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PROPOSED T. & N. O. TERMINAL ON JAMES BAY

As outlined in an address to the Toronto Branch, Canadian Society of Civil Engineers, March 26th, 1914

By J. G. G. KERRY,

Consulting Engineer, T. & N. O. Ry. Commission; President Kerry & Chace, Limited, Toronto

[The subject matter of this article consists of a general review of the engineering work that has been done up to date preparatory to the establishment of a railway terminal on the shores of James Bay. It has been gathered together on the direct instruction of the Commission that has charge of the operations of the Timiskaming & Northern Ontario Railway; and it is good evidence of the forethought shown by the Commission in preparing for the carrying out of a project that must shortly be of great public importance. Mr. Kerry states that the work of preparing this information has been entirely under the direction of the Chief Engineer for the Commission, S. B. Clement, B.A. Sc., M. Can. Soc. C.E., and his staff, who are entitled to much credit for the careful and thorough manner in which the necessary data connected with the project has been gathered together.—EDITOR.]

THE construction of the Timiskaming and Northern Ontario Railway was commenced about the year 1900, the enterprise being undertaken by the Provincial Government of that date in a somewhat blind compliance to the popular demand that a very definite effort should be made to open up the large and unknown area of land that lay to the north of the main line of the Canadian Pacific Railway and between the north shore of the Great Lakes and the south shore of Hudson's Bay. Almost simultaneously, the Provincial Government sent out a number of exploring parties throughout this area. These parties were in charge of various members of the Ontario Association of Land Surveyors, and from their reports the province first learned of the existence of that large area of arable land that is now known as the Clay Belt, and shown in Fig. 1.

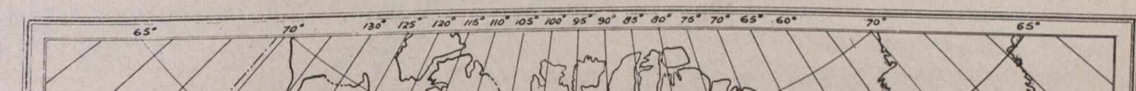


Fig. 1.

The importance of this so-called Clay Belt, not only to the Province of Ontario but to the Dominion of Canada at large, cannot be over-estimated. A study of the geographical distribution of our population at the present time will show that it consists of one large and rapidly growing unit which is located entirely to the west of the line of Lake Winnipeg. A second and larger unit is located entirely to the south and east of a line joining Orillia and Pembroke. The district lying between these two lines, with the exception of such towns as North Bay, Sudbury and Port Arthur, may be said to be entirely unsettled; this was absolutely true little more than 10 years ago, and in large measure remains true to-day. A possible result of the existence of so definite a cleavage in the settlement of the Dominion is the growth of a distinct west and a distinct east. From a national point of view this, more than any other one thing, is what we all desire to prevent and no effort should be spared that will tend to keep this possibility from becoming a reality.

Examining a map, such as Fig. 1, upon which the outline of the Clay Belt is marked, it will be seen that this Belt, which consists of most fertile land, stretches almost half way across the unsettled area which at present divides the Dominion. The speaker, therefore, regards the work of the commission in opening up the Clay Belt for settlement as possibly the most important national work now in progress in Canada.

Other organizations are also active in this work of development; the Algoma Central Ry. is building in from the south and west; the National Transcontinental Ry. and the Canadian Northern Ry. are traversing the Belt from west to east. The next work of importance would, therefore, appear to be the establishment of an outlet to

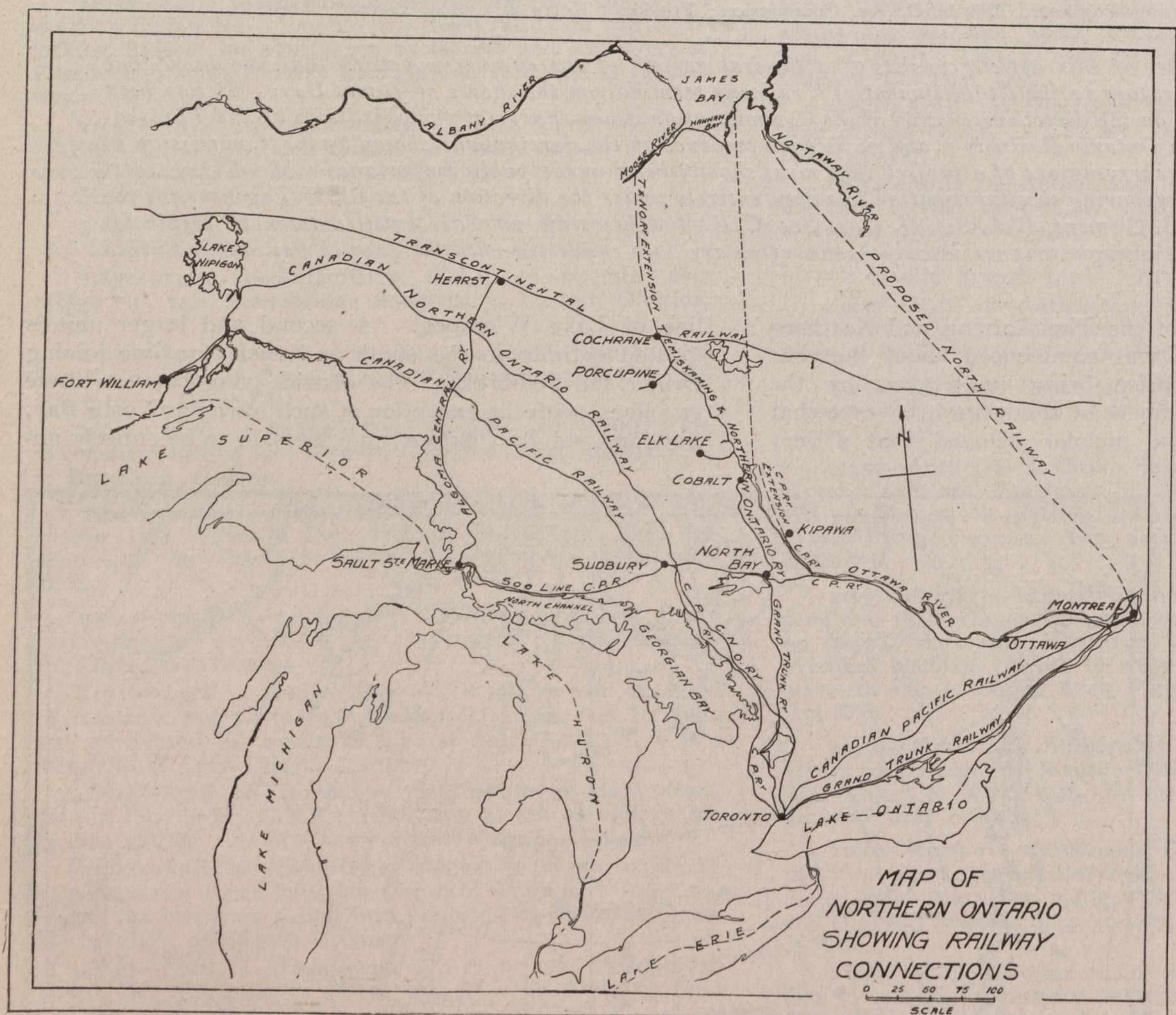


Fig. 2.

the north and the establishment of a rail connection with the only ocean coast line within the confines of the Province of Ontario. With such an end in view the commission has directed the carrying-out of the investigations that are discussed in this paper.

The most attractive location for the proposed terminal so far as present information goes, is at the mouth of the Moose River, as shown in Fig. 2, and this point may be referred to as Moose Harbor. It may be remarked that by far the larger portion of the Clay Belt is drained by the tributaries of the Moose River and that the natural movement of traffic will be along the line of these tributaries with a natural point of concentration at the harbor. Geographically speaking, Moose Harbor is not an isolated point and does not lie in an extreme corner of the possible confines of civilization. If on Fig. 1 a half circle is drawn with the harbor as centre it will be found that, without very material change of radius, Winnipeg, Port Arthur, Toronto, Ottawa, Montreal and Quebec can be reached, and it may reasonably be expected that in the not-distant future a commercial centre of some importance will exist near the harbor, and that this centre will transact business directly and independently with each of the cities that have just been mentioned.

A journey from Toronto to Moose Harbor after the completion of the railway extension will not be an arduous undertaking. The distance can readily be run within 24 hours, and, as a matter of illustration, the run may readily be compared to the present journey from Montreal to Chicago, or from Toronto to Port Arthur; in each case the distance between the points mentioned is rather greater than the distance from Toronto to Moose Harbor will be, this distance being roughly estimated at 670 miles.

The enterprise of extending the Timiskaming and Northern Ontario Railway to the Bay must be regarded as one of colonization and development; it is not possible to prove from statistics of present traffic that the undertaking will be a commercial success, the simple fact being that no traffic at present exists, although there is every reason to believe that natural resources abound from which an important traffic can be created.

The tributary district to the railway will consist not only of the Clay Belt, but also of the well-defined area of clay lands lying along the shores of James Bay, and geologically known as the Coastal Plain. The soils of this Plain bear much resemblance to those of the Clay Belt, and their development presents in a larger degree the same problems that have to be dealt with in the development of the Clay Belt. Where satisfactory means of drainage exist, the growth of the various species of northern timber proves the fertility of the soil, but the geologists regard the whole district, and particularly the Coastal Plain, as being of very recent creation, placing the period of its elevation above sea level at not more than 10,000 years. The drainage system is, therefore, quite imperfectly developed and large areas of land are buried under muskeg and moss. The condition is indeed very similar to that which exists on the prairies to the east of Winnipeg, the lands being so flat-lying that their slope is not sufficient to provide for the quick discharge of the melting snows in the spring and the formation of muskegs and swamps naturally follows. The natural slope of the lands is, however, sufficient to enable the engineers of the future to design and construct drainage works on a comprehensive scale that will be perfectly satisfactory in their operation, and with the construction of such works practically the entire area of the district will become available agricultural land.

Much of the district is already efficiently drained by the natural watercourses, and the colonizing energy of the province is for the present being concentrated on the settlement of these lands. In general, such lands carry a healthy growth of spruce wood of sufficient size to be valuable as raw material for pulp and paper mills. Intelligent development of such lands, therefore, provides work for the settler both in summer and in the winter. The clearing-up of the lands is, comparatively speaking, easy work, and the timber as it is cut finds a ready market.

The tributaries of the Moose River have direct courses on their way to the Bay and a relatively heavy fall per mile. As a consequence, numerous sites are found where water power can be cheaply developed, and one of the early industries of the district will be the manufacture of pulp and paper. This has been already undertaken on a large scale at Iroquois Falls which itself is not distant more than 200 miles from the Bay.

In this development the opening of a port on the Bay must play a considerable part, providing a route by which such necessary materials as coal can be brought in without excessive freight charges and such low-grade materials as groundwood pulp can be exported, freight charges being perhaps the most important item in the market cost of the last-named product.

The district north of the height of land is so completely overlaid with clay that there is there little probability of further mineral development, but the mining profession of the Dominion is now looking to the areas lying along the northern shores of Hudson Bay as the probable site of the next important mining developments, and these areas will be most readily reached by steamer from Moose Harbor. Should any extensive deposits of low-grade mineral be located, this mineral will find its most economical route to the markets of the North American Continent by way of Moose Harbor and the Timiskaming and Northern Railway to connect with the navigation of the Great Lakes at North Bay.

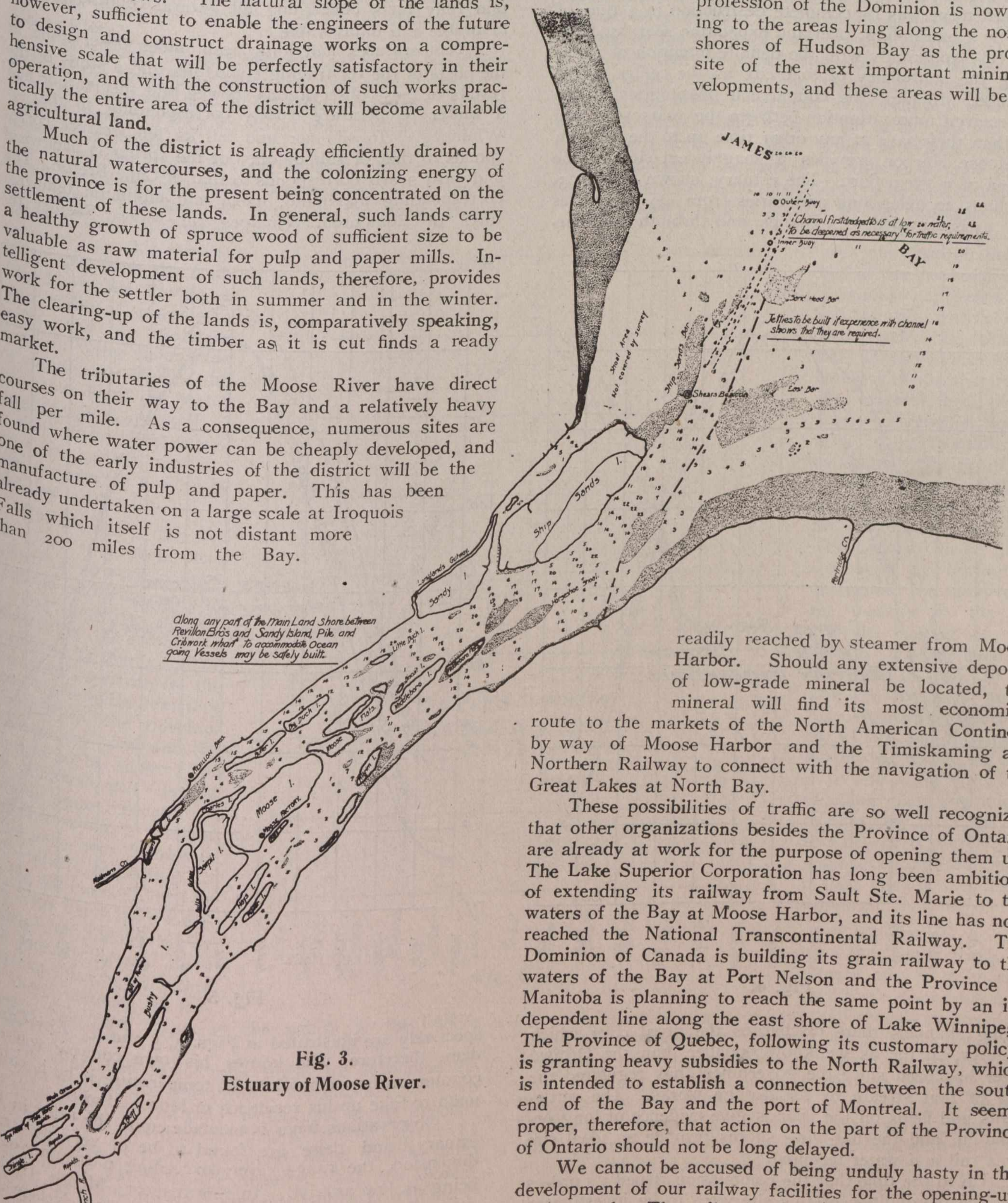


Fig. 3.
Estuary of Moose River.

These possibilities of traffic are so well recognized that other organizations besides the Province of Ontario are already at work for the purpose of opening them up. The Lake Superior Corporation has long been ambitious of extending its railway from Sault Ste. Marie to the waters of the Bay at Moose Harbor, and its line has now reached the National Transcontinental Railway. The Dominion of Canada is building its grain railway to the waters of the Bay at Port Nelson and the Province of Manitoba is planning to reach the same point by an independent line along the east shore of Lake Winnipeg. The Province of Quebec, following its customary policy, is granting heavy subsidies to the North Railway, which is intended to establish a connection between the south end of the Bay and the port of Montreal. It seems proper, therefore, that action on the part of the Province of Ontario should not be long delayed.

We cannot be accused of being unduly hasty in the development of our railway facilities for the opening-up of the north. The rail end reached Orillia shortly after 1870, it reached North Bay about 1886, and was continued from North Bay to Liskeard between 1900 and 1905, and on to Cochrane about 1910, an average movement northward of perhaps 10 miles per year.

Historically, Moose Harbor, under the name of Moose Factory, is an old and long-settled port, from which the business of the surrounding country has been handled for nearly 250 years. Generations of people have lived and died there, and the suitability of the site as a point of permanent residence is beyond question. It is interesting to note that one of the earliest experiences of this settlement was its complete destruction in a time of peace by a marauding, overland expedition sent out from Montreal—apparently with the definite intention of maintaining the supremacy of that city as the centre of the fur trade. In fact, the commercial possibilities of the Bay received more attention between the years 1670 and 1700 than they have at any other time up to the present.

Moose Harbor provides a magnificent site for the creation of a great port. The estuary, shown in Fig. 3, is perhaps 20 miles long and varies from 1½ to 3 miles wide. It is crowded with islands, and through the intervening channels there discharges the great river which is never, so far as we know, smaller than the Ottawa River has been since the government has regulated the flow of that stream by its storage works. The settlements and fields on the islands give evidence of long occupation, and the flat-lying shores provide an ideal site for a rail and water terminal.

Up to the time that the commission issued its orders that the possibilities of this site were to be investigated there was a general impression that the construction of an ocean terminal at the south end of the Bay was for all practical purposes an impossibility, and that the shallow and rocky shores presented an obstacle that could not be overcome within the limits of reasonable cost. The first definite information concerning the locality was obtained by survey parties sent out in 1911, which made a complete instrumental survey of the estuary during that season. The natural conditions, as shown by the plans prepared from these surveys, were so advantageous that further instructions were given by the commission to continue the investigations and to ascertain fully facts concerning all natural conditions, both favorable and unfavorable.

Temperatures had long been under observation at the posts of the fur-trading companies and a study of the results of these observations showed that the Harbor had a winter temperature closely corresponding to that of Winnipeg. In summer and fall its temperature corresponds to that of Edmonton, but the spring is backward and most nearly corresponds to that of Cape Breton. The corresponding maximum, mean and minimum temperatures of Edmonton, Winnipeg and Moose Factory respectively are illustrated in Figs. 4, 5 and 6. Any Canadian, therefore, who knows his own country will encounter no new conditions of temperature if he is called upon to take up his residence in Moose Harbor.

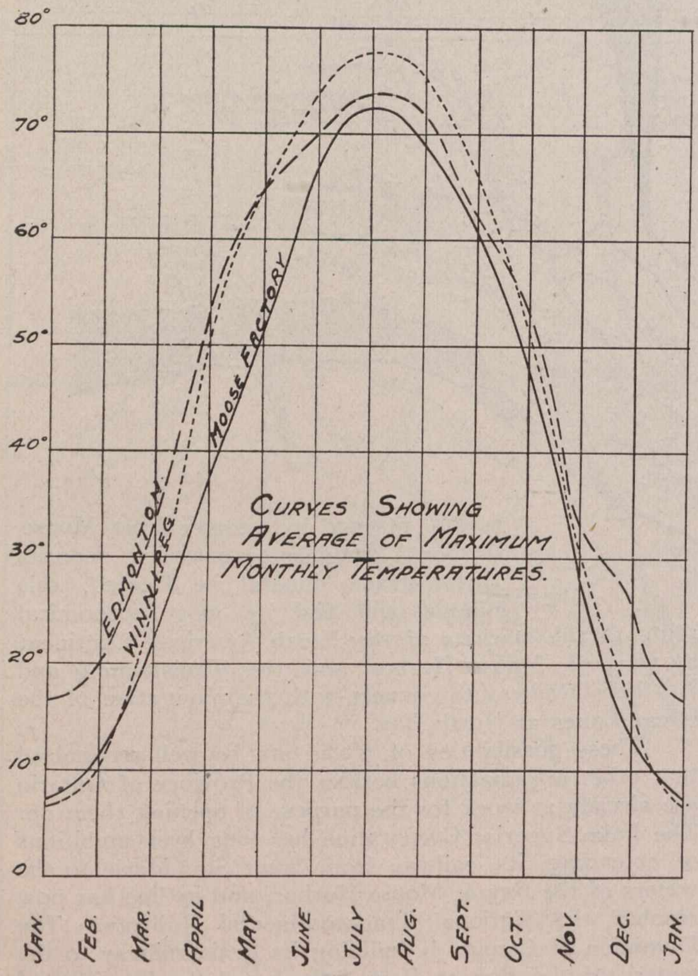


Fig. 4.

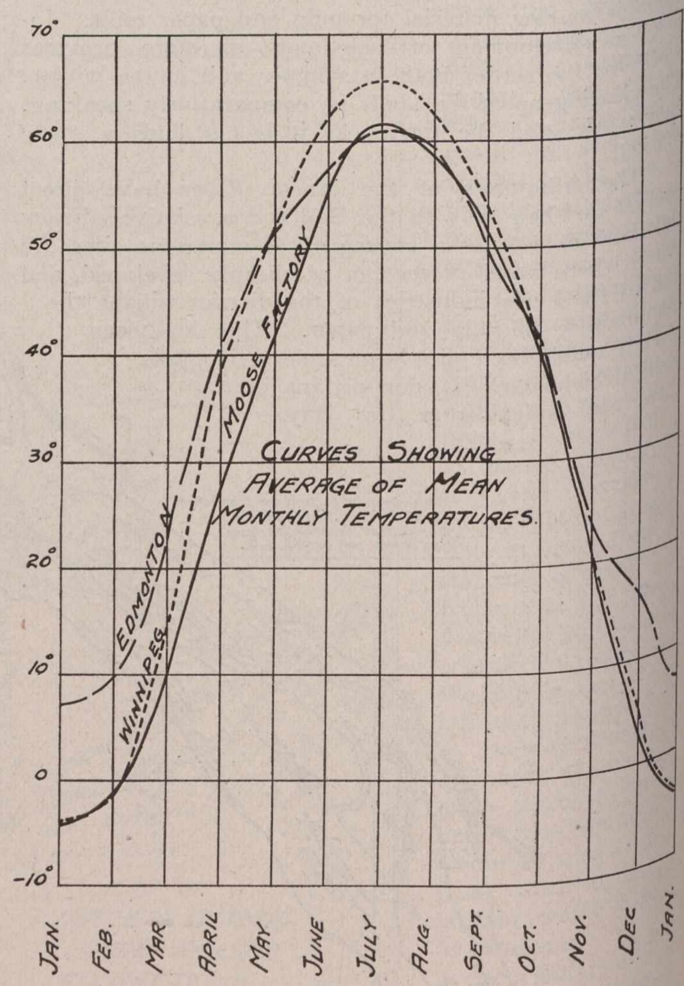


Fig. 5.

Observations have been made upon the tides in the estuary, and these are found to be of very moderate dimension, the range rarely exceeding 6 ft. and often being as low as 2 ft. In this respect, Moose Harbor compares very favorably with its rivals, Port Nelson and Rupert House, the extreme range of the one being given as 18 ft., and of the other as 12 ft.

Measurements have been made of the currents in the estuary created by the tides, and the maximum velocity of these currents, under ordinary conditions, has been found to be about 4½ lin. ft. per second, or, roughly, 2½ knots per hour. Such velocities will not in any way interfere with the movement of modern steamship traffic. Higher velocities than those which have been determined by the observations will exist during the periods of the discharge of the spring floods, but as a general rule these floods will have passed by before the active traffic of the port commences for the year. Fig. 7 is a chart of tide velocities from the report of J. G. McMillan on the Moose River.

The surveys of 1911 showed that in the neighborhood of the fur-trading posts the river was divided into two great channels, and that the depth of water in these channels varied to such an extent that their improvement would be expensive.

Below the posts the two channels united into one broad and deep waterway, bordered by very extensive sand bars. The depth of water in the main channel varies at low tide from 15 to 20 ft., but this fairway is cut off from the main Bay by a bar having a total width of, roughly, 4 miles and a minimum depth of water at low tide of about 6 ft. Beyond the bar the depth of water steadily increases until at a short distance out soundings are secured that are satisfactory for any probable navigation.

The studies of the site have not yet been completed up to such a point that the engineers can give a very positive opinion concerning the method of formation of this bar. The bar itself constitutes the most formidable existing obstacle to the development of the port, and the method to be adopted for its removal will depend largely upon the cause of its formation. Similar bars have been formed in other rivers, sometimes out of the silt carried down by the river itself, and sometimes from silt carried by the littoral currents. It is questionable whether either of these methods of formation has been active at the mouth of the Moose River.

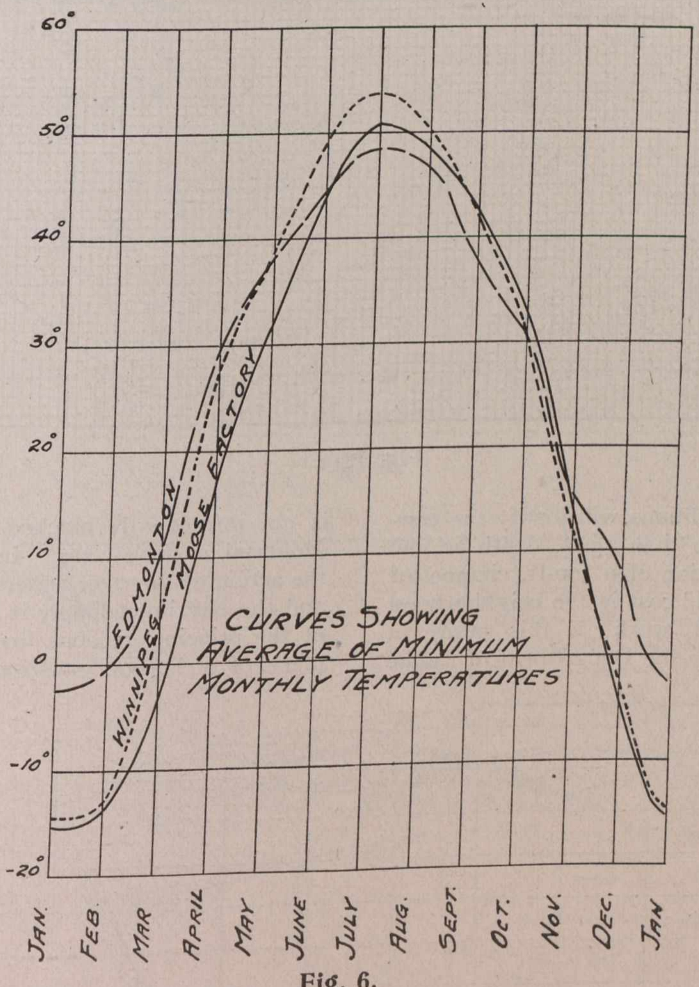


Fig. 6.

No effort has as yet been made to determine the direction and force of the littoral currents, but owing to the shallowness of the coast waters and to the exposed situation of the coastline strong and variable currents of this nature are certain to be found from time to time. Owing to the nature of the material along the shores, it is not believed that these currents will carry any large amount of silt with them, or that they have contributed materially to the existence of the river bar.

Efforts have been made to determine the quantity of silt carried down by the river itself; but although the waters at their ordinary stage are often discolored the material in suspension is so light that it is almost impossible to secure a deposit from a sample taken out of the river and it is probable that for at least nine months in the year the river carries with it no material that would be a factor in bar building. At the time of the annual break-up the shores and bed of the river are badly eroded by the ice-shoves and large quantities of earth and similar material are carried down into the estuary. During the early summer such deposits of material are distributed by the action of the tides and currents. In view of the fact that the spring discharge of the Moose River is very heavy and that the maximum currents will be found in the deepest channels, it is believed that there will be no appreciable deposit of silt in any channel which may be cut across the bar. There is evidence that the flood discharge of the river is as high as 400,000 second-feet, but this figure is not considered to be well established.

The theory held at present by the engineers is that the river channels have been cut through the clay bed of the Coastal Plain in an almost haphazard fashion by the waters of the river itself, and that the bar at the mouth simply consists of the material of the original bed of the Bay, no channel having been cut at this point because the velocity of the river water has been checked by its impact against the waters of the Bay. This theory can be partly confirmed by borings to determine the quality of the material in the bar, and the making of such borings was planned for the spring of 1913. In that year the ice went out of the river at an unexpectedly early date and the survey parties had to flee for their lives and were forced to abandon their equipments to the mercies of the ice-shoves. It is purposed to make good this deficiency in data during the present summer.

A number of borings have been made along the estuary and in each case the material found has been a material which can be readily and cheaply removed by dredging. Solid rock has been noted along the coast line some miles to the east and some miles to the west of the estuary, but not in its immediate vicinity. The borings also give some indication of solid rock in the bed of the river some miles above the fur-trading posts, but no such indications have been found in that portion of the river which it is proposed to improve.

Some time has been devoted to the study of such typical cases of bar formation as Toronto Island and as the Passes of the Mississippi River, but the underlying causes in these cases are forces which apparently are not at work to an appreciable extent in the estuary of the Moose River. The engineering precedents which have been established in dealing with natural difficulties similar to those just referred to will, none the less, be of great value in determining the final lay-out for the development of Moose Harbor. Perhaps the most valuable of them is the now recognized persistence of a river in maintaining its banks and channels unaltered, even when these are built up of most easily eroded materials.

The depth that will be required in the channel at low water will naturally increase as the traffic increases. It is not believed that traffic conditions will justify the construction of a channel of more than 15 ft. depth at low water at first, and the excavation of a 300-ft. channel of this depth out to the Bay should cost in the neighborhood of $600,000. Heretofore all work of this nature in Canada has been carried out by the Department of Public Works and the estimate given above is based on the average cost of the dredging that has been done by that department. If precedent is followed, the cost of executing this portion of the development will fall upon the Dominion of Canada and not upon the Province of Ontario or the Timiskaming and Northern Ontario Railway.

At the post of the Hudson Bay Company an extended, but not wholly systematic, series of observations has been kept of the dates upon which the river has been closed by ice and of the dates of the annual spring break-up. Comparison between this record and a similar record for the port of Montreal has been made and shows, in Fig. 8, that the open season for the port of Montreal is more than a month longer than the similar season at Moose Harbor. The open season at Moose Harbor will have a duration of from 5½ to 6 months, and, should the traffic warrant the expense, it could be readily extended at both ends by the use of ice-breakers. In one respect the comparison above referred to is not fair to Moose Harbor in that it overlooks the fact that Moose Harbor is directly on tide water and is open to the sea as soon as the ice goes out. This is not true in the case of Montreal, where the river between Quebec and Montreal is not infrequently blocked by ice after the harbor of Montreal is itself clear. In the case of Moose Harbor, the action of the river waters in sweeping clear the harbor and the bay immediately in front of the estuary was one of the principal reasons for selecting a river terminal in place of a harbor constructed out into the bay itself.

An examination of the winter ice cap over the estuary has shown that this cap consists of a fairly uniform sheet of about 3 ft. in thickness and that there is little drift ice or bordage under the main ice cap. Examination has also been made to determine whether frazil ice existed in quantity in the channels of the estuary, as it is usually found to exist in the lakes and pools of the St. Lawrence watershed. It was expected that, owing to the winter cold and to the rapid and turbulent course of Moose River, large quantities of this frazil ice would be found to be present as it was well-known from the labors of the Montreal Flood Commission of 1888 that such ice constituted one of the principal causes of the great spring floods in the harbor of Montreal. No explanation has as yet been advanced for the absence of

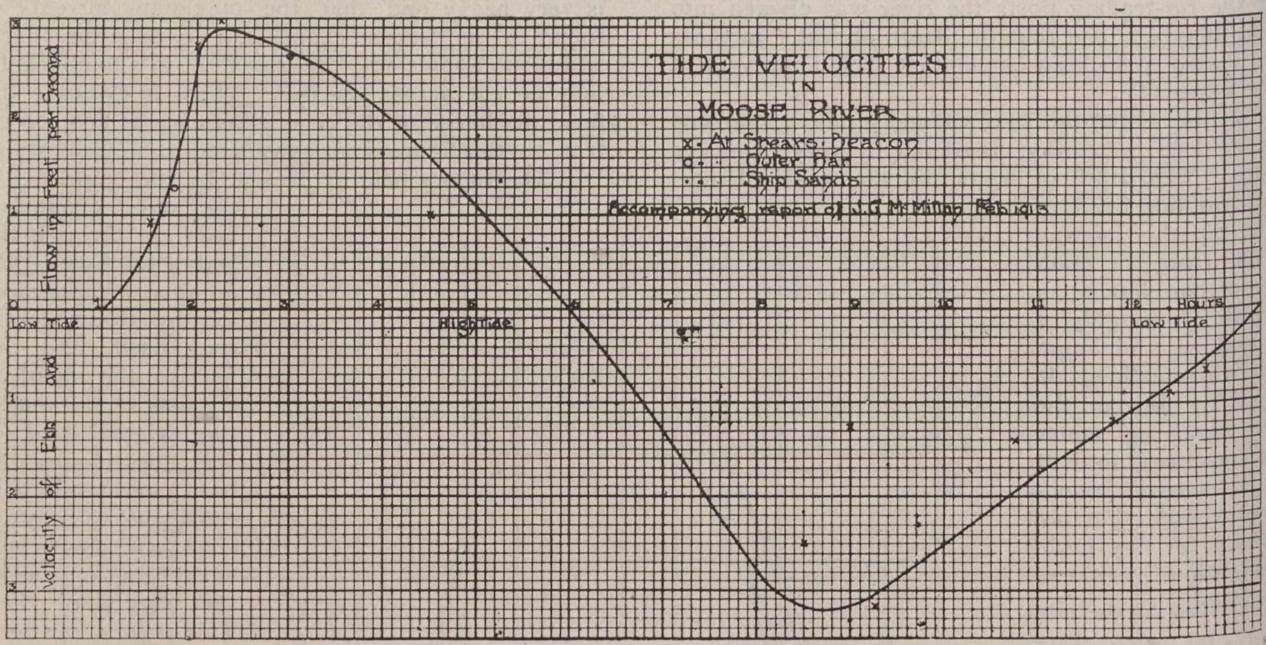


Fig. 7.

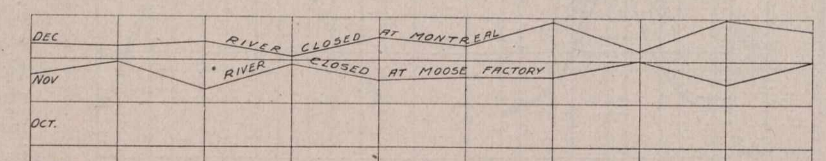


Fig. 8.

frazil ice from the Moose estuary, but this absence certainly removes from the undertaking one of the most serious difficulties that has to be overcome by Canadian hydraulic engineers.

Enquiry at the Hudson Bay post revealed the fact that only on rare occasions does the ice move quietly out of the harbor. As a general thing, the ice cap remains solid and undisturbed until it is shattered to pieces by a rush of water and float ice from the upper and more southerly portions of the river, and heavy shoves almost invariably accompany the clearing of the harbor. So far as spring conditions are concerned there is, indeed, a very close resemblance between Moose Harbor and Montreal. In each case there is a river of great width with many shallow areas, with obstructions in the form of islands, and with low-lying shores. The channels are blocked with ice and the clearing forces are the spring waters which, in the two cases, are not far from equal in quantity. The St. Lawrence River is a much greater stream than the Moose, but its flow throughout the year is also much better regulated, and as a consequence there is not on the St. Lawrence the great difference between the spring and fall discharge that exists in the case of the Moose River. The movements of the ice in the Moose estuary, as described by the officials of the Hudson Bay Company and by the observers sent out by the commission, are very similar to the well-known movements of the ice in Montreal harbor, and the construction methods that have long been followed with success in Montreal harbor may, with safety, be adopted by the engineers of the commission.

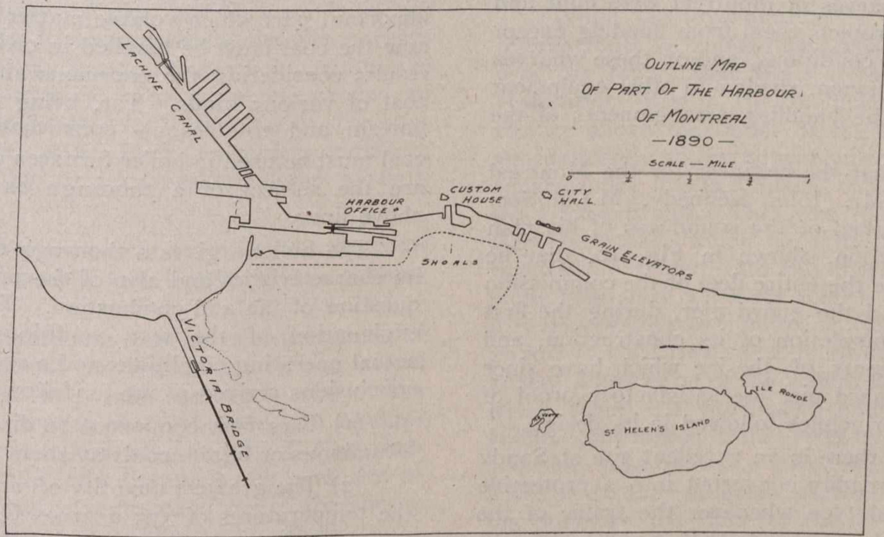


Fig. 9.

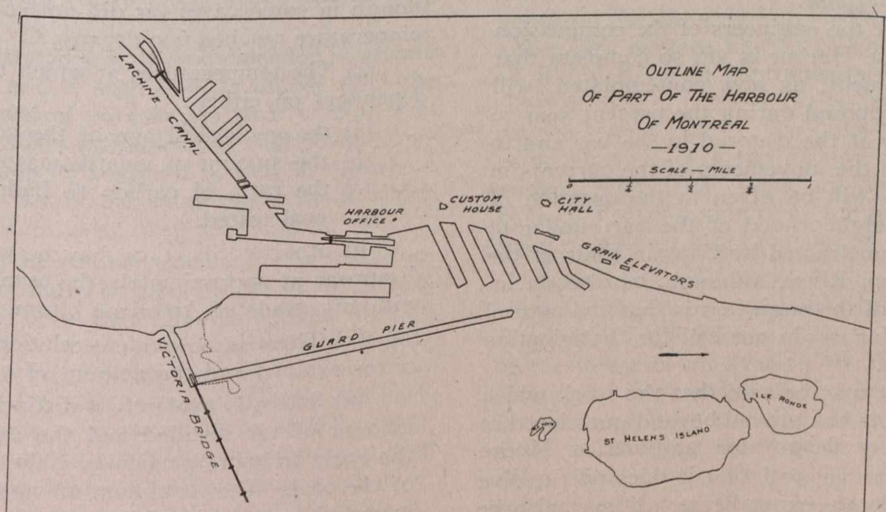


Fig. 10.

For possibly 100 years, wharf construction in Montreal took the form of heavy timber cribs built roughly parallel to the original shore of the river and to a height of 10 or 12 ft. above normal summer water. All sheds and handling apparatus were removed from the wharves every autumn, and invariably in the spring the flood waters rose until they were deep over the wharf sites. As the moving ice was lifted by the waters the force of the shoves was rarely found to have expanded itself upon the wharves themselves, although occasionally portions of the upper part of the wharves were completely torn away. The extent of such damage has been proved to be slight and it was always readily repaired from year to year. There is no evidence to show that the ice-shoves in Moose Harbor are as great or greater than some of the shoves that have been observed in recent years at Montreal, and it is believed that in the earlier years of its development no better plans can be made for Moose Harbor than those which have worked successfully for so long in Montreal.

There is an excellent site on the north shore of the estuary, extending from the post of Révillon Frères to the head of Sandy Island, for a development on the Montreal principle. The channel in front of this shore is of satisfactory depth, and the lands behind it have the proper contour for an efficient railway yard. The cost of 1,000 ft. of crib wharfing may be estimated at approximately $150,000.

How often this wharf will be overflown in spring it is impossible to say, as the rise of the waters in the estuary, which reaches a maximum of 20 ft., is caused entirely by the ice-shoves and the location of these shoves is very variable from year to year. Sometimes the force of the break-up is expended as far as 15 miles above the bar, while at other times the shoving, jamming and flooding may continue to within three or four miles of the bar itself. In the spring of 1913 the final ice-shoves occurred at a point unprecedentedly low in the estuary, and the waters overflowed areas on which the engineers had, in a preliminary way, projected terminal works which were believed to be safe from flood.

Considering again the history of the port of Montreal, Fig. 9 shows a map of the port some 20 years ago, before it was decided that the traffic had grown to be of such importance that it could not be satisfactorily handled with terminal facilities that had to be removed out of the way of the action of the ice every year, and the present main harbor of Montreal was then designed, two principal problems to be solved being protection from flooding and protection from the destructive force of the great ice-shoves which had been known to pile ice to the depth of 60 ft. upon the then existing wharves. The latter difficulty has been met by constructing across the face of the harbor and parallel to the main thread of the river an enormous earth bank known as the Guard Pier. The material for this pier was obtained from the bed of the river in enlarging and deepening the harbor, and it is built to such height that no ice-shove has passed over it and by reason of its material and shape it is practically invulnerable so far as damage from ice action is concerned. Behind the protection of this pier the present concrete and timber wharves of Montreal were built and to an elevation which protects them from flooding except under the most extreme conditions, and on these wharves have been built the permanent sheds and other equipment which now constitute the handling arrangements of the port of Montreal.

It is noteworthy that the engineer for the Montreal Harbor Commission, Mr. John Kennedy, M.Can.Soc.C.E., was so fully satisfied of the soundness of his plan of guard pier construction, shown in Fig. 10, that he did not hesitate to place the entire fleet of the commission in the river, but behind the guard pier, during the first winter following the completion of its construction, and the very slight movements of the ice which have since occurred behind the guard pier are satisfactory proof of the soundness of the principles followed in its design.

In Moose Harbor there is an excellent site at Sandy Island which can be readily converted into a protective harbor of the Montreal type whenever the traffic of the port has grown to such magnitude that it will justify the expenditure involved in such construction, and there appears to be no reason why this site should not be indefinitely reserved for the purpose.

It is not the view of the engineers of the commission that their work at Moose Harbor is yet so complete that the outlines of development, as now contemplated, will not be altered. It is proposed during the present year to determine the character of the material in the bar and to make a special study of the movements of the currents in the estuary. Attention will be given to the question of training walls in the neighborhood of the bar similar to those so successfully constructed by Captain Eads at the mouth of the Mississippi River, although, as already indicated, the judgment of the engineers is that the natural conditions in Moose Harbor do not call for the adoption of Mississippi methods.

As a conclusion, it may be said that the work which has been done up to date has proved beyond question that the construction of a deep-water terminal at Moose Harbor is perfectly feasible, and that it does not involve more than a very moderate expenditure. It may also be said that no problem will arise in the construction of the harbor works which has not already been successfully dealt with elsewhere, and that the exploratory surveys for the railway extension from the present terminus at Cochrane to the Harbor are so well advanced that this portion of the undertaking is known to be a piece of railway construction of the most ordinary type.

A 90-mile concrete boulevard along the shore of Lake Michigan, from Chicago to Milwaukee, is being planned.

An announcement was made at the Maritime Motor Show in St. John, N.B., to the effect that the Dominion Motor Car Company will erect a factory at Coldbrook, N.B., 3 miles from St. John, to assemble and manufacture sections of a British car which will be placed on the Canadian market.

TAR FORMING TEMPERATURES OF AMERICAN COALS.

THE University of Wisconsin has just issued a bulletin prepared by O. C. Berry, under the direction of Prof. A. G. Christie, on the characteristics of the volatile matter in bituminous coal. The bulletin covers a series of investigations to determine the temperature limits between which tars are distilled from various classes of coal; the temperature limits of the maximum rate of evolution of tars, and the relative quantities of tars distilled from various general classes of coal. The object of the research centres around the important part which volatile matter plays in determining how the coal must be handled in order to obtain the best results considering the enormous annual consumption of coal of various kinds. Tar, being one of the most important and troublesome constituents, especially where coal must be used in boiler furnaces or in producer plants, are the subject of a thorough examination along the above lines.

The bulletin gives a thorough discussion of coal and its characteristics and also of the problems related to the question of tar and combustion. This is followed by an explanation of the test conditions as compared with actual operating conditions and a record of the tests. The conclusions arrived at are as follows:

(1) Tars first commence to distil from any grade of bituminous or lignite coals at about 300 degrees C.

(2) The greatest quantity of tars are distilled between the temperatures of 375 degrees C. as an average lower limit and about 475 degrees C. as the final temperature.

(3) The tars have all been evolved on the average when the coal reaches a temperature of 550 degrees C., though in some cases tar did not cease to appear till the temperature reached 600 degrees C.

(4) The temperatures at which the tars distil are not dependent on either:

(*a*) the geological age of the coal,
(*b*) the amount of volatile matter in the coal,
(*c*) the ratio of carbon to hydrogen in the class of coal tested.

In other words, tars may be expected to appear or disappear at approximately the temperatures given above with any grade of American bituminous coal.

(5) There is no evident relation between the amount of tar evolved and the amount of volatile matter in coal.

(6) There is evidently a distinct relation between the amount of tar distilled and the geological formation of the coal, or, more particularly, the carbon-hydrogen ratio of the coal. The maximum amounts of thick tars can be expected from coals with carbon-hydrogen ratios ranging from about 13.5 to 18. It is also possible, knowing the carbon-hydrogen ratio of any given coal, to predict with considerable accuracy the probable amount of tar that will be distilled as compared with some other known coal.

(7) There are added reasons for believing that the volatile matter of western coals contain fixed gases and watery vapors of low heating value if not entirely non-combustible. This is shown by the small amounts of tar deposited and by the low heating value when calculated on the "unit coal" basis.

The Northern Electric Company, of Montreal, has recently closed a contract whereby it will establish in Regina its general headquarters for the west.

BOUNDARY WATERS OF RAINY RIVER DISTRICT.

THE negotiations between Canada and the United States relative to the water level of Lake of the Woods, and which have been under way for some time, formed the subject of a progress report dated January 16th, 1914, to the various governments by the International Joint Commission, to whom the matter was referred.

The collection of information has involved an immense amount of difficult field work, including flood damage surveys on the shores of the lake, storage surveys of the lakes in the vicinity of the international boundary tributary to the Rainy River and reconnaissance surveys of the secondary storage basins lying wholly within the boundaries of either country. The work was carried on under the supervision of Mr. A. V. White, of Toronto, and Mr. A. F. Meyer, of St. Paul, consulting engineers of the commission, by field parties appointed by both countries.

The following questions were submitted to the commissioners by the Canadian and United States governments:—

(1) In order to secure the most advantageous use of the waters of the Lake of the Woods and of the waters flowing into and from that lake on each side of the boundary for domestic and sanitary purposes, for navigation and transportation purposes, and for fishing purposes, and for power and irrigation purposes, and also in order to secure the most advantageous use of the shores and harbors of the lake and of the waters flowing into and from the lake, is it practicable and desirable to maintain the surface of the lake during the different seasons of the year at a certain stated level; and if so, at what level?

(2) If a certain stated level is recommended in answer to question No. 1, and if such level is higher than the normal or natural level of the lake, to what extent, if at all, would the lake, when maintained at such level, overflow the lowlands upon its southern border, or elsewhere on its border, and what is the value of the lands which would be submerged?

(3) In what way or manner, including the construction and operations of dams or other works at the outlets and inlets of the lake or in the waters which are directly or indirectly tributary to the lake or otherwise, is it possible and advisable to regulate the volume, use, and outflow of the waters of the lake so as to maintain the level recommended in answer to question No. 1, and by what means or arrangement can the proper construction and operation of regulating works, or a system or method of regulation, be best secured and maintained in order to insure the adequate protection and development of all the interests involved on both sides of the boundary, with the least possible damage to all rights and interests, both public and private, which may be effected by maintaining the proposed level?

During the winter months of 1912-13 the consulting engineers devoted their attention to the gathering of data from various governmental and other sources on both sides of the boundary. They also made a personal reconnaissance of portions of the Lake of the Woods watershed in order to ascertain the extent and character of the field work necessary to determine the best means by which regulation might be secured and also to determine the possible effect that certain schemes of regulation might have upon the various interests using the waters of the Lake of the Woods and the shores and harbors thereof.

During the winter the engineers also completed their plans for work in the field, and in the spring as soon as conditions would permit survey parties were gathering the essential data. This field work was prosecuted throughout the summer and autumn of 1913. The care with which the work was distributed and the energy with which it has been pushed forward has resulted in very substantial and gratifying progress in the gathering of important information upon some of which the commission will no doubt base its final report to the two governments.

While the investigation is still incomplete and all figures must be subject to revision, it is stated in the progress report that the watershed involved in the investigation—that is, the combined area of land and water surface above the outlet of the Lake of the Woods—is approximately 26,000 square miles, of which about 15,000 square miles are in Canada and 11,000 square miles in the United States. This area forms part of the Hudson Bay watershed, which finds its principal outlet through the Nelson River. Into the character and extent of the main watershed below the mouth of the Winnipeg River, it is unnecessary to inquire, so far as the present investigation is concerned, but it is important to have some general knowledge of the waters which join the Winnipeg River from the northwest, and which go to swell the volume contributed to that river by the Lake of the Woods and its tributaries. It is estimated that the English River and other affluents of the Winnipeg River below the outlet of the Lake of the Woods drain an area of about 29,000 square miles.

The intricate system of waterways which finds its outlet in the Lake of the Woods through Rainy River extends on the one side into northern Minnesota and on the other into western Ontario. This area above the mouth of Rainy River is approximately 20,000 square miles. That portion of it above the outlet of Rainy Lake is about 14,500 square miles. The Lake of the Woods itself contains an area of 1,400 square miles; Rainy Lake, 325 square miles; and there are also within the watershed some 36 lakes ranging in area from 10 to a hundred square miles, besides a large number of smaller bodies of water.

One of the results of the hearings was to bring out not only the variety and magnitude of the resources of the Lake of the Woods region, but also the importance of the interests involved in the development of these resources on both sides of the boundary. Not less than $100,000,000 have already been invested in this important district, including the lumber industry, pulp and paper mills, power plants, flour mills, fisheries, etc. The lumber mills are situated at various points on the Rainy River and the north shore of the Lake of the Woods, the valuable timber limits which supply them covering thousands of square miles in Ontario and Minnesota. Large pulp and paper mills are situated at International Falls, Minn., and Fort Frances, Ontario, and flour mills at Kenora, Ontario, on the north shore of the Lake of the Woods. Large power plants, representing an investment of many millions of dollars, are found at International Falls in connection with the pulp and paper industry, at Kenora for the operation of flour and other mills, and on Winnipeg River for the purpose of supplying light, heat, and power to the city of Winnipeg and operating the Winnipeg street railway. The towns of International Falls, Fort Frances, and Kenora are also lighted by the power plants in their vicinity.

Navigation has been maintained more or less on the Lake of the Woods and Rainy River for over 30 years by steam craft engaged in freight and passenger service, lumbering, and the fisheries. The navigation interests complained that their operations were interfered with by low water in Rainy River, caused by the operation of the power works at International Falls and Fort Frances.

The Canadian government has shown its interests in the navigation of these waters by subsidizing a line of steamers between Fort Frances and Kenora, by extensive dredging at the mouth of Rainy River, and by the provision of lights and other aids to navigation. The United States government has also carried out dredging at Warroad and elsewhere on the south shore of Lake of the Woods. Some years ago a sum of money was voted by the Canadian Parliament for improving the navigation of Rainy River at the Long Sault Rapids by means of a dam and lock. Difficulties arose owing to the international character of the stream, and in 1911 a private corporation, the Western Canal Company, was incorporated having the same object in view. Nothing, however, has yet been accomplished.

Many years ago the Canadian government built a canal on the Canadian side of the river at International Falls. This canal is now closed at the upper end by the waste gates of the power dam, but the Canadian government has reserved the right to re-open the canal whenever it may be required for navigation purposes. In the plans of the power company the United States government also ordered provision for a canal on the American side, should it be found necessary at any future time. In connection with these existing or projected locks at International Falls and the Long Sault Rapids, mention may be made of a larger project, which has been mooted in Canada, for creating a navigable waterway by means of a series of locks and dams and the improvement of existing waterways between Lake Superior and Lake Winnipeg.

A large portion of the country surrounding the Lake of the Woods and its tributaries is not of a nature suitable to agriculture, but farming is being carried on along the banks of Rainy River; on the south shore of the Lake of the Woods, where there is much valuable agricultural land, in the neighborhood of the North West Angle, on the eastern shore of the lake north of Rainy River, and on some of the islands. Complaints have been made that some of these lands, which are low lying, have been flooded by reason of the maintenance of the Lake of the Woods above its natural level by the operation of dams at the outlet of the lake, which dams are wholly in Canadian territory.

The fisheries of the Lake of the Woods are both extensive and valuable. Over 1,500,000 pounds of fish were shipped from these waters in 1912. Statements were made at the hearings to the effect that changes of level in the lake were detrimental to the fisheries, as the lowering of the water injures the spawning grounds.

Some evidence was obtained at the hearings at International Falls, Warroad, and Kenora as to sanitation and the pollution of waterways. Complaints have since been received as to the pollution of the waters of Rainy River by sewage disposal and by the dumping of refuse from the pulp and paper mills at International Falls.

The hearings held by the commission in September, 1912, indicated in a general way the requirements of the various interests concerned in the levels of Lake of the Woods:

(1) Navigation requires a high summer level of the lake.

(2) Agriculture, immediately along the shore of the Lake of the Woods, requiring a fixed maximum level, which will obviate undue flooding and make available the greatest area along the shore for agricultural purposes.

(3) Industries, broadly divided into: (*a*) Manufacturing interests, requiring a more or less uniform flow throughout the year. (*b*) Municipal plants for light, heat and power, requiring a regulated flow, which varies with the seasons, the winter loads being heavier and necessitating an increased flow.

(4) Fishing, requiring a fairly uniform lake level, otherwise considerable fluctuations will expose reefs and destroy fish spawn.

Difficulties in Regulating Lake Levels.—The harmonizing of these interests, which under the extremes of demand are conflicting, makes the problem of the regulation of lake levels somewhat difficult. The regulation of the levels of the Lake of the Woods, having in view not only present but prospective needs, depends upon the regulation of the inflow as well as that of the outflow. It therefore involves two classes of controlling works:

(*a*) Primary works, to be located in boundary waters at the outlets from the Lake of the Woods.

(*b*) Secondary works, to be located in each country, to regulate the run-off into the boundary waters which supply that lake.

In view of the entire drainage area involved, about 26,000 square miles, being largely wooded, these secondary controlling works, necessary in a measure to-day, will become imperative in the future. And the vast interests depending on the timber supply in this great watershed must be concerned in the upkeep of that supply, so closely related to the conservation of the water resources of the district.

The field work in connection with the investigation has been divided into several more or less distinct sections:

(1) Detail and reconnaissance surveys of the shores of the Lake of the Woods, Rainy Lake, Namakan, Kabetogama, Sand Point, Crane, and a number of other lakes.

(2) Topographic and other data relating to outlets of Lake of the Woods.

(3) Stream flow records and meteorological data throughout the drainage area.

Extent and Necessity of Surveys.—The surveys in connection with the Lake of the Woods fall naturally into two classes. So far as the south shore of the lake is concerned, and certain areas on the east and west shores, where the lands are low lying, detail surveys are being made to show the effect on these lands—particularly those susceptible of cultivation—of various levels of the lake. The north shore, on the other hand, is generally more elevated, and a comparatively rapid reconnaissance survey was considered sufficient to obtain the data needed in connection with the investigation.

Between the months of June and October, 1913, a party of engineers made a detailed topographic and hydrographic survey of the lowlands along the southern border of the Lake of the Woods, from a point in Manitoba two miles north of the international boundary, south and east through Minnesota, and north again into Ontario, to a point about three miles northeast of the mouth of Rainy River. This survey covered about 70 square miles of actual area, and has been carried out in a manner to enable the commissioners to answer to what extent, if at all, would the lake, when maintained at such level, overflow the lowlands upon its southern border.

The field work elsewhere on the Lake of the Woods, comparable in character to that already done on the south shore, will cover certain areas on the easterly shore of the lake from near the mouth of Rainy River up to and including portions of the Big Grassy River, also on the west shore from about the international boundary northward to North West Angle Inlet. It is proposed to place the engineers in the field as early as practicable this spring and conclude the surveys before the early fall of 1914.

In carrying out the reconnaissance survey of the northern portion of the Lake of the Woods, including the principal islands and the shores of Shoal Lake, work was commenced in September, 1913, at Kenora and carried along the north and east shores of the lake to the mouth of Miles Bay. The entire shore line of the Lake of the Woods, including the principal islands and Shoal Lake, has now been examined, with the exception of the comparatively small areas on the east and west shores already referred to.

As Rainy Lake is the most important secondary storage reservoir in the Lake of the Woods watershed, and the level of the lake is controlled by the dam at International Falls, it was considered necessary to ascertain to what extent it could be utilized for storage purposes, and what the effect of certain levels would be on the surrounding lands, timber, etc. This survey has been completed, and the results are now being plotted, collated, and analyzed in the office.

It being thought desirable to have an examination made of some of the larger secondary storage reservoirs above Rainy Lake and lying wholly within the Province of Ontario, arrangements were made with the hydrographic branch of the Hydro-Electric Power Commission of Ontario to carry out the work.

These surveys were carried out in the summer of 1913, and included an examination of Upper and Lower Manitou Lakes, Otukemamoan Lake, White Otter Lake, Clearwater Lake, and Lac des Milles Lacs. As a result of this reconnaissance the following opinions have been advanced:

(1) That in all cases it would be physically possible to construct storage works of sufficient extent to entirely control the run-off of the watersheds above the outlets of the various lakes.

(2) That works of sufficient extent to control the run-off above the outlet of Lac des Milles Lacs would add considerably to the area of the lake due to the drawing out of large tracts of muskeg, and that some damage would be caused by backwater in the village of Savarne.

(3) In the case of all the other wakes examined the entire run-off of their respective watersheds could be controlled by comparatively inexpensive works without damaging timber of any value and without material increase in lake area.

(4) That dams have at one time or another existed at the outlets of all the above lakes, and timber dams in good condition now exist at the outlets of Manitou, White Otter, and Clearwater Lakes.

Arrangements have been made with the Public Works Department of Canada for certain surveys in the vicinity of the Long Sault Rapids, at the lower end of Rainy River, but as it was not found possible for the department engineers to complete this work during the season of 1913 a small survey party was detailed by the consulting engineers to make a preliminary survey.

During the summer of 1913 surveys above Kettle Falls were resumed and embraced the north shore of Namakan Lake.

During 1913 a number of men of the Manitoba hydrographic survey of the Canadian Department of the Interior have been engaged in collecting hydrographic data and in making surveys of the various outlets of the Lake of the Woods in the vicinity of Kenora and Keewatin.

In addition to the general field work, consisting of detail and reconnaissance surveys, water gauges, established by departments of both governments, and the commission were being read once, twice, or three times daily at various points on the Lake of the Woods watershed. Current meter gaugings were made almost daily at the various outlets of the Lake of the Woods, and frequent meter gaugings were also made of various tributary waters. Complete meteorological records, embracing temperature, humidity, rainfall, evaporation, and wind velocity were kept daily during the season.

Although only a little more than a year has elapsed since the investigation was begun, the commission in that time covered by surveys and reconnaisance a large portion of the drainage area of about 26,000 square miles, and has also collected a vast amount of necessary and important engineering data and obtained much other necessary information concerning the interests of the people in both countries to be affected by the final conclusions and recommendations of the commission. The data and information thus far obtained is being tabulated and put in proper and convenient form and from which maps are being prepared for the use of the commission in forming and illustrating its conclusions on which final recommendations to the United States and Canada can be based.

The waters involved in this investigation mark the boundary between two great countries for a distance of almost 500 miles. These waters are the common property of the United States and Canada. The right to their use is a right enjoyed in common by millions or more people living under separate and distinct governmental jurisdictions along and in the vicinity of the boundary thus marked. Heretofore the exercise by the people of both countries of this common right to the use of these waters without international agreement or other limitation has, as we are informed, led to frequent and sometimes serious and acrimonious controversies and diplomatic negotiations between the two governments. These controversies have extended over a period of more than 15 years. At times they became so serious as to threaten destruction of private property.

Conclusions and recommendations, therefore, as to the normal levels and other conditions surrounding the use of these waters, their future regulation and control and the limits within which the people on both sides of the boundary may hereafter exercise their common right to use these waters for sanitary and domestic purposes, for navigation, for fishing, for power, and for municipal and industrial purposes generally, to be of value to the governments must necessarily be based upon the most careful and thorough examination of all the facts essential to intelligent and correct conclusions and practical recommendations. While the work thus far has been conducted with all the expedition possible and at a minimum cost, to complete it will require at least as much time and labor as has thus far been expended.

At a representative meeting of the Niagara District Hydro Radial Union at St. Catharines, it was decided to ask the various municipalities in Lincoln, Welland, Haldimand and East Wentworth to petition the Hydro-Electric Commission of the province to make a survey for a proposed radial line through the peninsula.

MECHANICAL PURIFICATION OF SEWAGE

Description of Riensch-Wurl Screen as Used in German Practice.

THE Riensch-Wurl Separator Disc is now being used in a large number of German sewage screening plants. The following are interesting abstracts from an article by Engineer Endris, of Hamburg, Germany, which is being distributed by the Sanitation Corporation of New York City, who have obtained the

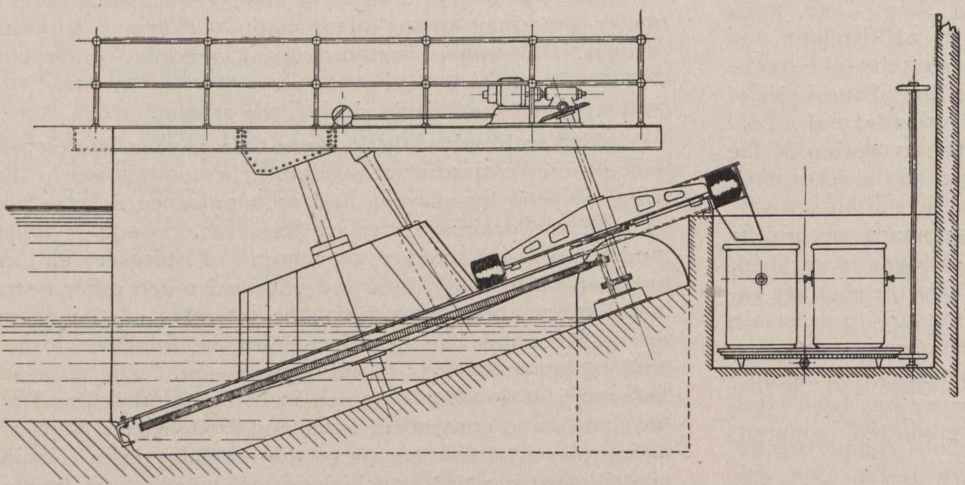


Fig. 1.—Elementary Outline of Riensch-Wurl Screen.

Canadian patent rights to the Riensch-Worl and other German sewage apparatus:

"The construction and method of the disc is clearly shown by the accompanying illustrations. It consists of a round disc provided with slots, the disc being suitably located at an inclined angle of 10 degrees to 30 degrees in the sewer, completely closing the cross-section of the canal. As Fig. 2 shows, the upper part of the disc extends above the water. The profile of the disc always conforms closely to the surfaces of the canals and has the advantage that the surface offered to the water entrance increases to the proportion of the rapidity of the increase in the canal profile, which is not the case in a rectangular pipe. The diameter of the disc is chosen to suit the volume of sewage and ranges between 1.3 to 8 m.

"The capacity of the disc depends upon the rapidity of flow, and the size of the slots, and is between 6 and 4,500 liters per second. The effluent of the main sewer is conducted diagonally against the disc. Shortly after the immersion of the rotating screen, it is covered with suspended matter, and during its travel through the water forms a sort of sludge filter, by which particles considerably smaller than the width of the slots are retained. On its exit from the water the screen is covered with solid substances of all kinds, as shown in Fig. 2. The solid substances are cleaned off above the surface of the water by a set of rotating brushes mounted on a spider, which revolve around the spider shaft and also on their own axis.

"In consequence of a special construction the bristles of the brushes are not pressed against the screen plate with too much force, nor the dirt squeezed through the slots, but the screen plate is gone over lightly and every spot brushed several times. The brushes carry the sludge into a circular trough, from which it is further transported by buckets, belt conveyer, tilting carts, or other device.

"In Fig. 1, the separator screen consists of two firmly connected parts, a smooth ring part, which lies diagonally in the sewage stream, and a hat-shaped frustum of a cone. The screen cone is cleaned by a special brush, the screen disc is in turn cleaned by revolving brushes.

"The usefulness of the screen depends particularly upon the construction of the screen plates which separate the solids from the fluids. They are made of bronze or brass, slots of cone shape, widened out on the under side about ½ to 5 m.m. wide. The screen plates are so arranged on the iron framework as to cause the least possible loss of head in the water.

"The screen surface, being made of large plates, insures a smooth and uniform surface without any projections on which sludge might possibly accumulate, while the close arrangement of the perforations provides the most advantageous possible use of the screen for the passage of the water.

"The framework (Fig. 1) is braced rigidly on all sides. All the load carried in a single one of the arms of the disc is cared for by a structural iron framework and is borne up by the main shaft itself. In the smaller and the medium sizes, up to 5 m.m. in diameter, the framework is secured to the carrying shaft and is hung to ball-bearing support which is supported by the service bridge. The ball-bearing support is constructed as pivot over the surface of the water. In the larger types (5 m.m. in diameter and over) the shaft is

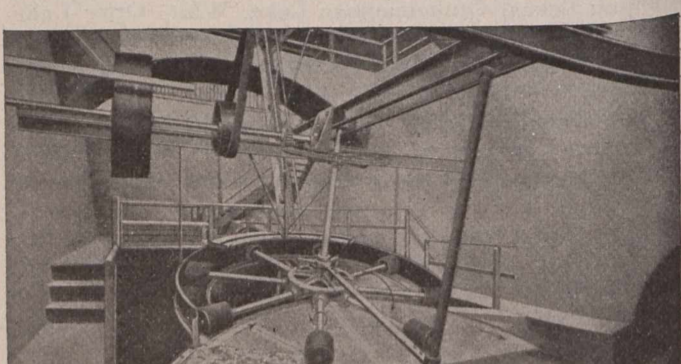


Fig. 2.—Riensch-Wurl Screen, Showing Method of Operation.

stationary and the framework of the screen rotates in a ball-bearing support arranged around the shaft above the water. In this way all the weight is taken up by the supports above the surface of the sewage and is easily cared for. A steady bearing is provided for the lower part of the main shaft, and consists of a roller bearing equipped with stuffing boxes.

"Thorough lubrication, together with the slow rotatory movement (0.3-0.2 rotations per minute) and the small power consumed insures freedom from trouble.

"The manner in which the brushes are attached to a central brush body with radiating arms, makes the cleaning of the discs particularly efficacious. While in all other screen arrangements the screen surface is cleaned only once at each rotation the distribution of the brushes in the Riensch-Werl system permits the cleansing of the plates as frequently as desired. Normally, the screen plates are cleaned from 4 to 5 times each rotation in such a manner that a clean brush passes over the previously brushed surface. The brushes describe intersecting paths on the plates so that no single spot is left untouched by them.

"Summarizing the principle features of the screen:

"Large screening surface, high efficiency, low consumption of power and slight running expense, slight loss of head involved, adequate and substantial construction details, noiseless rotatory motion, and cleanliness. The mechanism is constantly in sight and the cleaning of it takes place above water; the clearance with walls of canal is precise and adjustable."

EFFECT OF CONCRETE ON STEEL.

That concrete has a preservative effect on steel has long been known, and many instances have occurred where ancient concrete has been broken away from metal with which it had been in contact for ages, and it has been found that the surface of the metal was as bright and clean as on the day when it was first placed in position. Some remarks made by Dr. W. H. Walker (the Director of the Research Laboratory of Applied Chemistry of the Massachusetts Institute of Technology) some little time ago will well bear repeating in this connection. Every engineer is well aware of the fact that acidulated water, no matter how small the percentage of acid may be, tends to corrode steel by increasing the number of hydrogen ions present, and Dr. Walker made it clear from the tests he carried out that there were certain alkaline substances present in concrete which corrected any acidity, and so protected the contained metal work from corrosion.

This fact has an important bearing upon the question, which lately has been much discussed, as to whether concrete will protect iron or steel from corrosion. Inasmuch as Portland cement, when it sets or hardens, liberates a quantity of caustic lime, which is a strong alkali, and since good concrete is saturated with this strong alkali, the answer to the question must be in the affirmative. Iron or steel will not corrode when embedded in concrete. But caustic lime is soluble in water, and poorly made concrete is not impervious to moisture. Therefore, if iron be embedded in concrete through which water is allowed at any time to percolate, this calcium hydrate will be slowly, but surely, dissolved. With it will disappear the inhibiting action of the concrete and iron embedded therein will, in time, rust and become corroded. To ensure absolute protection of the reinforcing members of concrete construction, therefore, such concrete must be of good quality, and sufficiently dense and carefully made to render it waterproof.

The Aztec Oil and Asphalt Refining Company of Canada have moved from the Shaughnessy Building, Montreal, to larger offices in the Power Building, Craig Street, Montreal.

ENGLISH FOR ENGINEERS.

By Benjamin P. Kurtz,
(In California Journal of Technology.)

When facts of iron and steel, of girders and trusses, are turned into a written report, they are presented no longer in their own tangible, objective medium or material, but in the new and subjective medium of words. Now, in the first place, it is to be noted that in this passage from the realm of objective reality to written representation there is ever present the dangerous chance of deflection of facts and even of their actual transformation—in a word, the danger of error. This merely because of the sudden transition to a new and unaccustomed medium. More narrowly regarded, however, the difficulty arising here is that of accuracy of statement plus the adaptation of technical facts and information to the laws and economy of mental attention. In order to gain and hold the attention of the reader, in order to present facts in such fashion that they may be easily and thoroughly understood, and that the general proposition may be seen to be supported at every point by its details, so that there is the mutual proof of a complete harmony between parts and the whole—in order to accomplish this successful communication with another mind, it at once becomes necessary to marshal the objective facts or material in such fashion that they will find a ready, orderly, and emphatic entrance into the mind of the reader. Facts without grouping dissipate the attention; poor grouping, overlapping, division, insufficiently marked separation confuse the attention; diffuse, wandering connections weary the attention; neglect to distinguish between division and implication, or between fact and hypothesis, muddle the conception of the reader; tortuous and nebulous sentences befog the conception of the writer; insufficient recognition of the necessity of exemplification and illustration, and ignorance of their difference, leave the reader too much to do or undo; the very lack of knowledge of what constitutes a definition, and of the fundamental methods of expanding a logical definition, lay the entire argument open to objection or render its outlines amorphous. In two words, the necessity of being understood, not the achievement of truth; the necessity of presenting groups of facts in accordance with the habits of trained thought-attention, not the accuracy of turning one fact into one phase—this is that new labor and skill required of the technician when he expounds his facts and thoughts to other minds in the medium of words.

BRIQUETTING OF SLACK.

"Conservation" calls attention to the fact that much coal is never utilized in Canada through piling the slack into huge "dumps." Such material is very valuable, and by means of a briquetting plant, may be converted into fuel of commercial value. Tests made in the United States show that the cost per ton of briquettes loaded on cars, from a briquetting plant at the mine would vary from about $3.50 to $5. The binder used is tar, which may be obtained as a by-product in the manufacture of coke. The briquettes withstand weathering better than ordinary coal, and there is less waste in shipment.

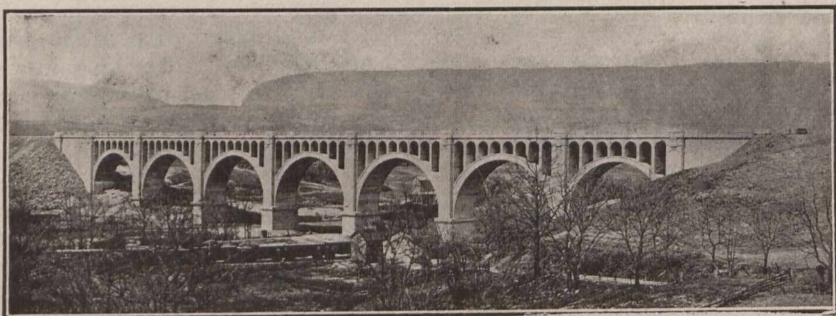
Renewed application will be made to the Railway Commission to order a start by the C.P.R. on its proposed freight tunnel from Burrard Street to the False Creek yards, according to a recent decision of the bridges and railways committee of the city council.

SOME LARGE CONCRETE BRIDGES

EXAMPLES OF THE APPLICATION OF CONCRETE TO BRIDGE DESIGN FOR VARIOUS USES—DETAILS OF THE IMPORTANT CONCRETE BRIDGES.

By L. S. BRUNER, A.M. Can. Soc. C.E.

CONCRETE, in its modern meaning, has been used in bridge construction for a great many years. While at first these structures were rather small, there has been a gradual increase in the length of the spans and length over all until at present we see arches of over 300 feet and viaducts of from half a mile to several miles in length.



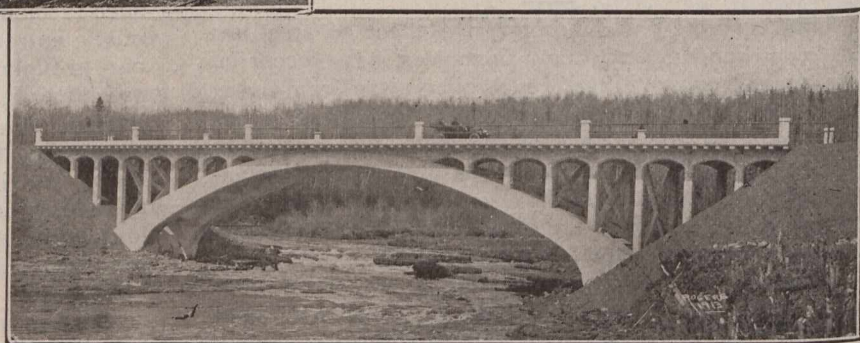
Paulin's Kill Viaduct, D.L. & W.RR.—1,100 ft. long, 115 ft. above water.

The last few years have witnessed a remarkable growth in the use of concrete for long bridges and viaducts. They have been used for all classes of traffic, from those over which the traffic is entirely vehicular, to combined vehicular and trolley, and also railways.

One of the earlier of these immense structures was the Walnut Lane bridge in Philadelphia. It spans the Wissahickon Creek, the valley of which is a part of Fairmount Park, and connects Germantown and Roxborough, two of the city's finest residential districts. Prior to the construction of this bridge all traffic between the districts had to make a wide detour.

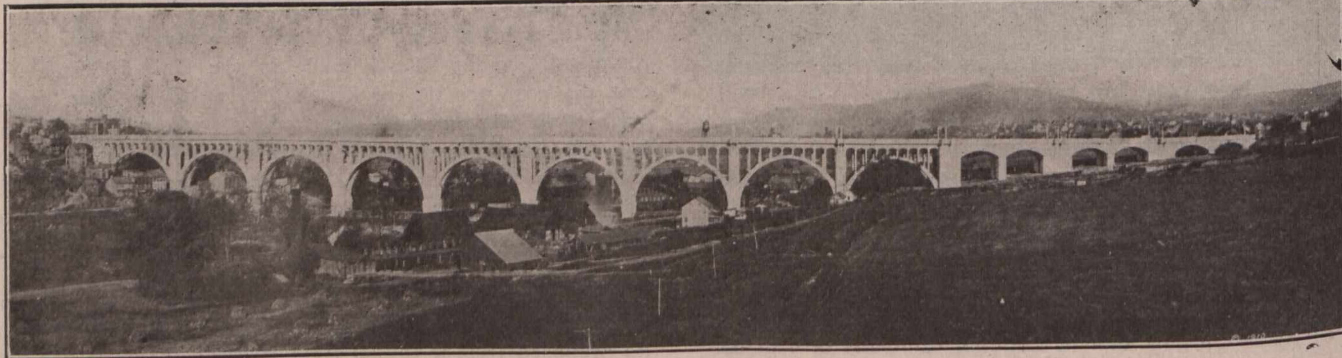
The total length of the bridge is 585 feet, consisting of a main span of 233 feet and five secondary spans. No reinforcement was used in the arch construction. The roadway is 150 feet above the creek and has a width of 56 feet, including sidewalks. The total cost was $262,000. Concrete was decided upon principally for two reasons. In the first place the surroundings were such as to warrant a structure that would be in keeping with the natural beauty of the valley with its high wooded slopes on either side of the winding creek. Further, it was recognized that the maintenance of concrete would be very slight, due to the nature of the material and its great durability. While a fund for maintenance could have been provided for in any other class of structure, there was always the danger that the actual repair work might be neglected and the bridge become dangerous or unsightly, due to lack of proper care.

Following the construction of the Walnut Lane bridge, large concrete bridges and viaducts seemed to spring up all over the continent as well as in other parts of the world. Hardly was this bridge started before the Salt Lake, Los Angeles and San Pedro Railroad began the construction of a reinforced concrete bridge 1,000 feet long over the Santa Ana River at River Side, California.



Black Bay Bridge, Current River, Port Arthur, Ont.

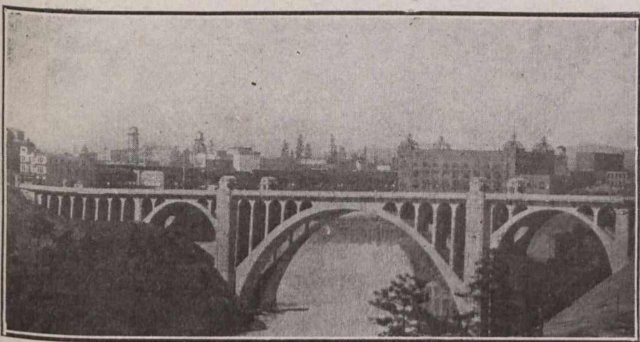
The year 1910 saw the completion of Medina River bridge at San Antonio, Texas; the Almendares bridge at Havana, Cuba; and the Rocky River bridge at Cleveland, Ohio. The last named bridge was the largest of these, having a total length of about 800 feet and a main span



Allentown Viaduct—2,650 ft. long, 140 ft. high.

of 280 feet, 47 feet longer than that of Walnut Lane. This bridge is 100 feet high and contains 26,000 cubic yards of concrete. It was completed at a cost of $208,302.

All kinds and conditions of construction are represented in the later bridges. The Risorgimento bridge at

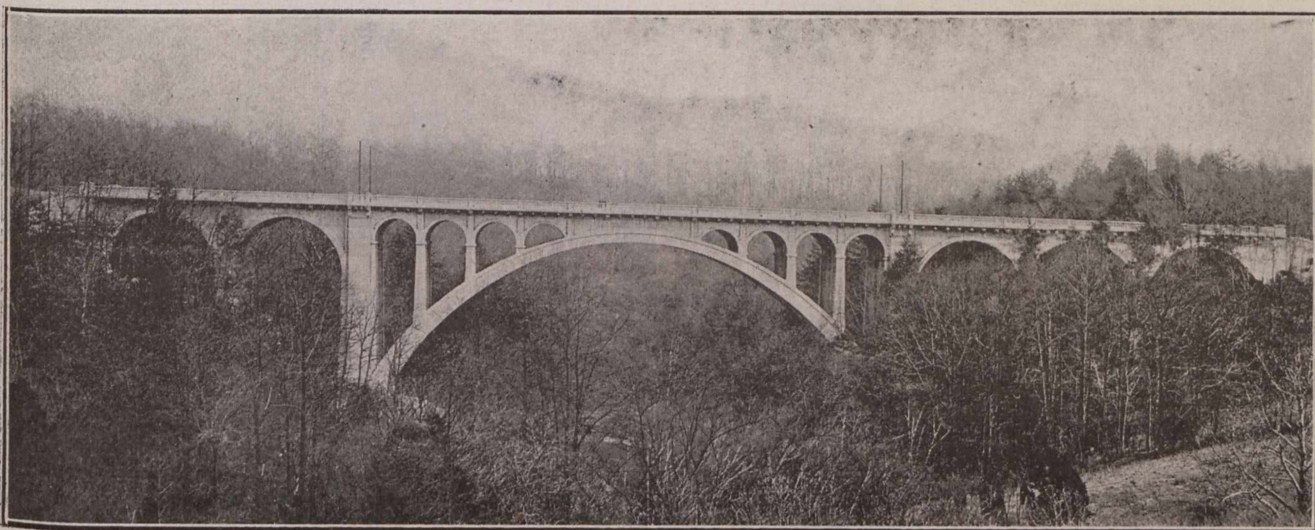


Munro Street Bridge, Spokane, Wash.

Rome, Italy, with a span of 328 feet, is built on a pile foundation, the soil being almost a liquid mud. The Dallas-Oak Cliff viaduct in Texas, the total length of which is 4,778 feet, has 51 arches, almost all of which are founded on piles. Spokane, Wash., subject to great extremes of temperature, boasts two of the larger structures. The first, Monroe Street bridge, has a main arch of 281-foot span and a length over all of 784 feet. The second bridge, completed last year, is 940 feet long.

Quite a few of these bridges are over a thousand feet in length. These are: West 7th Street bridge, Fort Worth, Texas, 1,041 feet; Dan River bridge, Danville, Virginia, 1,064 feet; Martin's Creek viaduct, Kingsley, Pa., 1,200 feet; Connecticut River bridge, Washington, D.C., 1,341 feet; Penn Street bridge, Reading, Pa., 1,350 feet; Delaware River bridge, Yardley, Pa., 1,446 feet; Colorado Street bridge, Pasadena, Cal., 1,470 feet; Catawba River bridge, Charlotte, N.C., 1,670 feet; Main Street viaduct, Fort Worth, Texas, 1,752 feet; King's Highway viaduct, St. Louis, Mo., 1,857 feet; Grand Avenue viaduct, Milwaukee, Wis., 2,088 feet; Tunkhannock Creek viaduct, Nicholson, Pa., 2,230 feet; South Eighth Street viaduct, Allentown, Pa., 2,600 feet; Dallas-Oak Cliff viaduct, Texas, 4,778 feet, and the Galveston, Texas, causeway, 12,642 feet.

More complete details of the most important bridges are given in the table on next page.



Walnut Lane Bridge, Philadelphia.

The Ford Motor Company are looking for an appropriate site for the construction of a large assembling plant at or close to Winnipeg.

The Metal Shingle and Siding Company, with headquarters at Preston, Ont., has decided to establish a branch at Regina, Sask.

For the first three months of the year the British coal and coke shipping trade exceeded 18,234,300 tons, as compared with 18,028,400 tons for the corresponding period of 1913.

It is reported from Sarnia, Ont., that a prominent manufacturing firm in the United States is looking for a good location at Point Edward, on which it intends to build a good-sized plant for the manufacture of a creosote preparation for use on block pavements and railway ties.

Definite word has been given to the Mayor of Medicine Hat, Alta., to the effect that the Maple Leaf Milling Co. of Toronto will commence construction on its plant at Medicine Hat in May; and also the Ontario and Manitoba Milling Company will commence construction on a plant very shortly. The two companies represent an investment of about $2,000,000. This word follows upon the recent statement that the Saskatchewan Bridge and Iron Works will commence its $1,000,000 plant at Medicine Hat within 30 days.

The Asphalt and Supply Company Limited, of Montreal, have moved from the Transportation Building to larger offices in the Board of Trade Building, Suite 303 to 307.

Announcement is made of the 14th annual 6 weeks' summer school of the College of Engineering of the University of Wisconsin, which opens on June 22nd. Courses of instruction and laboratory practice are offered in electrical, hydraulic, steam and gas engineering, mechanical drawing, applied mechanics, testing of materials, machine design, shopwork and surveying, in addition to which, subjects may be taken in the College of Letters and Science.

Gifford-Wood Company, of Hudson, N.Y., are celebrating the 100th anniversary of the founding of their business. In 1814 Elihu Gifford, grandfather of the present general manager of the company, founded the business at Hudson. In 1905 the business founded by the Gifford family was amalgamated with the firm of William T. Wood and Company, of Arlington, Mass. The Wood firm also dates back to the very early part of the 19th century. In commemoration of the 100th anniversary, the firm has issued a handsome souvenir booklet, giving photographs of the works; of the executive staff; and of the ice-handling machinery, ice tools, coal-handling machinery, elevators and conveyers, and other equipment which they manufacture.

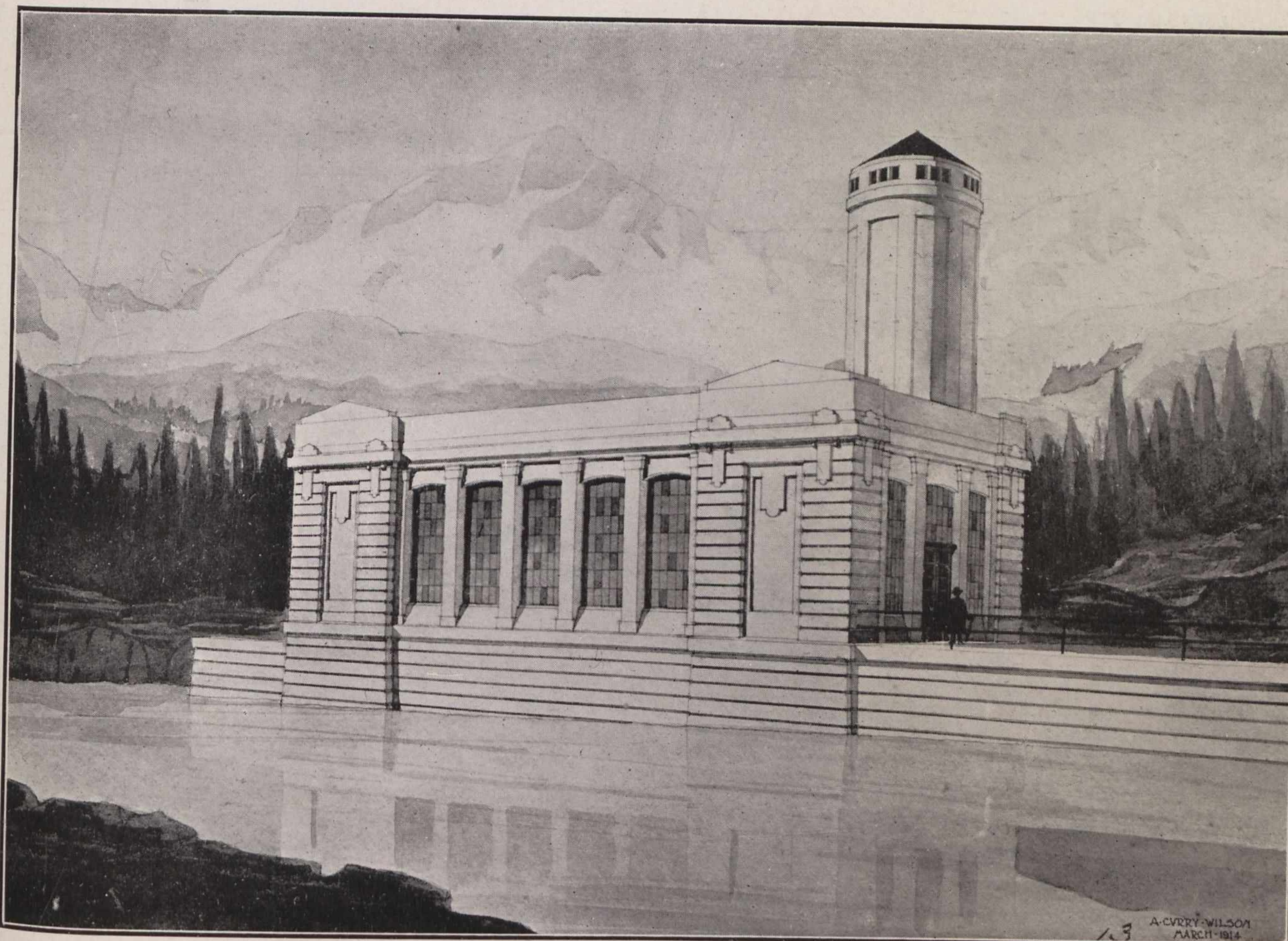
DETAILS OF SOME LARGE CONCRETE BRIDGES

Location	Name	Length	Width	Height	Number of Arches	Longest Spans	Cost	Cu. Yds. Concrete	Tons Reinforcing Steel	Year Completed	Designing Engineers	Contractors
Spokane, Wash. ..	Monroe Street	784	68	130	3	281	$ 487,000	25,000	.....	1912	C. McIntyre, City Engr.	Day labor.
St. Louis, Mo. ...	King's Highway Viaduct	1,857	90	..	15	170	387,000	26,010	1,500	1912	A. C. Janni, City Engr.	Wm. P. Carmichael Co.
Rome, Italy	Risorgimento	...	65½	51	1	328	235,000	......	.....	1911	La Societa Porcheddu.	Porcheddu & Bentivegna.
Dallas-Oak Cliff, Tex.	Viaduct	4,778	53	60	51	79.5	570,000	......	.....	1912	J. G. Hedrick. L. R. Ash, Kansas City.	Corrigan, Lee & Halpin, Kansas City.
Fitchburg, Mass. ..	5th Street	651	40	..	6	200	....	5,000	420	1913	J. H. Fuertes, New York.	McHarg Barton Co., N.Y.
Reading, Pa.	Penn Street	1,350	80	43	14	5-110	....	......	.....	....	B. H. Davis, New York.	L. H. Focht, Reading, Pa.
Pasadena, Cal.	Colorado Street	1,470	38	175	9	223	188,000	11,000	600	Erecting	Waddell & Harrington, Kansas City.	Mercereau Bridge Cons. Co., Los Angeles.
Des Moines, Ia. ...	Walnut Street	503	84½	..	6	75	167,661	10,897	316	1911	City Engr. Dept.	John Wheeler Cons. Co., Geneva, Ill.
Riverside,[1] Cal. ...	Santa Ana Bridge ..	1,000	..	60	10	100	1,000,000	12,500	None	1909	B. H. Davis, New York.	McArthur Bros. Co., N.Y.
Allentown,[2] Pa. ...	S. 8th Street	2,600	46	125	9	120	306,000	......	.....	....	Wm. Hunter and W. S. Maloney.	Talbot Cons. Co., N.Y.
Yardley,[3] Pa.	Delaware River	1,446	66	70	14	91	....	34,670	263	....		
Spokane, Wash. ..	Latah Creek	940	59	139	7	150	416,000	......	.....	1913	Waddell & Harrington.	J. E. Cunningham.
Danville, Va.	Dan River	1,064	23	..	13	158' 7"	39,410	2,804	148	1911	W. J. Watson & Co.	Thomas Sheehan.
Pittsburg, Pa.	Atherton Ave.	377	53	50	3	98	95,000	8,000	175	1913	Pittsburg Engr. Dept.	Crawford Cons. Co.
Charlotte, N.C. ...	Catawba River	1,670	..	..	5[4]	161	70,000	......	.....	1912	W. J. Watson & Co.	C. W. Reynarth Co.
White Plains, N.Y..	Rye Outlet	924	25	100	5	129	....	......	.....	1911	N.Y. City Engr. Dept.	H. S. Kerbaugh, Inc., Phil.
Havana, Cuba	Alemendares	711	34	48	3	190	217,751	12,820	195	1910	Barclay Parsons & Klapp	Barclay Parsons & Klapp.
Ashville, N.C.	French Broad River.	932	30	50	2	145	70,000	......	.....	1911	R. P. Johnston, Ashville.	Clark & Co., Baltimore.
Fulton, N.Y.	Broadway	700	48	..	5	145	....	......	.....	1913	Concrete Steel Engr. Co., N.Y.	Day labor.
Cleveland, Ohio ..	Rocky River	800	56	100	3	280	208,302	26,000	.....	1910	A. B. Lea, A. M. Felgate.	Schillenger Co., Toledo.
Philadelphia, Pa. ..	Walnut Lane	585	56	150	6	233	262,000	......	.....	1908	H. H. Quimbly, Phila.	Reilly & Riddle.
Galveston,[5] Tex. ..	Causeway	12,642	66	12	28	70	1,625,000	74,000	2,620	1912	Concrete Steel Eng. Co., N.Y.	A. M. Blodgett Cons. Co., Kansas City, Mo.
Port Arthur, Ont. .	Current River	212	26	33	1	130	15,484	......	.....	1911	City Engr. Dept.	Seaman & Penniman, Ft. William, Ont.
Pittsburg, Pa.	Larimer Ave.	670	50	110	8	312	170,000	9,471	446	1912	Pittsburg Engr. Dept.	J. F. Case Co., Pittsburg.
Nicholson,[6] Pa. ..	Tunkhannock Viaduct	2,230	34	240	10	180	....	164,000	1,140	Erecting	D. L. & W. R. R	Fleckiver & Bush, N. Y.
Kingsley,[6] Pa.	Martins Creek Viaduct	1,200	34	150	9	150	....	......	.....	....	J. G. Wray, Chief Engr., Hoboken, N.Y	....
Fort Worth, Tex. ..	Main St. Viaduct ..	1,752	70	..	4	225	373,952	......	.....	Erecting	Brenneke & Fay, St. Louis.	Hannan, Hickey Bros. Cons. Co., St. Louis.
" " " ..	West 7th St.	1,041	..	..	..	...	....	......	.....	..	....	....
" " " ..	Samuels Ave.	438	..	..	..	...	650,000	......	.....	Erecting	....	....
" " " ..	E. 4th St.	438	..	..	..	...	....	......	.....	....	....	....
San Antonio, Tex. .	Medina River	330	..	65	3	110	25,000	......	53	1910	Tarrant Cons. Co., Forth Worth.	....
Milwaukee, Wis. ..	Grand Avenue Viaduct	2,088	67	80	10	145	550,000	45,000	270	1911	Concrete Steel Engr Co., N.Y.	National Engr. & Cons. Co., Milwaukee.
Washington, D.C. .	Connecticut R. Bridge	1,341	52	120	7	150	850,000	......	None	1907	Geo. S. Morrison.	....
Bern, Switz.	Halen	787	33	131	5[4]	286	100,000	9,020	121	1913	J. Bollinger, Favre & Co., Zurich, Sw.	Müller, Zerrleder & Gobat, Bern, Switz.

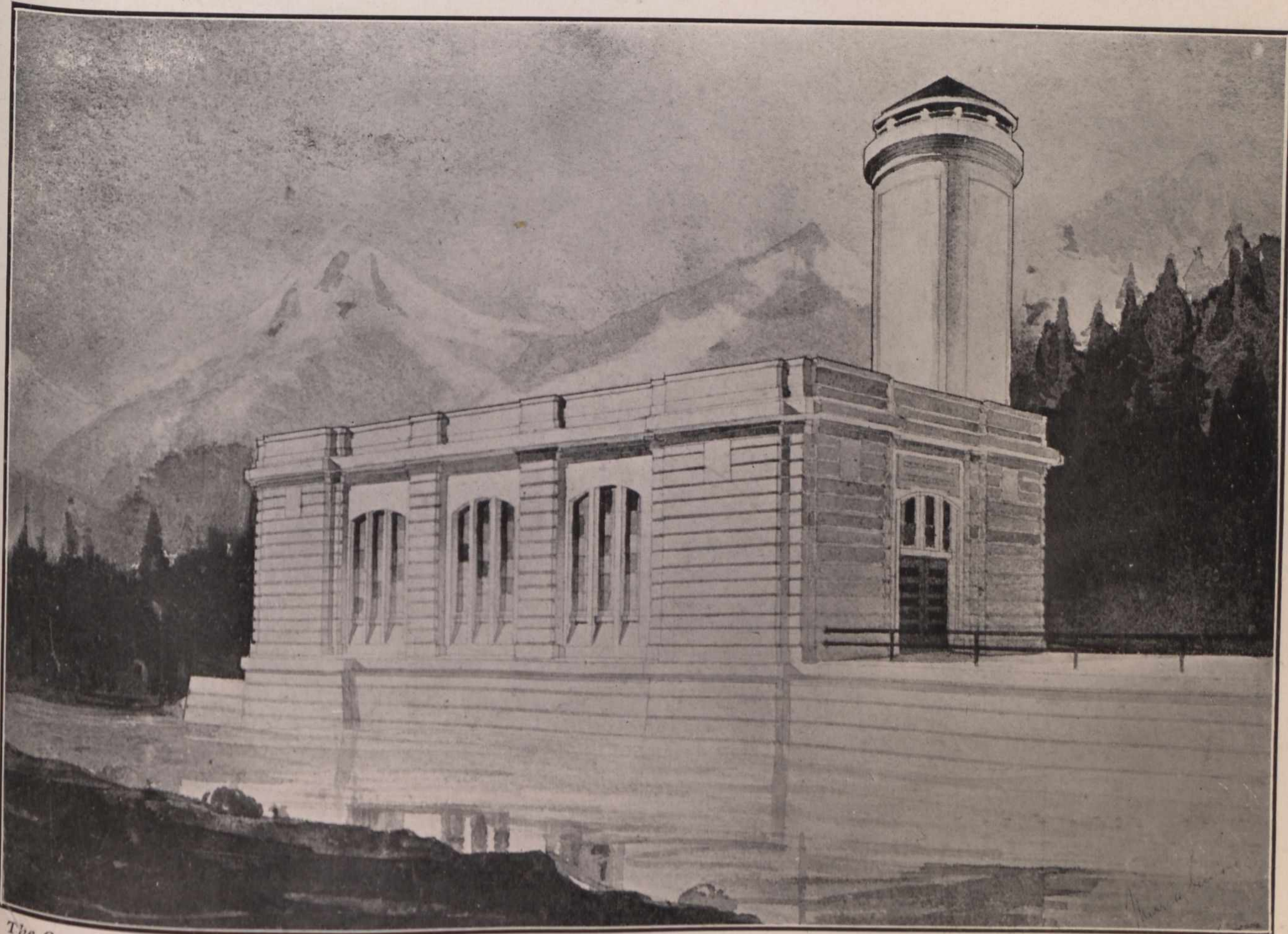
1. Salt Lake, Los Angeles and San Pedro Railroad.
2. 8% Grade.
3. Philadelphia & Reading Railway.
4. Also several girder spans.
5. Railroad, Trolley & Highway.
6. Delaware, Lackawanna & Western Railroad

STUDIES IN POWER STATION ARCHITECTURE

Some competitive designs executed in the Department of Architecture, University of Toronto.



Designed by A. CURRY WILSON.



Designed by MERRILL DENISON.

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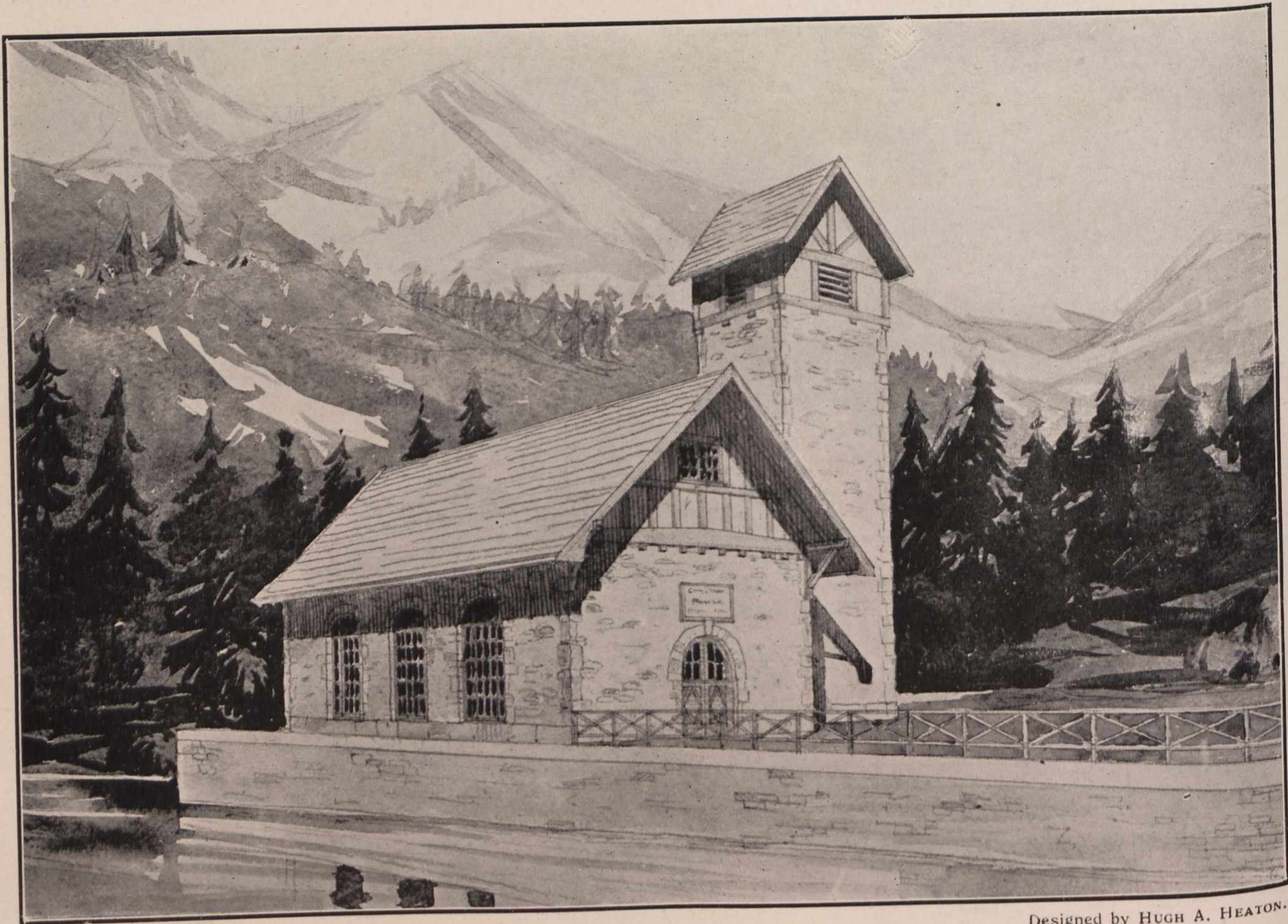
Designed by J. LESTER HUSBAND.



Designed by HUGH A. HEATON.

The Canadian Engineer

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CONTENTS OF THIS ISSUE.

ARCHITECTURE IN ENGINEERING WORK.

During the last few years considerable attention has been paid to the aesthetic appearance of the engineer's work, especially in the larger undertakings. Much, however, might be accomplished to render the engineer's solution of the smaller problems not only economical and useful, but pleasing features of the landscape.

Mr. C. H. Mitchell, Consulting Engineer for the Dominion Water Power Branch, in designing a small power station to be situated near Banff in the Rocky Mountain Park, offered prizes to the students in the Department of Architecture of the University of Toronto for suggestions of an architectural treatment. There were fifteen designs submitted by the students, all of which have considerable merit and offer valuable suggestions to the engineer in his study of similar problems. The students of the University were all intensely interested in the solution of this problem, and the staff in charge have expressed themselves as feeling greatly indebted to Mr. Mitchell, and also to the Commissioner of Dominion Parks, Mr. Harkin, and to Mr. Challies, both of whom not only gave their consent, but were kind enough to loan photographs of the surroundings of the intended station.

The award of the competition was as follows:
First prize—A. C. Wilson.
Second prize—M. Denison.
Third prize—L. Husband.
Mention—H. Heaton and H. R. Watson.

It is perhaps needless to inquire if our readers concur in the opinion that certainly all those power stations erected for the public, especially those located near any tourist centre, should have some such local feeling and architectural character as represented by the illustrations appearing in this issue. The local governments, as well as the federal, could do much to educate and refine their citizens if more attention were paid to these matters.

THE GOOD ROADS CONGRESS IN MONTREAL.

The provisional programme of the Canadian and International Good Roads Congress to be held in Montreal during the week of May 18th, has just been issued. The following speakers, together with their subjects, are among those who will take part in the proceedings:

W. H. Connell, Chief of Bureau, Department of Public Works, Philadelphia, Pa.—"Important Considerations Entering Into the Selection of Pavements for Roads and Streets."

R. W. Brock, Deputy Minister of Mines, Dominion Government, Ottawa, Ont.—"Road Materials and Their Use."

Arthur H. Blanchard, Professor, Highway Engineering, Columbia University, New York—"Modern Bituminous Surfaces and Bituminous Pavements."

W. A. McLean, M.Can.Soc.C.E., Provincial Highway Engineer, Department of Public Works, Province of Ontario, Toronto, Ont.—"Highway Legislation."

A. T. Laing, Lecturer, Highway Engineering, University of Toronto,—"Technical Training of Highway Engineers."

Archibald Curry, C.E., City Engineer, Ottawa, Ont. —"Macadam Roads With Bituminous Tops."

E. A. James, B.A.Sc., Consulting Engineer, York County Highway Commission, Toronto, Ont.—"Maintaining Macadam Roads."

T. Hugh Boorman, Treasurer, The American Society of Engineering Contractors, New York City—"Modern Road Construction in the United States and England."

Hyndman Irwin, B.A.Sc., Editor, *The Canadian Engineer*, Toronto, Ont.—"The Relation of the Technical Press to the Good Roads Movement."

Paul D. Sargent, M.Am.Soc.C.E., Chief Engineer, State Highway Commissioner of Maine, Augusta, Me.—"Development of the State Highway System in Maine."

B. Michaud, Deputy Minister of Roads, Province of Quebec, Quebec City—"Highway System of the Province of Quebec."

Lieut.-Col. W. N. Ponton, Hon. President, The Ontario Associated Board of Trade, Belleville, Ont.—"Good Roads as a Factor in the Progress of Cities and Towns."

Dr. E. M. Desaulniers, Chambly County, M.L.A., St. Lambert, P.Q.—"Road Legislation of the Province of Quebec, Compared With Other Provinces."

Major W. W. Crosby, Consulting Engineer, State Highway Commission, Baltimore, Maryland; R. A. Meeker, Engineer, Department of Public Works, New Jersey; Jean de Pulligny, Chief Engineer, Bridges and Roads, and Director of the "Mission Francoise d'Ingenieurs aux Etats-Unis," and others, have also signified their intention of being present and of reading papers.

Among the exhibits will be that of the Department of Public Works of the Ontario Government consisting of a series of minature models showing the development of road building from the early Roman roads to the types in use at the present time.

LETTER TO THE EDITOR.

North Toronto Sewerage System.

Sir,—With reference to the article appearing in the Toronto Evening Telegram of April 28, 1914, giving some opinions of Mr. T. Aird Murray on the North Toronto sewerage system, I would like, as a civil engineer, to draw your attention to a statement made in one of the closing paragraphs.

Mr. Murray refers to the city engineering officials as being "wedded to the old-fashioned combined sewerage system, . . ." I beg to take objection to the use of the term "old-fashioned."

It is an idle question to ask whether the separate system is superior to the combined system. Under certain conditions the latter may be better, for others the former may be more suitable. More correctly speaking, all depends on the local condition, especially on the condition of the flowing river into which the effluent is led and on the method of purification adopted. Since both systems are nearly equal as far as traffic and public health is concerned, the question of cost only is decisive with respect to which is to be preferred in the locality under consideration.

As to the separate sewerage system, the public sewers can be easily adapted to the fluctuations of flow. They consequently can be designed with small cross-sections in which the velocity and cleansing action are relatively large and uniform. The cross-sections are usually calculated for maximum capacity running full. The filling up of the half section will then probably be obtained daily for some time. Deposits of putrescible matter seldom occur and these can be easily removed by regular flushing which, owing to the small cross-section, requires only a small amount of water. The formation of gas is very slight. In consequence of the frequent filling of the sewer an ample circulation takes place.

The storm sewers are carried on the shortest route to the nearest river or flowing water. By avoiding all long routes better grades and correspondingly smaller cross-sections are obtained. At the same time, the rain water pipes can be laid at smaller depths as they have not to drain deep cellars.

For the separate system the surface water is carried off either completely or partially. The saving is important by the omission of storm sewers. As soon as nuisances are caused to the traffic by the superficial removal of the rain water, or nuisances of any other kind are created, a new layout of a storm sewerage system can always be effected.

The separate system is always an advantage if the stream into which the effluent is to be discharged can be reached by means of short sewers, while the combined flow, on the contrary, has to be conveyed for a long distance on a flat grade. The route of transportation of the large quantities of storm water is, in this case, shorter with the separate system. The long sanitary sewers having only small cross-sections, thus the cost of removal per unit of quantity of sewage (storm and sanitary flow) is less than the removal in a common conduit.

Likewise, the separate system is preferable if the sewage has to be pumped to a higher elevation while the storm water runs off by gravity on a natural grade. A further advantage is that the house connections in the separate system for the conveyance of the sanitary flow are not liable to be backed up by heavy showers in the sewers which may be of value in flat districts.

In the case where the storm sewers cannot be carried to rivers closely located, the twin sewers of the separate system are always more expensive than the simple combined system, and the latter is to be preferred.

A great factor in favor of the separate system is indeed the easier purification of the sewage in consequence of the more uniform condition.

However, it is often necessary to lay out a complete scheme on the separate and on the combined system in order to compare the two. Here it is necessary to bear in mind that the house connections of the separate system cost twice as much as those of the combined, apart from the fact that the construction requires more careful attention necessary to prevent the storm water finding its way into the sanitary sewers.

From what I have said and in spite of the undeniable advantages of the separate system, there is no reason to call, as an adherent of one system, the other old-fashioned. Such a behavior shows narrow-mindedness and deserves no consideration. The cost of the sewerage system, the method of purification to be adopted, and the condition of the flowing stream are the only decisive momenti.

Therefore, if a combined system is installed, the objectors can only conclude that one has considered more the experience and ability of an engineering expert than the inciting myopia of would-be engineers.

ERWIN KOHLMANN,
Dr.-Ing., Dipl.-Ing.

Toronto, April 29, 1914.

[NOTE—The foregoing letter refers to an extensive sewage project recently recommended by Mr. R. C.

Harris, Commissioner of Works, Toronto, for that section of the city formerly known as the town of North Toronto. The scheme calls for a combined system, the estimated ultimate cost being $4,144,256. The improvement divides the district into two sections at Eglinton Avenue. In the section north of Eglinton Avenue it is proposed to construct lateral sewers to cost $422,000 and thirteen trunk sewers to cost $584,644. Two storm outlet sewers are provided, the cost of which is estimated at $366,275. The sewage disposal plant for this district will cost $305,900 and consist of a stand-by tank for the treatment of storm water, detritus tanks, Imhoff tanks, chlorinating devices, sludge-drying beds and sprinkling filters.

The sewage disposal plant in Section 2, will be similar to the above, but of larger capacity, and will cost approximately $400,000. The work in this section involves the construction of lateral sewers estimated to cost $390,000 and seven trunk sewers costing $648,000. Two storm outlet sewers will cost about $360,000, while a dry-weather-flow sewer to the disposal works is also proposed. It should be stated that the estimate of each disposal plant includes a site for future development and that each trunk sewer will have a superficial area exceeding four square feet.

In the interview to which Mr. Kohlmann refers, Mr. Murray, who designed the present system of sewage in North Toronto, criticises the expenditure of $4,000,000 on the proposed combined system. The present system was designed on the separate plan, to take domestic sewage only with a small proportion of roof water where necessary, but no surface water. Mr. Murray contends that the separate system is the only suitable one for the district, claiming that the purification point of view is one of the chief considerations relative to its sewage system as the practice of discharging sewage into the Don River must be continued for some time. In pronouncing the separate system of sewage as the ideal one for a suburban district such as North Toronto, which will probably be free from manufacturing industries, Mr. Murray alludes to the excessive cost of the project as outlined above and refers, as Mr. Kohlmann states, to the city engineering officials as being wedded to the old-fashioned combined sewage system. Hence Mr. Kohlmann's criticism.—Editor.]

A NEW STEEL SHEET PILING SECTION.

A new form of Lackawanna steel sheet piling section is now being rolled for use in 90-degree corners of rectangular cofferdams or retaining walls, either with the hook or guard on the outside. These rolled corners overcome the necessity of using specially fabricated and less easily driven corners. Moreover, they weigh less per lineal foot than the fabricated corners, and can be used wherever the conditions of load are not excessive. With the flexibility characteristic of this make of joint the two new corners will meet most requirements.

The Port Arthur city council has been approached by J. Stewart of Chicago with a request for a favorable consideration of a proposal for the location of a coal gas plant at Port Arthur. The matter is being considered by the industrial committee of the council.

It has been reported that the Standard Oil Company has entered into an agreement with the Chinese government, or with Yuan Shih-Kai, the dictator president, for the control of the extensive oil fields of northern Shensi. The amount paid by the company for this concession is not known.

SEWAGE POLLUTION OF BOUNDARY WATERS.

THE investigation into the pollution by sewage of the boundary waters between Canada and the United States has received frequent mention in *The Canadian Engineer*. The whole subject is being well summed up by Dr. Allan J. McLaughlin, chief sanitary expert and director of field work for the International Joint Commission, in a paper to be read next week at the convention of the American Water Works Association, and published in the Journal of the Association for March, 1914. In December, 1910, Dr. McLaughlin was directed to investigate the sewage pollution of interstate and international waters with special reference to the spread of typhoid fever. In 1911 he completed a sanitary survey of the entire watershed of the Great Lakes on the United States side of the boundary. Briefly the conditions found were as follows:—

An excessive prevalence of typhoid fever, especially in the winter and spring months, punctuated at intervals by explosive epidemics. This excessive prevalence of typhoid fever especially in the winter and spring months was due in greatest measure to the unrestricted discharge of sewage into interstate and international waters used as sources of public water supplies. Disaster followed the use of this sewage polluted water for one of two reasons, either a failure to purify or the inefficiency of the attempted purification.

The delusion that water from the Great Lakes or their connecting rivers needs no purification has been cherished for years in our cities and even with our disgraceful record of waterborne typhoid and the lessons of numerous disastrous epidemics, it is still no easy task to convince municipal officials that purification of these waters is necessary.

The remedies suggested by the writer at that time were:—

1. Safe water supplies, that is, water shown to be safe by daily bacteriologic examination.

2. Supervision and control of water supplies by the state to ensure efficiency and a safe effluent at all times.

3. Control of sewage discharge within permissible limits to prevent an unreasonable burden or responsibility upon filter plants.

4. Prevention of pollution from vessels.

In order to secure efficient and uniform results from the application of these remedies, he recommended that two sets of standards for water be formulated.

1. Standards for filtered or treated water.

2. Standards for raw water at the intakes.

In accordance with this recommendation in January, 1913, the U.S. Surgeon-General appointed a commission for the determination of a standard of purity for drinking water, and the report of that commission will soon be published. This report will furnish a minimum standard to which all common carriers, trains and vessels must conform to prevent the spread of disease in interstate traffic. This furnishes the first standard recommended. The fixing of the second standard or standard for raw water at the waterworks intakes is a much more complex problem. However, great strides have been made in this direction also.

A committee of the national association for the prevention of pollution of rivers and waterways, made up of Geo. C. Whipple, Edward Bartow, Geo. M. Wisner, H. W. Clark, and Dr. McLaughlin, studied the problem of standards in a general way and agreed upon certain fundamental principles which made a very good starting point for more intensive studies. This brings us to the work of the International Joint Commission.

The term Commission is misleading, as this body is in reality a tribunal formed under the treaty of January 11, 1909, between Great Britain and the United States to prevent disputes regarding the use of the boundary waters and to settle questions now pending or which may arise hereafter between the United States and Canada, involving the rights, obligations or interests of either in relation to the other or the inhabitants of the other along their common frontier. In addition to their judicial powers the Commission, under Article IX. of the treaty, is empowered to investigate and report upon such questions as may be referred to it by the two governments. It is provided that such reports under Article IX. shall not be regarded as decisions of the questions and shall in no way have the character of an arbitral award under this investigative function.

The question of pollution of boundary waters was referred to the Commission by the two governments. The reference was in two sections, the first dealing with the location, origin and extent of pollution and the second dealing with remedies. The text of the reference was as follows:—

1. To what extent and by what causes and in what localities have the boundary waters between the United States and Canada been polluted so as to be injurious to the public health and unfit for domestic or other uses?

2. In what way or manner, whether by the construction and operation of suitable drainage canals or plants at convenient points or otherwise, is it possible and advisable to remedy or prevent the pollution of these waters, and by what means or arrangement can the proper construction or operation of remedial or preventive works, or a system or method of rendering these waters sanitary and suitable for domestic and other uses, be best secured and maintained in order to insure the adequate protection and development of all interests involved on both sides of the boundary, and to fulfil the obligations undertaken in Article IV. of the waterways treaty of January 11, 1909, between the United States and Great Britain, in which it is agreed that the waters therein defined as boundary waters and waters flowing across the boundary shall not be polluted on either side to the injury of health or property on the other?

The Commission took up first the question of location, origin and extent of pollution. At the Detroit session February 20, 1913, Dr. McLaughlin was placed in charge of the investigation as chief sanitary expert and director of field work. Associated with him on the Canadian side were Dr. John W. S. McCullough, Chief Health Officer of Ontario, and Dr. John A. Amyot, Professor of Hygiene, University of Toronto. Canadian laboratories were established at Fort Frances, Port Arthur, Sault Ste. Marie, Sarnia, Windsor, Amherstburg, Port Stanley, Fort Erie, Niagara-on-the-Lake and Kingston, Ontario, and Montreal. American laboratories were established at Port Huron, Michigan, Detroit, Michigan; on U.S. Revenue Cutter "Morrill"; Buffalo, New York; Youngstown, New York; Clayton, New York; and Van Buren, Maine.

In the interest of economy and efficiency it was deemed wise to utilize such established governmental agencies as might be available for the field investigation. Accordingly the co-operation of the United States Public Health Service, the Provincial Boards of Health of Ontario and Quebec, the State Board of Health of Michigan, and the Department of Health of the State of New York was secured and was of very great value to the Commission in carrying out the work.

The work extended from the Lake of the Woods through the entire chain of the Great Lakes and St. Lawrence River to the St. Johns River on the Maine—New Brunswick border. Field work began in April and terminated November 1. There were over 1,400 sampling points and over 19,000 samples taken and examined bacteriologically. The report presents as indices of pollution the average number of the colon bacillus per 100 cc. of water and the number of bacteria per cubic centimeter of water. The results of the investigation are shown by averages in concise form for each sampling point and cross-section by tables and colored maps. In addition, diagrammatic representation is employed to show the degree of intensity of the area of pollution in each section of the boundary waters. In certain localities on the Great Lakes and in all their connecting waters dangerous sewage pollution was shown to exist, but the bulk of the Great Lakes waters remains in its pristine purity. The investigation shows that the colon bacillus is practically never present in unpolluted waters, and that the normal bacterial content of Great Lakes water is less than 10 per cubic centimeter. Great Lakes water is classified tentatively into five classes in this report, from the relatively pure water through slight, moderate, serious to gross pollution. The sources of pollution in the order of their importance are sewage from cities, sewage from vessels navigating these boundary waters, and the inevitable pollution following rains and thaws. The distance pollution may travel in the Lakes was demonstrated also. At the mouth of the Detroit River and at the mouth of the Niagara River serious pollution extends normally more than 10 miles into the lakes and on occasion was found 16 to 18 miles from shore. The distances from the cities of pure water in the lakes, the enormous cost of long pipe lines, coupled with the engineering difficulties in placing intakes beyond a 70-foot depth, make it impracticable in most instances to secure pure water from the lakes without treatment. The present position of intakes is such that there is not a single municipality using lake water which can be said to possess a safe water supply without treatment.

As might be expected, the areas most grossly polluted are in the connecting rivers upon which large cities are situated. The pollution from vessels renders the St. Mary's River above the cities of Sault Ste. Marie unfit as a source of water supply without treatment, and vessel pollution combined with the sewage from the cities of Sault Ste. Marie cause gross pollution of the St. Mary's River from the Sault to Neebish Island.

Because of sewage pollution there is no point in the St. Clair River from which a safe water supply could be secured without treatment.

The Detroit River is polluted from Lake St. Clair to Sandwich sufficiently to make the water an unsafe source of water supply. From below Sandwich to its mouth the Detroit River is grossly polluted from shore to shore.

Gross pollution in the Niagara River extends along the American shore from Buffalo to Strawberry Island, throughout the entire Tonawanda Channel, and below the Falls gross pollution extends from shore to shore throughout the entire river and for miles out in Lake Ontario.

Investigation of the St. Lawrence River (Lake of the Thousand Islands) was made at two distinct seasons. The results obtained in April showed a slight degree of pollution. The results obtained in August showed a greatly increased pollution obviously due to the increase in summer resort population and to the sewage discharge from vessels.

The report of the field work gives an accurate survey of the origin, location and extent of pollution and completes the first half of the reference. The Commission is about to take up the second half of the reference which relates to remedies for pollution.

Dr. McLaughlin's suggestion to the Commission in regard to proceeding with the second part of the reference consisted of three steps:

1. Secure the opinions of the most eminent sanitary engineers by submitting a list of questions. These opinions would form a sound basis for formulating a general policy and possibly some general minimum requirement.

2. Public hearings at which the municipalities could present their cases including expert engineering testimony, plans and projects.

3. Employment of expert sanitary engineers for the formulation of special standards for each waterway in excess of general minimum requirements depending upon local conditions and necessities.

It is probable that the Commission will proceed somewhat according to this outline. In so doing and in carrying out the third step formulation of special standards, we will realize the second of the essentials which are necessary for the protection of the public health, viz.: A standard for the raw water at the intakes.

The standard for raw water at the intakes in each locality seems to be the only means by which an equitable adjustment can be secured between the two agencies in producing safe water, viz.: water purification and sewage treatment.

In concluding his paper, Dr. McLaughlin strongly accentuates to the American Water Works Association the necessity for safe water supplies and he enumerates several cardinal necessities to be observed in the purveying of water to the public.

There has been entirely too much confidence in untreated surface supplies. A surface supply from an inhabited watershed is rarely safe without treatment and can only be said to be safe when daily bacteriologic examination shows it to be free from pathogenic or intestinal germs. To ensure safe water bacteriologic control is just as much a necessity for water purification plants as for untreated supplies. With a polluted source the mere installation of a purification plant does not guarantee safe water. Even if perfect in design and construction unless efficiently operated and controlled a safe effluent need not be expected. Reference was made to filter plants designed by very capable engineers—perfect mechanisms which if properly operated would produce safe water—placed in the hands of an assassin who was a promoted stoker and absolutely ignorant of bacteriology or chemistry.

Another point brought out referred to the adjustment of the balance between water purification and sewage treatment. He has seen very good filter plants struggling with a raw water which imposed an unreasonable responsibility upon the plant. A safe effluent under such conditions was secured at the price of eternal vigilance. filter plants are not infallible and their operators, even when skilled, are only human. Dr. McLaughlin believed a decent raw water should be made available for all plants and where necessary treatment of sewage should be carried at least far enough to secure this result.

The greatest obstacle to proper operation and control of plants has been the difficulty of securing the right man to place in charge of the plant. The best type of man for this position is a graduate in sanitary engineering. He will not only be conversant with the mechanical details of the plant, but will be able to adjust his chemicals according to the constituents and needs of the raw water. Most important of all, he will be able to make daily bacteriological examinations to determine the efficiency of purification. Nearly all the disasters due to sewage-polluted water supplies which have occurred were due to lack of daily bacteriological knowledge of the public supply or the inefficient operation of plants by unskilled men. The employment of such a graduate is economy even in small cities. There may be cases, however, where it is impossible, for economic reasons, to pay the necessary salary. In these cases local men must be employed, and trained to do the work. Here the Board of Health will find a very useful function. The State authorities could supervise the installation of a small, inexpensive laboratory equipment in small plants and give instruction to the local man in making the necessary water examinations. Whenever possible, however, young graduates of sanitary engineering schools should be employed; and such men are well worth their salary, considering the saving in the economical adjustment of chemicals and fuel costs made possible by intelligent supervision. The greatest asset, however, to be credited to skilled operation is the saving of human life effected and the satisfaction of knowing that safe water is being furnished every day.

The Mississippi River Commission, which met at St. Louis, Mo., on April 15, agreed to recommend that Congress appropriate $12,000,000 for the improvement of the river next year.

Approximately 500 mineral claims have been staked at Beaver Lake and registered at the Dominion land office at Prince Albert, Sask., since the rush to the goldfields commenced a few months ago, and 350 powers of attorney have been taken out.

At a general meeting of the Standard Oil Company of Canada, held on April 16, in London, Eng., resolutions were agreed to for the reconstruction of the company and the registration of a new company under the name of the Coatsworth Natural Gas Company, Limited. The capital of the new company will be £35,000.

The Commission of Conservation at Ottawa, acting in co-operation with the provincial governments, has been making an extensive investigation into the water-powers of the western provinces. Field parties have covered practically all the territory in these provinces, particularly in British Columbia, and a report will be issued shortly, giving full data, including the results of systematic stream measurements. The information respecting the water-powers in the eastern provinces was published in a report by the commission two years ago.

The following items of expenditure were given in the summary of capital expenditure published in the report for 1913 for the corporation of the city of Vancouver, B.C.:—

General Funds:—	
Street and lane improvements	$582,322.86
Sewers	540,107.16
Bridges	217,674.96
Rock crusher and bunkers	10,167.15
Waterworks	678,416.40
C.P.R. subway	21,728.33
Local Improvements:—	
Cement walks and curbs	138,132.99
Pavements	657,838.20
Street widening	427,940.64
Opening lanes	17,899.13
Ornamental street lighting	38,608.21
Macadam roadways	832.85
Wooden curb	92.70
Re-surfacing	1,567.45
Street and lane extensions	38.40

THE USE OF ELECTRICITY IN THE STEEL HARDENING ROOM.

By R. H. Cunningham, B.A.Sc.,
General Manager, Canadian Hoskins, Limited,
Walkerville, Ont.

IN April 16th, 1914, issue of *The Canadian Engineer* the writer attempted to present in a general way the heat treatment operation of steel known as the process of hardening, and to explain its effect in relation to the varying composition which the material may have. The article referred to the critical temperatures which were associated with steels of different carbon content, and touched upon the theory governing the peculiar phenomena and characteristics one found in connection with the process. The necessity of accuracy for good results in the hardening of carbon steel was emphasized, and it is the purpose of this article to describe a practical means of determining the correct temperatures upon which these good results depend.

The necessary apparatus for the process which the writer has in mind consists of a small electric furnace in which to heat a specimen of the steel to be tested, a special thermo-couple pyrometer for indicating the temperature of this specimen throughout its range of heating, and a specimen itself, properly shaped for clamping to the thermo-couple. The apparatus for this purpose, as shown in Fig. 1, illustrating what is known as the Hoskins' recalescent outfit has a crucible chamber 2 1/16 in. in diameter and 2½ inches deep. Heat is produced by means of the resistance offered to the passage of an electric current through the "resistor" or heating element. This "resistor" is of a special metal in the form of wire which is wound in close contact with the chamber

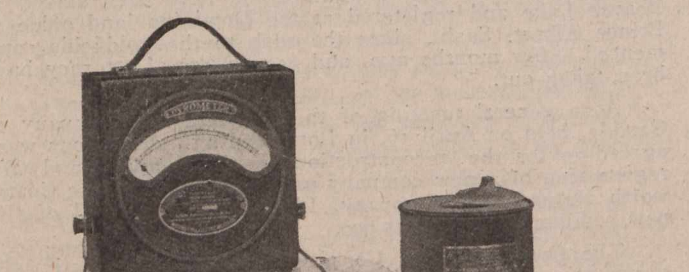


Fig. 1.—Recalescent Outfit. Note the two test specimens of steel, one fastened to couple.

lining. The furnace is designed so that it can be used on standard lighting circuits to which ready connection is made by means of a twin-conductor cord and lamp plug. In operation, it consumes 3½ amperes at 110 volts and is capable of producing a chamber temperature of 1,000° C. (1,832° F.) which is considerably higher than any required by a carbon steel.

The pyrometer of the outfit is of the thermo-electric type. This instrument embraces a thermo-couple, connecting leads and indicating meter. The thermo-couple is of small wire so as to respond quickly to any slight variation in temperature. The welded end of this couple is slightly flattened to enable the making of a good contact between it and the specimen of steel. The meter is portable and indicates temperatures up to 1,400° C. (2,552° F.).

The specimens of the steel to be tested should be small so as to heat quickly and uniformly. A well-formed specimen is made with two duplicate parts, each 1¼ inches long by ½ inch wide by ¼ inch thick. These pieces are clamped, by means of two ⅛ inch bolts, one on either side of the welded part or extreme end of the thermo-couple. Care is taken to form a tight contact,

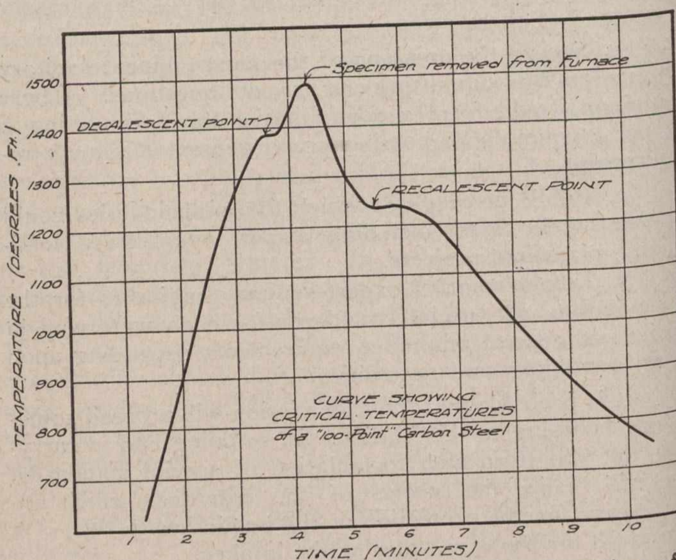


Fig. 2.—Heating-cooling Curve, Showing Location of "Critical Temperatures."

though not to cause an undue strain on the couple. The dimensions here given for the test specimen are not essential, though convenient; any pieces which will permit of tight contact with the thermo-couple and of ready heating in the furnace chamber, may be used.

Method.—With the specimen fastened to the couple, as just described, the furnace is connected in circuit and the cover placed over the chamber opening. The temperature within the chamber rises steadily. When it becomes 925° C. (1,700° F.) the end of the couple, with specimen attached, is inserted in the chamber.

The steel specimen rapidly heats up, its temperatures being constantly the same as that of the welded junction of the thermo-couple, due to the intimate contact between them. This temperature, indicated by the meter, will rise uniformly until the "decalescent" point of the steel which is being tested is reached. At this temperature the indicating needle of the meter becomes stationary, the added heat being consumed by internal changes instead of by increase of temperature. These changes completed the temperature again rises, the length of the elapsed period of time depending upon the speed of heating. With the furnace temperature kept constant at the initial point here given (925° C. or 1,700° F.), this "speed of heating" will be such as to allow of readily observing the pause in motion of the needle. The temperature at which this occurs should be carefully noted as it is the decalescent point.

To obtain the lower critical point, the temperature of the piece is first raised above the decalescent point by about 40° C. (104° F.). In this condition it is removed from the furnace and rested on top to cool. The decrease of temperature is at once noticeable by the fall of the meter needle. At a temperature somewhat below the decalescent point, varying with the composition of the steel, as previously mentioned, there is again a noticeable lag in the movement of the needle. The temperature at which this ceases entirely is the recalescent point. Immediately following there may occur a slight rising movement of the needle, as explained under "Theory" in the preceding article already referred to.

During these intervals of temperature lag, on both the heating and cooling of the steel, there may occur a small fluctuation in the temperature. In order to get results that are comparable, a definite point in each of these intervals should be considered, each time a test is made. Hence both the decalescent and recalescent temperatures are taken as the points at which the needle first becomes stationary.

As all operations of heat treatment of a steel centre around its critical points, the importance of knowing these exactly is realized. To make certain, each test should be checked by a second reading. The time required for this is small. A close arrangement of two succeeding readings will give assurance of the correctness of the determination.

Results Obtained from Sample Specimens.—In order to show graphically the necessity of working carbon steels at the proper temperature points, here dwelt upon, a series of specimen pieces of the same steel were treated at different temperatures. The steel used contained exactly 1% of carbon. A number of test specimens were made of this from different parts of the same bar.

First, the critical points of this steel were determined. With the test furnace at a temperature of 935° C. (1,700° F.) the specimen, fastened to the welded junction of the thermo-couple, was inserted in the chamber. When its temperature had exceeded the decalescent point of the steel by 100° F., or at 805° C. (1,480° F.) it was removed from the chamber and allowed to cool. Temperatures were recorded throughout both the heating and the cooling. In Fig. 2 these values have been platted. The curve shows graphically the location of the critical points, and also the retardation of motion which precedes these and the slight fall or rise of temperature, as the case may be, which follows them.

With this data obtained, 7 specimens of the same steel were heated, in the electric furnace, each to a different temperature. As these pieces were removed from the furnace they were immediately quenched in water. The temperature of the quenching bath was held constant at 45° F. These hardened pieces were then broken at right angles. The fractured surface of each was photographed under a microscope. These photographs are here produced in the same size as the originals—in Figs. 3 to 8 inclusive. Due to magnification, each of the first five of these represents a portion of a circular area of the actual steel, 0.05 in. in diameter; in the last two, of 0.1 in. in diameter.

An inspection of these shows at once the serious effects on its structure—and hence on its strength—of overheating a piece of steel. The specimen shown in Fig. 3 is very badly "burned," as evidenced by the extreme coarseness of its grain. The specimen in Fig. 4, hardened at 150° F. lower temperature, shows less coarseness, though still badly burned. The succeeding specimens show a gradual improvement, as the temperature at which they were hardened approaches the decalescent point of the steel. Fig. 8 shows a specimen which was quenched, just after the hardening change in its structure had become complete, at 5° F. above the critical temperature. The very fine grain and closely woven texture of this fracture show a properly hardened steel, one which has both the desired hardness and the maximum of quality.

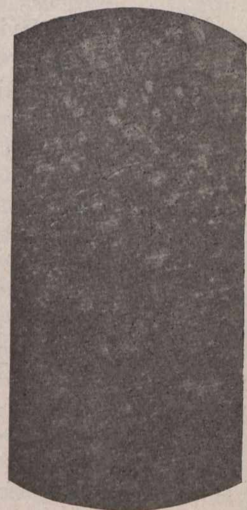


Fig. 3.
Quenched at 1900° F.

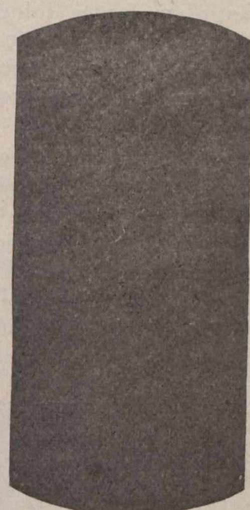


Fig. 4.
Quenched at 1750° F.

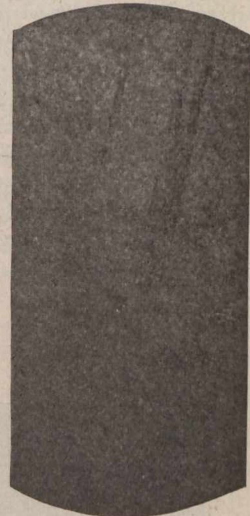


Fig. 5.
Quenched at 1600° F.

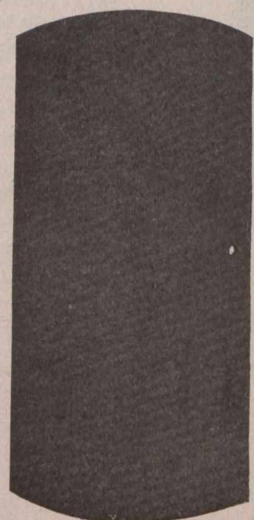


Fig. 6.
Quenched at 1510° F.

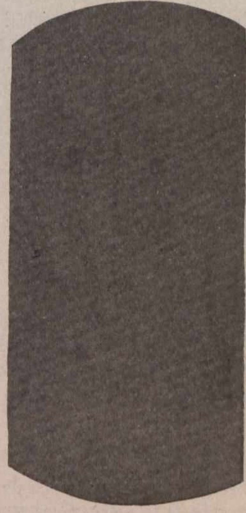


Fig. 7.
Quenched at 1425° F.

Fig. 8.
Quenched at 1385° F.

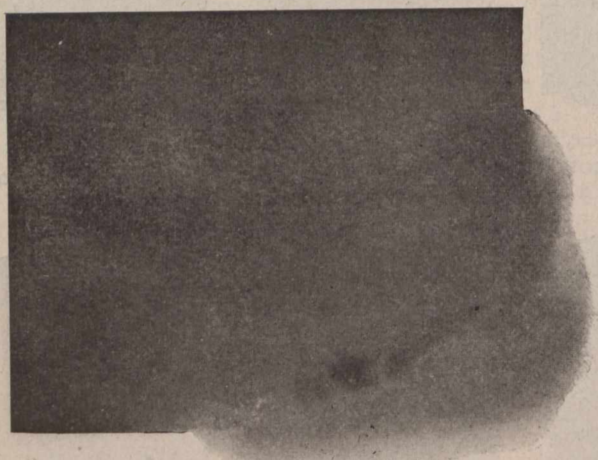
Fractured sections of carbon steel, carbon content 1%. (Figs. 3 to 7 inclusive magnified 50 diameters. Fig. 8 magnified 25 diameters).

The specimen shown by Fig. 9 was hardened just as the temperature reached the decalescent point. This illustration shows the direction in which the hardening moves, namely, from the exterior toward the interior. This would naturally be expected as the temperature of the surface—which is exposed directly to the source of heat—reaches the critical point first. As seen in the illustration, the structural change has been completed only in the surface layer—toward the corner—of the specimen. Here the grain is fine, the steel hardened, while the interior is still in the unhardened state as evidenced by its coarser grain. This condition indicates the necessity of heating the piece uniformly.

While 1,900° F., the temperature at which the specimen of Fig. 3 was hardened, represents a very excessive heat, yet it is not infrequent that carefully machined parts are ruined by overheating to even this degree. The practice of guessing at hardened temperatures can only result in uncertainty at the best. Yet, by use of the apparatus here described, the correct hardening temperature of any carbon steel can be exactly determined.

The hardening of carbon steels for the highest quality and greatest saving entails, then, three things: First, a definite knowledge of what constitutes the correct temperature at which to harden the steel. The fundamental theory and facts underlying this have been presented in the article in April 16th issue.

The second point necessitates a positive means of accurately determining this hardening temperature for any carbon steel. The outfit described above is a direct and economical answer to this. The simplicity of the apparatus, its ease and certainty of operation, compel attention to its use. It makes possible the maximum quality in the finished steel, and the greatest saving in production cost.



(Magnified 25 Diameters.)

Fig. 9.—Fractured section of a 100-point carbon steel quenched just at its decalescent temperature (1380° F.), showing uneven hardening due to lack of uniformity of heat penetrations.

The third consideration is that the correct hardening temperature, once determined, is actually carried out in the hardening work. A simple and effective way of doing this is by checking the temperature of the hardening furnace by means of a pyrometer. For this purpose, the meter of the recalescent outfit may be used in connection with a second and heavier thermo-couple.

When there is a large quantity of work to be hardened, economy dictates a permanent installation of pyrometers. The convenience of such installations is manifest. A thermo-couple is placed in each furnace. A number of these, from three to sixteen, depending upon individual conditions, are connected by wire leads, through a selective switch to one meter. By a turn of the switch, the temperature of any furnace may be read at once from the meter. This makes it possible for the foreman, at a single point, to know definitely the temperatures of all of the hardening furnaces in use. It eliminates all guesswork, makes responsibility absolute and results positive.

Temperature Measurement.—The majority of industrial operations involving the production or utilization of heat require some reliable and practical means for measuring the intensity of heat. In some cases this is essential because the successful outcome of the operation depends upon a particular temperature. In others the cost of generating heat is the important consideration and it is then a matter of economy to know the temperature so that energy will not be wasted in generating surplus heat.

These well-known facts have been widely disregarded in industrial plants, in spite of resulting inefficiency and waste, because of a general lack of confidence in many of the devices which have been available for measuring temperatures where ordinary thermometers are not suitable.

This unsatisfactory state of affairs has existed because so many of these devices are totally unsuited to industrial work. They are either of the strictly laboratory variety, too fragile and expensive for shop use, or, if strongly enough built to stand hard usage, are correspondingly inaccurate and unreliable.

The pyrometer that has been developed by Hoskins Manufacturing Company will operate up to 2,300° F. for continuous service and 2,500° F. for intermittent use, and will handle the great variety of operations requiring heat. This is from 500 to 600° higher than recommended for any other type of base metal type pyrometer.

The Thermo-Electric Pyrometer.—These pyrometers are of the thermo-electric type, it being the most widely adaptable and practical of all temperature measuring devices for temperatures above the range of ordinary thermometers and up to approximately 1,370° C. (2,500° F.).

Briefly, the chief advantages of the thermo-electric pyrometer are that it gives direct readings of temperatures above the range of thermometers and that temperatures of one or many points may be taken at a central location distant from the source of heat.

The limiting low temperature for which the thermo-electric pyrometers are recommended is, under average industrial conditions, near 100° C., although they can be used to advantage below that temperature when proper provision is made for keeping the "cold-end" temperature constant.

For the benefit of those who are not familiar with pyrometers and to make clear the purposes and advantages of certain late improvements, the following explanation is given. The principle upon which the thermo-electric pyrometer operates is the measurement of a current of electricity generated by the action of heat on the junction of two dissimilar metals.

The thermo-electric pyrometer consists of two essential parts, namely, the thermo-couple and the meter. The thermo-couple, which generates the electric current, is composed of two wires of dissimilar metals connected at one end. This connected end of the couple is called the "hot end" and is placed in the furnace or heated space, the temperature of which is to be measured. Except at the hot end, the two wires, or elements, do not touch. The free ends are known as the "cold end" of the thermo-couple from the fact that this end of the couple is always kept away from the heat, and generally at the temperature of the outside air. When the hot end of the thermo-couple is heated it generates an electro-motive force, the intensity of which is determined by the difference of the temperature of the hot-end and the temperature of the cold end.

The meter is the indicating part of the pyrometer. It is connected by means of a pair of copper lead-wires to the cold end of the thermo-couple and measures the current caused to flow by the electro-motive force of the thermo-couple.

Instead of indicating the value of the current in electrical terms the meter is calibrated to indicate directly in degrees F. or degrees C., as may be desired.

In order that the meter will indicate the actual temperatures of the hot end and not merely the difference between the temperature of the hot end and the cold end, the starting point of the meter must be set to agree with the temperature of the cold end. As the most convenient temperature for the cold end is that of the average room, the starting point or "zero setting" of the meter is usually at 25° C. or 77° F. for calibration.

Unless some special provision is made for the purpose, it is obviously impossible, in practice, to keep the cold end constantly at the room temperature for which the meter was calibrated. This variation is considerable and introduces an error which has been one of the principal objections to the thermo-electro pyrometer. The so-called cold end error has been a serious obstacle to the use of the thermo-electric pyrometer, especially on large permanent installations. In the above instrument this has been practically eliminated by means of the zero adjuster and cold end water jackets.

Before the zero adjuster was developed it was necessary, in order to obtain the correct temperature, to add or subtract from the meter reading the difference between the cold end temperature and the zero setting. With the zero adjuster it is only necessary to reset the meter zero or starting point to agree with the thermo-couple cold end temperature, whereupon the meter will automatically read the correct temperature of the hot end.

When the pyrometer equipment consists simply of a meter and a single thermo-couple, the zero adjuster alone is sufficient to correct for the thermo-couple cold end temperature variations. It is seldom that the cold end temperature is subject to rapid variations and it is thus a very simple matter to occasionally reset the meter zero in agreement with the cold end temperature, thereby obtaining correct temperature indications by the meter.

It is when the installation consists of a number of thermo-couples all connected through a selective switch to the same meter and when the various couples are subject to different cold end temperatures that a cold end water jacket is necessary, since it would, of course, be impracticable to reset the meter zero to agree with the cold end of each thermo-couple in turn.

The function of the cold end water jacket is to keep the temperatures of the cold ends of a number of thermo-couples at approximately the same temperature. With this accomplished, but one setting of the meter zero is necessary, regardless of which couple is connected to the meter when the reading is taken. The manner in which the cold end water jacket accomplishes its purpose will be made clear by the following description of the Hoskins cold end water jacket..

This water jacket consists of a coil of seamless steel pipe covered with a layer of heat insulating material. The coil is of sufficient diameter to permit the insertion of the thermo-couple spool. Six or less of these jackets are connected in series to a water line having sufficient pressure to keep a continuous flow of water through the system. A thermometer is inserted in the pipe before the first jacket and another after the last one of the series. These thermometers indicate the temperatures of the water as it enters and leaves the jackets and the mean of the two temperatures is taken as the temperature at which to set the zero. As the increase in the water temperature is never over 10°, the maximum error would only be 5°, which is sufficiently accurate for practical purposes. With this system it is seldom necessary to adjust the meter zero more than once or twice a day.

Protecting Tubes.—The choice and use of the proper protecting tubes has much to do with the success of the thermo-electric pyrometer. At high temperatures the elements of the couple become somewhat soft and susceptible to the action of gases. By protecting the couple with a tube of the right type it is possible to prevent or delay these injurious effects and lengthen the life of the thermo-couple elements. The protecting tube also protects the couple against mechanical injuries.

Quite contrary to the general impression, it is not oxidizing but reducing gases which seem to have the most detrimental effect on the thermo-couples. An oxidizing gas causes a gradual deterioration of the couple which can be observed and which permits the user to provide another thermo-couple before it breaks down. But with reducing gas, the action may be sudden and local and frequently causes a couple in good condition to break shortly after being put in the heat. It is this fact in connection with the wrong choice or entire lack of tubes that has caused much unnecessary dissatisfaction with thermo-electric pyrometers.

For temperatures up to 1,200° F. a good steel tube will give excellent satisfaction, in ordinary furnace gases. From 1,200 to 2,000° F. a nickel chromium protecting tube should be used. However, above 2,000° they are not very satisfactory and a very heavy seamless steel tube should be used.

Calibration.—In plants where a large number of pyrometers are used it is advisable to have an easy and dependable way by which to periodically check the accuracy of the various thermo-couples and meters. The most satisfactory way to do this is to use an accurate check pyrometer with which the installed pyrometers can be compared under service conditions.

The method of checking is to place the thermo-couple of the check pyrometer in the same protecting tube with the service couple, being careful to see that both couples are inserted to the full depth of the protecting tube. By then comparing the readings of the two meters the accuracy of the service pyrometer can be determined. In order that there may be sufficient room for both the service and the check couples, all protecting tubes should have an inside diameter of at least ¾ inch.

The type of pyrometer best adapted and most used for checking is the portable instrument. They should, of course, be very accurate. In order that it may be kept in this condition it should be used for no other purpose than checking and should be calibrated occasionally.

For low reading pyrometers the calibration may be done by placing the thermo-couple in a heated oil bath and comparing the readings of the meter with those of a high-grade mercury thermometer, having a range up to 150° C. (300° F.). The vessel for holding the oil should be approximately 6 in. deep by 4 to 6 in. in diam., and may be heated by a gas burner or electric hot-plate. Constant stirring of the oil should be done to insure a uniform temperature throughout. Any oil having a high flash point, or some of the waxes such as paraffine, beeswax, etc., may be used.

For calibrating pyrometers for temperatures above red heat, the welded or hot end of the thermo-couple should be covered with a tight winding of No. 14 or No. 16 B. & S. gauge standard melting point wire. The couple should then be inserted in a tube furnace similar to the electric furnace shown in Fig. 1, with the welded end of the couple approximately in the centre of the furnace. The furnace should be up to heat before inserting the couple and should be kept at a temperature approximately 100° F. higher than the melting point of the calibrating wire. The pointer of the meter will then move up the scale with a gradually decreasing speed until the calibrating wire begins to melt, when the pointer of the meter will come to rest. After the calibrating wire has melted the pointer will again move upward. Pure copper wire, under oxidizing conditions, melts at 1,065° C. (1,949° F.) and pure zinc wire at 419° C. (786° F.). In order to have a strictly oxidizing atmosphere, an open end electric furnace should be used for calibrating work.

In using this method of calibration, care should be taken not to have the furnace temperature too far above the melting point of the calibrating wire, or the pointer will move so rapidly that the melting will be of such short duration that the holding point may be missed.

A very satisfactory way of calibrating pyrometers is by using the freezing points of melted salts as follows:

Pure common salt, Na Cl., is melted in a pure Acheson graphite crucible in an electric furnace. When the salt has been raised to a temperature of 100 or 200° F. above its melting point, the bare welded end of the thermo-couple is inserted in it to a depth of from 2 to 3 in. The crucible is then removed from the furnace and allowed to cool. The pointer on the meter will drop gradually until the salt begins to freeze, when it will stop until the salt is frozen. The freezing point of pure salt may be taken at 800° C. (1,472° F.). Before further use, the couple end should be washed clean in hot water to remove all traces of the salt, otherwise the couple will deteriorate rapidly, especially when heated considerably above the melting point of salt in an open furnace.

When calibrating pyrometers, care should be taken to see that the zero setting of the meter is in agreement with the cold end of the couple.

When the pyrometer is found to be reading too high the correction is made by increasing the adjusting resistance; and if reading too low, the resistance is decreased. The adjusting resistance is No. 26 B. & S. gauge wire of low temperature coefficient. In changing this resistance the connections should always be carefully soldered and the different turns insulated from one another.

Changing the resistance on the couple spool should not be attempted by the user unless he thoroughly understands, and has had some experience at, such work.

The following table gives the latest available data by the Bureau of Standards on certain substances which may be used for calibrating pyrometers:

Water boils at	100° C.	(212° F.)
Tin freezes at	232° C.	(450° F.)
Zinc freezes at	419° C.	(786° F.)
Common salt freezes at	800° C.	(1472° F.)
Copper, in oxidizing atmosphere, freezes at	1065° C.	(1949° F.)

Among the orders recently placed with English firms, figures an oil tank steamer of about 3,800 tons gross and about 365 feet in length for the Australian Government, to be built by Swan, Hunter and Wigham Richardson.

It is reported from Fredericton, N.B., that the residents of Granite Hill, Bear Island, Upper Queensbury and the districts on the other side of the St. John River in that vicinity are moving again to have a steel highway bridge built across the river at Bear Island.

THE CLAYWORKING INDUSTRY IN NEW BRUNSWICK.

In a report by Joseph Keele on the clay and shale deposits of New Brunswick the geological survey branch of the Department of Mines, Ottawa, has just published some very interesting information. The report covers work done in that province by the Geological Survey during 1911 and 1912. A chapter is devoted to the extent at present of the clay industry, and from it we make the following extracts:—

Up to the present time the clay deposits of New Brunswick have only been developed to a very limited extent.

Wooden construction prevails, to the exclusion of almost all other kinds, except in the business portions of the cities and towns, because lumber has hitherto been plentiful and cheap in the province.

The danger from extensive fires is always present when wooden construction is so freely used in closely-built communities. This was evident in the total destruction of the town of Campbellton by fire during the summer of 1910. Since then, the demand for structural clay wares is increasing, but they are not yet used as largely as they might be, because everything except common brick has to be imported.

New Brunswick possesses in its Carboniferous rocks, certain shale beds, adapted for making those higher grades of clay wares which cannot be produced in the Provinces of Quebec or Ontario, where these raw materials are absent. Clayworkers will probably find it to their advantage to locate works for the production of materials, not only for home consumption, but also for export.

Proximity to markets, although desirable, is not so essential to manufacturers of the higher grades of clay wares, such as face bricks, paving bricks, sewer-pipe, electrical conduits, fireproofing, etc., as these materials are frequently transported for long distances. A plant equipped for a large output of common brick can only be maintained close to cities, where the demand for them is constant during the greater part of the year. These plants frequently represent a considerable expenditure of capital, being furnished with artificial driers, continuous kilns, and machinery driven by steam or electric power. The surface clays can be worked in a primitive manner, with a small outlay of capital, to suit the demands of small towns or rural communities. Such plants are able to maintain their position, because the price of common brick would not pay the cost of carriage from large centres where their manufacture is carried on more scientifically.

When the need for underdraining the cultivated areas in the Province becomes more generally known, these clays will have a much wider application. Drain tile can be made from any of the surface clays. Tile are made from stiff mud, usually by an auger machine having a circular die, although different styles of plunger machines and also hand presses are used in their manufacture. They are made in sizes varying in diameter from 2 inches to 3 feet. Any means of drying and burning may be used with the smaller sizes, but the larger sizes require considerable care to prevent cracking. Contrary to the popular notion, it is not necessary for drain tile to be porous, so that they should be hard burned. Besides sufficient hardness, the important requirements for drain tile are straightness, uniformity of diameter, and smoothness of ends.

The only pottery in operation in the province is located at St. John. It is owned by J. W. Foley and Company, who manufacture butter crocks, teapots, jars, and flower pots. Most of the raw material is imported from the State of New Jersey.

The following details concerning the clay-working industry of the present time in New Brunswick are briefly given.

Fredericton.—M. Ryan and Son are the only brick manufacturers at this city. The material used is a surface clay, of the estuarine type, somewhat similar in character to that worked in the Annapolis and Shubenacadie valleys of Nova Scotia. The clay is moulded in a soft mud machine, without any preliminary pugging, but nevertheless makes a good grade of brick. The freshly moulded bricks are hacked out on the ground to dry in the air, but since Mr. Keele's visit, Mr. Ryan has installed a steam drier. Burning is done in a patent double chambered downdraft kiln, each half having a capacity of 90,000 bricks. The brick settles 12 inches in 31 courses during the burning.

St. John.—Two brickyards are in operation in the vicinity of this city. The clays used are all similar, being evidently remnants of marine or estuarine deposits laid down at a slight elevation above present sea-level. The clays are smooth and plastic, and free from pebbles. Any pebbles found in the finished bricks have probably come from gravels overlying the clays. The brickyard of Mr. John Lee is located on Courtney Bay at the Little river. The material used here is a tough, reddish brown clay and worked to a depth of 6 or 7 feet below the surface. The brick clay rests on a very hummocky boulder drift, which crops out in a few places in the bottom of the pit. The clay, after being broken down from the bank, is dumped into soak pits along with some sand, and kept there for a day or so before going to the machine. Sand-moulded or, soft mud bricks, some re-pressed bricks for facing buildings, and field drain tile are manufactured. The freshly moulded bricks are placed on covered pallet racks and air dried. There are two down-draft kilns, two up-draft case kilns, and one scove kiln. The output is 25,000 bricks per day during the season, which are mostly sold in St. John.

St. Stephen.—There are two brick yards in operation near this town, making soft mud brick and drain tile. The material used is taken from a terrace of marine clay which occurs along the valley of the St. Croix river. Mr. John Laming has made bricks here during the last 31 years. He uses a small stiff mud machine for making wire-cut brick for facing, and for drain tile. He also makes soft mud bricks, which form the greater part of his output. The demand for drain tile is intermittent; these are only made to order, and not stocked. The principal object of interest is the tiles with which the building is roofed. These tiles were made by Mr. Laming, 22 years ago, from the clay in his own pit. These tiles are S-shaped, and although not hard burned, are still quite intact for the most part.

Sussex.—The brickyard operated by Mr. John Heffer is situated a few miles north-west of Sussex. The material used is a stiff, reddish clay, from 3 to 10 feet in thickness, overlying boulder clay. A stiff mud machine driven by horse-power is used. The bricks are hacked out on the open ground to dry, and afterwards burned in a scove kiln. The burned bricks contain some scattered, small pebbles and clay lumps, showing the need of passing the clay through rolls, or through a long pug mill, to prepare the clay for the machine. As the clay is becoming too thin for working at this locality, the plant will shortly be moved to a fresh clay deposit in the neighborhood.

Moncton.—The brickworks are located at Lewisville, 2 miles from Moncton. The material made is a glacial clay situated almost at tide level, and underlain by boulder clay. The maximum depth of the clay is 7 feet. This plant is equipped with a stiff mud machine and steam driers. The burning is done in scove kilns. The brick clay also occurs at various points around the city of Moncton, but is worked only at this locality at present.

Chatham.—There are two brick plants in the neighborhood of Chatham, owned by the W.S. Loggie Company. The plant at Nappan river uses a stratified, reddish clay, about 12 feet deep, lying on bed-rock, to which is added about 10 per cent. of sand. Sand-moulded bricks only are made; they are dried on pallet rocks, and burned in scove kilns. The bricks are set 36 courses high in the kiln, and the fuel used is dry spruce and tamarack. The output is hauled in wagons to the railway, and shipped principally to Campbellton. The working season lasts from the middle of May to December. An excellent deep red, hard, building brick is produced at these works.

The plant at Nelson is worked in a similar manner, and produces common brick of a quality very much like those at Nappan. This plant is better situated for transportation, as the bricks have only to be hauled over the bridge across the Miramichi river, to the railway station on the north bank.

On April 15, a delegation of 1,000 gathered at Ottawa, 700 of whom were from Montreal, and formed a permanent organization, whose purpose will be to promote the construction of the Georgian Bay Canal and furnish all necessary information for the recently appointed Government commission on the project; and to present to the Government arguments in favor of the immediate start of construction of the waterway.

The preliminary report on mineral production in Canada in 1913 shows a total value of production amounting to $144,031,047, an increase of 6.65 per cent. over the previous year, representing an average production per capita of $18.57, as against $18.27 in 1912 and $14.93 in 1910. The amount of coal produced was valued at $36,250,311, an increase of $231,267. The gold produced amounted to a value of $16,216,131, an increase of $3,567,337. The value of pig iron produced was $16,540,012, an increase of $1,989,013. There was a decline in the production of copper from a value of $12,718,548 in 1912 to $11,753,440 in 1913, and a decline in silver production from $19,440,165 to $18,984,012. Cement production increased from $9,106,556 in 1912 to $11,227,284 in 1913.

During the coming summer, a new railroad, thousands of miles in length, will be opened to traffic in Central Asia. It is a line which, linked to the existing Trans-Siberian Railroad at Krasnoyarak, crosses through the northern part of the province of Irkutsk, north of the Baikal Lake, through Eastern Siberia, and then through the Amur province, northward to the Amur river, to Kakhaborovsk, where it joins the already existing line that runs due south to Vladivostok. The surveys for this new line were already begun while the Russo-Japanese peace negotiations were in progress at Portsmouth, N.H., in 1905. It is built entirely on Russian territory; and, since the province of Eastern Siberia, and of the Amur, lying north of Manchuria, are perhaps more rich in minerals than any other portion of the world, the line bids fair to prove of the utmost economic importance. Much of the line has been laid through primeval forest, and through jungles where man had never set foot before, and where the temperature ranges from tropical heat in summer to 89½ below zero in winter; where the men had frequently to work for days and months standing almost thigh-deep in icy marsh. $2,050,000,000 have already been voted by the Duma for the construction of the road. Whether it will be sufficient or not to cover its cost is not known. It is intended that this new main line is to constitute the main trunk of a vast network of subsidiary lines. It will connect Moscow, over an all-Russian route, with the Czar's great stronghold on the Pacific, Vladivostok.

TRAVELLING CONCRETE PLANT.

A NOVEL concrete mixing plant with elevator tower and distributing chute is described in the "Canal Record" of Panama. It is being used for mixing and placing the concrete in the caisson shells and superstructures of the quay wall and pier now under construction at the Balboa terminals. Four units of the type are in use. The system has advantages of convenience, speed, and reduced labor cost.

Each unit consists of a hoisting engine, of approximately 20 horse-power, steamdriven; a ½-cubic yard portable mixer; an elevator for raising the concrete so that it can be distributed from a hopper by gravity; and a jointed distributing chute, for placing the concrete from the hopper. All of these items are mounted on a single flat car, resting on a 5-foot gauge track. The plant is advanced along the track with the progress of the placing. The sand, rock, and cement for the concrete may be handled to the mixer direct from cars coupled to the flat car in the rear, or from stock piles alongside the site of operations. In either case, they are carried to the mixer in wheelbarrows, over suitable staging.

The hoisting engine boiler furnishes steam for the mixer, and, by cables running over sheaves at the top of the elevator tower, raises and lowers the elevator car.

The elevator is a hollow timber framework, 4½ by 6 feet in plan. In the unit of which the side and front views are shown herewith, the tower rises to a height of 41 feet 3 inches above the deck line; in this type, the distributing chute is 52 feet long, with a distributing radius of 48 feet. In two other units of similar general design, the chute is longer, having a distributing radius of 78 feet. The elevation of the tower is determined by the requirements of distributing the concrete by gravity. In each case, the tower is braced by timber outriggers.

The elevator car is the body of an ordinary ½-yard Decauville dump car, mounted on trunnions. At an elevation determined by the length of the chute, it dumps automatically into a hopper which rests on a projection on the front side of the elevator shaft. The hopper is six by six feet in plan at its top, converging into juncture with the distributing chute. It has a capacity of about one cubic yard.

The distributing chute is of 14-inch steel pipe. It is in two sections of equal length, connected by means of a swivel joint. The upper section is known as the swivel arm, and the lower section as the nozzle arm. The upper section is connected with the hopper discharge by a swivel joint, and can swing to either side to a position at right angles with the axis of the flat car. The nozzle arm, swinging under the upper section, can describe a circle, the centre of which is the joint between the two sections. This combination of motions allows the mouth of the chute to be placed over any point in the semicircle described by swinging the chute with both sections extended in the same plane.

The method of supporting the chute is of especial interest. Both sections of the chute are supported by means of a pivoted latticework boom, projecting outward and upward from the front of the base of the elevator tower. The timbers of the boom pass on both sides of the upper section of the chute, allowing its support to be effected by the cross pieces. In addition, the boom passes far enough beyond the upper section to allow vertical guys to be attached to the intermediate joint, and slanting guys to be extended to the end of the nozzle arm. This does away with extraneous supports for the nozzle arm, and with the services of laborers in carrying it from point to point.

The system allows the mixing and placing of from 180 to 200 cubic yards of concrete per day from the ½-yard mixer. The arrangement of the chute allows the placing of concrete all over the semicircle in front of the mixer without the use of men with wheelbarrows, operating on runways laid over the reinforcement. These features are especially desirable in the pier construction, where it is important to complete a section, including a main girder and extending half-way to the girders on either side, in one day, in order that the concrete may harden in a complete unit.

In the new pier No. 1, each section is 29 feet 6 inches long by 75 feet 11 inches wide, and contains 191 cubic yards of concrete. One mixing unit will complete a section a day; but in case of breakdown, another unit can be withdrawn from caisson work and sent to supplement the placing for the pier. Each outfit is practically as portable as a wrecking crane.

The force for each unit consists of approximately 30 silver employees in charge of a white foreman. Twenty-five men are engaged in wheeling materials from cars or stock piles and supplying the mixer; one man is in charge of the mixer; one runs the hoisting engine; and three are out at the end of the chute distributing the concrete into the forms. This arrangement makes the labor cost very low.

The report of the Timiskaming and Northern Ontario Railway Commission for the year ended October 31st, 1913, shows a total mileage of the railway in operation at the end of that year amounting to 432.77, including 252.8 miles of main line, 80.64 miles of branch lines, and 99.33 miles of yards and sidings.

It has been decided to construct dams along the creek at Caron, Alta., for the purpose of protecting the infiltration pipe gallery and to increase the storage capacity of the Caron head works. They will be built of concrete and will be finished this summer.

In the two years, 1912-13, in British Columbia, the demand for structural materials—stone, cement, clay products, etc.—has not been so great latterly as in 1910 and 1911, so the value of the output of this class of non-metallic minerals was probably lower in 1913, and in the absence of data on which to base calculations no definite statement can be made. The marble-quarry in the Ainsworth Mining Division was worked and marble was shipped from it. Near Victoria, on Saanich Arm, a second cement manufactory was started, and near Princeton a beginning to produce cement was also made, but in neither case was a large output made. The Vancouver-Portland Cement works at Tod Inlet continued to make an important production. The destruction by fire of the large pottery works at Victoria has added to the decrease in production of structural materials, but this loss in output is only temporary, the erection and equipment of new works having been provided for.

The following table shows the mileage of the various classes of work carried out under Street Improvement By-laws and General Revenue for 1913 at Vancouver, B.C.:—

	Miles.
Clearing and rough-grading streets	22.134
Ditching and crowning streets	4.516
Clearing and rough-grading boulevards	17.822
Clearing and rough-grading lanes	5.250
Grading streets	12.688
Grading boulevards	15.155
Grading lanes	3.009
Rocking streets	5.148
Rocking lanes	2.110
Extending rocking to curbs	1.228
Resurfacing streets	4.405
Plank roadways, streets	22.941
Plank roadways, lanes	12.107
Three-plank walks	32.460
Bulkheads	.825
Culverts and box-drains	.664

Coast to Coast

Moose Jaw, Sask.—The City Council of Moose Jaw has voted down the recommendation of the city commissioners that drilling for gas at the city test well be discontinued.

Moose Jaw, Sask.—The new ten-circuit automatic storage battery switchboard, which will be installed at the Central Fire Hall, Moose Jaw, during the next month, will represent an outlay of $6,000.

Toronto, Ont.—The first through train has traversed the new C.N.R. line between Quebec and Toronto, arriving in Toronto on May 1; and the entire road has been pronounced satisfactory by the officials.

Winnipeg, Man.—Recently at Winnipeg a statement was published to the effect that the earnings on all Canadian railways during 1913 amounted, broadly, to $200,000,000 according to figures just compiled. These figures include all the subsidiary lines, and other affiliations of any nature.

Port Mann, B.C.—Plans are being perfected by the C.N.R. for extensive terminal facilities at Port Mann, B.C., its Pacific freight terminus and ocean port. Plans passed upon this year by the management call for yard trackage to store and manipulate 10,000 freight cars and 1,000 passenger coaches.

Vancouver, B.C.—The Burrard street bridge, a part of the C.P.R. terminal improvement scheme at Vancouver, has been completed with the exception of the ramp, which will lead from the waterfront end of the viaduct to the dock level; and this cannot be built until the old immigration sheds have been removed

Bassano, Alta.—The great irrigation dam of the C.P.R. at Bassano, Alta., was formally opened on April 26 by Sir Thomas Shaughnessy, president of the company. It is claimed that the Bassano dam is the largest in the world, and is even longer than the famous Assouan dam of Egypt. The water it contains will cover 14,000 acres to a depth of one foot.

Toronto, Ont.—Owing to changes which have been effected in the Power Commission Act by the Ontario Legislature, Ontario townships will now be able to make contracts for hydro-electric power without submitting the matter to a vote of the ratepayers. All that is required is a petition from residents of the township; and when this is submitted and considered, the council may enter into a contract with the commission.

Guelph, Ont.—The annual report of the Light and Heat Commission of Guelph shows very satisfactory returns; and though the rates were reduced 5 per cent. at the beginning of the year for power, residential and commercial lighting, with the increase of business that this reduction has effected, it is expected to make a further decrease in rates at the end of the year or earlier. The report shows that over twice as many electric services were installed in 1913 than in the previous year.

Regina, Sask.—During 1914, over $1,500,000 will be expended on roads and road improvement in Saskatchewan, according to the decision of the highways commission of the provincial government. Of this outlay, $500,000 is to be expended in bridge work, the largest undertaking of the bridge department this year probably being the completion of the high-level bridge at Saskatoon, which is to be completed by December 31. Approximately $100,000 is to be expended on small concrete and steel bridges.

Toronto, Ont.—Main estimates have been tabled in the Ontario Legislature for 1914-15 totalling $9,810,749.66, while those tabled for 1913-14 were $9,524,387. Of this year's amount $8,811,749.66 is to be voted to meet current expenditure, while $849,000 will be set aside for capital expenditures, $150,000 being provided for other purposes. The current expenditures for 1913-14 were nearly half a million lower than for this session, being $8,353,387; but the amount provided for capital expenditure a year ago was considerably larger than the vote now asked for, running up to $1,042,000.

Montreal, Que.—The construction program of the Montreal harbor commissioners has been resumed. Dredging has been started on the South Shore Channel, and an endeavor will be made to have the channel completed before the closing of navigation. Also a start has been made at tearing down the old Victoria pier, work is being carried out at the new drydock, the widening of the ship channel in the harbor is to be continued, the construction of sheds at sections 23 and 24 is being rushed, while the addition to the commissioners' elevator is practically completed.

Saskatoon, Sask.—The total contract for the completion of the students' residence of the University of Saskatchewan, for which contracts were awarded last week, will entail an approximate expenditure of $216,000 for Section A; and, including Sections B and C, the total cost will be $265,000. In addition to the residence construction, the new Physics Laboratory will be constructed this year at a cost of between $120,000 and $150,000, and will constitute the first unit of the new science block. Also this year the foundation work for the proposed chemistry building will be undertaken.

Vancouver, B.C.—According to the opinion of Engineer Breckon of Vancouver, the laying of pipe across the First Narrows, including the hauling of the second main already started, will entail an additional expense of $6,000 to $10,000, or about $70,000 for the rest of the work on the connecting of the Point Grey pipe with Little Mountain reservoir. Of this, $45,000 will be needed for the crossing of False Creek and the few special valves along the route for fire protection. At the end of March the expenditure on the pipe line was $430,738, so that the total cost will be more than $500,000.

Edmonton, Alta.—It has been reported at Edmonton that $500,000 has been received by the Provincial government of Alberta to be used for the building of western Canadian railway lines. It is stated by the secretary of railways that it is for the Canadian Northern Western, a subsidiary company of the Canadian Northern. This amount is the first instalment of $6,000,000, for which bonds were placed on the market last spring. Moreover, according to the railways branch, over $11,000,000 is available for railway construction in Alberta this year, on railways guaranteed by the Provincial Government; and it is estimated that 700 miles of railway should be constructed during the present year.

Toronto, Ont.—The C.P.R. bridge over the Don River, 9 miles from the Union Station, has been completed by the Walkerville Bridge Company. The contractors for the cement work were Dickenson and Burns. The new bridge is much stronger and heavier than the old bridge, alongside of which it has been erected. It is about 1,000 feet long, weighs over 1,200 tons, is 120 feet above the level of the River Don, and is supported by 9 steel towers and 2 concrete abutments. Two of the towers provide openings for roadways, one on either side of the river; while the largest tower spans the C.N.R. line to Winnipeg, 80 feet below the level of the bridge. The completion of the bridge allows now of the completion of the small portion of work yet undone on double-tracking the line from Agincourt to Leaside. When the other new bridge over the west Don has been finished, the two old bridges over the main and west Don rivers will be strengthened and improved so as to afford a complete double track from Streetsville in the west to Agincourt in the east.

Ottawa, Ont.—It has been announced recently at Ottawa that, with a view to enabling the engineers of the government to work out the best scheme of power development on the main Saskatchewan river, and at the same time not to impair future navigation, it has been considered advisable to have a thorough examination made on the ground by the hydraulic engineer of the water power branch this coming summer. In the meantime, Hon. W. J. Roche, minister of the interior, has directed that all available Dominion lands, contiguous to this power site, be removed from any disposition whatever, and be dealt with only under the Dominion water-power regulations. During the past two seasons the engineers of the Dominion water power department have investigated the possibilities of this river in the vicinity of Grand Rapids, where the river disgorges into Lake Manitoba; and, while incomplete, a photographic survey of the whole region has been made.

Fort William, Ont.—The mayor of Fort William has outlined to the city council an agreement which will doubtless be entered into by the city and C.P.R. company. It is to the effect that the city and the railway company shall jointly build a new subway with cement piers and abutments and steel superstructure at McVicar street, with a revetment wall that would give an additional width of 7 feet of roadway from the subways to the local sheds, and afford a double roadway and two sidewalks through the subway; that the city dock shall be extended 50 feet to the harbor line; that the company shall give the city 200 feet of frontage down the river from the present city dock; that the city shall give the company surface rights on McTavish street between the railway tracks and the river, reserving the right for an overhead right-of-way for access to a bridge, whenever it should be necessary; and that the city shall pave and maintain the Syndicate avenue subway. This basis of agreement has been authorized by council and forwarded to the company.

Toronto, Ont.—Recently in the Ontario Legislature, while outlining the expenditures for which a vote of $5,000,000 in the supplementary estimates has been required by the Hydro-Electric Commission, the Hon. Adam Beck stated that the question of the commission entering upon the work of actually producing power would sooner or later have to be solved. The Ontario Power Company is now supplying power to the Commission, and wants to have the contract reopened. It desires permission to utilize the remainder of the available water at Niagara Falls, which would bring its maximum development to 106,000 horse-power. If this is done it proposes to relinquish rights to export 50 per cent. of the power developed to the United States, and to leave 60 per cent. for use by the Hydro-Electric at $12 per h.p. The Commission is paying $9 per h.p. at present, and it is not thought that the $12 rate is low enough. If cheaper power cannot be procured the Commission may have to install its own plants. Two sites are available, one below the whirlpool, and the other the spillway of the Welland Canal, if power rights to this can be secured from the Dominion Government.

Esquimalt, B.C.—The following particulars have been published concerning the drydock to be constructed by the Dominion Government at Esquimalt. The north side of Lang's Cove has been chosen as the dock's site. Its dimensions will be as follows: length from caisson stop to head wall, 1,150 feet; width of entrance, 120 feet; depth on sill at ordinary high water spring tides, 40 feet; width at coping of dock walls, 144 feet. It will be divided, as stated, into two parts of 650 and 500 feet, respectively, each part being closed by a ship steel caisson. The dock will be emptied by three centrifugal pumps, each having a capacity of 60,000 gallons per minute. The pumps and other machinery will be run by electric power generated by the dock power plant. After the rock excavation has been finished, the walls will be constructed. For these concrete will be used, with granite copings and alters. All keel and bilge blocks will rest on granite stripe extending the full length of the dock, and granite will be used for caisson stops. On the south side a basin will be formed; and the structure around this will be built of reinforced concrete piles. In addition to the drydock work proper, a large area of land must be reclaimed, and an extensive frontage of wharves, for which reinforced concrete will be used, must be constructed.

Medicine Hat, Alta.—Contracts have just been awarded by the Southern Alberta Land Company, of Medicine Hat, for the removal of some 560,000 cubic yards of earth, for the purpose of carrying to completion the first stages of the work and the placing of about 30,000 acres of land under water by next spring. All contracts are to be completed by October 15, 1914, and the total cost will be about $80,000, running somewhat under the engineers' estimates. In about two weeks another contract will be let for 150,000 more cubic yards of excavation, part being at the Little Bow river and the balance near the head of the main canal near Gleichen. The contracts let this week are for some 5 miles of the main ditch, leading from the new reservoir to the Little Bow river, which is some 15 miles from the main reservoir, known as Lake McGregor—this main canal to be 44 feet wide at the bottom, 78 feet across the top, and to hold 8 feet of water; and for the laterals, to provide for the direct watering of the 30,000 acres of land next spring. On April 1st occurred the completion of the new dam at the intake on the Little Bow river, a piece of work that represents a cost of about $70,000. By July 1st or sooner, water will be turned into the main canal, the reservoir holding about 30,000 feet of water. Thus far the company has expended about $4,500,000 on this enterprise, and it bids fair to be one of the most important in the Canadian West, as the plans call for the irrigation of over 200,000 acres of land.

Victoria, B.C.—Active operations are reported as now in progress by the contracting firm, Messrs. Grant, Smith, and McDonnell, in connection with the building of the two new piers in the greater harbor improvement program. Five large scows have arrived at Vancouver for the purpose of dumping the rubble foundation of 300,000 tons, of which the first 60,000 tons is ready for delivery. The cribs to be built will be 58 in number. Each requires 110 tons of steel work, and when complete will be a ferro-concrete structure weighing 3,500 tons. These will be constructed on a floating drydock which is now at the Bremerton Navy Yard, in Seattle, and which will arrive at Victoria shortly. This drydock has a carrying capacity of 8,000 tons, is 385 feet long, 115 feet wide, and has a depth of 55 feet. When the drydock has been delivered, the construction of cribs will commence at the company's gravel property at Albert Head, where excavations are to be made to provide a slip for the floating dock. The most modern machinery for the removal of the gravel will be installed at a cost of $40,000; and when in operation, the output will be in the neighborhood of 1,800 cubic yards daily. Also, the company proposes opening up and equipping with donkey engines, steam shovels, etc., a rock quarry in the vicinity of Victoria, by means of which the company expects to bring to the site of the piers about 60,000 tons of rubble each month. It is anticipated that the necessary quantity of material will be dumped before next winter is far advanced. When the work is well under way, the contractors will have 12 scows, a dredge scow and a drill boat in operation, the latter to be used in removing rock for excavating underneath the cribs. The contract is to be carried out under the supervision of Mr. J. S. Maclachlan, Dominion Resident Engineer.

NEWS OF THE ENGINEERING SOCIETIES

Brief items relating to the activities of associations for men in engineering and closely allied practice. THE CANADIAN ENGINEER publishes, on page 90, a directory of such societies and their chief officials.

AMERICAN SOCIETY C.E. CODE OF ETHICS.

The Board of Directors of the American Society of Civil Engineers is placing before the membership the following proposed code of ethics, and is recommending its adoption:—

It shall be considered unprofessional and inconsistent with honorable and dignified bearing for any member of the American Society of Civil Engineers:—

(1) To act for his clients in professional matters otherwise than as a faithful agent or trustee, or to accept any remuneration other than his stated charges for services rendered his clients.

(2) To attempt to injure falsely or maliciously, directly or indirectly, the professional reputation, prospects, or business, of another Engineer.

(3) To attempt to supplant another Engineer after definite steps have been taken toward his employment.

(4) To compete with another Engineer for employment on the basis of professional charges, by reducing his usual charges, and in this manner attempting to underbid after being informed of the charges named by another.

(5) To review the work of another Engineer for the same client, except with the knowledge or consent of such Engineer, or unless the connection of such Engineer with the work has been terminated.

(6) To advertise in self-laudatory language, or in any other manner derogatory to the dignity of the profession.

It is noteworthy of observation that the American Society of Mechanical Engineers and the American Institute of Electrical Engineers have both discussed codes that are very similar to each other, the latter having already adopted theirs. The above code, compared with the others, is quite brief and simple, and free of all attempts to lay down general rules of practice that are devoid of ethical bearing.

The draft will be presented to be acted upon by the members at the convention in Baltimore, Md., on June 2nd. The opinion generally expressed is that it will be adopted.

CLUB "SMOKER."

The Engineers' Club of Toronto will hold a smoker in the club rooms on Friday evening, May 8th. The occasion will admit of examination and criticism of the preliminary plans of the proposed new Engineers' Club building.

COMING MEETINGS.

AMERICAN WATERWORKS ASSOCIATION.—Thirty-fourth Annual Meeting to be held in Philadelphia, Pa., May 11-15, 1914. Secretary, J. M. Diven, 47 State Street, Troy, N.Y.

CANADIAN AND INTERNATIONAL GOOD ROADS CONGRESS.—**To be held in Montreal, May 18th to 23rd, 1914. Mr. G. A. McNamee, 909 New Birks Building, Montreal, General Secretary.**

INTERNATIONAL CONFERENCE ON CITY PLANNING to be held in Toronto, May 25-6-7, 1914, in charge of the Commission of Conservation. Secretary, James White, Ottawa.

AMERICAN SOCIETY FOR TESTING MATERIALS. —**Seventeenth Annual Meeting to be held in Atlantic City, N.J., June 30 to July 4, 1914. Edgar Marburg, Secretary-Treasurer, University of Pennsylvania, Philadelphia, Pa.**

AMERICAN SOCIETY OF ENGINEERING CONTRACTORS.—Summer convention to be held at Brighton Beach, N.Y., July 3rd and 4th, 1914. Secretary, J. R. Wemlinger, 11 Broadway, New York.

UNION OF CANADIAN MUNICIPALITIES.—Annual Convention to be held in Sherbrooke, Que., August 3rd, 4th and 5th, 1914. Hon. Secretary, W. D. Lighthall, Westmount, Que. Assistant-Secretary, G. S. Wilson, 402 Coristine Building, Montreal.

AMERICAN PEAT SOCIETY.—**Eighth Annual Meeting will be held in Duluth, Minn., on August 20, 21 and 22, 1914. Secretary-Treasurer, Julius Bordollo, 17 Battery Place, New York, N.Y.**

CANADIAN FORESTRY ASSOCIATION.—Annual Convention to be held in Halifax, N.S., September 1st to 4th, 1914. **Secretary, James Lawler, Journal Building, Ottawa.**

ROYAL ARCHITECTURAL INSTITUTE OF CANADA.—**Seventh Annual Meeting to be held at Quebec, September 21st and 22nd, 1914. Hon. Secretary, Alcide Chaussé,** 5 Beaver Hall Square, Montreal.

CONVENTION OF THE AMERICAN SOCIETY OF MUNICIPAL IMPROVEMENTS.—To be held in Boston, Mass., on October 6th, 7th, 8th and 9th, 1914. C. C. Brown, Indianapolis, Ind., Secretary.

AMERICAN HIGHWAYS ASSOCIATION.—Fourth American Road Congress to be held in Atlanta, Ga., November 9-13, 1914. J. E. Pennybacker, Secretary, Colorado Building, Washington, D.C.

PERSONALS.

G. W. BARRETT was recently appointed sewerage engineer for the town of Esquimalt, B.C.

NORMAN HICKS has been appointed engineer to the town of Weston, Ont., and to the Weston Water, Power and Light Company.

G. H. ARCHIBALD, of St. Catharines, has been appointed city engineer of Saskatoon, Sask., to succeed Geo. T. Clark, resigned.

J. L. BUSFIELD, B.Sc., of the Mount Royal Tunnel and Terminal Company, Montreal, has recently been elected associate member of the Institution of Civil Engineers, Great Britain.

C. C. MENDHAM, who has been connected with the outdoor staff in Toronto of the Herbert Morris Crane and Hoist Company, Limited, has now been appointed resident engineer in Berlin for that company.

OBITUARY.

The death occurred at Beamsville, Ont., on May 4th of Senator William Gibson, who for many years took an active part in railway and bridge building in this country. For 22 years he had charge of the construction of masonry work on the Grand Trunk system in Canada. He built the approaches and portals of the Sarnia tunnel and had charge of the doubling of the Victoria Jubilee bridge at Montreal.

ORDERS OF THE RAILWAY COMMISSIONERS OF CANADA

Each week on this page may be found summaries of orders passed by the Board of Railway Commissioners, to date. This will facilitate ready reference and easy filing. Copies of these orders may be secured from *The Canadian Engineer* for small fee.

21666—April 17—Authorizing C.P.R. to construct spur for J. E. Wilder, Montreal, Que., from point on easterly limit of right-of-way of main line, Farnham Subdivision, in Lot Cadastral No. 70-A, (Civic), Cote des Neiges Ward, city of Montreal.

21667—April 17—Authorizing C.P.R. to construct spur for Goold, Shapley and Muir Co., Limited, Regina, Sask.

21668—April 17—Authorizing C.P.R. to construct, at grade, tracks of spur for city of Moose Jaw across River St., in said city; and to construct, at grade, 2 tracks of wye connection on Main line, Sask. Div., across Manitoba St., and Second Ave., city of Moose Jaw, Sask.

21669—April 15—Authorizing C.P.R. to construct spur for city of Edmonton, Alta.

21670—April 16—Authorizing C.P.R. to reconstruct bridge No. 37.5 on Havelock Subdivision, Ontario.

21671—April 15—Authorizing Esquimalt and Nanaimo Ry. to construct siding for Empire Lumber Co., from a point on Osborne Bay Branch of its Railway, mileage 2.5, Vancouver Island, B.C.

21672—April 18—Approving location Pointe aux Tremble Ry. through town of Montreal East, Que.

21673—April 18—Authorizing Cedars Rapids Mfg. and Power Co. of Montreal to take an additional width for its right-of-way for its transmission line across certain lots in Parishes of St. Joseph de Soulanges and St. Ignace du Coteau du Lac, Province of Quebec.

21674—April 17—Directing that C.P.R. construct spur from point on its railway connecting main line with St. Lawrence and Ottawa Line, leading to Sussex St. freight yards, to and into premises of Dustbane Manufacturing Co., Limited, Tp. of Gloucester, Co. Carleton, Ont. subject to and upon certain conditions.

21675—April 18—Authorizing C.P.R. to construct a rearrangement of sidings for McGregor and McIntyre, Limited, on parcel of land lying north of its tracks and easterly of Shaw Street, North Toronto, Ont.

21676—April 18—Authorizing C.P.R. to construct spur for S. A. Early and Company, Limited, in Subdivision, Lot 26, Block 165, city of Saskatoon, Sask., on Co.'s main line, Sask. Division.

21677—April 18—Authorizing C.N.O.R. to construct across Scarlett Road, between Lots 36 and 37, Cons. 3, F.B., Tp. York, Ont., by means of a structure carrying highway over railway.

21678—April 18—Authorizing C.N.O.R. to construct across Jane St., between Lots 36 and 37, Con. 3, F. B., Tp. York, Ont., by means of structure carrying highway over railway.

21679—April 20—Directing that C.P.R. construct spur into premises of S. A. Hamilton Co., Limited, crossing First Ave West in city of Moose Jaw, Sask., subject to and upon certain conditions.

21680—April 18—Authorizing C.N.R. to construct across twenty-nine(29) highways in Province of Saskatchewan.

21681—April 21—Relieving G.T.R. from providing further protection at crossing of highway immediately east of Pike Creek Flag Station, Tecumseh, Ontario.

21682—April 22—Authorizing G.T.P. Branch Lines Co. and C.P.R. to operate trains over crossing by G.T.P. Branch Lines Co.'s tracks of C.P.R. Calgary to Edmonton Branch, in City of Calgary, Alta., without being brought to a stop.

21683—April 21—Amending Order No.18032, dated Nov. 13th, 1912, by adding after word, "Company," in 9th line of operative part of Order, words "less one-fifth of such cost, which is to be borne and paid by Village of Cardinal."

21684—April 21—Relieving G.T.R. from providing further protection at crossing of Colborne St., City of London, Ont.

21685—April 20—Authorizing, subject to terms and conditions contained in agreement, C.P.R. to construct highway crossing, at level, over its tracks, at McDougall St., in City of Port Arthur, Ont.

21686—April 22—Suspending "sine die," schedules of G.T.R. and M.C.R.R. in so far as they increase rates now charged on Caustic Soda and Bleaching Powder; disallowing schedule of P.M.R.R. in so far as it increases rates heretofore charged on Caustic Soda and Bleaching Powder; and directing that rates lawfully in force on said commodities immediately prior to effective dates of said schedules be continued in effect until further Order of Board.

21687—April 22—Authorizing, at its own expense, Board of Highway Commissioners for Prov. Sask., to construct highway crossing through station grounds of C.N.R. at Brancepeth siding, N.W. ¼ Sec. 27-46-23, W. 2 M., Saskatchewan.

21688—April 21—Authorizing C.N.R. to construct Seventeen (17) highways in Province of Alberta.

21689—April 25—Amending Order No. 20423, dated Sept. 25th, 1913, by inserting certain words and figures and adding certain clauses.

21690—April 27—Amending Order No. 21513, dated Mar. 16th, 1914, by striking out words, "the cost to be divided equally between the two companies," in 6th and 7th lines of operative part of Order, and substituting words, "the cost to be borne and paid by the Applicant Company."

21691—April 26—Authorizing C.L.O. and W. Ry. (C.P.R.) to take certain lands in town of Bowmanville, Co. Durham, Ont., for purpose of constructing a freight yard, and approaches thereto, subject to and upon certain conditions.

21692—April 23—Authorizing Cedars Rapids Mfg. and Power Co. of Montreal, to take additional width of 25 ft. for right-of-way of its transmission line across Lot 7, Con. 2, Tp. Cornwall, Co. Stormont, Ont., property of James Dingwall.

21693—April 28—Amending Order No. 21476, dated March 11th, 1914, by striking out words, "the bridge over," in recital of Order, and words, "bridge over the said," in operative part of Order.

21694—April 21—Relieving C.P.R. from speed limitation of fifteen miles an hour over railway between mileage 0 and 41, Golden to Spillimacheen, B.C.

21695—April 28—Authorizing C.P.R. to operate over Two bridges, namely, No. 15.6, Alta. Div., Lethbridge Sub. Div., and No. 91.1, Alta. Div., Lethbridge Sub division, Alta.

21696—April 27—Dismission complaint of Milton Pressed Brick Co., Ltd., of Milton, Ont., against action of C.P.R., in holding up construction work on their double tracking between Toronto and Guelph Jct., Ontario.

21697—April 28—Authorizing Kettle Valley Ry., to construct ,at grade, its ballast pit spur across highway between

21698—April 29—Authorizing C.N.R. to construct spur for P. O. Dwyer Co. across Elm Ave., through Blocks 112 and 113, Parkdale, Edmonton, Alberta.

21699—April 29—Authorizing G.T.R. to construct certain extensions to branch line, or siding, and spur therefrom, into premises of Maple Sand, Gravel and Brick Co., Ltd., Tp. Vaughan, Co. York, Ontario.

21700—April 29—Authorizing G.T.R. to construct siding into premises of Toronto Brick Co., Ltd., Tp. Scarboro, Co. York, Ont., near York Station.

21701—April 29—Authorizing Alberta Central Ry. to construct, at grade, its ballast pit spur across highway between N.E. ¼ Sec. 8 and N.W. ¼ Sec. 9-39-3, W. 5 M., and highway between N.E. ¼ of Sec. 8 and S.E. ¼ Sec. 17-39-3, W. 5 M., Alta., at mileage 34 west of Red Deer.