PAGES

MISSING

The Canadian Engineer

A weekly paper for civil engineers and contractors

2,305,310 H.P. Developed from Water in Canada

That Is the Installed Capacity of Canadian Hydro-Electric Plants According to Census Just Completed by Ottawa Authorities—Installation of Additional Units in Present Plants Would Add 530,000 H.P.—Queenston and Other Developments Under Way Not Included

IN co-operation with the Dominion Water Power Branch, and aided by the Ontario Hydro-Electric Power Commission, the Quebec Streams Commission and other provincial organizations, the Dominion Census Bureau has just completed a census of the developed water power in Canada, the returns indicating a total of 2,305,310 h.p.

The accompanying table analyzes the installed turbine or water-wheel capacity by provinces and by use of power. The total of 2,305,310 h.p. is several hundred thousand horsepower in excess of any previous estimate, and proves that Canada's utilization of hydro-electric power is even more marked than had been realized.

Of the total water power developed, 1,727,471 h.p. is installed in central electrical stations,—that is, in stations developing electrical energy for distribution and sale; 352,214 h.p. in plants owned and operated by pulp and paper companies; and 225,625 h.p. in other manufacturing and industrial establishments.

INSTALLED TURBINE HORSE-POWER IN CANADA

	*Central Electric Stations. H.p.	†Pulp and Paper. H.p.	Other Industries. H.p.	Total. H.p.	H.p. per 1,000 Population.
Yukon	10,000	.....	3,392	13,392	1,574
British Columbia	221,625	46,450	44,348	312,423	506
Alberta	32,580	.....	300	32,880	63
Saskatchewan	.....	.....	.....	.....	....
Manitoba	64,100	.....	12,072	76,172	133
Ontario	791,163	133,952	59,945	985,060	359
Quebec	597,601	155,512	89,648	842,761	376
New Brunswick	6,878	2,800	5,191	14,869	41
Nova Scotia	3,354	13,500	9,170	26,024	51
Prince Edward Island	170	.....	1,559	1,729	19
	1,727,471	352,214	225,625	2,305,310	276

*Includes only stations which develop hydro-electric power for sale.
†Includes only the water power owned by pulp and paper companies.

The central stations already constructed throughout the Dominion are designed for the development of 530,000 h.p. more than the capacity of the machinery now installed. Of this amount, the installation of about 270,000 h.p. is at present under contemplation. These figures do not include the 300,000 h.p. Queenston plant which the Hydro-Electric Power Commission of Ontario has under construction, nor any of a number of smaller entirely new developments that are either planned or under construction.

Column 5 of the table discloses interesting figures concerning the development in the various provinces on a per capita basis. The hydro power developed per thousand of population ranges from 1,574 h.p. in the Yukon to 19 h.p. in Prince Edward Island and none in Saskatchewan. The average for the entire Dominion is 276 h.p.

Of course, the availability of hydro power (that is, the distribution, density and occupation of the population in the vicinity of the sources of supply), has a direct bearing upon the amount of power developed. The exceptionally high ratio in the Yukon is accounted for by the extensive use of hydro power in the mining industry, in conjunction with the comparatively small population.

The per capita figures of hydro power developed in the Dominion, when compared with similar figures for other countries, are indicative of the leading position of this country, both in the extent and in the utilization of its water power resources.

Norway, and possibly Sweden, are the only countries where the per capita utilization of water power exceeds that of Canada. The most recent figures available for the United States indicate a utilization of less than 100 hydraulic horsepower per thousand of population.

The fundamental reason underlying the extensive use of water power in Canada is that practically every commercial centre from coast to coast, excepting only a few in the middle Prairie Provinces, has an abundance of water power available, not only for present needs but also for all anticipated requirements for many years to come.

The estimate of developed water horse-power in Canada that was published in the preliminary report of the British Conjoint Board of Scientific Societies (Water Power Committee) was 1,735,560 h.p. It is now seen that this figure was no less than 569,750 h.p. too low. The estimates for other countries, as included in the Conjoint report, were as follows:—

Austria-Hungary, 566,000 h.p.; France, 650,000 h.p.; Germany, 618,100 h.p.; Great Britain, 80,000 h.p.; Italy, 976,300 h.p.; Norway, 1,120,000 h.p.; Russia, 1,000,000 h.p.; Spain, 440,000 h.p.; Sweden, 704,500 h.p.; Switzerland, 511,000 h.p.; United States, 7,000,000 h.p.

The Conjoint report estimates that about 16 millions of the world's industrial horse-power are developed from

hydraulic sources, and that (exclusive of 21 millions used by railways and 24 millions by shipping), the total of all the horse-power (steam, gas and water-power) used in the world's industries is 75 millions. If these Conjoint figures be correct, the power developed in Canada from water resources is about 15 per cent. of all the power so developed, or about 3.1 per cent. of the world's total industrial power from all sources, or approximately 2 per cent. of the world's total developed power of every kind.

Being Published by Government

The data regarding central stations is being published by the Dominion government in two volumes. Part I. is a statistical survey, with accompanying explanatory matter, while Part II. forms a comprehensive directory of all commercial and publicly-owned power stations in operation throughout Canada, whether water-driven or steam-driven, showing the principal features of each, the locations where blocks of electrical energy are for sale, the prices at which power is obtainable, transportation facilities available in the vicinity, etc.

The statistics dealt with in these two volumes include only central electrical stations; that is, stations developing electrical power for sale. All other electrical establishments, such as electric railways, etc., are excluded. Outstanding features of the report regarding central stations are as follows:—

Capital and Labor

The capital invested in central power stations totals $356,004,168, of which 79.5 per cent. is invested in commercial stations and 20.5 per cent. in municipal or publicly-owned stations. Total employees number 8,847, receiving wages and salaries totalling $7,777,715 per annum.

The total revenue received from the sale of electrical energy is $44,536,848, of which $29,135,399 is secured by commercial and $15,401,449 by municipal plants.

Power Installation

The primary power installation in central stations totals 1,844,571 h.p., of which 78.3 per cent., or 1,444,314 h.p., is installed in commercial stations and 21.7 per cent., or 400,257 h.p., in municipal stations. Of the total primary horse-power installed, 1,652,661 h.p. is derived from water, 180,800 from steam, and 11,710 from gas and oil.

Cost of Construction

Of interest is the actual cost of construction of hydro-electric power stations per installed horse-power. Omitting all real estate, transmission and distribution equipment, seventy representative hydro-electric stations throughout the Dominion, with an aggregate turbine installation of 745,797 h.p. and a total construction cost of $50,740,458, show an average cost of $69.11 per installed turbine horse-power. The figure represents the average capital cost of construction at the power site.

Directory of Central Stations

The directory, which forms Part II. of the report, constitutes the first governmental attempt to compile systematically a ready reference of this sort. Garcke's Annual, issued in England, and McGraw's Directory, published in the United States, have attempted to deal with this field in Canada, but the material which has now been compiled is much more comprehensive than either of those publications.

For Part I. (statistical), application should be made to the Dominion Bureau of Statistics; and for Part II. (directory), to the Dominion Water-Power Branch, Ottawa.

The Engineers' Club of Toronto, in the annual statement for the year 1918, reports a net loss of about $700 on the operation of the club. There are now 410 resident members and 136 non-resident, besides 20 members of other classifications, such as absent, associate, honorary, etc.

ADDRESS BY SIR ADAM BECK

"Ontario Hydro's" Chairman Discusses Radial Railways, Government Railway Operation, St. Lawrence River Power Development and Prices of Power

SIR ADAM BECK spoke for ninety minutes in the council chamber at Hamilton, Ont., last Tuesday evening, outlining the policy of the Hydro-Electric Power Commission of Ontario in regard to "Hydro Radials," and discussing various national questions in a general manner.

Mayor Booker, of Hamilton, presided, and on the platform were F. A. Gaby, chief engineer of the Hydro; Gordon Wilson, M.P.; Allan Studholme, M.P.P.; and a number of officials of Hamilton and surrounding municipalities.

The council chamber was densely crowded with citizens, yet only two questions were asked when Sir Adam finished speaking. One was in regard to the rates on hydro radials as compared with privately-owned radials. Sir Adam replied that he did not know what the rates would be, but operation would be at cost, and the proposed line from Hamilton to Burlington would be only seven miles, compared with eleven miles for the existing privately-owned line.

The other question was as to whether the motor traffic along the Toronto-Hamilton highway would be a serious competitor of the proposed hydro radials. Sir Adam did not think that it would be, provided that a quick and efficient radial service were operated at cost.

Criticizes Government's Railway Policy

Sir Adam proposed that the Hydro Radials should enter Hamilton over the G.T.R. right-of-way, with a terminal at the foot of James and Stuart streets. He declared that they will move D., L. & W. coal cars to Toronto. "It remains for the city of Hamilton to pass the necessary by-laws," said Sir Adam. Turning to the Mayor, he said:—

"You will have a great deal more to say in the operation of your own radials under the Ontario Hydro Commission, than you will have even with Federal-government-owned roads."

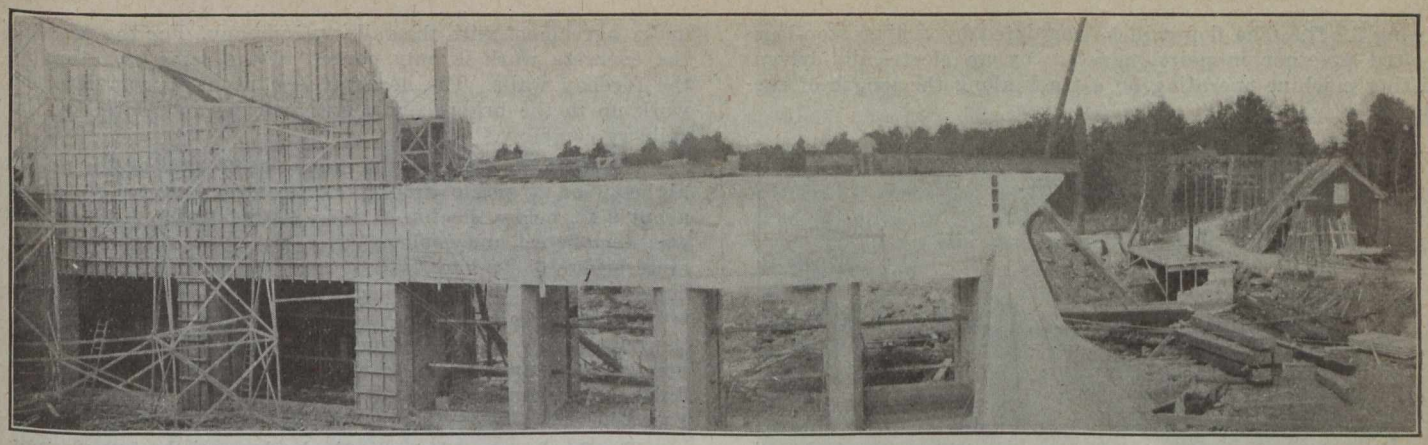
Sir Adam severely criticized the Dominion government for not taking over the G.T.R. "Public men can bedevil anything," he said. "They have bedeviled the railway situation in Canada by taking over the non-paying concerns." He ridiculed the idea of the government talking about taking over the Toronto Suburban and the Toronto Eastern as feeders to the national railways. "We will build all the feeders they want for their lines," he declared amid applause.

"The Toronto Suburban to Guelph," he said, laughingly, "wiggles and waggles all over the place. If they came to a rock, the engineers went around it; if a valley, they went down and up the other side. If they couldn't buy a lot, they went all around it. The Toronto Eastern parallels the C.N.R. all the way. And they talk about these being feeders. The G.T.R. should be taken over, and a combination of the C.N.R. and G.T.R. with our feeders would save, according to experts, over $300,000,000 to this country. Do you know the deficit the country will have to find for the present railways operated by the old management of the Mackenzie interests? Over $50,000,000 for this year."

Probing Montreal Prices

Sir Adam stated that experts for the Hydro-Electric Power Commission of Ontario have been placed in Quebec province to find out the facts in answer to Sir Herbert Holt's statement that Montreal has the cheapest power in America. "We have thousands of their bills and will publish a report in the near future. We have found to date that in domestic lighting, Hamilton has rates 100 per cent. cheaper than Montreal; in commercial rates, 200 per cent. cheaper; and the power rates are 65 per cent. higher in Montreal than Hamilton."

Sir Adam severely criticized Hon. N. W. Rowell for stating the Dominion Government intended to develop the water-powers of the St. Lawrence River for the whole of the people of Canada. "What right have they?" he asked. "The water-powers of Ontario belong to the people of Ontario and the people will maintain their rights."



HEADWORKS OF POWER HOUSE

Power Development at Drummondville, P.Q.

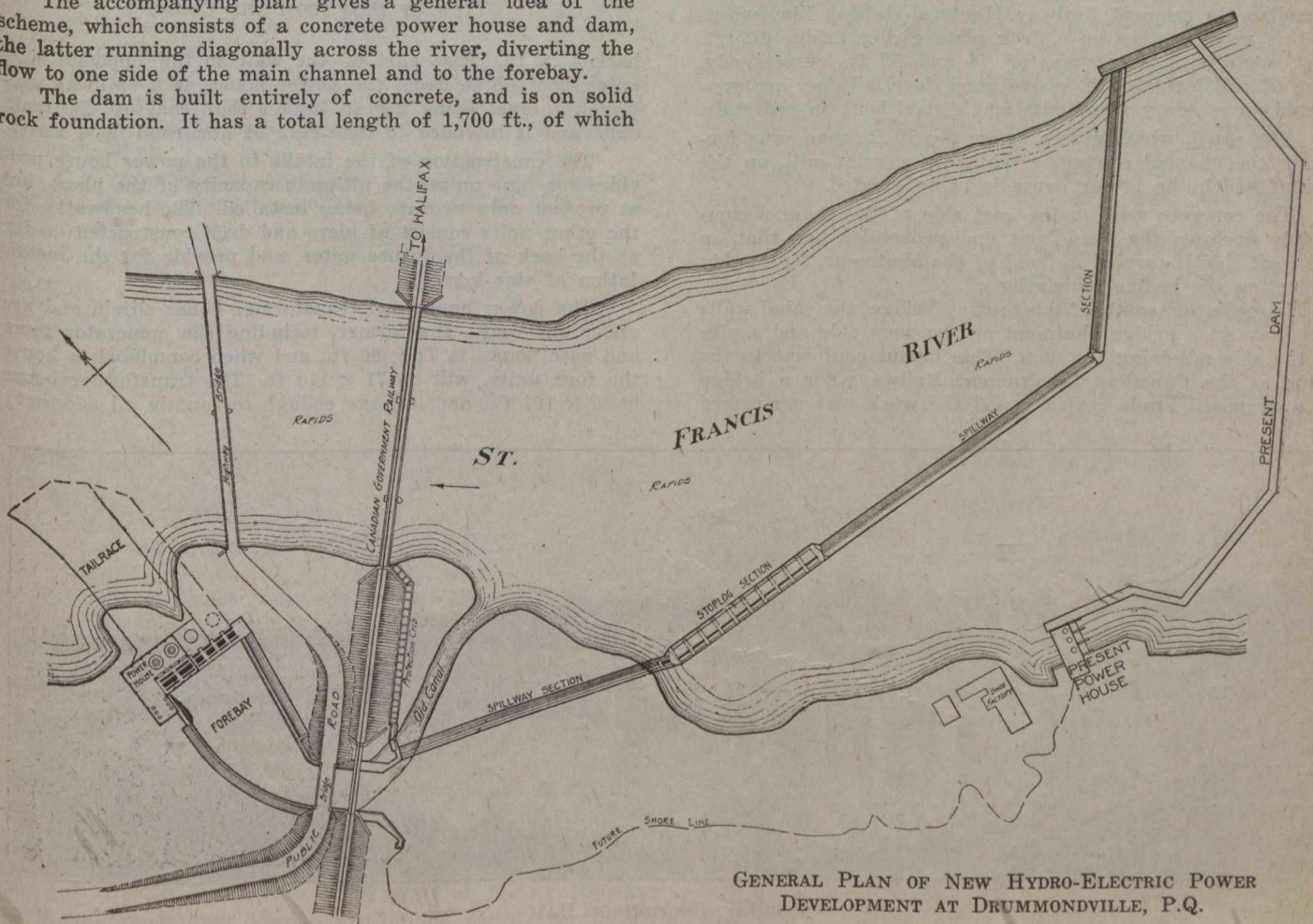
Southern Canada Power Co. Is Building Concrete Dam, 1,700 Ft. Long, Extending Diagonally Into St. Francis River, and New Power House With Capacity of 18,000 H.P.—3,500 H.P. Vertical Units, 32 Ft. Head

AT Drummondville, P.Q., on the St. Francis River and about sixty miles east of Montreal, the Southern Canada Power Co., Ltd., of Montreal, is constructing a hydro-electric power development. At that point, the St. Francis River has a fall of about 32 ft., comprised mostly of rapids below the present timber dam, which is about 5 or 6 ft. high, supplementing the head for the power plant now in operation. The ultimate capacity of the development is to be 18,000 h.p., but at present only one-third is being utilized.

The accompanying plan gives a general idea of the scheme, which consists of a concrete power house and dam, the latter running diagonally across the river, diverting the flow to one side of the main channel and to the forebay.

The dam is built entirely of concrete, and is on solid rock foundation. It has a total length of 1,700 ft., of which 1,440 ft. is an overflow section, having a maximum height of 16 ft. (see drawing). The stop-log section is 260 ft. long. The latter consists of nine piers, 6 ft. wide and 30 ft. long, with an abutment at the junction with the spillway at each end.

The piers are spaced 26 ft., centre to centre, providing a clear opening of 20 ft. The apron is at the same elevation as the bed of the river, the clear opening beneath the deck



GENERAL PLAN OF NEW HYDRO-ELECTRIC POWER DEVELOPMENT AT DRUMMONDVILLE, P.Q.

being 19 ft. The flow will be regulated by timber stop-logs bolted together in pairs, handled by an electrically-driven lifting machine operating on a track along the length of the deck.

CANAL ENTRANCE AND SPILLWAY

Access to the deck, which is 6 ft. higher than the crest of the spillway, is obtained through a tunnel 4 ft. wide and 7 ft. high through that part of the spillway extending to the forebay walls at the railway crossing. The land entrance is at the ground level behind the bulkhead wall, which extends to meet the crib protection work parallel to the railway. The other end of the tunnel terminates in a well 4 ft. wide and 16 ft. long, exit being by means of an iron ladder.

Electric lights are placed at frequent intervals throughout the tunnel. A drain is provided to take care of any seepage. This section of the spillway, owing to the tunnel through the centre, is made wider than the regular section, and also is reinforced with steel.

The water diverted by the dam passes underneath the Canadian Government Railway, Montreal-Halifax Line, which at this point crosses on a deck plate girder bridge 105 ft. long, comprising two spans of 76 and 35 ft., respectively, base of rail being 12 ft. above pond level. These are supported on masonry abutments and a steel bent on pedestals.

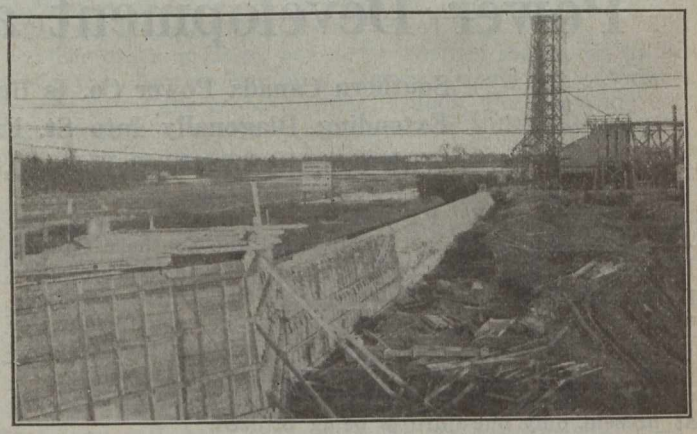
The canal, which passes under the 70 ft. span, was formerly the channel conveying water to a grist mill, on the site of which the power house is being erected.

The concrete wall on the east side of the channel completely encloses the steel bent and pedestals, and that on the west side is carried in front of the abutment, thoroughly protecting the bridge foundations.

Immediately south of the railway bridge, the canal walls terminate in a bridge abutment on the west side and a pier on the side adjoining the dam. This layout conforms to the plans of the Canadian Government Railways for a bridge on a proposed grade revision, and the work was performed under agreement with the railway company. For the present, the concrete work is only poured to the same elevation as the forebay walls. The necessary additions to complete the work up to the bridge seats, etc., will be done later by the railway company.

North of the railway, the canal was crossed by the public highway on a single arch concrete bridge at an elevation about 9 ft. below the top of the existing walls. This bridge was demolished and replaced by a two-span, reinforced concrete bridge 65 ft. long, with a roadway width of 24 ft. The floor is 9 ins. thick, supported by seven concrete beams 16 × 27 ins., sealed on the under side by a 4-in. slab in order to prevent any accumulation of debris during high water periods. The approaches to the bridge are earth with a top finish of broken stone, and are constructed to a grade of 1 in 20.

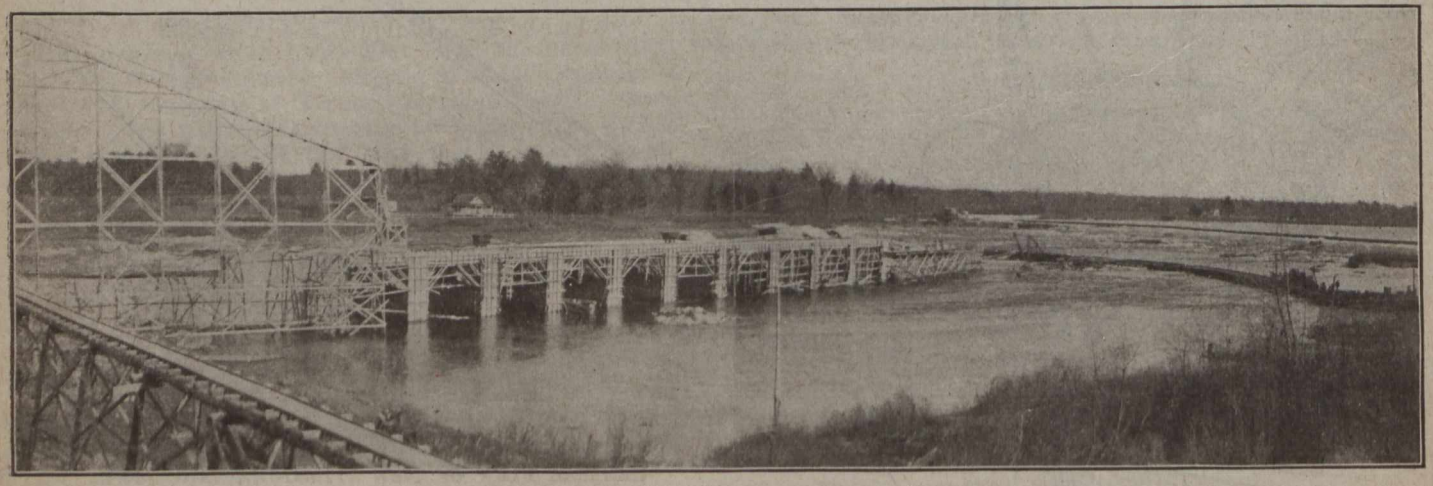
The forebay wall between the bridge and the transformer house has a retaining wall section, and averages 18 ft. in height. The batter on the stream side is 1 in 12, and on the back 4 in 12. That part of the wall on the opposite side, extending 168 ft. from the power house, is a spillway section, the crest being 2½ ft. higher than that of the main dam, and is intended to take care of abnormal flood water.



VIEW OF DAM FROM THE CANAL

The construction of the intake to the power house provides for four units, the ultimate capacity of the plant, but at present only two are being installed. The headworks for the other units consist of piers and deck constructed as far as the back of the future gates, and provide for the installation of stop-logs.

The power house and transformer house adjoin and are under one roof. The former, including the generator room and gate house, is 71 × 66 ft., and when completed to house the four units, will be 71 × 140 ft. The transformer house is 37 × 101 ft., and is large enough to contain all necessary

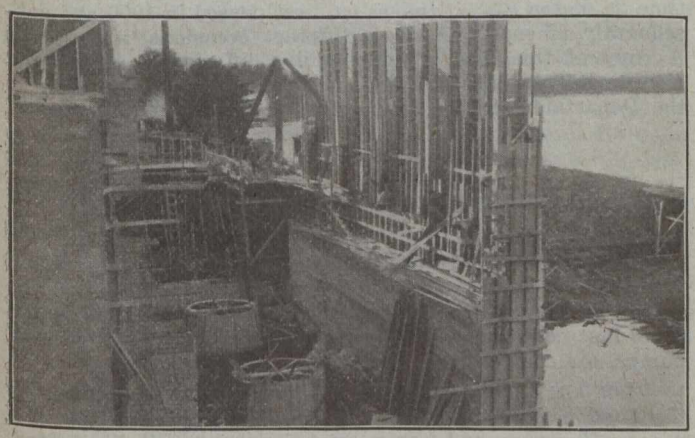


STOP-LOG SECTION OF DAM

transformers, switches, etc., for the operation of the plant at its full capacity.

All construction is of reinforced concrete. The intakes, scrollcases and draft tubes are formed in mass concrete. Structural steel is used for all roof supports, trusses being used in the generator room and part of the transformer house, and 24-in. I-beams in the gate house and upper roof of the transformer house.

The present proposed installation consists of two 3,150-k.v.a., 60-cycle, 2,300-volt, alternating-current generators, with a speed of 100 r.p.m. Each of these is directly connected to a vertical turbine rated at 3,500 h.p. under a 32 ft. head. Two 100 k.w., 125-volt, d.c. exciters are provided, one being

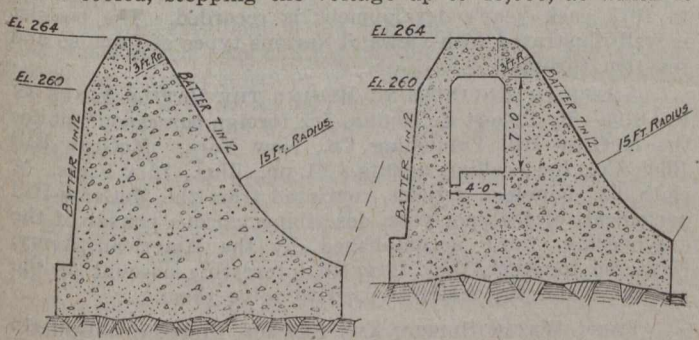


POWER HOUSE UNDER CONSTRUCTION

motor driven at 870 r.p.m. and the other direct-connected to a horizontal turbine with a speed of 400 r.p.m. The latter is placed in the basement of the transformer house, 15 ft. below the main floor level, the intake for the water wheel being through the side wall from intake for unit No. 1, and immediately in front of the gate.

This floor also contains the water intake and filters which supply the transformers, the oil pressure tank, the coal bunker and the boiler supplying steam for the heating of the building.

The transformers are 1,000 k.v.a., oil-insulated and water-cooled, stepping the voltage up to 48,000, at which it



SECTIONS THROUGH SPILLWAY DAM

is transmitted. These transformers are placed at the west end of the building, directly under the high tension gallery, and are mounted on rails at right angles to a main track running down the centre of the building, on which a track operates to convey any of the transformers to a point beneath a travelling crane.

The high tension apparatus is placed on a gallery that is 28 ft. above the transformer floor and that occupies the full width of the wing of the transformer house. The transmission exits are through the roof.

The switchboard panels are located on a gallery at the opposite end of the transformer house, and so situated that the operator has a full view of all parts of the generating room and transformer house above the main floor. Low tension switches are in concrete compartments beneath the gallery, and are operated electrically from the board, as are also the high tension switches. The switching apparatus installed provides for operating the plant at its ultimate capacity.

A 60-ton overhead travelling crane operates over the generator room and across one end of the transformer house, and a similar crane of ten ton capacity handles the work in the gate house and that part of the building adjacent to the transformers.

The gate for each intake is 12 × 26½ ft., constructed of steel and operated from the deck of the gate house by an electrically-driven worm gear.

The electrical equipment is being supplied by the Canadian Westinghouse Co., Ltd., Hamilton, Ont., and the turbines and intake control machinery by the Boving Hydraulic & Engineering Co., Ltd., Lindsay, Ont.

W. C. Hawkins is president and F. W. Teele, vice-president and engineer, of the Southern Canada Power Co., Ltd. The plant was designed by Wm. Kennedy, Jr., consulting engineer, Montreal, who is represented on the work by E. Loignon. The contractors for the plant are Morrow & Beatty, Ltd., Peterborough, Ont., of which firm H. A. Morrow is president and J. A. Beatty vice-president. The resident engineer for the contractors is James Dick, to whom *The Canadian Engineer* is indebted for the above information.

TO MAKE WIRE ROPE AT LEASIDE, ONT.

ANNOUNCEMENT is made by the Canada Wire and Cable Co., Ltd., of Toronto, that they are installing machinery for the manufacture of all sizes and kinds of steel wire cable and wire rope, and expect to have same in operation by March 15th. The machinery will be installed at the company's new plant at Leaside, Ont., a suburb of Toronto; and within the near future, the electrical wire and cable end of the company's business will be transferred from their present factory in West Toronto to the Leaside plant.

The Leaside buildings had just been completed when war was declared and the intended removal of the electrical wire and cable-making machinery was consequently deferred, the new premises being occupied during the war by the Leaside Munitions Co., Ltd. It was the part of the company's program before the war that wire rope would be manufactured at Leaside.

The company is manufacturing practically all of the wire-rope-making machinery at its own machine shops at Leaside. All sizes of rope will be manufactured, from sash-cord to the largest hawsers, including steel-core and hemp-core cable.

It is expected that over 200 men will be employed in the new department, and when the electrical department is transferred to Leaside, there will be a total of about 600 employees. The company owns fifty houses at Leaside, twelve of which have been completed, the remainder being under construction.

Interests closely associated with the new enterprise state that there should be ample market for their product without seriously interfering with other Canadian manufacturers of wire rope, because before the war there was a large importation of wire rope from Great Britain, and also considerable from Germany. In fact, it is estimated by the Canada Wire and Cable Co. that, at times, half of the wire rope being sold in Canada was British or German.

The new company also hopes to get a certain amount of export business. While the extent of this business is still problematical, F. C. Connery, of the company's sales department, has gone to Europe and will remain there for some time as their sales representative.

F. J. Bell, of Toronto, is president and general manager of the Canada Wire and Cable Co., Ltd.; T. A. Gass, sales manager; and H. Horsefall, works manager. Mr. Horsefall was formerly superintendent of the Dominion Wire Manufacturing Co., Montreal.

The Engineer's Library

HYDRAULIC AND PLACER MINING

REVIEWED BY J. B. TYRRELL

Consulting Mining Engineer, Toronto

By **Eugene B. Wilson.** Published by John Wiley & Sons, Inc., New York; Canadian sales agents, Renouf Publishing Co., Ltd., Montreal. Third edition (1918), 5 x 7¼ ins., 434 pp., 90 figures, cloth, $3 net.

In 1898 the rush of people of all classes to the new placer mines of the Klondike, in the far north-western corner of Canada, was at its height, when 28,000 people, very few of whom had ever seen a gold pan, crossed the mountains to the source of the Yukon River and descended that stream in 7,124 boats of various kinds.

All hoped to win fortunes by extracting and collecting gold from the gravel and bed-rock into which it had been concentrated by stream action through the ages since middle tertiary times. During the previous year, some mining claims, or portions of claims, had been found to be marvellously rich, and stories about them had been magnified a hundred fold by constant repetition. Creeks had been given such names as "All Gold" and "Too Much Gold," for the prospectors, when recording discoveries on them, had stated that "you had to mix gravel with the gold to sluice it."

At first the Argonauts bound for the new gold fields considered that no previous knowledge was necessary to enable them to make fortunes from such ground as they were certain to be able to stake or acquire, but after arriving in the Klondike many of them realized that they did not know what to do, and that there were many things about placer mining which it would be useful for them to know. Mr. Wilson's book, first published in that year, supplied a manual of information which was of much assistance to these miners, while, at the same time, it told people who contemplated going "inside," what they would need to do when they got there, and the laws by which they would be governed. It was, therefore, a welcome contribution to the literature of placer mining at that time.

In 1907 a second edition was issued, with 116 more pages than the first, and now we have a third edition, 68 pages larger than the second, or 410 pages in all, with an index.

The increase in size of the book has been largely in space devoted to a discussion of the capacity and transporting power of water and the proper methods of construction of ditches, flumes, sluices with their riffles, etc.

Many additional pages are also devoted to hydraulic mining. With reference to this method of removing earth and separating it into its various constituent parts, the author states in his preface: "The Giant has expanded from its original field, that of disintegrating gold-bearing gravel beds, to dislodging different kinds of minerals and materials from their resting places. Within the past ten years very able mountains of wasted coal that covered the landscape in the vicinity of anthracite mines in north-eastern Pennsylvania have disappeared, washed away by streams of water issuing from nozzles."

An interesting chapter gives a brief account of the development of placer mining, and at the end of the book are a number of useful hydraulic tables.

The chapter on prospecting placer ground gives various methods of estimating its value by drilling, etc., but the author does not rise above purely mechanical ideas in valuation, and gives no consideration to a knowledge of the structure or of the formation of the deposits, to the presence or absence of pay-streaks, or in fact to any data which might be gathered by a careful study of the history or mode of formation of the valleys in which the placers occur.

In some places, in matters of measurement, too, he slips into error, as on one page he speaks of an ordinary American gold pan holding from 15 to 25 lbs. of gravel, while on another page he speaks of material (sand or gravel) running 40 and 70 pans to the yard, which would make the contents of these pans weigh respectively 43 and 75 lbs., quite impossible weights.

In the chapter on geology, the writer has not kept in touch with a knowledge of the geology of the Klondike, as shown by a statement that "Ice rivers were the factors that disintegrated and transported the gold to those places where it is now found in Siberia and the Klondike," whereas "ice rivers," or glaciers, played no part in the formation of the placers of the Klondike.

Chapter 14, purporting to give the Canadian Yukon Mining Laws, is misleading, for the laws cited are those of 1898, which were repealed many years ago. At the present time *the Yukon Placer Mining Act*, first passed in 1906 and subsequently amended on three different occasions, is in force. A copy of this Act, which is quite different from the old Mining Regulations of 1898, may be obtained by a letter to the Department of the Interior, Ottawa.

PUBLICATIONS RECEIVED

NOVO ENGINES.—Catalogue No. 50, issued by the London Concrete Machinery Co., Ltd., London, Ont., who are the agents in Canada for Novo engines. Forty pages and cover, 6 x 9 ins., coated paper. Illustrating Novo gasoline engines, pumps, air compressors, etc.

LONDON CONCRETE MIXERS.—New catalogue issued by the London Concrete Machinery Co., Ltd., London, Ont., 6 x 9 ins., 60 pages and cover, coated paper, well illustrated. Covers line of concrete mixers, hoisting engines, elevators, barrows, carts, tile machines, block machines, cement working tools, etc.

WATER POWER.—Reprint of statement made by Sir Adam Beck, chairman, Hydro-Electric Power Commission of Ontario, to the Committee on Waterpower of the House of Representatives, second session of the sixty-fifth Congress of the United States, at Washington, April 15th, 1918. 72 pages and cover, 6 x 9 ins., no illustrations.

STEAM TURBINE PROGRESS.—Circular 1591, published by the Westinghouse Electric & Mfg. Co., Pittsburgh, Pa. Written by Francis Hodgkinson. The early history of steam turbine engineering is described and the early machines installed in America are illustrated. From 1899 to 1917 each year's development is recorded. The booklet is well illustrated with views of various types of impulse and reaction turbines.

AMERICAN ENGINEERING BEHIND THE BATTLE LINES IN FRANCE.—By Robert K. Tomlin, Jr., foreign correspondent for the McGraw-Hill Publishing Co., New York. McGraw-Hill Book Co., Inc., selling agents. 91 pp., illus., 12 x 9 ins., ¼ cloth, $2. Nineteen articles, reprinted from the McGraw-Hill periodicals of the past year, describing various phases of the engineering work accomplished by the American Army. Gathered together, they form an interesting account of the problems and the methods used to solve them.

FARM WATER SUPPLY AND SEWAGE DISPOSAL.—Bulletin 267 of the Ontario Department of Agriculture, written by Prof. W. H. Day. Prof. D. H. Jones, R. R. Graham and H. L. Fulmer, all members of the staff of the Ontario Agricultural College. Eighty pages and cover, 6" x 9", illustrated. Subjects covered are:—Why Pure Well Water Pays; Wells, Pumps, Power Pumping and Water Systems; Bacteria and the Water Supply; Chemistry of the Farm Water Supply; Farm Sewage Disposal; Bacterial Action in the Septic Tank System of Sewage Disposal.

ASSOCIATION OF MUNICIPAL ELECTRICAL ENGINEERS OF ONTARIO.—Advance copy of two papers to be presented at meeting to be held in Toronto to-day and to-morrow, January 30th and 31st. "Bare vs. Weatherproof Covered Wires for Potentials Above 750 Volts," by A. S. L. Barnes, of the engineering staff of the Hydro-Electric Power Commission of

(Concluded on page 188)

Wooden Structures in Railroad Engineering

Their Economy, Disadvantages and Preservation; With Especial Reference to the Treatment of Railway Ties — Description of the McMullen System of Drying Timber by Means of Warm Air Saturated With Moisture

By H. K. WICKSTEED
Chief Locating Engineer, Canadian National Railways

FOR a decade or more, the question of a future tie supply for the railways has been a serious one in the United States, owing to the rapid depletion of the forests, and within the past five years the anxiety has spread to Canada.

Nearly five years ago the writer, in the course of other business, became acquainted with the late Geo. W. McMullen, of Picton, Ont., a man who had made the conservation of waste a life study, and who had also made wonderfully successful studies in other fields. The conversation turned, on one occasion, to the subject of the preservation of timber, and some facts and theories of extraordinary interest were developed.

Mr. McMullen had, in the course of other investigations, become possessed of a fairly complete laboratory and was in close touch with modern bacteriology and practical chemistry. As a result of the acquaintance, experiments of great interest were made, involving an entirely new process of drying timber, more especially with reference to railway ties.

Demand for Railway Ties

Assuming the average life of ties, for instance, at six years, the Canadian Northern system alone will need over four million per annum, and the other two trunk roads something more than this, or say from twelve million to fifteen million in all. Our northern forests cannot stand this drain for any length of time. Much less can we hope by any reasonable efforts in reforestation to keep abreast of the demand. The timbers used are slow-growing ones, with the exception of jack-pine, and even this takes thirty or forty years to attain sufficient size.

There are two means by which we can stave off the impending famine, one by increasing the life of the timber tie, and the other by using some other material altogether, such as steel or concrete. Such experiments as have been made in the latter expedient have not been altogether satisfactory from the point of view of economy, even where they were physically.

The first expedient is the only one which has come into any considerable use on this continent, and it has usually taken the form of injection of creosote into the pores of the wood. This acts as an antiseptic, preventing the bacterial growth which results in decay through what we are accustomed to call "rot."

The creosoting process, while a great advance on the use of raw woods, is by no means a perfect cure; first, because it is expensive, nearly doubling the cost of the tie; second, the timber is somewhat weakened in the process, owing principally to the high temperatures to which the wood is subjected; third, to be at all effective the timber should be thoroughly seasoned or dried, and this is hardly practicable by existing means except at the sacrifice of time and space and the locking up of a considerable amount of capital for that time.

The Germans stack and air-dry their ties for eighteen months or more before treatment, and even then do not get a dry tie or a perfect product; and in America it seems to be seldom that more than one-third to one-half of this time is allowed.

Dry Woods Almost Indestructible

According to notable chemists, dry or cellulose woods are almost indestructible by any ordinary agency to which a tie is exposed. The bacterial growth requires moisture and oxygen for its development. It would appear, therefore, that if we thoroughly dry a piece of timber, and keep it dry, it will last indefinitely. We know from actual experience that this is so. Everyone has used or seen old timber in the form of beams and joists taken from buildings two or three centuries old and perfectly sound. In these cases moisture has been excluded. Again, every one has seen, or at any rate read of, piles and foundation timbers many centuries old in a perfect state of preservation. In these cases oxygen has been excluded.

We all know that exposed timber will generally last longer when coated with paint or tar or some waterproofing material. The exceptions are where the timber has been waterproofed before it was seasoned, with the effect of retaining the moisture already in the wood and preventing its evaporation. Timber, even when air-dried for a considerable length of time, still contains fifteen per cent. or more of moisture, the percentage varying with the nature of the material and the size.

Seasoning Timber Increases Strength

Another point not so well recognized or understood is that seasoning timber increases its strength by as much as 80 to 100 per cent. in some cases over that of the green wood. It will be seen at once that, consistently with reasonable expense and loss of time, it is well worth while to dry not only ties but also timber of any kind used as a beam or strut, where strength is necessary. If we increase the strength by even 60 per cent., we require only 62 per cent. of the amount of material, and, as this percentage is dry while the other contains a very large amount of moisture, the saving in freight is very much more than the apparent 38 per cent. In Eastern Canada, at any rate, transportation is a very large item in the cost of our timber and is compelling us, as a matter of expediency, to use steel and concrete where we should use timber if it were readily available.

It being granted that drying or seasoning is extremely desirable, the question is as to the means. In the case of ordinary lumber, air-drying, supplemented by a few hours in a kiln, is fairly satisfactory. In that of dimension timber it is not so; first, because the air-drying in the case of large timber takes years to accomplish; second, because the temperatures used in the ordinary kiln are so high as to injure the strength of the timber; third, because even when carried on with the greatest care and deliberation, the outside laminæ dry first and shrink before the heart of the wood has any chance, and this shrinkage causes checks and cracks which for many purposes render the wood useless.

Immersion in Sea Water

When the "wooden walls of England" were a reality, the seasoning of large sticks was carried on by immersion in sea water for a period of three years, more or less; the saps and resins were dissolved and washed out, and the pores of the wood left open and filled only by water.

The subsequent drying was then easily, quickly and uniformly carried on throughout the stick, and the resultant deposits of salt acted as antiseptics just as the creosote does in the modern process. This was, perhaps, the most perfect seasoning possible or ever accomplished. The process was very likely suggested to the English shipbuilder by his observation of the condition of logs and driftwood which, after years of immersion, had been cast upon his shores by the Gulf Stream and local winds and currents.

The Eskimo knows no other process than this and his woods are very perfect and lasting. But, in these days of rush and hurry, it cannot be expected that anyone will prepare his material three or four years in advance. Probably the excellent reputation which Canadian white pine had with

the British Admiralty was largely due to its long immersion in the waters of the Ottawa and the St. Lawrence before it was finally loaded on shipboard.

Washes Out the Liquids

In the experiments made in the last few years and above mentioned, an effort was made to use the same process that nature does, and dissolve, neutralize or wash out the sap and other liquids or semi-liquids which obstruct and close the pores, and to do this within a reasonable time—much faster than nature unassisted can accomplish the work.

Hot water is more effective than cold water, and hot vapour of water is, in some cases, still more so. In the new process, which is simplicity itself in theory (although the best form of mechanical application took much time and thought to study out), warm vapour, or in other words, warm air saturated with moisture, is circulated around the ties. This opens and cleans the pores of the wood just as a Turkish bath does in the case of a man. The liquid components of the saps and resins filling the vesicles themselves, expand with the heat and force their way out, to be diluted and carried away by the warm vapour.

After some hours of this treatment, the amount of moisture is reduced by very slow degrees until at the end it is practically dry and the timber is removed with not more than five per cent. of moisture left in it. The rapidity with which this is done depends upon the size and nature of the timber, just at it does in other methods, but no subject has yet been found which did not in the end yield to treatment. Care is taken not to let the temperature of the kiln get above 160° F., so that no injury may be done to the fibre of the wood.

Coating to Exclude Moisture

Timber so treated is, I believe, indestructible, except by fire, so long as it is kept dry. Even without further treatment, it will undoubtedly long outlast unseasoned material. In this shape, it is in pre-eminently good condition to receive creosote, but we believe that creosote is absolutely unnecessary, and that the elements of decay being altogether removed from the inside, all that is necessary is to keep them from entering from the outside. Some waterproof coating is desirable, and, in the case of ties, a cheap one is the only one that can be economically used.

In the experiments so far conducted, a heavy oil was found which answered the purpose perfectly and which is an inexpensive by-product of the refineries. The ties are merely dipped in a hot bath of this material for a few minutes and, on coming out, are sanded by a sand blast to absorb any superfluous stickiness and to make them easier to handle, just in the same way as an asphalt road is sanded.

Timber for building, where neat joints and carpentry are required, would probably be better treated with some pigment mixed with oil or varnish, but, for rough work, the asphalt or mineral tars seem to be all-sufficient and very inexpensive. The estimated cost of the drying process is about twenty cents, and of the protective coating, approximately ten cents, per tie.

Increases Supply of Tie Timber

The prospect which is opened up by this process is something more than merely getting the equivalent of the process-creosoted tie at a less cost. It is, besides, the potentiality of using timbers which are now useless for the purpose, or nearly so. The northern birch, for instance, is a strong, reliable wood, used by the Indians for every purpose requiring a hard wood, but unavailable for ties or bridge timber on account of its superabundant sap and its consequent tendency to rot rapidly.

The poplar and the balsam are others for which there is at present practically no demand. These timbers are particularly interesting to us just now on account of the recent opening up by the railways of thousands of square miles of northern forests, of which, with spruce and jack pine, these are the main constituents. The use of these woods for commercial purposes means not only millions of dollars to the railways in reduced cost of ties and in freight, but more millions to the people of Canada who have been burning up and wasting this forest growth as something not only worthless but as actually impeding settlement.

Conserves the Northern Forests

It is quite conceivable, I think we may say probable, that the settler in New Ontario, Northern Saskatchewan or Alberta, will find it profitable to conserve the forest on a considerable portion of his land, cutting from year to year only the mature timber so as to encourage the young growth. Aside from the question of ties and pulp wood, what a large potential value there is in poplar, balsam and spruce! In Winnipeg's early days, poplar lumber was the principal material in house-building, and there was no fault to be found with it except its shrinkage, which drying would have prevented.

Balsam is to this day the principal cut of the little country mills in northern Nova Scotia for home use, and is an excellent material for inside carpentry. Spruce is probably the finest known material for spars, and only its perishability prevents it from making a cleaner, straighter and stronger telegraph pole than the crooked, twisted cedars we are now using. Birch is already coming to its own in the manufacture of furniture.

Our northern settler has been in the habit of burning up most of these timbers as almost worthless, in order to grow potatoes in their stead. A century ago, the settlers in south-western Ontario thought much the same about the white pine and the black walnut, and some of the wealthiest residents in that portion of the country to-day are those whose fathers, either by accident or design, left some of the original forest standing.

Tests by the C.N.R.

Although much of this article was written two years ago, there is practically no change in it except in respect to one or two details as a result of more testing.

A number of ties have been put in the Canadian Northern track, and while the times have been somewhat too strenuous of late for experimenting, and changes in staff have led to the neglect of the examination of these from time to time, some of them have been taken up and tested for absorption of moisture and for signs of rot.

I have one sample of a tie dug up very recently which had been under the track in the Trenton yard for over three years, and I have another sample of a birch tie which has never been under the track at all, but which shows how absolutely perfect the drying part of the process is, and what a valuable timber birch is. Most people know what an absolutely worthless timber it is if used in outside work without seasoning. Unquestionably the reason is the amount of sap which it contains. If this be dried out and the wood sterilized, it is as strong and lasting as most other hardwoods and better than some. It is incidentally the only hardwood in Northern Ontario and Quebec.

As a result of our experiments with these ties, we concluded that in the main the experiments were in the right direction, but that certain waterproofings were imperfect. They melted and ran under a strong, hot sun, and when abraded, as was inevitable in the case of ties, the waterproofing was gone. Some of the more tarry products which penetrated the grain of the wood were much better, and we believe them to be very good indeed.

Creosoting Would Be Perfect

Except for the expense, creosoting after the seasoning process has been carried out would be perfect, but I for one an extremely doubtful of the efficacy of creosoting for an unseasoned stick of timber. It always seems to me like putting a coat of paint or varnish on green wood. This merely closes up the outside pores of the wood and prevents the evaporation and oxidation of the juices and saps of the interior.

I have already alluded to the care which the Germans take with their drying and seasoning, but we are too impatient in this country to wait for this and we give at most eight or nine months, which is not enough. All of us probably have seen standing timber after a bush fire. For a year

or so the seasoning goes on all right, and then the borers get to work. They bore through the hard, seasoned outside shell so as to get at the juices of the interior, which shows that the juices are there although the stick has been seasoned under almost ideal conditions, standing straight on end and nearly always with the bark on to shed rain and snow.

Creosoting, I understand, costs now some 40 cents per tie, so that the treated tie costs us considerably over $1 and is heavier and harder to handle than the untreated tie. One of the advantages claimed for the seasoning is that it very greatly reduces the weight instead of increasing it, and that as a result we have less to pay for transportation and for trackwork. The seasoning can be accomplished in a month or less (the time varies with the character of the timber), so that even if we resort to creosoting we save time and interest on money invested in green ties and we save room in our piling yards and drying sheds.

Reinforced Concrete Ties

I have dealt in the above practically altogether with ties because it is one problem which is bothering us railway men a great deal. Even before the war and the recent enormous advance in prices, we had become so impressed with the growing scarcity and increasing cost of timber ties that we had been making all kinds of experiments with metal and concrete ties, not in order to cheapen the first cost but to lengthen the life of the tie and so make its annual cost less.

If we go into concrete at all, it has always seemed to me that we should alter our whole system of support to a longitudinal instead of a transverse bearing, and this again would alter the most economical form of rail to be used. Possibly, we might, with a long stringer of concrete, giving us the necessary stiffness and rigidity, dispense with enough steel to pay for part of the increased price of the bearing, but imagine what we should get into in the way of drainage and precautions against frost heaving in our climate!

I have seen reinforced concrete ties doing very excellent work in the tropics, but our frost conditions alter the whole aspect of the matter. Shimming upon the top of a concrete tie would be a very different matter from drawing the spikes out of a wooden tie and putting longer ones in, or, as we have to do sometimes, putting a complete new tie on top of the old one.

I am afraid that for many years to come we must continue to use wooden ties—at any rate, on all but the most perfect and most heavily congested parts of our railways—and this being the case, and the supply diminishing while the demand increases, it behoves us to make them as long-lived as possible.

Bridges, Buildings, Tanks, Etc.

There are, besides the item of ties, a great many other utilities about a railway which we have hitherto been accustomed to build of wood but for which, latterly, we have been substituting structures of steel, concrete and other materials. The reasons for the substitution have been the same—increased life and lower maintenance charges (and in the case of timber trestles, water tanks and buildings—danger from fire).

On the Canadian Northern system, at least, we have had numerous cases of bridge decks catching fire, and in many cases the fires have spread from the decks to the body of the structure. But in how many cases have we found that the commencement of the fire was where some little rot had started, and that a smouldering fire had been fanned by a strong wind into a blaze!

Ballast decks have been introduced to obviate these fires, but they don't seem to have come into general use, and the tie, aside from fire risk, certainly does not last so long as if freely ventilated. Prevent the rot and I think you will find that the risk of fire is greatly diminished. Season the timber thoroughly, and apply a fireproof coating of tar and sand, similar to what we often put on our building roofs, and the risk will disappear almost entirely.

In this case the question of abrasion of the protective coating does not come up at all, but the protective coating, whatever it may be, should not be put on unseasoned timber.

We all know of old bridges and other structures which have been protected from the weather, have stood up for a generation or more, and have been replaced only because too small or too weak for modern loads, and in many cases where wooden bridges have been replaced by steel and concrete, it is somewhat questionable whether the change was economical in the fullest sense of the word, and whether it would not have been better policy as an intermediate step to take more care in preserving the timber and putting concrete abutments and piers under it.

One of the main reasons for much of the substitution of steel for timber in the recent past has been the growing scarcity of the timber and the cheapness of the steel, but still more recently the conditions have been reversed and steel has become very difficult to obtain while timber has not increased in price in the same ratio. These, of course, are largely temporary conditions, but they are not going to readjust themselves in a few months.

Permanent Work Sometimes Uneconomical

Permanent work which will last through the centuries is all very well in its proper place—in connection with great undertakings which will themselves be useful for centuries. Railways, in this country at any rate, are not always of this character, and I have known several cases (I have at this moment in mind some very expensive and well constructed works), which have been a stumbling block and deterrent to improvement because they were built in the wrong place and the authorities did not want to throw them away.

How many of our railways are located in the wrong place to suit modern conditions of traffic? Not so much because of blunders or shortsightedness on the part of the original builders, but because the financial and economic conditions of the present day are entirely different from those of a generation ago; and who can say to what extent these conditions may be changed another generation hence?

Take the case of the Canadian Pacific across the western plains, for instance. It has been relocated and rebuilt for miles, but who shall say that the original location and construction was wrong? Is not the financial success of the C.P.R. direct evidence to the contrary? and that the light grading and cheap timber trestles and bridges were absolutely right and good policy?

Take the opposite case—the Grand Trunk, built two generations ago to the high constructive standards of the English roads. Not only was the road handicapped from the start by enormously high capitalization, but it was deterred from making desirable changes in location by the existence of such expensive works. I have myself been told that a certain location was unacceptable because it would "scrap" a $50,000 structure. The Canadian Pacific is to-day built on that identical location and is hauling nearly double the Grand Trunk loads.

Economy vs. Parsimony

Consider the now developing railway situation in Canada. Two transcontinental roads have been built across the continent, and with the avowed intention of competing in a great many cases. The change in economic and sociologic conditions has brought it about that these two lines have come under the same ownership and managerment. One of these has cost about double what the other has. Without asking the question whether one might have been dispensed with altogether, it is safe to say that the money which has gone into expensive construction could have been put to very much better use if it were available to-day.

Because we have made a great effort and surprised ourselves by borrowing nearly a billion dollars from our own people, there is no reason why we should rush into indiscriminate expenditures. There is an enormous amount of work to be done to bring our railways to the highest standard of efficiency, and it behoves us to be sure that our money is spent judiciously. There will be none too much to go around, and anything in the way of economy that can be effected, consistent with due respect for the safety of the public (let us not confuse economy with parsimony), will be well worth investigation.

OFFICE RECORDS OF THE ST. LOUIS WATER DIVISION, DISTRIBUTION SECTION*

THE personnel of the force comprises an engineer-in-charge, assistant engineers, superintendents of construction, labor, stables and vehicles, meters, inspection; a chief draftsman, chief clerk and the draftsmen, clerks, stenographers and helpers working under these men.

For distribution purposes, the city is divided into six districts, each having a station building, with a station foreman in charge. The most central of these stations is used as the construction superintendent's headquarters, and is known as "the main distribution office," from which all orders emanate, and to which all reports are sent. Another station, known as the "pipe yards," is used as a supply depot and meter testing station. Each district is divided into sections, in charge of section men reporting to the station foreman.

Tabulated on Cards

All material is tested before being used; the pipe, valves, hydrants, special castings and fittings are tested at the place of manufacture, and all other material at the city testing laboratory. The test records are kept at the main office in the city hall. Pipe for contract work is delivered by railroad to depots in different parts of the city, convenient to the work. All other material is stored at the pipe yards and delivered as needed. Records are kept at the pipe yards showing in detail the exact stock on hand at all times.

On receipt of petitions for water mains from property holders on certain streets, or upon notice from the street division that certain streets (without water mains) are to be paved, or when new mains appear to be needed for distribution purposes, record cards are made out, showing the names and extent of the streets. An inspector then ascertains the number and story-heights of all houses on the street, and the kind of pavement, if paved. An engineer then determines the size and length of pipe, number of fire hydrants, valves and special castings needed; estimates the cost of material and labor and total cost, and tabulates these items on the card. The engineer-in-charge will then place on the card a check mark in such a way as to show at a glance whether the work is recommended or not recommended. In a somewhat similar way various requests for additional fire or sprinkling hydrants, private connections, fire lines, etc., are received, considered and either recommended or not recommended. These records are then filed for future reference.

Indexing and Filing Records

All contract work recommended must be approved by the Board of Public Service and contracts awarded for the work. A record is kept, year by year, of all bids received, and the supply clerk keeps a card index of the current prices of all material used by the water division. On pipe lines, lowerings, etc., the engineers make plans and profiles of the work, stake out the line and enter their notes in the customary engineer's field book. The plan and profiles and a copy of the engineer's notes are then given to the contractor, or in case of work to be done by the distribution section, to the superintendent of construction, with instructions to lay the pipe, castings, etc. On small jobs simple instructions are issued to do the work, accompanied when necessary by sketches and memoranda giving all necessary data. On the larger jobs regular pipe laying inspectors are assigned. On the smaller jobs, the station foremen act as inspectors. Longer jobs (not contracts), pipe laying and pipe lowering are done by pipe laying foremen in charge of what are known as "floating gangs." These men work in all sections of the city, reporting to the superintendent of construction at the main office.

The pipe laying inspectors keep a daily record of labor and material used, and obtain and record measured locations of all pipe, hydrants, valves and special castings, etc. This record is known as the "inspector's notes." On the smaller jobs and routine work the section men fill out a "daily report sheet," ruled in three columns viz.: "Name," "Time," "Work done and material used." The station foremen obtain and record the measured locations, which, with the "daily report," are collected by the superintendent of construction and brought to the main distribution office. Here, under the direction of the chief clerk, a stenographer types these memoranda into sheets known as distribution notes, if the work is done for the city, and "private connection notes" if done for private parties.

At the end of each month the chief clerk forwards to the chief draftsman a "recapitulation sheet" of all "distribution notes" and "private connection notes" sent down from the main office. This list is checked against the chief draftsman's "posting record," and must agree with it, so that no notes can be lost in transit between offices. The engineer's notes, profiles, distribution notes, and private connection notes are now turned over to the chief draftsman, who numbers the notes serially, and enters them in a "posting book," and is then responsible for the correct platting and recording of the work done on all the drafting room records, and of indexing and filing these records, so that they will be instantly available when needed.

Posting on Distribution Map

The regular drawings of hydrants, special castings, valves, tools, buildings, etc., are filed in a vertical steel plan file, and indexed in the usual way. Profiles and foreign drawings are rolled up and filed serially in numbered tubes in metal pigeon-hole cases, and card-indexed according to subject matter.

The draftsman may then post the maps and other records in the following order:—

First Posting.—This is done on the distribution map. This is a map of the entire city, on a scale of 1,320 ft. to the inch, on which high-pressure mains are shown in blue and low-pressure mains in red. The size of the pipe is accurately indicated by the thickness of the line; 1/5 in. indicates 48-in. pipe, 1/6 in., 36-in. pipe, 1/8 in., 30-in. pipe, 1/16 in., 20-in. pipe, 1/20 in., 15-in. pipe, 1/32 in., 12 in. pipe, 1/40 in., 10-in pipe, 1/64 in., 8-in. pipe, a single thin line, 6-in. pipe, and a single thin dotted line, 3 in. or 4 in. pipe. No hydrants, valves or special castings, except the separating valves between high and low pressure, are shown on this map. On all other records the size of the pipe and nature of the special castings, etc., are shown by the conventional signs or symbols. Thus, three lines close together, two of them dotted, enclosing a central full line, indicate 48-in. pipe; two full lines enclosing a central dotted line, 36-in. pipe; three full lines, 30-in. pipe; one full line and one dotted line, 20-in. pipe; two full lines, 15-in pipe; two dashed lines, 12-in. pipe; single dashed line, 10-in pipe; single dot and dash line, 8-in. pipe; single full line, 6-in. pipe; single dotted line, 3-in. or 4-in. pipe, the size being written on the line if necessary. Conventional signs are used for different types of valves, hydrants and other accessories.

Section Maps and Loose-Leaf Books

Second posting; section maps. These maps are on a scale of 200 ft. to 1 in., only 19 being required for the entire city. About 125 city blocks appear on each section map. Cloth blue prints of these maps, mounted on map rollers, are kept at the various stations. These maps are invaluable, especially to the "night station foreman." The numbered separation valves are shown on these maps as well as all other valves, special castings, hydrants, etc. If a water main of any size should burst or a joyrider break off a hydrant and a flood threaten any locality, the foreman refers to the map of the scene of the accident and orders his gang to close the proper valves until repairs are made.

Third posting; loose-leaf plat book. These plat books are on a scale of 100 ft. to the inch, 278 of them being required for the entire city. About 30 city blocks are shown on each plat. On these plats a given city area occupies four times the space it occupies on the second map, and of course

*From the December Journal of the American Water Works Association.

shows the pipe, hydrants, valves and other specials far more clearly and distinctly. These plats are consulted on all occasions where exact measured distances, pressures, grades, etc., are not required.

Fourth posting; street intersection cards. These are on a scale of 50 ft. to the inch, over 6,000 being required for the entire city. These cards, when completed, show on one-half of the card the building and curb lines of all street intersections, and measured locations of all water mains, valves, hydrants, etc., within a radius of one-half the distance from the given street intersection to the next nearest street intersection along any street. On the other half of the card are listed references pertaining to the water main, i.e., the engineer's book and page, inspector's book and page, profile number, date of laying, pressure in pipes and grade of street intersection at centre lines of street. On the back of the card appears the name of the street, under which the card is classified and alphabetically filed, and on the front the name of the intersecting street. A serial number on the back indicates the place of the particular card in the "run" under which it is indexed. A transparent envelope protects the card from soiling or blurring. These cards are in daily use, answering the thousand and one queries received from the public or from other city departments, where exact and specific information is required.

Fifth posting; separation cards. These are made for all intersections at the boundaries of high and low districts, and differ from the street intersection cards only in that the high pressure mains are shown in blue, and low pressure mains are shown in red, and the numbered separation valves are shown.

Sixth posting; sprinkling hydrants. A very complete and accurate list of sprinkling hydrants is kept. This list shows the number of "Sprinkling Districts," 42 in number, in the city, showing the number and location of the hydrants in each district, the total number of which on Jan. 1, 1918, was 1,894 hydrants.

Hydrants Are Numbered

All additions or removals during the previous year, and deductions to be made on account of oiled streets, and the amount due by sprinkling contractors for the use of the hydrants, are also accurately shown. In addition to this list, all hydrants are shown on a complete city map, scale 1,320 ft. to the inch, divided into sprinkling districts. Each hydrant is numbered, the number appearing on the map adjacent to the hydrant. Enlarged maps of each section on scales varying from 200 to 600 ft. to the inch, are also kept so that the distances between hydrants can be scaled at any time.

Seventh posting; drinking fountains. All fountains are shown on a complete city map, scale 1,320 ft. to the inch. The character of the fountains is designated by conventional symbols for the various fountains installed by the city, by humane societies, saloons, etc., these fountains being for horses and in some instances for dogs or other small animals. Special symbols also indicate special ordinances fountains, metered fountains, or the new type known as "bubbling" fountains, from which citizens may drink when thirsty without danger of contamination. A numerical "District Book" of fountains and an alphabetical card index giving exact location, ownership, date of installation, memoranda relative to the maintenance and care and condition of the fountains, date of withdrawal, etc., are also kept.

Pitometer and Pressure Records

Eighth posting; pressure records. Pressure gauges are maintained at six carefully selected points in the city, and the charts from them are collected and filed daily, thus keeping, as it were, a finger on the "water pulse" of the city. In addition, numerous special gauge-readings have been taken at a number of well chosen points, at various grades, and platted in a city map, scale 2,000 ft. to the inch. By making allowance for differences in grades, we have computed reliable maximum, minimum and average pressures, for practically the entire city. These pressures are recorded on the "Street Intersection Cards."

Ninth posting; pitometer records. A large number of pitometer readings have been taken at points selected with a view toward determining the direction and volume of the flow, by night or day, from the pump mains into the feed mains, and thence into the distribution mains to the consumer. These readings are recorded on a complete city map, scale 800 ft. to the inch. On this map are drawn three sets of concentric circles, at 1-mile intervals, covering the entire city. The centre of one set of these circles is at the Baden High Pressure Pumping station, one at the Bissell's Point Low Pressure Pumping Station, and one at the Compton Hill Reservoir.

These are the principal records to be posted; and as each record is posted, the draftsman marks on the inspector's or distribution note an abbreviation of the name of the record as "D" for distribution map; "SP" for sprinkling map, etc. When the notations on the note show that all records have been posted, the chief draftsman O.K.'s the note, and it is then pasted in a numbered "gummed stub" book. As the sheets are pasted in, they are paged serially, and index cards made up alphabetically, by street names.

In all municipalities, inherited records are more or less faulty and incomplete, owing in a large measure to continual changes in administration, poor systems in the past, the personal or human equation of the employees, or in some instances as in that of our own city of St. Louis, to a fire at the city hall some years ago, which destroyed a number of records. It is frequently found that measured locations are, either altogether missing, doubtful or evidently incorrect. To remedy this condition as far as possible two methods were used with great success by the present administration, in the St. Louis Water Division:

How Errors Are Avoided

1. Copies of the section maps previously referred to were laid out on a table at the main office of the distribution system. The section foremen were then called in, one after another, and, with the chief draftsman went over the maps carefully and minutely. Where the section man recognized an error, or was in doubt as to any point, notes were made of the error or doubtful condition, and the corrections made when correct information was obtained, by inspectors delegated to this work. A very large number of important corrections were made in this manner.

2. In the drafting room a set of cards known as "Information Cards" (known among the draftsmen and engineers as "I.C." cards), are kept, and on them are entered requests for information on any doubtful point, for corrected locations, or for missing locations which develop in the course of the day's work. On each card is marked the number of the section, from which the information desired is to be obtained; and on the back of the card is marked the name of the street under which the card is classified. On the face of the card is marked the intersecting street, very much as in the case of the street intersection card. The cards are then grouped by sections, the streets being alphabetically arranged in their group. It is then a comparatively easy matter to send out inspectors to obtain the necessary information or obtain it direct from the section man in charge of the section.

By use of these two systems the faulty or missing information cases have been reduced to a minimum, and the value of the record system has been rendered nearly 100 per cent. in the present distribution system.

The annual meeting of the Toronto branch of the Engineering Institute of Canada was held January 22nd, at the Engineers' Club. Prof. Peter Gillespie, retiring chairman, read the annual report and explained that the infrequency of meetings during the past year was due to the war and the epidemic of influenza. Prof. Gillespie delivered a brief address, urging the engineers to greater public service and outlining various ways in which there are outstanding opportunities to serve the public, such as conservation of coal, development of waterpowers, sanitation, etc. After the formal business of the meeting had been completed, the new chairman, A. H. Harkness, and the new secretary-treasurer, W. S. Harvey, were introduced, the remainder of the evening being devoted to musical entertainment.

AMERICAN ROAD BUILDERS' ASSOCIATION

THE Ninth American Good Roads Congress and the Sixteenth Annual Convention of the American Road Builders' Association will be held February 25th-28th, at Hotel McAlpin, New York City. The tentative program contemplates devoting February 25th and 26th to the presentation and discussion of papers, and February 27th and 28th to the consideration of reports to be submitted by several committees. The business session of the association will be held on the afternoon of February 28th, and the annual banquet on the evening of the 26th or 27th.

Among the subjects that will be presented for discussion are the following:—

National highways and federal aid for state highway improvements; relation of highways to railways and waterways; efficient methods of contracting for highway work during the reconstruction period; efficient methods of promoting highway bond issues; efficient methods of drainage for different geological conditions; foundations for heavy horse-drawn and motor truck traffic; methods of maintaining highway systems prior to construction by the state or county; economic utilization of labor-saving machinery; cost keeping for highway contractors; street systems, their relation to highways outside of urban districts; the efficiency of the French broken roads during the war; efficiency of bituminous surfaces under motor truck traffic; recent developments in the construction, maintenance and reconstruction of cement-concrete pavements; present status of brick pavements constructed with sand cushions, cement mortar beds and green concrete foundations; and recent practice in the construction of stone block pavements.

Committees will submit reports on the following topics:—

Regulations covering speed, weight and dimensions of motor trucks; methods of financing highway improvements for states, counties and towns; civil service requirements for highway engineering positions; sources of supply of unskilled labor for highway work; convict labor on highway work, organization, administration, camps and cost data; reconstruction of narrow roadways of trunk highways with adequate foundations and widths for motor truck traffic; methods of strengthening and reconstructing highway bridges for heavy motor truck traffic; efficient methods of snow removal from highways outside of urban districts; guarantees for pavements on roads and streets; and uniform highway signs.

Next year it is proposed to hold in connection with the convention, a comprehensive exhibit of road machinery, equipment and materials. But at the time when it was decided to hold this year's convention in New York, the war was still in progress, and it was considered impossible to have an exhibition on a large scale. It was therefore decided to limit this feature to the facilities afforded by the "Winter Garden" on the top floor of the Hotel McAlpin. The session of the convention will be held in the ballroom, which is also located on the top floor and adjoins the "Winter Garden."

ENGINEERING INSTITUTE ELECTIONS

AT a meeting of the council of the Engineering Institute of Canada, held January 21st at Montreal, the following elections and transfers were announced:—

Members—A. J. Barnes, Halifax; I. P. MacNab, Halifax; J. S. Misener, Dartmouth.

Associate members—J. Griffiths, England; R. C. Harris, Calgary; J. W. Houghton, Winnipeg; W. G. Jones, North Vancouver; A. T. MacDonald, Kentville, N.S.; W. B. MacKay, Halifax; R. L. Nixon, Kentville; W. K. Scott, Montreal; G. L. Stephens, Halifax.

Transferred from associate member to member—C. R. Crysdale, Vancouver; E. H. Darling, Hamilton.

Transferred from junior to associate member—W. E. Hobbs, East Kildonan, Man.; D. Whittaker, Pincher Creek, Alta.

Letters to the Editor

THE C.N.R. MOUNT ROYAL TUNNEL

Sir,—With reference to the interesting article on the above great work by H. K. Wicksteed in your issue for the 23rd inst., the reader might be led to believe that the only tunnels in the Old World which exceed this one in length, are the three great Alpine tunnels. This is incorrect, as the celebrated Severn Tunnel on the Great Western, and the Totley Tunnel, on the Midland Railway, in England, both exceed the Mount Royal Tunnel in length. The former, which is a subaqueous tunnel, by the way, is 4.36 miles long, and the Totley measures 3.54 miles against 3.25 miles for the Mount Royal tunnel. In justice to the engineers of these English tunnels, these facts should be noted.

C. O. THOMAS.

Montreal, P.Q., January 27th, 1919.

CHIEF ENGINEER AND ASSISTANT—THEIR RELATIONSHIP AND ITS ETHICS

Sir,—In this country fifty years ago, the engineering "profession" was unknown. Then the engineer was considered a skilled workman with pluck enough to command and direct unskilled laborers; competent enough to estimate values; experienced enough to design details in a definite line of construction. He applied building methods suitable to the resources and financial standing of that epoch; large rubble foundations, wooden bridges, canals, quays and cribwork structures were his earliest field activities.

Later came railroad problems, structural steel developments, industrial researches demanding wider knowledge of natural resources and their utilization. The skilled workman had to make a study of these by himself. He had to become acquainted with combinations and devices, every day more numerous and complicated; not only to master these, but at the same time to develop his connections so as to come into closer touch with his competitors,—his future confreres.

Universities made place for new chairs in order to prepare the youth for this science, while older engineers organized themselves into a corporation, a parent organization, with the purpose of placing the young wheels in the right path leading up toward professional heights, so that engineers could compete honorably with any other liberal profession of the highest standing.

Such was our father's aim; such is ours. The engineer ought to be of efficient service to the public. To this end, he should be governed by special laws of professional ethics, and so act upon the principles of charity and brotherhood that he and his fellow-engineers should be recognized as a commanding body in their own field of action.

Every sunrise gives birth to new methods and new problems. Engineers should be in readiness for co-operation. They should merge their experiences; they need the resulting benefit as much as they need the discoveries of a university's research bureau. Most engineers are glad to offer their experiences for the welfare of humanity, the progress of industry. Discussion of difficulties is on their daily program, and they always expect that it shall be so conducted as to be perfectly understood and to facilitate the best conclusions.

This is the reason why there is no monopoly of authority in engineering, and there should not be. All are members of a same family. Professional expansion amongst engineers depends largely upon there being no chief to lessen individual initiative, but fellowship for the welfare of the profession, itself, and of the community as a whole.

These are the fundamental principles governing our aims. Engineers have to work shoulder to shoulder to report progress in different discoveries and developments, or in the enactment of regulations in economic methods of scientific

application. They are a profession of associates, and this relationship should exist between them privately as well as collectively.

On a staff there is a chief in name only. He should not be the man of control, but he who directs individual initiative for the betterment of the specialties to which each is adapted. He must not forget that he has to supervise the application of scientific data governed by daily progressive inventions and appliances; that the young graduate leaving the university may perfectly well bring to him an unexpected solution of a given question. He should not impose autocratic prerogative which might impair the subordinate's effectiveness by making him regard his chief as too able or too pretentious,—a condition which might make the assistant shy or set him a bad example.

He who takes the initiative to overload himself with any question of a general character, or of too many details, makes the greatest mistake possible in an executive. He at once loses the confidence of his assistant, who sees in his chief a bad interpreter of his intentions.

Chief or assistant,—both are engineers, with common ambitions and common objectives. Any man holding the least important executive position has a right to be consulted on the principal questions relating to the administration on which he is dependent, and no coercion must be exercised which should minimize his value and authority, or undermine his initiative and resourcefulness.

Capable chiefs like to be consulted, to consult and to advise. The assistant is the same. Both should aim at companionship. The former should not look too closely at things of minor importance on which a subordinate does not want to lose a large percentage of time which he regards as more useful in other directions. And the latter should not neglect minor problems which can be considered as resting in his domain only.

How often do we see pride overruling every decent principle of partnership, especially when a narrow-minded man attains to a high grade by favor, protection, etc.? Should one be sufficiently ill-advised to check up engineers with years of experience to see how they are distributing a title, to criticize the kind of lettering or the place where they are signing their names, when he neglects completely to make any suggestion on the idea of the plan and the safety of the structure, or to enter upon the least discussion on the technical conditions of the proposed or erected work? It is the appearance of the plan,—that is all that counts with some chiefs. It often seems as if good distribution of figures and their neatness are valued more than the correct solution of the work under consideration.

What indignation then arises in the heart of the designer! How humiliating is it for a live engineer to have to endure some remarks, and how impaired and diminished in his estimation is the man of the higher grade!

These are some of the reasons why initiative and discipline are sometimes sacrificed to the selfishness and autocracy of a chief who is at his post as a commander rather than as a professional associate to other members of the engineering family.

ROMEO MORRISSETTE.

Three Rivers, P.Q., January 15th, 1919.

TO PUBLISH QUEBEC BRIDGE REPORT

WHEN the Quebec Bridge was completed, the Board of Engineers recommended to the Dominion government that a full report be published in the interest of science. On account of the war, action on the recommendation was deferred, but it has now been decided to publish a very complete report, including all available data.

The Jamaican Government is considering the establishment of a floating dock in Kingston Harbor and the construction of a railroad along the water front, linking up the wharves.

OTTAWA'S NEW PUMPING PLANT

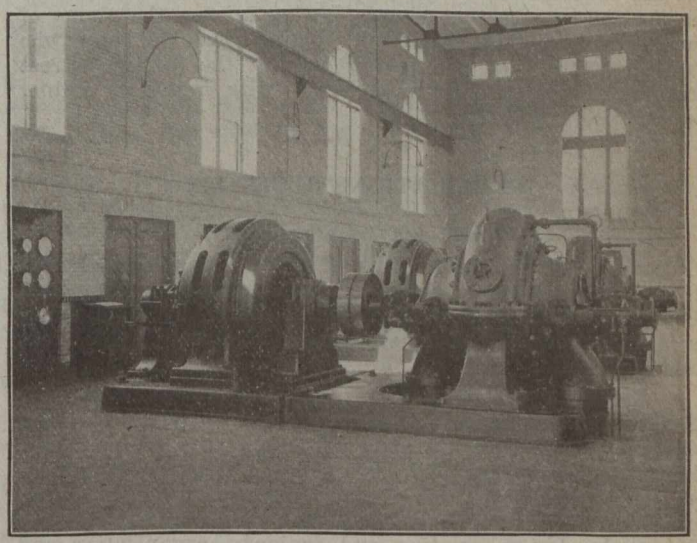
By L. McLaren Hunter
City Engineer's Office, Ottawa, Ont.

ACCOMPANYING is an interior view of Ottawa's newest pumping station,—the High Lift Station at Lemieux Island. This station is equipped with two units for pumping water from a sedimentation basin to a 51-inch main. Provision has been made for extensions as required.

The pumps now installed are each rated to deliver twenty million Imperial gallons in 24 hrs., against a pressure of 123 lbs. per sq. in. They can deliver 25 million gallons a day against 100 lbs. The pumps were supplied by Escher Wyss & Co., and are driven by 1,600 h.p. Westinghouse induction motors.

The normal pressure is 80 lbs., but for fire-fighting it is raised to 100 lbs.

The city waterworks department obtains all of its electrical energy direct from the power plant of the Ottawa & Hull Power Co., at an annual cost of $14 per h.p. The rating



20 M.G.D. Against 123 Lbs. Pressure

is based on a 20-minute peak, extended over each month in the year. The power used at the Lemieux Island station is taken from the power company's Chaudiere plant at 11,000 volts and is transmitted by submarine cable to the Lemieux Island transformer station, where it is stepped down to 2,200 volts for the motors.

By means of the transformer station on Lemieux Island, a considerable saving is effected, as the power is taken direct from the generators of the power company, the latter having no expense for transforming or transmitting the power.

The plant was designed and constructed under the supervision of J. B. MacRae, consulting engineer, Ottawa. W. E. MacDonald, the city's waterworks engineer, represented the municipality during the construction of the system and is now in charge of its operation.

The Otira tunnel in New Zealand has been "holed through" and will be completed within two years. The tunnel is over five miles long and was started in May, 1908. A waterfall will be developed to provide power to electrify the tunnel.

At a recent meeting of the Manitoba Branch of the Engineering Institute of Canada, a committee of five was appointed to launch a campaign for the widest possible exploitation of Manitoba's resources. The following are members of the committee: J. G. Sullivan, consulting engineer; W. Smaill, of the engineering staff of the Greater Winnipeg Water District; J. M. Leamy, provincial electrical engineer; W. P. Brereton, city engineer; and W. J. Dick, formerly mining engineer of the Commission of Conservation.

TORONTO'S SEWAGE DISPOSAL PROBLEM

At a meeting of the Toronto city council held last Tuesday, the following motion by Controller Maguire was referred to the Works Committee:—

"That the Commissioner of Works and the Finance Commissioner be requested to associate themselves with the best sewerage experts obtainable, and report on the following:—

"(1) Can the Morley Ave. sewage disposal works be operated efficiently without creating a nuisance to that section of the city where it is installed?

"(2) Was the plant constructed properly, having in view the growth of the city, or were there any engineering defects?

"(3) What would it cost to build an entirely new sewage disposal plant?"

Controller Maguire also introduced the following resolution, which was referred to the Transportation Committee:—

"That the transportation commission apply to the legislature at its next session for power to immediately permit of the construction of car shops in order that we may commence the construction of cars, having in view the giving of employment to those returning from overseas and those who have returned and the taking over of the Toronto street railway in 1921, so as to be ready with first-class rolling stock."

PUBLICATIONS RECEIVED

(Continued from page 180)

Ontario; and "The Advisability of Electric Companies Handling Appliances and Supplies and Maintaining Standard Prices as Established by the Manufacturers," by W. B. Johnson, manager New Business Dept., Montreal Light, Heat and Power Co.

RECOMMENDED PRACTICE FOR CONCRETE ROAD AND STREET CONSTRUCTION.—Booklet issued free by the Portland Cement Association, Chicago, Ill.; 6 x 9 ins., 48 pp.; well illustrated; coated paper. A reprint of the report presented to the American Concrete Institute by its committee on concrete roads and pavements. The subjects covered are: Materials, design, grading and drainage, organization and equipment, handling and hauling of materials, mixing and placing of concrete, joints and reinforcing, finishing, curing, maintenance, and resurfacing of old concrete pavements.

AN ADVANCED COURSE IN QUANTITATIVE ANALYSIS.—By Henry Fay, Ph.D., D.Sc., Professor of Analytical Chemistry in the Massachusetts Institute of Technology. First edition 1917. 111 pages, 6 x 9 ins., cloth, $1.25 net. Published by John Wiley & Sons, Inc., New York. Renouf Publishing Co., Ltd., Montreal, Canadian selling agents. An advanced manual of quantitative laboratory practice especially compiled for the steel and allied industries. The latest methods of analysis are set forth in detail, and emphasis is placed upon the possible causes of failure in the various determinations and the means to avoid same. Several of the methods of determination seem to be original with the author and are of considerable interest. Useful tables of logarithms, etc., are included at the end of the reading matter.

At the annual meeting of the American Institute of Mining Engineers, to be held February 17th to 20th in New York City, there will be two joint sessions with the Canadian Mining Institute, and it is expected that a number of prominent Canadian mining engineers will attend.

The short course on "Farm Power" at the Ontario Agricultural College, Guelph, includes a lecture on February 5th by R. R. Graham on "Water Power on the Farm and How to Take Advantage of It"; and on February 6th by J. W. Purcell, of the Ontario Hydro-Electric Power Commission, on "Hydro Installations" and "Hydro-Electric Power on the Farm."

STATE AID FOR HOUSING

In a circular recently issued by the Ontario Government the provincial scheme for assistance to prospective builders, as worked out by J. A. Ellis, director of the Ontario Bureau of Municipal Affairs, is outlined as follows:—

"The Dominion Government has agreed to make a loan to the Ontario Government for housing purposes. The province will loan to municipalities upon the following terms:—

"Municipalities and companies incorporated under the Housing Accommodation Act (R.S.O., Chap. 220), may acquire lands and construct houses for returned soldiers, and also for working men and women and those of small means. The act will be amended to include all municipalities.

"The type of house to be constructed shall not exceed $2,500 in cost for the construction of each house. The maximum cost of each house, together with the cost of the land and interest during construction, is not to exceed $3,000.

"The building scheme of each municipality, including the laying out of the land and the plotting of the buildings thereon, the plans of the houses, the form of construction, and the location of the land to be developed, shall be approved by the Director of the Bureau of Municipal Affairs, or such other person or body as may be designated for that purpose.

"The loan will be for a period not exceeding twenty years, at 5 per cent.

"Municipalities are to make loans to individuals, firms incorporated as before mentioned, and to persons who own their own land and desire to erect houses thereon for their own occupation, and to farmers for the erection of houses for their employees.

"If a municipality itself acquires land and constructs houses, it will be loaned the full amount required therefor.

"The loan to be made to a housing company shall not exceed 85 per cent. of the value of the land and buildings.

"A loan may be made to a farmer, and to a person who owns his own land, to erect a house thereon for his own occupation to the full value of the building. Also to a person for the erection of a house on land owned by the municipality, provided he contributes in cash the value of the lot or 10 per cent. of the whole cost.

"The loan will be made by the province to the municipalities on progress estimates as required.

"It is suggested that all houses be sold on the monthly repayment plan. The period of repayment must not exceed twenty years and the rate of interest 5 per cent.

"The monthly repayment for twenty years to cover interest, and repayment of principal will be about $20 per month for a $3,000 house. Interest will be charged on arrears. The whole or any part of the principal may be repaid at any time during the twenty years.

"Municipalities and housing companies must enter into agreements for sale of such houses, and give deeds for same when the payments are completed.

"Such agreements for sale may be cancelled on default for three months, but a person can sell his interest in the property at any time before default.

"A person taking a house must covenant to repair, and to pay taxes and insurance.

"Municipalities are to repay the province monthly at the same rate as the above monthly repayments. These repayments to begin one month after the houses are completed.

"Housing companies are to repay a municipality in the same way, and to give the municipality a mortgage upon all the land and houses for which the loan was secured.

"Interest to be charged on arrears in both cases.

"Any municipality may come under the provisions of the proposed legislation after it is enacted upon a by-law being passed by the council.

"The council must then appoint a commission for the purpose of the act, composed of three members, of whom the mayor shall be one, and the other two nominated by the council, not members of the council, and elected for two years, one retiring each year."

SOME HISTORICAL NOTES ON THE DEVELOPMENT OF WATER POWER*

By Arthur Surveyer
Consulting Engineer, Montreal

UTILIZATION of the power to be derived from rivers in their flow towards the sea antedates history. We know, however, that the Chinese and the Egyptians used crude float wheels, driven directly by the current, to raise water, grind corn and for other ordinary purposes. In the last part of the 16th century, London city had a pumping plant operated by a float wheel. One hundred years later, a most elaborate pumping plant driven by undershot water wheels was established on the Seine River near Saint-Germain.

In Canada, the first water-operated grist-mill was erected at Montreal in 1668, at the foot of the St. Mary's Rapids, and the first water-driven saw-mill was constructed along the Niagara River by the French in 1725, to furnish lumber for Fort Niagara.

Many of the English textile mills of the latter part of the eighteenth century were hydraulically operated. In the American colonies, the development of water falls was forbidden; but later, after the separation, their utilization was an important factor in the growth of the textile industry of the New England States.

With a few exceptions, however, such developments were comparatively unimportant and did not apply to very high heads. The harnessing of the higher and more important water falls is a modern conquest, begun in the last fifty years, and achieved in the last twenty-five years. The principal factors in this conquest were the superseding of old water wheels by the modern turbines, and the numerous discoveries in the field of applied electricity.

It is interesting to note, at this particular time, the prominent part played by the French engineers in the advancement of the modern water power industry. The first rational data for the design and construction of turbines were brought forth towards 1826 by Burdin, Fourneyron and Poncelet. Later Jonval, Fontaine and Girard introduced new types of wheels; then came the Francis turbine, and finally the "American" turbine. About 1830, both Girard and Fourneyron had already operated, though with indifferent success, turbines under heads varying from 300 to 500 feet. These were notable achievements, if we consider the constructional difficulties involved in such developments. However, Aristide Berges is considered by his countrymen to be the father of the "white coal" industry. In 1869, he successfully operated in his pulp and paper mill at Lancey, a wood pulp grinder driven by a turbine operating under a 650 ft. head. Four years later, he installed, in the same factory, another wheel working under a head of 1,640 ft.

The necessity of utilizing the hydraulic power almost at the point of production was, at that stage, a great handicap to the growing exploitation of water powers. True, energy was being transmitted at Schaffhausen, over a distance of half a mile by teledynamic cables, and also by water under pressure, at Geneva and Munich; nevertheless, it was only after several discoveries in the applications of electricity had made possible the distant mobilization of energy under this new form, that the hydro-electric enterprises received the impetus which caused it to become one of the most important factors in modern industry and to revolutionize many social conditions.

The invention of the electric ring dynamo, by the Belgian electrician Gramme, was the beginning of an industrial movement comparable in importance to the introduction of steam. It was shortly after Gramme had discovered the reversibility of the electric dynamo, and the possibility of using it either to generate electricity, when driven by some other motor, or to act as a motor, when connected by wires to another electric dynamo, that a French engineer, Marcel Deprez, successfully conducted a series of experiments on the transmission of electricity, on a line eight miles in length running between the town of Vizille and the city of Grenoble. In 1882, Gaulard and Gibbs perfected, in England, the electric transformer, thus increasing the economical distance of power transmission.

In the first hydro-electric plant built at Lauffen, Germany, in 1891, the energy was generated at 50 volts, then raised to 13,000 volts and transmitted to the Frankfort Exhibition 75 miles away. The improvements in the insulators now permit the use of voltages higher than 150,000 volts, and power has been transmitted over distances exceeding 250 miles.

*Excerpt from an article in "The Montreal Daily Star."

GEODETIC SURVEY ACTIVE DURING THE WAR

Carried Out Wire Drag Survey to Make Certain Waters Available as Naval Base—Projection of Arc of Primary Triangulation Along B.C. Coast

DURING the past year, the Geodetic Survey Branch of the Department of the Interior had the pleasure of co-operation of an international character in war service of some importance, says the "Canadian Official Record."

At the request of the United States Coast and Geodetic Survey, a party was detailed for triangulation work on the Atlantic Coast. A wire drag survey was carried on by the United States organization to make certain waters available as a naval base for allied fleets, and the positions of numerous points and lighthouses to control the accuracy of this survey were furnished by the operations of the Canadian party.

It is interesting also to note that at the commencement of the war, when the presence of German cruisers was feared in the North Pacific, a Geodetic Survey party in Dixon Entrance and Hecate Strait was able to render some assistance to the naval authorities at Prince Rupert. As the Survey had parties on prominent points on the outlying islands, the connecting of these points with Prince Rupert was of great importance in keeping the authorities there acquainted with what might be transpiring in the nearby waters.

Work for Militia Department

The activities of the Geodetic Survey of Canada during the past season have been confined to work of strictly economic importance. Besides the operations mentioned above, triangulation surveys were extended in New Brunswick eastward towards Nova Scotia to fulfil requests made by the Militia Department for the geographic position of points to control the accuracy of their topographic maps in the Halifax vicinity.

Reconnaissance surveys were also extended in the direction of Sydney, C.B., at the request of the same Department. Smaller surveys were undertaken in the St. John, N.B., and Moncton, N.B., vicinities at the request of the Topographic Division of the Geological Survey.

On the lower St. Lawrence River, one party was engaged on primary triangulation, determining also the position of lighthouses and church spires, used in connection with the mapping operations of the Hydrographic Survey of the Naval Department.

In British Columbia

In British Columbia there is another example of international geodetic co-operation. The engineers of the Geodetic Survey of Canada last season continued the projection of an arc of primary triangulation along the British Columbia Coast from the Juan de Fuca strait to Dixon Entrance. The United States Coast and Geodetic Survey having undertaken an extension of this work to the head of Lynn Canal, the Canadian surveys are now contemplating the continuance of the primary triangulation along the Yukon River to the point of crossing of the 141st meridian of longitude.

This work, when completed, and taken in conjunction with the extension contemplated by the United States Coast and Geodetic Survey of their triangulation in the vicinity of Tacoma, Washington, to the Canadian triangulation in the Juan de Fuca strait, will constitute a geodetic arc of over twenty-five degrees of latitude and will connect Alaska, Yukon Territory and British Columbia with the recently adopted North American Datum.

SALARIES OF RAILROAD ENGINEERS

American Association of Engineers Asks U.S. Railroad Administration to Adopt Schedule Prepared by the Association

WITH the approval of the governing body of the association, the Railroad Committee of the American Association of Engineers has forwarded to the United States Railway Administration a schedule of monthly salaries which the association recommends should be paid to railroad engineers. This is probably the first attempt made by an organization of engineers to say what monthly salaries should be paid to their members.

"On account of the responsibility resting upon the railroad technical engineer for the success of transportation," says C. E. Drayer, secretary of the American Association, "it is important that he receive proper recognition in the way of pay. This is of interest and importance to the public. Had the engineer been adequately represented in the hearings before the Wage Board of the U.S. Railroad Administration, the orders issued by that board might not have been totally oblivious of his work. The schedule proposed by the Railroad Committee is not final, and comment is invited. It will be noted that there is no attempt to take up specialties in the railroad field, but it does lay the ground work for uniformity in classifying the various positions in railroad engineering departments."

The schedule is as follows, salaries first mentioned being for railroads having over 5,000 miles of track; and the second, salaries for railroads having less mileage. (In the case of instrumentman, rodman, tapeman, designer, draughtsman, junior draughtsman and tracer, the salaries first mentioned are for engagements for one year or more, and the second salary is for temporary work):—

CHIEF ENGINEER.—In charge of entire railroad system, responsible for all engineering work and organization, including valuation.—Salary commensurate with duties performed.

ASSISTANT CHIEF ENGINEER.—In charge of portion of line or entire territory; reporting to Chief Engineer; responsible for such work as may be assigned to him by the Chief Engineer.—Salary commensurate with duties performed.

DISTRICT ENGINEER.—In charge of two or more divisions; reporting to Assistant Chief Engineer in charge of that territory; responsible for all maintenance of way and minor construction.—$425; $375.

ASSISTANT DISTRICT ENGINEER.—Same territory as District Engineer—like responsibilities. Reporting to District Engineer.—$350; $300.

DIVISION ENGINEER.—In charge of one division; responsible for all maintenance of way and permanent way work.—$375; $350.

RESIDENT ENGINEER.—In charge of one residency; reporting to Division Engineer. In charge of construction work only. This position not required for maintenance of way or permanent way work.—$275; $275.

ASSISTANT ENGINEER.—Acts as assistant to Division Engineer, Assistant District Engineer, and Assistant Chief Engineer. Responsible for such duties as may be assigned him.—$275; $275.

CHIEF DRAFTSMAN.—Reports to Chief Engineer or Assistant Chief Engineer; in charge of general drafting room at principal headquarters.—Salary commensurate with duties performed.

ENGINEER OF BRIDGES.—Reports to Assistant Chief Engineer or Chief Engineer. Responsible for maintenance and construction of all bridges—wooden, steel, and concrete.—$400; $350.

VALUATION ENGINEER.—Responsible for all valuation work on entire system. Reports to Assistant Chief Engineer, or Chief Engineer.—$400; $350.

ASSISTANT VALUATION ENGINEER.—Reports to Valuation Engineer; has like responsibilities.—$350; $275.

SUPERINTENDENT OF MOTIVE POWER.—Responsible for maintenance of all mechanical equipment.—Salary commensurate with duties performed.

ASSISTANT GENERAL SUPERINTENDENT OF MOTIVE POWER.—Responsible for maintenance of all mechanical equipment on entire system or portion of system, as may be assigned by General Superintendent.—Salary commensurate with duties performed.

MECHANICAL ENGINEER.—Responsible for such work as may be assigned to him by General Superintendent or Assistant General Superintendent. Reports to Assistant General Superintendent or General Superintendent.—$400; $325.

ELECTRICAL ENGINEER.—In charge of all electrical construction and repair work of mechanical equipment. Reports to Assistant General Superintendent or General Superintendent of Motive Power.—$325; $275.

ASSISTANT ELECTRICAL ENGINEER.—Like Responsibilities to Electrical Engineer. Reports to Electrical Engineer and Assistant General Superintendent or General Superintendent.—$275; $250.

SIGNAL ENGINEER.—Responsible for all signal construction and maintenance. Reporting to General Manager or Superintendent of Telegraph.—$400; $350.

ASSISTANT SIGNAL ENGINEER.—Like responsibilities as Signal Engineer, Superintendent of Telegraph, or General Manager. In charge of entire system or territory assigned him by Signal Engineer.—$300; $275.

INSTRUMENTMAN.—Reporting to Engineer or Chief of his assigned department.—$200; $225.

RODMAN.—Reporting as assigned.—$125; $150.

TAPEMAN.—Reporting as assigned.—$100; $120.

DESIGNER.—Reporting to Chief Draftsman or as assigned, and qualified to prepare original design on engineering or architectural work.—$250; $275.

DRAFTSMAN.—Reporting to Chief Draftsman or as assigned, or general drafting work involving general detailing.—$160; $200.

JUNIOR DRAFTSMAN.—Reporting as assigned and qualified for general drafting room work.—$115; $160.

TRACER.—Reporting as assigned, and qualified to prepare neat tracings on special designs.—$110; $130.

SAYS ENGINEERS CAN AID AGRICULTURE

THAT the engineers of Western Canada have a splendid opportunity to help in the development of agricultural resources, was the claim made by Theodore Kipp, of the Ogilvie Milling Co., in a paper read this month before the Manitoba Branch of the Engineering Institute of Canada.

Mr. Kipp urged that problems of development of agricultural production are intimately related with those of engineering. He cited transportation, preservation and the putting of products into the best condition for market. He gave comparative statements showing the present ramifications of the grain industry and the possibilities of the development of a potato industry along similar lines, both in the production of the tuber and the industrial use of it through the installation of potato drying plants in various parts of Western Canada, and the use of these drying plants as feeders for large manufacturing plants located in industrial centres.

Winnipeg, he said, particularly affords facilities for industries of this character, including starch plants and industrial alcohol distilleries.

STANDARDS COMMITTEE REQUESTS SUPPORT

ASKING that the Canadian Engineering Standards Committee be supported, at least in part, by the Dominion government, a delegation of members of that committee interviewed Sir Thos. White, Minister of Finance, a few days ago, requesting that the government contribute $10,000 per annum. The cost of the committee's work is estimated at between $15,000 and $20,000. The object of the standards committees in the various countries is to secure an international standardization of machine parts so as to permit an interchange that will cheapen manufacturing, erecting and renewal costs, and also expedite deliveries.

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Telephone, Main 7404. Cable Address, "Engineer, Toronto."
Western Canada Office: 1208 McArthur Bldg., Winnipeg. G. W. GOODALL, Mgr.

PRINCIPAL CONTENTS

INTERNATIONAL JOINT COMMISSION

RECENT criticisms of the International Joint Commission in connection with the application of the St. Lawrence Power Co. for approval of a submerged dam across the South Sault Channel of the St. Lawrence River, have given much concern to those who are interested in the success of joint commissions for handling international differences. The International Joint Commission has two features of great value:—

(1) Its permanency, which ensures to its members the advantages of mutual understanding and training in the handling of any national questions.

(2) Its publicity, getting to the heart of the question on the spot and giving all interested the opportunity of free and open discussion at its hearings.

It is feared that a continuance of unwarranted criticisms, such as have appeared of late, may compromise the future of the commission, and thereby reduce the value of its useful work.

An editorial in one Canadian paper charges former Commissioner Mignault, who is now a member of the Supreme Court of Canada, with "side-stepping" some features of the St. Lawrence Power Co. dispute. It concludes with the following remark (which surely must have given offence to the Canadian members of the commission):—

"On both these counts we cannot see but that the Canadian members of the Joint Waterways Commission were guilty of being overruled (perhaps overawed), by the powerful interests against which they are supposed to be contending for Canada's interest."

What would happen to our Canadian courts if, when decisions were rendered, a cry should be set up in the press that the judges had been "overawed" by powerful interests and that they had shown no regard for their oaths of office?

International tribunals of a permanent character will never make any headway unless they have the confidence of the people of both countries. If they fail to obtain and hold that confidence, then to continue to maintain them would be simply a waste of public funds. But the irresponsible criticism indulged in by the editors of a few daily papers—editors who have not studied the great and good work effected by the International Joint Commission, and who know nothing of its high ability and ideals—does not mean that the International Joint Commission has lost public confidence. The thinking public in Canada still has every confidence in the commission, although it is thought that the Canadian personnel might be improved by having two engineers and one lawyer on the commission, instead of one engineer and two lawyers. Practically all of the problems before the International Joint Commission are of an engineering nature, and one lawyer should be sufficient to give adequate legal advice.

CANADA'S WATER POWER DEVELOPMENTS

ALTHOUGH considerable increase in turbine capacity is shown by the latest census of water-power developments in Canada, as compared with the last previously available figures, we venture to predict that if another census be taken a couple of years from now, that another even greater increase will be revealed, because many proposed extensions and new developments were delayed by the war and will now be undertaken.

The water power resources of Canada constitute an enormous industrial asset, chiefly on account of their strategical location. Most of the great water powers of this country are near industrial centres; conversely, nearly all of our big industrial centres have ample water powers within easy transmission distance.

This is a condition that is not enjoyed by many other countries. In the United States, for example, most of the best water powers are in parts of the country where there is but little industrial development; and where there is the greatest manufacturing activity, the available water powers are comparatively unimportant. It is not surprising that Canada's municipalities and industrial corporations are realizing in a practical manner the economic advantages accruing from the utilization of water power.

TRADE WITH SOUTH AMERICA

"WHEN more freighters are available for the South American trade, Canada should have a good opportunity of exporting many of her manufactures to at least four of the South American countries," said E. C. Austin, of Toronto, when interviewed by *The Canadian Engineer*.

Mr. Austin, who is a Canadian, has resided for many years in Venezuela and other South American countries and has just returned to Canada. He says that electrical machinery and supplies of all kinds are in great demand, and that the growth of electrical plants throughout South America has been remarkable. He warns Canadian manufacturers in these lines, however, that they will have close competition with the United States exporters, who are closely in touch with the demand.

Among the other products needed is paper of all kinds, particularly newsprint. "Some of the South American countries," says Mr. Austin, "are in much better financial position than is generally known, and the political situation also has greatly improved during the past few years. All of the South American countries now have favorable trade balances."

Mr. Austin thinks that Canadian manufacturers should be able to look first to Venezuela and Brazil. He says that the highest development is yet to come of the countries on the west coast, as, owing to the war, they have not yet received from the Panama Canal all the benefits which they will receive in years to come. Mr. Austin states that the recent extension of one or two of the Canadian chartered banks to South American fields will be of the greatest possible assistance in promoting Canadian trade in those countries, and he believes that other Canadian banks will be induced to open branches there by the increasing importance of the trade.

PERSONALS

HOWARD G. KELLY, president of the Grand Trunk Railway System, has gone to England to confer with his board of directors.

RONALD G. STARR, of Toronto, has been appointed engineer of the Orillia Water and Light Commission, in succession to the late W. K. Greenwood.

ANDREW MCCULLOCH, chief engineer of the Kettle Valley Railway Co., in British Columbia, has been appointed acting superintendent in place of J. W. Mulhern, resigned.

WM. STORRIE, chief engineer of the John verMehr Engineering Co., Ltd., is now in charge of the rebuilding of the mole at Zeebrugge, Belgium. His firm has secured contracts from the British government for considerable reconstruction work in that part of Belgium.

J. H. PARKIN, University of Toronto, this evening will give an illustrated lecture on the "Developments of Aeronautics," before the Ontario Section of the American Society of Mechanical Engineers. The meeting will be held at 8 o'clock at the Engineers' Club.

E. L. COUSINS, chief engineer and manager of the Toronto Harbor Commission, will give an illustrated lecture this evening in the Conservatory of Music, Hamilton. Mr. Cousins will describe the improvements to the Toronto harbor, and will indicate to what extent similar improvements could be made at Hamilton.

W. WALKER has been appointed division engineer, Eastern Lines, Grand Trunk Railway System, succeeding Major Bond, who is now chief engineer. Mr. Walker entered the Grand Trunk service in 1908 as assistant in the office of the engineer of maintenance-of-way. He was transferred to the chief engineer's office in 1909, and since 1917 has been acting division engineer of Eastern Lines. Before joining the Grand Trunk, Mr. Walker had a number of years' experience in railway and dock construction in Scotland and Brazil.

OBITUARIES

D. W. B. REID, formerly a member of the contracting firm of Reid and Archibald, died last week at his home in Halifax at the age of 76.

JAMES MACFARLANE, who was superintendent of the Beach waterworks pumping plant at Hamilton, Ont., for over half a century, died last week at the age of 90. Mr. MacFarlane was born in Perthshire, Scotland, and came to Canada at the age of 25. After spending a short time in Hamilton and Toronto, he went to Dundas, where he was employed by John Gartshore and Sons in the erection of pumps for the city of Hamilton. When the work was finished, the Waterworks Commissioners placed Mr. MacFarlane in charge of the plant, which position he held until his retirement in 1911.

At the thirty-ninth annual meeting of the Association of Manitoba Land Surveyors, held January 16th at Winnipeg, H. G. Beresford was elected president; Lieut. H. W. R. Gemmel, vice-president; R. H. Avent, secretary-treasurer. Executive council: G. A. Warrington, John Reid, H. G. Beresford and Allan Findlay.

The Ontario government is receiving numerous requests for the construction of colonization roads, and Hon. F. G. MacDiarmid says that the government will most likely increase the expenditure this year to $500,000, which has been the average yearly expenditure for some years past. Last year, however, it was only $200,000.

The total consumption of city water in Regina, in 1918, was approximately 50 million gallons less than in the previous year, the figures being, respectively, 870,699,473 gallons and 921,695,728 gallons. On a population basis of 35,000 this is equivalent to a reduction of 1,430 gallons per head, or 4 gallons per capita per diem. During December the consumption was only 61,595,167, as compared with 86,682,747 in the corresponding month in 1917.

TORONTO EXCHANGE TO MERGE WITH ASSOCIATION OF CANADIAN BUILDING INDUSTRIES

WHEN the newly-formed Association of Canadian Building and Construction Industries obtains its charter, the Toronto Builders' Exchange will become the Toronto branch of that Association, a resolution to that effect having been passed last Monday afternoon at the adjourned session of the annual meeting of the Toronto exchange.

President A. D. Grant was in the chair, and a large number of members were present. The secretary read the annual report, covering the work of the committees and finances. George Stocker, seconded by A. H. Dancy, presented the following resolution:—

"Be it resolved that the Toronto Builders' Exchange become amalgamated with the Association of Canadian Building and Construction Industries following forthwith upon its adoption of a constitution and by-laws, and the granting of its government charter."

W. E. Dillon read several communications from the president of the association, J. P. Anglin, Montreal, and gave a brief outline of the aims of the new organization. George Oakley, Jr., and others spoke in favor of the new association.

Mr. Gander moved an amendment to Mr. Stocker's motion in an effort to specify the representation which Toronto would have in the new association and also to limit the fees. Mr. Kirby moved an amendment to Mr. Gander's amendment, tending to lay the whole matter on the table for the time being. Mr. Dillon further amended the motion and suggested a four months' "hoist" for the motion and for both of the other amendments. After considerable discussion, all of the amendments were withdrawn excepting Mr. Kirby's, and that was voted upon and was defeated.

Mr. Stocker's original motion was then voted upon and carried. W. F. Evans explained that Toronto is now well represented upon the national council of the new association, and that he felt certain that these Toronto representatives can be entrusted to look after the city's interest and to see that the annual fees are not too high.

George Oakley, Jr., on behalf of the other members of the exchange, presented a silk umbrella to the retiring president, Mr. Dillon, and also made a similar presentation to Mrs. Dillon, who was not present but who had helped in the work of the exchange, it was thought, by permitting her husband to devote so much time to it.

As the Montreal Builders' Exchange passed a similar "merger" resolution several weeks ago, the Association of Canadian Building and Construction Industries will begin with several hundred members in Toronto and Montreal. Moreover, a movement is under way in Sherbrooke, Ottawa, London, Windsor, Winnipeg and several other cities, to have the builders' exchanges in those cities follow the lead of Toronto and Montreal and become part of the new national association.

Engineer Talbot, of Middlesex County, Ont., is preparing a report on the proposed construction of highways and bridges.

David Spence, Toronto, has been elected chairman for the current year of the Toronto and York Highways Commission. W. H. Pugsley, Richmond Hill, is vice-chairman.

At the annual meeting of the Builders' Exchange at London, Ont., held January 20th, all of the officers were re-elected, as follows: President, Harry Hayman; first vice-president, L. A. Boss; second vice-president, Ed. Gerry; treasurer, Thos. A. Jones; honorary secretary, Geo. S. Gould; directors, B. Noble, Geo. Hyatt, A. C. Nobbs, John Whittacker and T. R. Wright.

A. Campbell, who is reporting to the Dominion government on the advisability of federal aid for highways, will also advise regarding the best methods of obtaining co-operation between federal and provincial authorities and will recommend legislation necessary to secure greater uniformity. Mr. Campbell has held a number of conferences with provincial ministers of roads.