and educated at St. Ann's University, Mr. Belliveau since leaving college has been assistant engineer in the office of the Provincial Engineer, and has also served in the same capacity with the Western Division, Department of Highways and Bridges. He is at the present time assistant to chief engineer, Provincial Highway Board, Nova Scotia.

Bernier, Joseph Adelard, of Montreal, Que., transferred from the class of junior to associate member. He was born at Cap St. Ignace, Que., in 1885, and took his B.Sc. degree at Laval University at the age of twenty-two. After leaving college he became for one year leveller, etc., with A. T. Sabourin on the hydrographical survey of the Richelieu and Yamaska Rivers. In the following year Mr. Bernier became associated with the city of Maisonneuve as leveller and transitman with the chief engineer, and also draftsman and inspector of the construction for the Montreal Terra-Cotta Co., Ltd., Lakeside. Three years later he was made first assistant to E. Fusey, engineer in charge of sewers department. He is at the present time in charge of the sewers department, superintending the general works in the office and the construction of sewers.

Burnett, Archibald, of Swansea, Ariz., transferred from the class of associate member to that of member. He was born at St. Hyacinthe, Que., in 1876, and obtained the degree of B.Sc. at McGill University in 1902. Mr. Burnett was for a time with the British Columbia Copper Company as engineer and designer, and in 1912 became examining engineer and manager of two subsidiary mines with the Crown Reserve Mining Company. In 1917 he became efficiency engineer of Mine Methods, Limited, Verde Copper Co., of Jerome, Ariz. He is at the present time general superintendent of the Swansea Lease, Inc.

Calvert David Gordon, of Toronto, Ont., has been elected junior member. He was born at Napier, Ont., and received his education at the Public School and at Collegiate Institute, and in addition attended two and a half years at the S.P.S. at the University of Toronto. In 1913 he became assistant engineer on the C.P. Ry. under W. D. Pender, on construction of the Canadian Pacific Railway terminal yards at North Transcona, Manitoba. Mr. Calvert is at the present time engineer for the Canadian Stewart Co., Ltd., on Toronto Harbor Improvements, in charge of a portion of the work.

Chown, Reginald Cecil Frank, of Regina, Sask., elected associate member. He was born at Totnes, Eng., and educated at Plymouth College, and by private tuition in France and Germany. Mr. Chown was for five years in charge of the Berbice River District, Colonial Government, S.A., and later was in charge of prospecting West African Union Mines. In 1908 he became assistant to chief engineer with the Saskatchewan Government Telephones, and is at the present time construction engineer with the same organization.

Cimon, Joseph Marie Hector, of Quebec, Que., transferred from the class of student to that of junior. He was born at Rivière du Loup, Que., in 1893, and obtained his B.A.Sc. at Laval University in 1916. Since leaving college to date Mr. Cimon has been engineer for Price Bros. & Co., Ltd., Quebec, in charge of surveys and general hydraulic works.

Cox, Otis Stanley, of Halifax, N.S., transferred from the class of junior to associate member. He was born at Upper Stewiacke, N.S., in 1888, and educated at the Nova Scotia Technical College, where he received his degree. During the summer of 1912 he was engaged on instrument work with the I.C.R., Dartmouth to Deans Branch. Since 1913 to date Mr. Cox has been assistant engineer, Public Works Department, Halifax, N.S.

Crossing, W. B., "Somewhere in France." He was born at Bristol, England, in 1893, and educated at Bristol University and Bristol Engineering College. He also attended the Merchant Ventures Technical College at Bristol and the University of Manitoba, completing his course at the latter school in 1914. He served for a time as draftsman on the C.N.R., and also with the C.P. Ry. as surveyor. When the war commenced he enlisted and is now on active service. Elected junior.

Dalziel, Norman Pearson, of Ottawa, Ont., transferred from the class of associate member to that of member. He was born at Edinburgh, Scotland, in 1878, and completed his education at the Heriot-Watt College in 1896. After serving as apprentice to Blythe & Westland, Edinburgh, for four years, he became assistant engineer with the same firm. He was later appointed assistant engineer on the Natal Government Railways, and on surveys of railways in Zululand. In 1915 Mr. Dalziel became associated with the Imperial Ministry of Munitions, first as district inspector, and later (and to date) as chief inspector.

DAVIES, GEORGE VICTOR, of Quebec, Que., elected associate member. He was born at Liverpool, Eng., and educated in that city at the Technical School, and later at the University of Liverpool. Mr. Davies was for a time designer with Francis Morton & Co., and later was put in charge of design and erection of work with the Redpath, Brown & Co., Manchester. Since 1913 to date he has been assistant engineer with the St. Lawrence Bridge Co., Quebec.

DAWSON, SYDNEY GEORGE, of Ottawa, Ont., transferred from the class of junior to associate member. He was born at Plevna, Ont., and educated at Queen's University, where he took a B.Sc. degree. After serving for several years as rodman on the Transcontinental Railway and draftsman with the City Engineer at Ottawa, he was appointed resident engineer on sewers at Edmonton, Alta. He was for one year resident engineer on the Rideau River sewer at Ottawa, and in the following year became draftsman with the Imperial Munitions Board. In 1917 he became draftsman and junior office engineer with the Department of the Interior at Ottawa, and is at the present time district hydrometric engineer at Calgary.

DE WOLF, ALLAN HATCH, of Cranbrook, B.C., elected associate member. After completing his course in engineering at the Minnesota University, Mr. De Wolf was apprenticed to J. T. Laidlaw, Mining Engineer and B.C. Land Surveyor, and subsequently he was given charge of surveys covering land subdivision in British Columbia; timber, mine and mineral claim surveys in the Kootenays, B.C.; also irrigation engineering and flume building, railroad engineering and right-of-way surveying. Mr. De Wolf is at the present time City Engineer of Cranbrook, B.C.

FREDETTE, JOSEPH F., of Montreal, Que., transferred from the class of junior to associate member. He was born at Sherrington, Que., and educated at the Brevet Academique and by self-tuition in general engineering and hydraulics. He obtained a D.L.S. commission in 1914, and in the same year became first assistant to G. H. Herriot, D.L.S., on block outline surveys. He is at the present time with P. J. McGarry, B.Sc., D.L.S., on survey plans and computations in Merritton, Ont.

FREEMAN, J. REGINALD, of Halifax, N.S., has been transferred from the class of associate member to that of member. He was born at Milton, N.S., in 1881, and after completing his education at the I.C.S., he became instrumentman on the H. & S.W. Ry. He was for one year resident and assistant bridge engineer on James Bay Road, and in 1910 became resident engineer on the Transcontinental Railway. He is at the present time senior assistant engineer to H. A. Russell and W. P. Morrison, Department of Public Works, Halifax, N.S.

GOLDMAN, HYMAN A., of Toronto, Ont., transferred from the class of junior to associate member. Mr. Goldman was born in Russia in 1886, and obtained his degree in civil engineering at Valparaiso University in 1912. While attending college he was assistant on design and layout of a system of sewers in the town of Know, Indiana. In 1912 he became associated with the construction department of the C.P. Ry., and later was engaged for one year on designing and estimating in the bridge department of that company. After serving in various engineering capacities with several companies, Mr. Goldman in 1916 became assistant engineer with the Toronto Harbor Commissioners, which position he holds at the present date.

HART, PERCY EDWARD, of Toronto, Ont., elected member. Mr. Hart was born at Turnchapel, near Plymouth, England, in 1870. After leaving school he was for two years in charge of a small electrical plant, and in 1891 became construction foreman with the Edison Electric Co. Since 1913 Mr. Hart has been managing engineer with the Toronto Hydro-Electric System, in charge of all engineering matters in construction, operation and design.

HAYS, DAVID WALKER, of Medicine Hat, Alta., elected member. He was born at Bridgeport, Cal., in 1878, and educated at the MacKay School of Mines, Nevada, where he received his B.S. degree in 1900. Mr. Hays was for a time levelman and topographer for the Department of Highways, Cal., and later served as division engineer and district engineer on the Mickel Caisson project, Nevada, where he was in charge of laying out and construction of irrigation works, and also in charge of maintenance and general investigation. From 1912 to 1917 he was chief engineer with the Southern Alberta Land Co., and since that time has been general manager and chief engineer with the Canada Land and Irrigation Co., Alberta.

HEIN, OVE JENSEN, of Montreal, Que., elected associate member. Mr. Hein was born at Copenhagen, Denmark, in 1882, and received his C.E. degree in his native city in 1906. In the following year he became draftsman in the Bridge Department, C.P. Ry., at Montreal, and later became assistant engineer and resident engineer on construction of Hydraulic Fill Dam, Coquitlam, B.C. He is at the present time a member of the firm of Hein, Crombie Co., Engineers.

HEMMERICK, GEORGE, of Saskatoon, Sask., transferred from the class of student to that of associate member. He was born at Conestoga, Ont., in 1891, and obtained his B.Sc. at Queen's University in 1916. During the summer vacations while attending college he served in various capacities with different mechanical concerns, and in 1917 became assistant and resident engineer with the British Cordite Co. on plant construction at Nobel, Ont. He is at the present time with Murphy & Underwood, consulting engineers, in the capacity of draftsman and resident engineer.

JACK, ROBERT TORRANCE GRANT, of Toronto, Ont., elected associate member. He was born at Orillia, Ont., and educated at the S.P.S., Toronto. Since 1912 Mr. Jack has been resident engineer on sewer construction work in Toronto.

JAMIESON, WILLIAM TURNBULL, of The Pas, Man., transferred from the class of junior to associate member. He was born at Glasgow, Scotland, and received his education at the West of Scotland Technical College. From 1901 to 1906 he served apprenticeship with Wyllie & Blake, Glasgow, and later became resident engineer on construction of large sewage disposal works for various Scottish towns. For three years he held the position of assistant engineer for the city of Verdun. In 1911 he became associated with the N. T. Ry., as draftsman, instrument man and resident engineer. Mr. Jamieson is at the present time division and office engineer with the Hudson Bay Ry.

JETTE, JOSEPH C. H., of Three Rivers, Que., transferred from the class of junior to associate member. He attended the Mount St. Louis College in Montreal, his native city, and obtained his B.A.Sc. and C.E. degrees from the Polytechnic School in 1912. Since that time Mr. Jette has been assistant engineer for the Public

Works Department, Three Rivers District, in charge of construction of sewers, irrigation work, etc.

JOYCE, WALTER EDWARD, of Montreal, Que., elected associate member. He was born at New Haven, Conn., and educated at Yale, where he received the Ph.B. and C.E. degrees, and completed a post-graduate course in 1911. For two years after leaving college Mr. Joyce was draftsman and checker on structural steel bridges and reinforced concrete, Bridge Department, Kansas City. He later became assistant to H. D. Robinson, consulting engineer on bridges, with the C.N. Ry. at Montreal, where his work consisted in checking designs and preparing standard drawings of bridges for various spans. Since 1914 Mr. Joyce has been with the Mount Royal Tunnel & Terminal Co., Ltd., Montreal, as engineer of design in connection with the C.N.R.

KENDALL, LESLIE EVANS, of New Glasgow, N.S., transferred from the class of junior to associate member. He was born at Charlemagne, Que., in 1887, and received his B.Sc. degree at Queen's University. He was for six years leveller and transitman with the Militia Department at Ottawa. In 1912 he became assistant engineer and assistant resident engineer with H. Holgate, Montreal. Mr. Kendall is at the present time assistant inspector of shell components in charge of Maritime District, Imperial Ministry of Munitions.

KIPP, THEODORE, JR., of Winnipeg, Man., elected member. Born in Germany, in 1880, he emigrated to the United States the following year. After receiving his education at the Bradley Polytechnic Institute at Peoria, Ill., he was with the National Cereal Milling Co., of Chicago, for several years, and subsequently he became assistant manager, engineer and designer with the Independent Cereal & Milling Co., Peoria. Since 1914 Mr. Kipp has been consulting and sales engineer, Theodore Kipp Co., Ltd., Winnipeg, and is at the present time also general superintendent and engineer with the Ogilvie Flour Mills Co., Ltd.

LAKE, NORMAN JOHN, of Markdale, Ont., transferred from the class of student to that of junior. He was born at Brantford, Ont., and completed his education at McGill University. In 1916 Mr. Lake was placed in charge of cable installation with the Abitibi Power and Pulp Co. of Canada, Brantford, and for two years subsequent to this undertaking he was with the Canadian Westinghouse Co., engaged on installation of electrical machinery, in which capacity he is serving at the present time.

LAMARQUE, ERNEST CHARLES WILLIAM, of Anyox, B.C., elected associate member. Mr. Lamarque was born at Maidstone, England, and educated in his native town. In 1912 he was put in charge of right-of-way surveys for the C.P. Ry. in British Columbia, and two years later became locating engineer for the late D. A. Thomas (Viscount Rhonda), in the Peace and Slave River Districts. He is at the present time assistant engineer and surveyor for the Granby Mining, Smelting & Power Co.

LAMONT, ARCHIBALD WILFRID, of Winnipeg, Man., transferred from the class of junior to associate member. He was born at Mount Brydges, Ont. in 1889, and educated at the University of Toronto, where he obtained his B.A.Sc. degree in 1910. Subsequent to his college career he became sales engineer with the Canadian Westinghouse Co., Ltd., of Winnipeg, and later, for one year, held the position of power engineer with the Toronto Hydro-Electric. He is at the present time sales engineer and in temporary charge of the Canadian Westinghouse Co., Ltd., Winnipeg, Man.

LAVIGNE, ERNEST J. T., of Quebec, Que., transferred from the class of junior to associate member. He was born at Quebec in 1892, and obtained his B.A.Sc. degree at Laval University in 1916. Subsequent to his college career he became third assistant engineer with the Department of Public Works and Labor at Quebec, which position he holds at the present time.

MACDONALD, GORDON SCOVIL, of St. John, N.B., elected associate member. He was born at St. John in 1887, and took his B.Sc. degree at the University of New Brunswick. Mr. Macdonald has had five years' experience as draftsman with several railway companies, serving also at the same time in other capacities. He is at the present time district engineer, Marine and Fisheries Department, St. John, N.B.

MACKENZIE, WILLIAM DUNCAN, of Winnipeg, Man., elected associate member. He was born at Brantford, Kansas, in 1884, and finished his education at the S.P.S., Toronto. He was for two years rodman on the Trent Canal and later with the C.N. Ry. Since 1913 Mr. Mackenzie has been with the Greater Winnipeg Water District as transitman, later as resident engineer, and at the present time division engineer.

MACNAB, IRA PERCY, of Halifax, N.S., elected associate member. He was born at Malagash, N.S., and educated at the Nova Scotia Technical College, where he received his S.B. degree. After serving a four years' apprenticeship in a machine shop, Mr. MacNab became journeyman machinist, and later manager of the Truro Engineering Works. For the past three years he has been mechanical superintendent of the Nova Scotia Tramways and Power Co., Halifax.

MCCOLOUGH, REGINALD WALKER, of Halifax, N.S., elected associate member. He was born at Dartmouth, N.S., in 1887, and received his education at the Nova Scotia Technical College. He was for some time draftsman for the Halifax and Eastern Ry., and later on became instructor in surveying at the Nova Scotia Technical College. After being engaged for a time at instrument work for the Dominion Government hydraulic surveys he became resident engineer with the Canadian Government Railways, Dartmouth to Deans Branch. Mr. McColough is at the present time 3rd division officer, R.C.E., Halifax, N.S.

MIFFLEN, SYDNEY, CLARENCE, of Wabana, Nfld., elected junior member. He was born at Catalina, Nfld., in 1891, and received his B.Sc. degree at McGill University in 1914. After leaving college he was for one year engineer for the Furness Withy Co., St. Johns, Nfld. At the present time Mr. Mifflen is engineer with the Dominion Iron & Steel Co., at Wabana Mine, Newfoundland.

(Concluded in the next issue.)

TO INVESTIGATE ALKALINE ACTION

AT the last meeting of the council of the Engineering Institute of Canada, the committee of the western branches appointed to investigate the action of alkaline soil on concrete was ratified as follows:—B. S. McKenzie, W. G. Chace, W. P. Brereton, J. C. Holden, J. R. C. Macredie, E. A. Markham, H. McI. Weir, R. J. Lecky, Geo. W. Craig, F. W. Alexander, H. Sidenius and A. S. Dawson.

The business heretofore conducted in the name of John Baker, Jr., New York City, will, in future, be conducted as the Asphalt Department of the Texas Company. John Baker, Jr., has previously been special agent for the asphalt and road oil business of the Texas Co.

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Principal Contents of this Issue

THE CANADIAN MINING INSTITUTE

At an annual meeting of the Engineering Institute of Canada a few years ago, Prof. Haultain, of Toronto, declared that the Canadian Mining Institute represented an industry, not a profession; that it was a trade body, not a technical society; that it could never be absorbed completely by the Engineering Institute because its membership included many men who could not qualify for the Engineering Institute.

There ensued immediately a strenuous protest from many leading members of the Canadian Mining Institute. Exception was taken to Prof. Haultain's indictment on every count. But Prof. Haultain had taken a prominent part in both institutes for many years, and he viewed his subject from both standpoints. That the mining engineers generally are coming around to Prof. Haultain's opinion is evidenced by the editorial in the last issue of the Canadian Mining Journal, which says:—

"To us the essential difference between the Institutes is that one represents an industry, and the other represents a profession.

"The Canadian Mining Institute is chiefly composed of technical men. This is a natural consequence of the fact that mining and metallurgical operations are to a very large extent directed by and carried on with the assistance of technical men. It does not follow, however, that the Mining Institute is a mere technical society. We would be very sorry if it should become such. The aim of the Mining Institute is to develop the mineral resources of Canada. Among its members are several who have had no technical education, but have other qualifications which make them equally valuable as members. They would not qualify, and would have no particular desire to belong to, an engineering society; but they are eminently qualified to take a leading part in the mining and metallurgical industries.

"The Engineering Institute of Canada, on the other hand, represents no particular industry. It has, nevertheless, good and sufficient reasons for existence. Comparatively few mining engineers belong to the Engineering Institute because the Mining Institute gives them the advantages of a professional society, while it also represents their industry. The professional members of the Canadian Mining Institute will always be found ready to co-operate with the members of the Engineering Institute in efforts to improve the status of the engineering profession."

This is probably the first admission by anyone associated with the mining interests, other than Prof. Haultain, that the Mining Institute is not an engineering society. We wonder whether the Canadian Mining Institute would officially endorse this admission. If so, it would no doubt do much toward clearing up all differences of opinion between the two bodies. "It is a mistake, however, to expect that there will not be differences between the two Institutes," continues the Canadian Mining Journal. "The aims of the two are similar in some respects; but quite different in others. Failure to recognize the points of similarity and difference has been responsible for some unpleasantries in the past. Would it not be well for each Institute to undertake to make the members of the other more familiar with the nature of the respective societies?"

ENGINEERING PRIVILEGES.

One of the steps to be taken in the choice of a profession is the consideration of the associated privileges which one may reasonably hope to enjoy. The majority of engineering students look forward to the time when they can claim membership with at least one engineering society.

The Institution of Civil Engineers, of London, England, is the parent institution of the profession; it is certainly one of the privileges of the profession to belong to it, as it is to worthy men, and worthy men only, that its doors are opened. Formerly it was easier to obtain membership than it is to-day. At one time membership was obtained by little more than the securing of the names of a few "good men" on one's form of application. These men often knew little or nothing about the qualifications of the applicant, but signed the application because somebody else had signed it. The result was that the Institution's membership included names of some individuals who should, perhaps, have waited a little longer before applying.

To overcome this condition, the governing body of the Institution introduced a qualifying examination which eliminated those who did not possess the necessary knowledge and experience. But as there were many other similar examinations held throughout the world under the auspices of various universities, a list was compiled of those examinations which would be accepted in lieu of that held by the Institution. A number of universities outside of the British Isles are recognized in the list, including McGill University, Montreal, but no recognition is granted to the Faculty of Applied Science of the University of Toronto. It is difficult to understand the attitude of the Institution in regard to the University of Toronto. McGill University is an excellent college and well deserves its place on the Institution's list, but we feel that Toronto is equally worthy of recognition.

Correspondence has been exchanged by the Institution and the University of Toronto, but the former cannot yet see eye to eye with the latter. The University of Toronto naturally expects to enjoy the same privileges as her sister university at Montreal, and feels aggrieved that her graduates are not given similar recognition.

Surely the Institution is not in possession of complete information regarding the University of Toronto and its courses, or the recognition would be granted without question. Lt.-Col. Charles H. Mitchell is a very prominent graduate of the University of Toronto and is now well known and popular in England. He is also closely connected with the future interests of his Alma Mater. Would it not be advantageous for the University to request Colonel Mitchell to negotiate with the council of the Institution upon his return to London after the conclusion of the German capitulation?

PERSONALS

Lt.-Col. Reuben Wells Leonard, of St. Catharines, Ont., who by acclamation has been elected president of the Engineering Institute of Canada for the coming year, was born on February 21st, 1860, in Brantford, Ont. He was educated at the Brantford Collegiate Institute and at the Royal Military College, Kingston. He served in the North West Rebellion as staff officer of transport and in other capacities in the year 1885. Col. Leonard had previously gained two years' experience with the engineering staff of the C.P.R. on surveys and construction work in the Lake Superior district, and after the rebellion he again joined the C.P.R. to do similar work in Manitoba, Quebec, Ontario and British Columbia. He was thus engaged for a number of years, sometimes as chief engineer and manager of construction of important branches. In 1887 he became chief engineer of the Cumberland Railway and Coal Co., Nova Scotia, resigning in 1890 to accept the positions of chief engineer and manager of construction of the St. Lawrence and Adirondack Railway and consulting engineer for the Rutland Canadian Railway. From 1898 to 1901 he was chief engineer of the Cape Breton Railway. At various times since 1892 he constructed hydro-electric power plants, at Niagara Falls for the Park and River Railway Co., at St. Catharines for the Hamilton-Cataract Power Co., and near Fort William for the Kaministiquia Power Co. In 1906 he promoted the Coniagas Mines Ltd., and became president of that company and also of the Coniagas Reduction Co., which he organized in 1908. Col. Leonard is a governor of the University of Toronto; of the School of Mines, Queen's University, Kingston; of Wycliffe College, Toronto; and of Bishop Ridley College, St. Catharines. He is chairman of the St. Catharines Consumptive Hospital; ex-vice-president of the Canadian Mining Institute; member of the Council of the Institute of Mining and Metallurgy, London, England; member of the American Institute of Mining Engineers and ex-president of the Royal Military College. From 1911 to 1913 he was chairman of the National Transcontinental Railway Commission. Among his many other activities Col. Leonard is commanding officer of the Corps of Guides, Second Division. He is also a director of a number of industrial and manufacturing concerns.

John S. MacLean, advertising manager of the Canadian General Electric Company and also of the Canadian Allis-Chalmers for the past five years, has resigned.

Capt. C. S. L. Hertzberg, M. C., of James, Loudon & Hertzberg, Ltd., consulting engineers, Toronto, has left Vancouver as a conducting officer in charge of an engineering company which has gone to Siberia to prepare quarters for the Canadian Expeditionary Force.

R. F. Randolph, who has been general superintendent of the Dominion Iron and Steel Co., of Sydney, N.S., since 1st October, 1916, has resigned. For eight years before joining the staff of the steel company, Mr. Randolph was general superintendent of the Saucon works of the Bethlehem Steel Co., and previously was with the Cambria Steel Co. at Johnstown, Pa.

Major T. R. Loudon, of James, Loudon & Hertzberg, Ltd., who was recently invalided from France to Canada, has been appointed Commander of the Royal Canadian Engineers in Military District No. 11, which includes British Columbia and Vancouver Island. This appointment carries with it the responsibility of all the engineering work done by the military authorities in that district.

William Robert Worthington, B.A.Sc., chief engineer of the sewer section of the Toronto Department of Works, has been appointed as acting engineer to the Ontario Board of Health during the absence of Capt. F. A. Dallyn, who has gone to Siberia in charge of water supply and housing for the Canadian Expeditionary Force. Mr. Worthington retains his position with the city of Toronto, and will devote approximately half of his time to the city and half to the province.

Harry Emory Rice, hitherto assistant general superintendent of the Dominion Iron and Steel Co., has been appointed general superintendent, to succeed Mr. Randolph, who has resigned. He entered the service of the company to oversee the erection of the billet and rod mills, and upon the completion of these became superintendent. He continued to occupy this post until 1908, when he was made superintendent of all mills. Mr. Rice is a graduate of the Polytechnic Institute of Worcester, Mass., and a member of the American Iron and Steel Institute.

E. Mavaut, formerly of the Public Works Department at Ottawa, Ont., some months ago joined the staff of engineers of The Milton Hersey Co., Ltd., Montreal, to take full charge of their cement, sand and stone testing laboratories as director. Mr. Mavaut for three years tested building and structural materials for the Department of Public Works at Ottawa, after which he became Assistant Director and acted in that capacity for nine years. In January, 1916, he joined the Canadian Inspection and Testing Laboratories at Montreal as director of their cement laboratory.