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A WEEKLY JOURNAL

For CIVIL, MECHANICAL, ELECTRICAL and STRUCTURAL ENGINEERS and CONTRACTORS

MONTREAL OFFICE:
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Vol. 16. Toronto, Canada, March 26th, 1909. No. 13.

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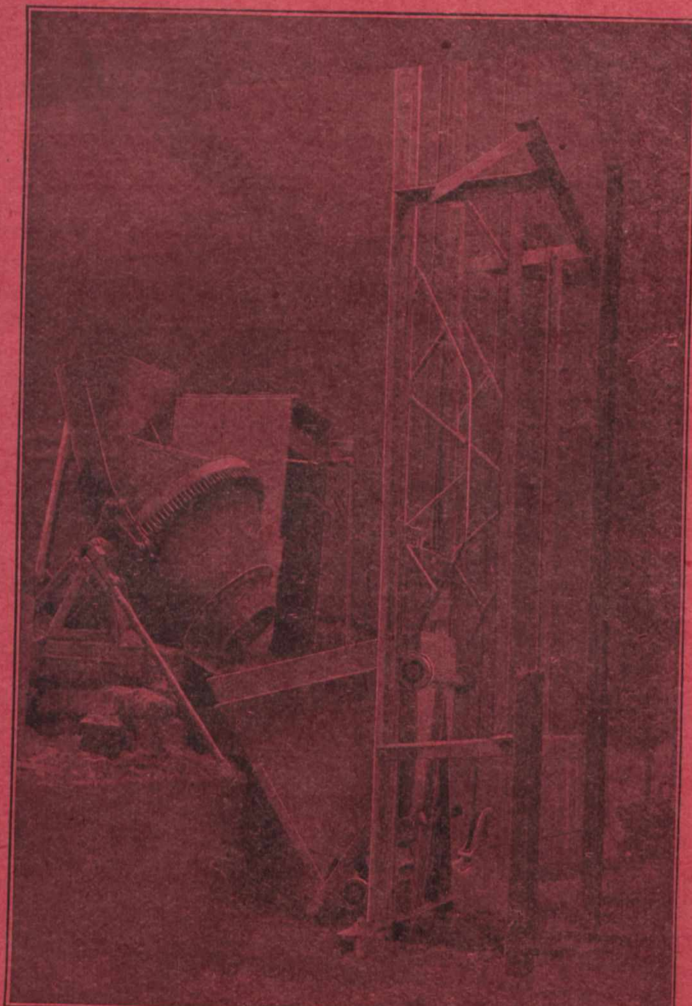

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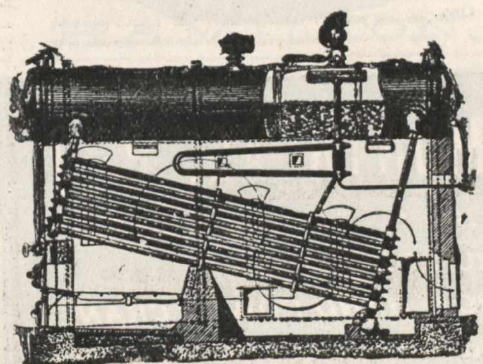

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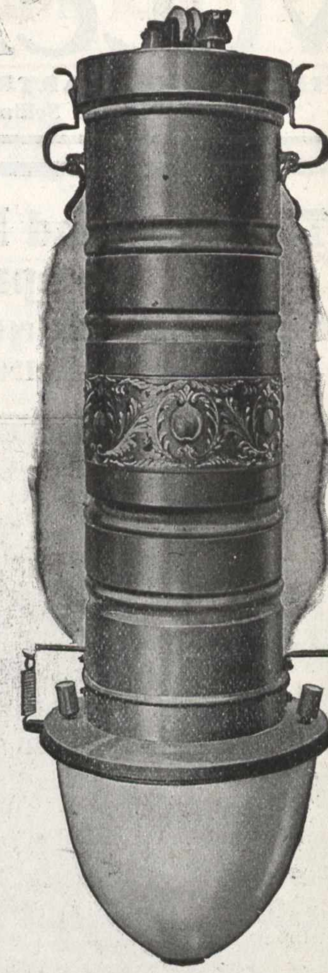

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The Canadian Engineer

WEEKLY

ESTABLISHED 1893

Vol. 16. TORONTO, CANADA, MARCH 26th, 1909. No. 13

The Canadian Engineer

ESTABLISHED 1893.

Issued Weekly in the interests of the

CIVIL, MECHANICAL, STRUCTURAL, ELECTRICAL, MARINE AND MINING ENGINEER, THE SURVEYOR, THE MANUFACTURER, AND THE CONTRACTOR.

Editor—E. A. James, B.A. Sc.
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NOTICE TO ADVERTISERS

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Printed at the Office of The Monetary Times Printing Co., Limited, Toronto, Canada.

TORONTO, CANADA, MARCH 26, 1909.

CONTENTS OF THIS ISSUE.

If you do not file your copies of The Canadian Engineer kindly forward us the issue for February 19th, for which we will extend your subscription one month.

TORONTO'S SEWAGE DISPOSAL SCHEME.

On Monday last the Council of the city of Toronto accepted by a large majority the proposed sewage scheme as amended by Messrs. Hering and Watson (experts).

We cannot see that there was any other course open to them under the present position into which the matter has grown.

We do not agree that the scheme presents any finality. On the other hand, something is gained by the concentration of the sewage at one point. The question of purification of the effluent before ultimate discharge into the lake may be considered at some future time.

It is to be regretted that when experts were called in to advise the city their instructions were not of a broader character than simply answering certain questions formulated by the city engineer. The question being considered is so large and the result so far-reaching that the attempt to report on a ten days' examination has very likely led the experts to report without considering the safest, most scientific, and ultimately the cheapest scheme.

They have, however, justified their services inasmuch as the main question affecting the neighborhood, viz., dealing with the sludge, is removed to some distance. Further, they have made it clear exactly what the city intends to do; and we know now for a fact that there is to be no attempt either to purify the liquid sewage or the sludge by any artificial method of sewage disposal, but that the lake will continue to take the liquid sewage and the sludge will be destroyed by a natural process of putrification.

The city of Toronto is a large and wealthy city. The city engineer has had many difficult and tangled engineering problems to solve, and none more important or more exacting than that which now engages his attention. A satisfactory solution he will surely find.

RESPONSIBILITY.

Already this year the number of new appointments as city engineers has been unusually large. In many cases the positions are made vacant because of dismissals—dismissals not because of incompetency, but because the city engineer's responsibility and power are not definitely prescribed, and he cannot exercise that firmness nor display the administrative ability which the head of such an important department should command. A city engineer should be made solely responsible for all the work of his department, and the council should delegate to him power commensurate with responsibility. Just so soon as the engineer permits interference in his department, whether in the nomination of assisstants, dismissal of employees, or the changing of plans and specificaions, it is absurd to hold him responsible for the work of his department or the character and extent of the work of his subordinates.

Frequently, city engineers have consented to the adoption of schemes fathered by aldermen, knowing full well, from an engineering point of view, they are unsuitable, and at times impracticable. In their efforts to please everybody they have attempted the impossible, and when failure comes those engineering-aldermen are the first to demand the retirement of the engineer.

The engineer who will refuse to accept the appointment unless given full power as to the selection of his staff and the arranging, designing and working out of engineering problems will save himself many anxious moments and do much to impress his employers with the idea that he is large enough for his work.

WATER SUPPLY.

In this issue will be found an interesting set of tables dealing with water consumption, and more particularly with water consumption in Canada and the cost of pumping. When the idea of preparing this table first occurred to us, we did not anticipate the many difficulties we encountered in compiling these figures. Over a hundred municipalities were requested to furnish information. One-third of that number responded. Many reasons may be suggested why so few of the officials were interested, but chief among these, we fancy, is the fact that their system of municipal accounting does not provide for the accurate cost keeping necessary to furnish reliable information. In a few cases it may be that the official did not feel that any good could come to his department from placing their returns side by side with those of other municipalities.

When publishing these returns, we recognized that in tabulating the figures furnished we are presenting costs based on systems far from uniform, and for that reason we shall be pleased to hear from our readers, criticizing the results and pointing out the inaccuracies which must be apparent to those who are familiar with the local conditions which cannot be allowed for.

An unlimited supply of water for domestic purposes, when free, leads to such abuses as indifferent plumbing, running taps in frosty weather, and unnecessary lawn sprinkling. Water waste should be carefully studied, and a comparison of returns is the first step.

EDITORIAL NOTES.

The title of a leading article in last week's "Engineer" should have read: "Skew Connections in Complicated Steel Structures, by Alexander Peden, Jr., A.M. Can. Soc. C.E.", a paper read before the Student Section of the Canadian Society of Civil Engineers in January, 1909.

* * * *

The Neptune Meter Co., of New York, have recovered judgment against the city of Halifax for the price of meters supplied to the city's water service department. The meters have proved effective in the saving of water, but someone conceived the idea of repudiating the account on a technicality. Fortunately for the city, such a farcical objection was not entertained, and the city's good name was saved.

* * * *

Gross receipts were shown for 1908 by the United States Steel Co. of $482,307,840, a decrease of $274,706,927 from the preceding year. The net earnings of the corporation were $91,847,711, a decrease of $69,116,963 from the year of 1905. This gives an idea of the great shrinkage in business in the United States. The report further shows that $16,965,181 was appropriated for depreciation, replacement and extinguishment funds, together with sinking funds on bonds of subsidiary companies, which is a decrease of $10,754,563 from 1907. The interest on bonds outstanding and sinking funds of the corporation was $29,247,851, an increase of $1,250,001 over the previous year. The production of rolled and other finished steel products for sale to customers outside of the organization was in 1908 only 6,206,932 tons, the lowest for any calendar year since the United States Steel Corporation has been organized. The prostration of the steel industry in the United States is reflected in the statement that the surplus for the year, after the payment of interest charges, appropriations and all other charges, was $10,342,886, a decrease of $4,836,851 from 1907. Then, after 1908 had expired, a continued decline in demand for steel and steel products led to the cut in prices which it was so fondly hoped would at once restore activity. But, says the Iron Age, last week: "Aside from a continued fair measure of activity in structural material, there has been no movement of much consequence in any of the finished lines. . . . It is understood that low prices have been named for structural material, and that 1.10 cents, Pittsburg, has been done."

DOMINION LAND SURVEYORS.

At the Dominion Land Surveyors examination in February there were thirty-four candidates up for the final examination, and of these 14 were successful:—A. J. Campbell, Toronto, Ont.; A. S. Campbell, Kingston, Ont.; H. L. Chilver, Walkerville, Ont.; A. Cummings, Fernie, B.C.; G. B. Dodge, Ottawa; P. N. Johnson, Edmonton, Alta.; G. H. McCallum, Ottawa; R. D. McCaw, O.L.S., Welland, Ont.; J. L. Rannie, Ottawa; W. A. Scott, Galt, Ont.; F. H. Sykes, Toronto, Ont.; A. Tremblay, P.L.S., Quebec, P.Q.; N. D. Wilson, Toronto, Ont.; C. R. Westland, Ottawa.

There were two candidates writing on the Dominion Topographical examination and one was successful, G. B. McColl, Winnipeg, Man.

COMING MEETINGS OF ENGINEERING SOCIETIES.

Architectural Institute of Canada.—6th April, 1909, general special meeting at 94 King Street West, Toronto.

Canadian Railway Club.—April 6th, Windsor Hotel, Montreal, 8 p.m.

Canadian Society of Civil Engineers.—(Manitoba branch), April 8th.

American Society of Civil Engineers.—April 7th, New York.

Nova Scotia Society of Engineers.—April 8th, Halifax.

Providence Association of Mechanical Engineers.—June 22, 1909, Annual Meeting. Secretary, T. M. Phetteplace.

Canadian Electrical Association.—Annual Convention at Quebec, June 16th, 17th, 18th, 1909.

American Water Works Association.—Annual convention, Milwaukee, Wisconsin, June 8th to 12th, 1909. Secretary, J. M. Diven, Charleston, S.C.

RAILWAY EARNINGS AND STOCK QUOTATIONS

NAME OF COMPANY	Mileage Operated	Capital in Thousands	Par Value	EARNINGS Week ending Mar. 20		STOCK QUOTATIONS — TORONTO				MONTREAL			
				1909	1908	Price Mar 19 '08	Price Mar. 11 '09	Price Mar. 18 '09	Sales Week End'd Mar18	Price Mar. 19 '08	Price Mar. 11 '09	Price Mar. 18 '09	Sales Week End'd Mar18
Canadian Pacific Railway	8,920.6	$150,000	$100	1,436,000	1,247,000	146¼ 145¾	166	167	75	146½ 146⅛	166	167¾ 167⅛	393
Canadian Northern Railway	2,986.9	....	....	169,400	142,800	....	....	....	....	....	....	....	....
*Grand Trunk Railway	3,568.7	226,000	100	710,526	685,552	....	....*1st. pref.104, 3rd pref. 44½, ordinary 18½				....	....	....
† T. & N. O.	305	(Gov. Road)	....	27,000	13,000	....	....	....	....	....	....	....	....
Montreal Street Railway	138.3	18,000	100	68,231	65,243	....	....	....	....	183 182¼	209 207	206¾ 206¼	37
Toronto Street Railway	114	8,000	100	67,259	62,680	98⅜	122	120	55	98¾ 98	122¼ 122	119½ 118½	162
Winnipeg Electric	70	6,000	100	....	....	143½ 142½	170 168	169	47	....	169	....	....

* G.T.R. stock is not listed on Canadian Exchanges These prices are quoted on the London Stock Exchange. † One week late.

CURRENTS AND SHORE PROCESSES IN LAKE ONTARIO.*

By Alfred W. G. Wilson, Montreal.

Introduction:—Within the last twenty-five or thirty years there has gradually grown up, as an offshoot from the Science of Geology, a science whose specific object is the systematic study of land forms, their characteristics, origin and history—the Science of Physiography. Under the impetus of new methods of investigation there have been marked advances made in our knowledge of the history of land forms and their processes of growth and disintegration. The results of these investigations have a very direct bearing on all engineering operations which attempt to guide or control those natural processes which product or modify topographic forms.

Shoreline processes and shoreline forms have been investigated by many observers, and many important papers have been published. It is only about ten years ago, however, that the subject was systematized by the recognition that there are progressive stages in the development of shorelines and shoreline topography; that initial forms, characteristic of newly formed lake basins or of sea coasts recently elevated, are followed by a sequential series of forms characteristic of later stages of the life history of shorelines, until extreme old age is reached. The life history of shores, the processes which are involved in the formation of shore zones and the later development of any given shoreline have all a very direct bearing on the construction and maintenance of docks and harbors on all our large water bodies, whether lake or ocean, on the presentation of coast lines, and to a certain extent on water supply and sewage disposal.

The problems presented by Toronto Harbor, Toronto water supply and sewage disposal form no exception to the generalization, and it is because of their bearing on these problems that the data given in this paper are here presented.

Only a summary of the results of a study of the shorelines, and shoreline processes on Lake Ontario can be given here, but, I wish especially to emphasize the fact that the processes described are world-wide in their operation, and that the land forms developed on the shore of the Great Lakes are forms characteristic of a certain stage of shore development wherever shorelines occur.

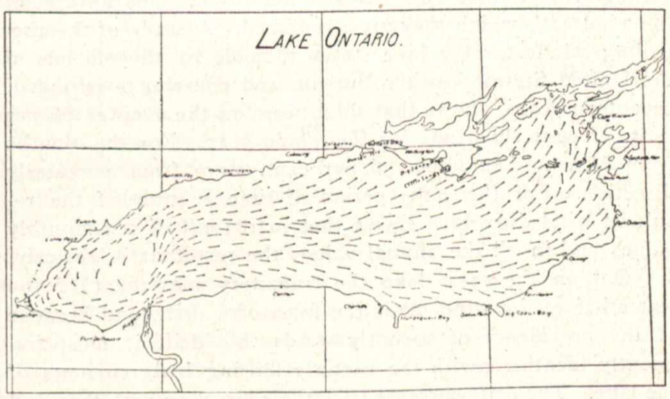
Geologic Processes on the Shores.

Movements of the Lake Waters:—Nearly all geologic processes on the shores of any water body are dependent on the movements of the water itself. The movements of the water of the Great Lakes are of four types—tide, seiche, current, and wave.

While the existence of periodic movements of the water of the Great Lakes corresponding to the tides is known, the amplitude of this movement is very small and in the present discussion it does not need to be considered. On all bodies of water exposed to the action of winds three distinct types of movements are developed—the seiche, the current and the wave. The current movement may also be developed directly or indirectly by gravity. All shore processes—degradation, transportation, aggradation and sedimentation, on a significantly large scale at least, must be through the operation of one or more of these movements, either acting separately or in conjunction.

The Seiche:—A wind blowing continuously for a considerable period of time in any given direction tends to force the surface water ahead of it and to pile it up on the lea shore. As a result the equilibrium of the water body as a whole is disturbed and a series of oscillations of the water body as a whole are set up. The amplitude of the seiche oscillation is directly dependent on the wind velocity and persistence in a constant or nearly constant direction. Its rate of propagation has been proven to be a function of the measure of the length of the water body in the direction of motion, and of the cross-section normal to this. As an agent of transportation when acting directly it is practically powerless. Acting indirectly through the operation of currents passing through narrow channels it may possibly be able to move some very fine materials, such as clay, held in suspension.

Seiche oscillations caused by strong easterly or westerly winds have at times a very marked effect on the depth of water in the harbors at the east and west ends of the lake. In the Bay of Quinte the seiche oscillation is frequently quite well shown and at Napanee a periodic variation of three feet or more is often noted.



Currents:—In 1892 and 1893 the United States Weather Bureau carried out a series of investigations on the distribution of the surface currents of the Great Lakes—bottle floats being employed. In his report on the results of the investigations M. M. H. Harrington groups the currents of the Great Lakes under four heads:—The body current, a surface current due to the prevailing winds, the return currents and surf motion.**

The body currents and the return currents may be regarded as constant. With these may also be associated the locally constant currents found at points of inflow and outflow of the main streams of the lake—the Niagara and St. Lawrence Rivers. At these points there is a small but constant current, really a portion of the body current of the main lake. Usually these local currents are too weak to be active transporting agents except in the immediate vicinity of the outlets or inlets. At the mouth of the Niagara River the discoloration of the lake water shows that a small amount of fine waste is carried out into Lake Ontario. Two miles off the mouth of the river the coloration has disappeared and the current has been merged with the general drift of the surface waters of the lake. The outer portion of the Niagara River current in Lake Ontario has been found to shift its position with the winds. The waters of the St. Lawrence where it leaves the lake are clear and practically free from sediment.

In Lake Ontario there is a slow general set of the mass of the water towards the outlet, while there is a pronounced vertical movement of the mass of water at the west end of the lake forming a backset eddy. Where by the action of the wind surface currents have driven more water to the eastward of the lake than can well pass through the discharge there must be more or less of a return current. In this lake no return current, so well marked as in the other great lakes of the system, has been found. The probability seems to be that in part it breaks up into smaller whirls along the great pockets of the coast on either side of the general current and that a considerable body of water is returned as an undercurrent.

The rate of the general east flowing drift is very slight, probably never exceeding twelve miles per day, more frequently being much less than this. The currents of the general circulation and the return currents are too feeble to transport even the finest sand which occurs along the

*Gulliver, Shoreline Topography Proceedings of American Academy of Arts and Science, vol. 34, 1899.

**Currents of the Great Lakes, Bulletin B., United States Weather Bureau, 1894.

beaches. They must, however, assist in the distribution of the finest silts and clays over the bottom of the lake.

The currents of streams tributary to the lake only effect the waters a very short distance from their mouths. After discharge, except for the first few yards of their course, the direction that the river water takes in flowing through the lake is determined wholly by the direction in which the lake waters at the point of discharge happen to be flowing at the time. Except in the immediate vicinity of the mouths of the streams in question these currents have no effect in modifying the lake shores.

With regard to the surface currents produced by the prevailing winds, their general direction is the same as that of the wind with which they are associated. A study of the prevailing winds for the lake stations, made by the officials of the United States Weather Bureau, and covering a period of seventeen years, shows that there were on the average 66 per cent. of westerly winds for the whole year. For the months from May to September 56 per cent. were from a westerly direction. For the same period of time a study of the resultant wind directions shows that in 183 out of 204 monthly values and in all the annual values the resultant is westerly.

Out on the open lake the transitory movement of the water before the wind takes the form of a drift, and because of the prevalence of westerly winds this drift is most frequently identified with the easterly flowing body currents of the lake. The drift currents vary their direction with the wind that causes them, usually starting a short interval after the wind has commenced to blow and continuing for some time, often several hours and occasionally several days, after the winds that caused them have ceased. Where this drifting surface water impinges on a shore a longshore current is developed, the direction of the current being dependent on the angle at which the drift impinges on the shore. These currents, which for convenience may be designated wind currents, are seen during wind-storms, and reach their maximum velocity at times of the strongest storms. They are so intimately connected with wave and surf movements that both must be considered together. It is when they act in conjunction that active erosion, transportation, and deposition take place. During a period of heavy storm a longshore current may require a velocity as great as four miles an hour.

The occurrence of undercurrents, moving in a direction contrary to that of the surface current or of the prevailing wind is a common feature. They will be caused wherever in any part of the lake the water is piled up above the mean level, since the head of water thus raised forces a portion of the water back as an undercurrent. They are also frequently formed when there is a change in wind direction following the development of a strong longshore current. The momentum acquired by the water will often maintain a strong undercurrent a little way off shore, for a long period after the direction of the longshore currents on the surface has changed.

Waves.—The same wind that generates a surface drift which becomes a longshore current where it impinges on the shore also develops waves. At a few points the water of a wave may roll up on the beach at the shoreline and run directly back again, but only at those points where the shoreline is parallel to the wave front. On the shores of the Great Lakes, where the shorelines sweep in great open curves with chords often from 4 to 8 miles in length, the wave front very frequently advances at such an angle to the shoreline that the waves roll up the beach obliquely. Where this happens the water never returns by the same path that it came, but runs off obliquely; so that material on the beach when moved by the waves tends to travel along the shore by a zigzag path, the angle at which the wave strikes the shore determining the angle between any two limbs of this path of travel.

Inter-relations, Waves and Currents:—Along a stretch of lake shore where the waves are impinging obliquely and where a number are always breaking at once, the tendency will be for the waves themselves to generate a longshore current flowing in the direction in which the bisector of the acute angle between the wave front and the shoreline points. This wave-generated current is always accordant with the longshore drift current caused by the same wind, and as they operate together in shore transportation they may be referred to simply as the longshore current.

After the wind which has started the waves and currents has ceased to blow, the swells still continue for some time, and even after the swells have ceased to be perceptible the longshore wind current remains quite strong, the momentum which the water acquired during the period of storm not being expended for some time after the storm has ceased. It not infrequently happens that a new wind from a different quarter may spring up and start to generate a current in an opposite direction. This affects the surface water first, while the lower water still retains the motion in the original direction, also the water immediately along the shore is affected to the bottom some time before the deeper water off shore has had its momentum destroyed and its direction of flow changed.

Transportation During Storms by Wave-Generated Longshore Currents.

In the shifting of materials along the shores the only effective agents of transportation are the wave-generated longshore currents and the waves associated with them. Transportation of all but the finest materials ceases as soon as the swells disappear, and is at its maximum at the time the waves are largest. The longshore currents of themselves are usually not strong enough to hold even fine sands in suspension for any length of time—as may readily be ascertained by experiment, or as is shown by the rapidity with which the water in the shore zone clears as soon as the waves cease. Clay in suspension is carried for some time by longshore currents, and also by the currents of the general circulation; sands and all coarser materials along the shores cease to move as soon as the agitation caused by the swells stops, they are transported both by waves and currents. The very coarse materials—cobbles and boulders—are shifted almost wholly by the waves.

The Supply of Waste:—Bedrock exposures on the shore of the lake are few in number. For the most part the materials found on the shores and adjacent to them are fine clays and silts, sand and gravels, cobbles and boulders. The clays and silts in large part are derived from similar materials in situ and are brought to the shores by various processes, in small part they are produced at the shore by the grinding of the coarser materials upon one another, and upon bedrock. The sands are derived almost wholly from sands of glacial origin. The gravels and cobbles come from beds of till in large part; along those portions of the shore where there are exposures of bedrock almost all of them are derived from the rock in situ, a small amount of glacial material being mixed with the rest. The boulders and large blocks are usually of glacial origin, though here and there one may note blocks of the adjacent bedrock shifted only a short distance from its source.

Distribution of the Waste on the Shores:—The waste supplied to the shores from the different sources is spread out in a nearly even sheet parallel to the shoreline; much of the finer material is carried out rapidly to the deeper waters and there deposited, while the sands and coarser debris are shifted along the shore within the limits of the wave swept zone. Most of the active transportation takes place during greater storms; during a period of light winds only sands and fine gravels are moved. Probably the greatest amount of transportation takes place during the period of autumn storms, though a very considerable movement takes place in the spring. During the summer months, except when there occurs an unusually heavy storm, transportation is very slight. During the winter months when the shores become lined with ice, transportation of all materials except sands and silt is at a minimum.

In the shifting of waste along the shore it is being moved locally now in one direction, now in the other, according to the wind direction. It is found, however, that a single great storm will undo the work of many previous gentler winds. A study of the transportation conditions along the shores of both lakes shows that two distinct resultant shifting movements may be recognized. On the north shore it has been found that in the vicinity of Whitby there is a division point west of which the resultant shifting movement is west, and east of which the resultant movement is east. The corresponding nodal point on the south shore lies somewhat west of Charlotte. The general eastward and westward shifting of the shore waste is also shown by the direction of transportation of certain well-known and easily recognized materials, such as fossils from known horizons, and also by the manner in which waste accumulates around docks and other obstructions, whether natural or artificial. It is also well shown by the forms of the various constructional features of the shoreline.

This systematic resultant movement of the waste towards the east and west ends of the lake respectively from distinct nodal zones near the middle of the length of the lake, is seen to be directly associated with the size of the storm waves. In Lake Ontario storms from the southwest will roll waves of maximum size on the northeast shores, the wind and waves having a free sweep toward this section of the shore over the longest part of the lake. Similarly storms from the southeast and east will roll maximum waves toward the northwest shore of the lake. It is these storm waves with the strong longshore currents associated with them that perform the maximum amount of transportation, and are the cause of the resultant shifting movements in the directions indicated.

Not only from actual observation may the waves be seen to be greater at the eastern and western ends of the lake than towards the middle zone at times when storms are blowing toward one end or the other of the lake,but the greater power of these waves is well shown in the height and character of the storm beaches along the shores. Near the middle of the lake on both shores the storm beaches of course debris lie about six feet above water level. At the eastern and western ends they lie about fifteen feet above the same level, being a little higher at the east than at the west end. Also at or near the middle of the north and south shores below the storm beaches there is a large accumulation of finer pebbles, gravel, and sand. At the ends of the lake the entire beach is at times made up of very coarse materials, the finer having been rolled out below the calm water level. Wave-base will also lie deeper below the mean level of the lake at the east and west ends than near the middle of the north and south shores.

Character of the Shoreline:—In its initial stages the shoreline of the basin now occupied by the present lake must have been very diverse in character. All later shore processes have tended to smoothen out these initial irregularities producing the long sweeping curves and beaches of graded waste that are its most characteristic feature. In the process of straightening and grading headlands were truncated; lines of sea-cliffs were formed, and bars and barrier beaches were built across many of the originally deep bays.

The barrier beaches which have formed the broad lagoons at the east end of the lake and also at Burlington Bay are the most notable of these. Among other shore forms which are characteristic of the present stage of development of the shores of all the lakes is Toronto Island, a form technically known as a flying spit.

Toronto Island:—Lake Ontario stood at its present level long enough prior to the formation of Toronto Island to cut a sea-cliff along the shore that now forms the mainland adjacent to the harbor. The old beach line can be traced for some distance east of the Don, but opposite the eastern end of Ashbridge's Bay, if the old abandoned beach exists, it is not readily distinguishable. There is enough of the earlier beach discernible to show that Lake Ontario waves were once actively cutting at the Don mouth, from which it is inferred that at that time the Don delta was not encroaching on the lake shore. The formation of Toronto Island has been, geologically speaking, recent. Its present location, form and growth are the result of action of several processes whose mode of operation is well understood.

As might easily be inferred, and as has been shown by actual observation in numerous instances, abrupt changes in the trend of the shoreline may frequently cause well defined longshore currents to be carried past the salient and out into deep water, where of necessity they will gradually lose their velocity and discharge the greater portion of their load. Raby Head, near Port Darlington, is just such a locality. On a number of occasions when strong storms were blowing from the southwest the writer has observed the waters of the longshore current moving eastward along the coast and discharging into the clear waters of the lake off Raby Head. The discolored water, which marked the course of the current, could readily be seen for as much as three miles east of the head, lying probably about two miles off-shore, with clear blue water between it and the mainland.

Coming west from Scarboro along the lake shore, one readily notes that there is a rather obtuse angle between the shoreline in front of the bluffs and that of the old beach back of Ashbridge's Bay and Toronto harbor. At Scarboro and Toronto the strongest waves and associated longshore current would come from the east and southwest in former times as now. Because of the marked change in the trend of the coastline, the longshore westbound current would tend to discharge out into the lake at the point where the relatively abrupt change in the direction of the shoreline took place. The cliffs at Scarboro would supply an exceptional amount of loose debris, much more than is found anywhere else along the north shore. The result would be the construction of a flying spit from Scarboro waste reaching out into the lake from the point of discharge of the shore current. This spit would gradually increase in length and also tend to broaden. In time it would protect the land adjacent to the mouth of the Don from eastern storms. Such storms as come from the west would not only be weaker agents of shore processes, but would tend to force the debris which the Don was discharging back into the bay, between the flying spit and the shore. In the early history of the lakes and of the bar it seems probable that the greater portion of the debris from the Don, like that from all the other streams up to the present time, was distributed along the shores by the shore processes, and that no distinctive delta was built up. In later times the protection afforded by the young Scarboro spit guarded the mouth of the Don from master storms, and forthwith it began to build up a delta, and, during the course of delta formation, to aid in filling of what is now called Ashbridge's Bay. The westward progress of the spit was, however, far more rapid than the Don filling, so that in time the portion that now forms Toronto harbor was built west of the Don mouth.

At first the flying spit would be narrow and ridge-like, but as the apex advanced into deeper water its progress westward would be slower, giving time and opportunity for storms from other than the dominant direction to variously modify its apex. The general history of all such spits seems to be that when they reach deeper water the outer end shall be turned shoreward by waves and currents from deeper water offshore. The combined action of forward building and shoreward spreading lead, in this as in other cases, to the broadening and hooking of the free end of the spit, and incidentally to the inclosing of a number of lagoons between minor bars built at successive intervals, according as the longshore or transverse processes were more active.

Conclusions:—Toronto Island as it stands to-day owes its existence to the inter-relations which have existed between **Shore Processes of Transportation** and the **Supply of Waste.** Interference with either of these will immediately be followed by other changes and modifications on all parts of the Island. It is possible to retard the operations of the shore processes, it is possible to reduce the supply of waste—but it is extremely rash to undertake operations of any nature which will tend to destroy the **balance** which has existed between the two, without carefully considering the effects that will necessarily be produced, and taking such precautions as may be needed to insure that these consequent effects shall not be injurious.

Put an obstruction across the path of the travelling sheet of waste, anywhere in its course, immediately accumulation will begin east of the obstruction. A diminution of the supply of waste west of the obstruction will immediately be followed by an attack of the erosion processes on those portions of the beach which are robbed of their protective cover of moving waste.

The piers at the Eastern Gap are checking the travel of waste westward. This is shown by the marked accumulations east of the piers. The equally marked recession of the beachline west cf the Gap was a necessary result of this stoppage. Were it possible to check completely the westward movement of the shore waste at this point the destruction of all that portion of the Island which lies west of the Gap would soon fol'ow. To maintain the present beachlines it will be necessary to adopt measures that will check the operation of the waves and currents of the lake on that portion of the beach which is deprived of its normal supply of waste. The method adopted should be cne that has been proven to be efficient under conditions similar to those which will exist along the beach west of the Gap.

With reference to the preservation of Toronto Island there is still another consideration, which has, so far as I am aware, never been taken into account. The landholders who own the properties along the shores at Scarboro have been losing thousands if not millions of cubic yards of material annually. To them this has been a direct financial loss, though if they have appreciated it, they certainly have failed to take any efficient steps to curtail the losses. Some day they will wake up to the fact that unless adequate steps are taken to retard the erosion of the sliffs nothing will be left to them. As soon as steps are taken to preserve the cliff fronts at Scarboro the supply of waste which uses Ashbridge's Bay bar as a rcad by which to reach the dumping-off place at the west end of the Island, will be reduced. With a reduction of the waste supply there will be a readjustment of the shore forms and shorelines. The cutting through of the bar will follow almost immediately, and its destruction will then be a matter of a very short time unless steps are immediately taken to check the action of the waves and currents along the bar in a manner similar to that now required west of the Eastern Gap.

In the second place, and this has a more direct bearing on the problem of sewage disposal and water supply now under consideration; there is indisputable and incontrovertible evidence that the resultant movement cf all solid materials at the shore zone is westward, no matter what may be the direction of local movements at any given time. This movement is always associated with and accompanies the longshore currents movement, hence there is a master movement of the longshore currents westward. These currents extend out from the shore to beyond wave base.

It is also known, largely from investigations of the United States Weather Bureau, that in the western end of the lake there is a nearly constant movement of the waters as a **backset eddy.** Where the edge of this eddy approaches the north shore near Toronto Island and westward, even during the periods when the movement of the surface water along the north shores is eastward, there is every reason to believe that this backset eddy continues on its course.

The local longshore currents westbound off Scarboro sometimes attain a velocity of nearly four miles per hour during a period of strong easterly winds. This means that any waste which would float or mix with the waters of the lake would occasionally reach the western end of the Island within two and a half hours from the time when it was discharged into the lake at any point near Victoria Park.

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THE
Sanitary Review
SEWERAGE, SEWAGE DISPOSAL, WATER SUPPLY AND WATER PURIFICATION

MONTREAL: "ITS HEALTH CONDITION."

Dr. E. P. Lachapelle, president of the Provincial Board of Health, lately addressed the Canadian Club on "Montreal of the Future."

In this connection the doctor points to three main factors requiring consideration: "A Proper Water Supply," a "Proper System of Drainage," and a "Broad System of Town Planning."

At present the citizens of Montreal drink unfiltered river water, the river receiving the untreated sewage.

The mortality rate is 25 per thousand, the average rate for cities of equal size is 18, and is in some cases as low as 14. The city has just come through a winter typhoid epidemic, the origin of which appears to unnecessarily puzzle the authorities. Typhoid may be said to be endemic in Montreal, and may become epidemic at any time.

Dr. Lachapelle sees no solution in the proposal to extend the water supply intake into the centre of the river. He rightly concludes that such surface water is, and must always be, subject to contamination, with a tendency to an increased degree of pollution in proportion to the increase of population and river traffic. He, therefore, advises that some method be adopted of purifying the river water before it is delivered for supply, and before any method is adopted he further advises experimental work with the waters of the St. Lawrence in order to justify the selection of any particular method. Here is sound scientific advice, which may mean the saving of unnecessary expenditure.

There are various methods of filtration and sterilization, with a combination of both, any of which may be best suited to the particular water under consideration.

With reference to the questions of "Sewerage" and "Sewage Disposal," the doctor points out that a comprehensive system of sewers on reorganized lines is required, which would make practicable the adoption of a method of disposal with a view to purification of the effluent. He predicts that the Legislature will shortly pass laws prohibiting the pollution of the St. Lawrence River.

The appointment of a commission of three experts is advised—one representing the Government, one the city, and the other the municipalities—this Commission to advise on the best system of sewerage and sewage disposal for the "Future Montreal."

In order to show locally what can be done in the matter of sewage disposal, the Provincial Board of Health are installing a plant for the new jail at a cost of $30,000.

The citizens of Montreal should be thankful that they have not only an eminently scientific mind at the head of the Provincial Board of Health, but also that this mind appears to grasp the practical and business end of the matter.

The total mileage of government railways in the Commonwealth of Australia, which has a population of about 5,200,000 at the close of the fiscal year 1908 was 14,662.

THE RECENT TYPHOID EPIDEMIC IN MONTREAL.

That an outbreak of typhoid should occur in Montreal in the winter season appears to many in the light of a mystery.

We note that Mr. Hilder Daw, civil egineer, of Montreal, puts the cause down to the want of sufficient sewer flushing during periods of severe frost. At such a time, owing to the frozen condition of all surface water, the sewers present conditions analogous to times of severe drought. He points out that the bacteria of typhoid may be emitted from manholes, upcast vent pipes, and by defective sanitary fittings, and that there may be a greater tendency for such emission when the flow of the sewers is sluggish owing to want of flushing.

Without going into the question as to what extent the infection of typhoid can be carried by sewer air and particles of sewer matter, there appears to be an important sanitary point raised affecting non-self-cleansing sewers during periods of frost when all surface flushing water is cut off.

That the sewers of Montreal are in this non-self-cleasing condition with the natural flow of sewage points to defective conditions accounted for either by insufficiency of gradient not allowing of self-cleansing velocities, that the sewers are of bad construction, or that this may be simply the effect of adopting the combined drainage system for both surface water and sewage.

The above points appear to be of a character which will come under the immediate scope of the commission proposed by Dr. Lachapelle.

Theories and theorizing as to just how a typhoid epidemic may have its origin in a city where the disease is endemic are seldom final or sufficiently comprehensive. The general hygienic conditions must be taken as a whole. No doubt the infection is carried by intestinal excremental discharges, but just where the various connections and points of contact come in as between sewage, water, milk and food, it is difficult to be dogmatic.

One thing is certain in the light of present knowledge, and that is, that there is no such thing as spontaneous generation. No amount of putrefying organic matter will develop a typhoid bacillus any more than it can develop a rabbit or a whale. The typhoid bacilli is there to commence with. There were no rabbits in Australia until they were introduced. The typhoid bacilli will not disappear from Montreal until such comprehensive measures are thoroughly taken as are so ably advised by the president of the Provincial Board of Health.

SIZE OF SAND GRAINS FOR WATER FILTRATION.

The question of whether a fine or coarse grained sand is to be adopted for water filtration depends on several considerations. For lake water containing very little sediment a fine sand may be used of a character which would be impossible with many river waters. The finer the sand grain the greater the bacterial removal efficiency, accompanied, however, by a slow rate of filtration, and increase of cost in removing the sediment scum.

The measurement size of a grain of sand is taken as being equal to a sphere of equal volume. The size of a particle of sand being irregular the longest possible diameter is taken along with the two axis at right angles, the cube root of their product being approximately equal to the mean diameter.

It is impossible to obtain sand of which the particles are equal in size, but the more uniform its character the better. When coarse and fine grained sands are mixed the finer particles are generally removed in washing, the tendency being for the effective size to increase.

The effective size in sand grain measurement is determined by the conclusion that 10 per cent. by weight of the total material in finer particles exerts the same influence as the remaining 90 per cent. of coarser particles; the reason being that the finer particles occupy the pores between the larger particles. Water flows easily over the larger particles, but trickles slowly through the finer which surround them. Therefore, whenever the effective size of a filtering material is given, it simply represents that 10 per cent. of the material is less than this effective size, and that 90 per cent. is coarser.

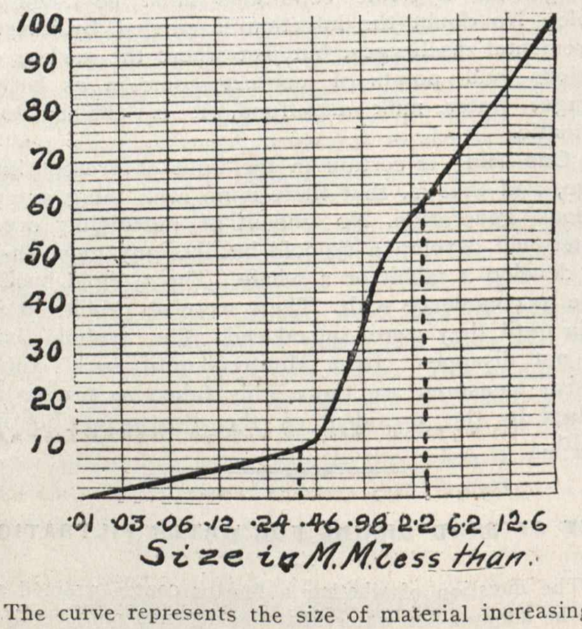
To take an example, we will refer to Lawrence Filter No. 6 result of examination of size of material. The filter is composed of material as follows:

Size in M.M.										
less than	12.6	6.2	2.2	.98	.46	.24	.12	.06	.03	.01
Per cent. .	83	73	57	32	13	7	4	2	.5	0

Ten per cent. of the material is to be found between the percentages 13 and 7, and the size of which this 10 per cent. is less than is between the sizes .46 and .24, viz., .35, which represents the effective size of the material for the above filter.

As well as the effective size, the uniformity coefficient has to be taken into consideration. This coefficient determines the coarseness of the material in the remaining 90 per cent. With very coarse material this uniformity coefficient is high, and with fine material low. This figure has been arrived at by experiment, and it is assumed that the uniformity coefficient is found in the ratio of the size of the grain, which has 60 per cent. finer than the total and the size which has 10 per cent. finer than the total.

To illustrate both the effective size and the uniformity coefficient, the following diagram is referred to, representing the material in No. 6 filter above noted.



The curve represents the size of material increasing in coarseness. Where the 10 per cent. line crosses the curve we have the point which marks the effective size, viz., .35. Where the 60 per cent. line crosses the curve we have the size 2.73, 60 per cent. of the material being finer than this. By dividing 2.73 by .35 the ratio 7.8 is obtained, this figure representing the uniformity coefficient.

The material of filter No. 6 would then be described as having an effective size of .35 M.M., and a uniformity coefficient of 7.8. This represents a fairly coarse material with a uniformity coefficient much greater than generally adopted for water filtration.

It has been found by experience that the size generally best suited to sand filtration is, when the grains have an effective size of .30 M.M. and a uniformity coefficient of 2.00.

Mr. H. W. Clark, chemist at the Lawrence Experiment Stations, has given the analyses of various samples of sand collected from European plants as follows:

Source.	Effective size 10 per cent. finer than (millimeters)	Uniformity coefficient.
London, E. Co.	.44	1.8
London, E. Co.	.39	2.1
London, E. Co.	.37	2.0
London, Lambeth	.36	2.3
Middlesborough	.42	1.6
Birmingham	.29	1.9
Antwerp	.38	1.6
Hamburg	.28	2.5
Altona	.32	2.0
Berlin	.33	1.9
Charlottenburg	.40	2.3
Chemnitz	.35	2.6
Mageburg	.39	2.0
Zuric	.28	3.2
Hague	.19	1.6
Amsterdam	.17	1.6
Liverpool	.43	2.0

Unwashed sand, even when fresh, presents sometimes comparatively large proportions of albuminoid ammonia, especially is this the case with river sands. In Europe it is generally the custom to wash even new sands, not only for cleansing purposes, but in order to remove the finer particles. Sand containing lime is to be avoided, as the lime will be taken up by the water and produce hardness.

In sand filtration it is now understood that the sediment film which forms on the surface retains the bacteria. With a fine sand the film layer forms readily, it, therefore, presents high bacterial efficiency, on the other hand the filter quickly clogs up, and the fine sand is more difficult to wash and the expense in consequence much increased.

THE SEPTIC TANK.

Chap. II.—Continued.

Recent Information as to Work Done.

Having in our last issue considered the question of sludge digestion, we will proceed to deal with the second claim, "A tank effluent in the best possible condition for either irrigation or filtration."

Septic Tank Liquor.

Conclusion in the Royal Commission Report on Sewage Disposal: "Domestic sewage which has been passed through a septic tank is **not more easily oxidized** in its passage through filters than domestic sewage which has been subjected to chemical precipitation or simple sedimentation." This is an extremely important point in the purification of sewage There is not the slightest doubt but that the septic tank claim in this connection has had general acceptance. Even among those who doubted the sludge elimination claim, there were many engineers to be found who have adopted the process in the full belief, that, a more readily oxidised tank liquor was produced than could be done by either simple or chemical sedimentation.

So important did the Royal Commission consider the point that they instituted special experiments by their own chemist at Dorking (England). "For the purpose of the experiment three identical percolating filters were constructed. One was fed with settled sewage, one with sewage which had been subjected to chemical precipitation, and one with septic liquor." (See para. 34, Report.) Mr. Eric H. Richards (the chemist) carried on the experiments for over a year, and conclusively proved, that, in the case of domestic sewage, septic tank liquor is not more easily oxidized in its passage through filters than other liquids. The Report goes on to say (para. 35): "The results of careful experiments previously carried out at Rochdale by Mr. Platt, at Leeds by Mr. Harrison, at Huddersfield by Mr. Campbell, and at Sheffield by Messrs. Wike and Haworth, at all of which places the sewage contains trade effluents from manufacturing processes, agree with our Dorking results."

Turning once more to the Hamburg experiments, Dr. Dunbar states (page 88): "I am unable to advance any theoretical considerations which would support the opinion that a septic sewage is more amenable to biological treatment than fresh sewage. The septic process changes the character of the disolved organic solids in the sewage in such a way that their powers of absorbing and of being absorbed are undoubtedly diminished. Instead of the easily decomposable bodies present in fresh sewage there are deposited on the surface of the filtering material bodies which are with difficulty decomposable, and which, therefore, accelerate the clogging of the filter and disturb the absorptive processes which should take place."

Here we have a very strong statement, it being claimed that septic liquor is even inferior to fresh sewage liquor for purposes of filtration. In fact, that any slight chemical change which the organic matter in solution may undergo has a tendency to clog the filtering material. At Hamburg it was found that contact beds could be filled six times a day with fresh sewage and yield satisfactory effluents, whereas, they would only take septic sewage twice a day.

In this consideration of septic liquor and after-filtration it must also be noted the tendency of the amount of suspended solids to increase, if full benefit is to be obtained of any sludge elimination. The special experiments carried out by the Royal Commission at Exeter and Ilford by which it was shown that there was a sludge elimination of 25 and 30 per cent., respectively, extended over two years, during which time the tanks were not cleaned out. We have noted that the solids in the tank effluent increase enormously in much shorter periods than two years; in fact, during the first few weeks working. With continuous septic treatment coarse filters may, therefore, be essential, whereas, it is established that the finer the filtering material, the more efficient will the effluent be, both chemically and biologically.

We find in the Royal Commission report (para. 40): "Although the point is not one in regard to which any general rules of a precise character can be laid down, we are inclined to think that in the case of small sewage works, constructed to serve populations of, say, 100 to 10,000, it would be best that septic tanks should be allowed to run, without being cleaned out, so long as the suspended matter in the tank liquor showed no signs of affecting the filters detrimentally, provided that the tanks were never allowed to become more than one-third full of sludge. In the case of towns with populations from 10,000 upwards, we think it advisable partially to clean out septic tanks at short intervals."

In the face of the above findings and experiments we must certainly conclude that this second claim advanced by the adherents of septic action has also not stood the test of experience.

Destruction of Pathogenic Germs.

We now come to the third claim which has been advanced for septic action, viz., the elimination or destruction of pathogenic germs. We will again note the words we quoted from septic tank literature: "With the exception of two, or possibly three, all pathogenic germs are aerobic. The unaerobic conditions provided in the septic tank are calculated to destroy them."

The Royal Commission state, (para. 33, Report): "We find as a result of a very large number of observations that the sewage issuing from septic tanks is, bacteriologically, almost as impure as the sewage entering the tanks." This claim of bacterial elimination efficiency is not so strongly advocated, perhaps, as the first and sec claims, but the inference is plainly made that we may calculate on all aerobic pathogenic germs being destroyed. We may here note that two, or possibly three, of the pathogenic germs are said to be anaerobic, and no claim is set up that these are destroyed. The typhoid and cholera organisms grow perfectly well in either aerobic or anaerobic conditions, and most of the pathogenic germs have this dual faculty.

That bacteria are removed from sewage by sedimentation is an established fact. The germs are not as a rule in a free state in the sewage, but are in colonies, generally, in connection with particles of suspended matter. The settlement of the suspended matter, therefore, removes from the sewage a large per centage of these organisms. At Clifton (England), with ordinary sedimentation, 90 per cent. of B. coli are removed from the raw sewage, and from 60 to 70 is a general percentage of removal. In the case of septic treatment, however, and removal by sedimentation appears to be compensated for by an equal return of organisms to the supernated liquor by the sludge putrefactive process. The continued bubbling up of gases from the sludge, as well as carrying upwards small particles of matter, carries up germs, and so impregnates the tank liquor. B. coli analyses of septic liquors showed no reduction at the following works in England: Accrington, Andover, Caterham, Exeter, Guilford, Hartley, Whitney, Manchester, etc.

In connection with the Hamburg experiments Dr. Dunbar says with reference to the view that pathogenic germs are destroyed in septic tanks: "This is by no means the case. . . . I have had experiments carried out with a cholera-like vibrio, which, as regards resistance, is quite comparable to the extremely sensitive cholera vibrio. Our experiments showed that these micro-organisms remained active for thirty-three days in a septic tank, and only ceased to be recognizable after this period."

It must now be apparent that the above noted claims in connection with septic treatment of sewage have not stood the test of time and experience. Just why these assumptions have ever gained the ground that they have it is difficult to say. No doubt erroneous conclusions have resulted from an imperfect knowledge of the real actions and reactions which take place in putrefactive processes. At the present time. many of our apparently established theories of the principles attending the nitrification and decomposition of organic substances are undergoing severe shocks, necessitating modifications. In America, generally speaking, there has been a greater tendency to accept septic treatment without questioning than there has been in Europe. In fact, so strong a hold has the term "septic" taken on the minds of some people that the general term "sewage disposal" has almost been supplanted by the process term "septic." This is especially so in Canada. It is common in the case of municipalities about to adopt sewage disposal to find su-h described as a proposal to adopt "septic tanks," no matter what the method of treatment may really be.

(To be continued.)

QUESTION AND ANSWER DEPARTMENT.

Ratepayer, New Toronto, asks: "Do the patents covering the septic tank process cover also aeration and filtration of the outlet sewage."

We must refer you to the article in issue of 12th inst. on the Septic Tank, in which the findings of the Court of Appeal are fully given in the case of The Septic Tank Company vs. The Saratoga Springs, New York, Municipality. From this decision, as far as the United States are concerned, the patents certainly cover the adoption of the process of sludge dissolution, both as far as the septic tank is concerned and in the case of this tank process being used in conjunction with aeration or filtration operations. No legal decision has, as far as we know, been given in Canada, in the question of the validity of the patents. No royalties can be collected on tanks which make provision for regular removal of the sludge and in which no advantage is taken of the septic process of sludge putrefaction in the tanks.

B. Coli.—The Hamburg experiments have been carried out for a period of over nine years. Dr. Dunbar is simply the chief of the "Hamburg State Institute of Hygiene" and has had charge of the experiments. The results of the experiments have been separately published in State papers; but the publication of Dr. Dunbar's book and its translation into English has brought the results of the experiments in a concise manner before the English-speaking public. The date of publication was after that of the 5th Report of the Royal Commission on Sewage Disposal.

Ammoniacal Nitrogen in Sewage Tests.

As ammoniacal nitrogen in parts of 100,000 is used as an estimate of sewage strength in the tables referring to strong, medium and weak sewage in Royal Commission Report, we have been asked how the ammoniacal nitrogen can be determined from ordinary sewage analyses.

Ammoniacal nitrogen may be arrived at by multiplying the amount of free ammonia in parts of 100,000 by 14 and dividing by 17. Thus supposing a sewage to contain free ammonia in parts of 4.75 in 100,000. Then free ammonia

$$4.75 = \text{ammoniacal nitrogen} \quad \frac{14}{17}(4.75) = 3.91.$$

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BURNING DEBRIS FROM SEWAGE.

For a considerable period the Metropolitan Water and Sewerage Commission of Massachusetts have followed the practice of compressing into blocks the material collected with their screens before the sewage enters the pumps and utilizing it for fuel beneath their boilers. They early learned, however, that the brick-work was burned out very rapidly whenever this fuel was used in connection with externally fired boilers. On the other hand it was found to have no effect upon the steel plates. As a result internally fired boilers have been adopted.

In the recent installation made at Deer Island, in accordance with plans by F. W. Dean, engineer, of Boston, a number of horizontal return tubular boilers were to be replaced by those of the internally fired type. Scotch boilers were adopted, the combustion chambers being made of steel plate with water spaces and without brick-work, except in the bridge walls and around the fire doors. All objectionable effect of the gases from the sludge was thereby avoided. The compactness and convenience of this type is shown by the fact that they met the requirements where there was insufficient room for vertical boilers, and where the locomotive type could not be used because of lack of space to remove and replace the tubes. But with the Scotch type the tubes could be drawn within the firing space of the boiler house.

IRON AND STEEL OUTPUT IN CANADA FOR 1908.*

The total shipments of iron ore from mines in Canada in 1908 were 203,490 short tons, valued at the mine at $486,857 as compared with 312,496 tons valued at $666,941 in 1907. The greater part of this production was from the Helen mine, Michipicton, delivered to Midland and Hamilton. During 1908 very little Canadian ore was exported.

* From a report by John McLeish, B.A., of the Department of Mines, Ottawa.

Pig Iron.—The total production of pig iron in Canada in 1908, from both Canadian and imported ores, according to direct returns from mine plants comprising 16 furnaces, was 630,835 short tons, valued at $8,111,194, as compared with 651,962 tons, valued at $9,125,226 in 1907. These figures do not include the output from the two electric furnace plants making ferro-products, which are situated at Welland, Ont., and Buckingham, Que. Of the total during 1908, 6,709 tons, valued at $171,383 were made with charcoal as fuel and 624,126 tons, valued at $7,939,811, with coke.

Steel Production

	1907 Tons	1907 Value	1908 Tons	1908 Value
Ingots—Open hearth (basic	459,240	$ 9,157,703	443,442	$6,001,277
Bessemer (basic)	225,989	4,293,791	155,557	2,535,287
Castings — Open hearth (acid and basic)	20,602	2,031,380	9,051	617,126
Other steels	1,151	129,716	713	79,912
Total	706,782	$15,612,590	588,763	$9,233,602

Iron and Steel Bounties Paid.

	1907 Tons	1907 Bounty	1908 Tons	1908 Bounty
Pig from Canadian Ore	95,915	$ 201,421	101,647	$ 213,458
Pig from imported ore	537,803	591,584	517,427	569,170
Total, pig iron	633,718	$ 793,005	619,074	$ 782,628
Steel ingots	666,590	1,099,873	556,289	917,877
Steel wire rods	68,738	412,417	49,630	297,779
Total bounty paid	......	$2,305,295	....	$1,998,284

The amount of Canadian ore, including mill cinder, etc., used was 219,266 tons, while the quantity of imported ore was 1,051,445 tons. The total amount of coke used during the year was 817,746 short tons valued at $1,770,320. The total amount of charcoal used was 1,121,990 bu., valued at $85,738. The quantity of limestone flux charged was 483,065 tons. The plant of the Atikokan Iron Company, Ltd., was out of commission throughout the year, while a number of others were operated for a part of the year only. The blast furnace at Londonderry was in blast for little over a month and the furnace of the Deseronto Iron Company, Ltd., for about two months.

Steel.—The returns from eight companies making steel showed a total output as in the accompanging table.

A statement of the bounties paid on iron and steel during the calendar year, furnished by the Trade and Commerce Department, is also given.

The rates of bounty issued were the same in both years.

The vertical cross section of public roads in Paris always includes sidewalks and one convex highway. The section across the highway is drawn according to an arc of parabola, of which the height of the centre of the roadway above the gutter is determined by the formula:

$$F = \frac{D}{4} \frac{L^2}{L-1}$$

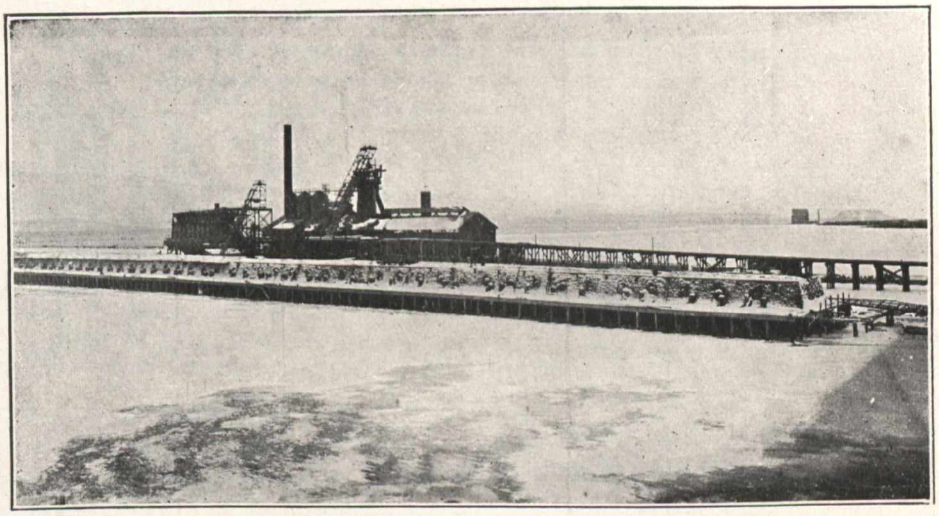
L being the total length of roadway between sidewalks; D being the difference of level between the bottom of the gutter at the curb and a point on the surface of the pavement, distant one metre therefrom. In wood pavements this difference in elevation is usually 0.6 metres. In a general way, the height of the gutters in Paris is relatively great. This is one of the consequences of the system of cleaning which has been adopted and which consists, after all the refuse sweepings have been cast into the gutters, in flushing them into the sewers by daily washings.

THE ATIKOKAN IRON COMPANY'S PLANT.

Of late years considerable attention has been given to the deposits of iron ores that are found in the Thunder Bay and Rainy River districts of northwestern Ontario. Various projects were put forward for the utilization of these ores, but it remained for The Atikokan Iron Company, Limited, organized in 1905, to demonstrate the practicability of roasting and smelting the high sulphur magnetites of the Atikokan range for the production of foundry iron.

The furnace plant of this company is located on the western extremity of the town of Port Arthur and is built fronting the shore line of Thunder Bay. Considerable difficulty was experienced in securing proper foundations, as the ground was low and swampy, necessitating the driving of hundreds of 22-foot piles which were afterwards capped with reinforced concrete. The company's property has a lake frontage of 1,800 feet with a depth of 3,000 feet, which is mostly muskeg and will be filled in with furnace slag, granulated for the express purpose of yard making.

Construction was started in 1906, the furnace being blown in on July 17th, 1907, and continuing in blast until the 14th of December in the same year, when owing to the unfortunate condition of the iron market, the works and mines were closed down until the outlook improved for a more profitable disposal of the product.



Atikokan Iron Company, Port Arthur, Ont.—General View of Works.

Roasting the Ore.

The plant comprises a blast furnace with all modern improvements in the way of stock handling apparatus, an ore roaster operated by the blast furnace gas, and a battery of 100 beehive coke ovens.

The ore arrives in 50-ton drop bottom steel cars from the mines 131 miles southwest of Port Arthur on the Canadian Northern Ry., and is discharged from a trestle to stock piles, or may be dumped direct to the bins feeding the roaster skip car. A McMyler hoist equipped with an orange-peel grab bucket serves to load the stock ore into cars, which are transferred over and discharged into the roaster skip bin.

The type of roaster adopted is the same as that in use at the Wiarton Furnaces, New Jersey, the Lebanon furnaces of the Pennsylvania Steel Company and the English plants of Bolckow, Vaughan and Company, Limited, Middlesbrough, and the Frodringham Iron and Steel Company, Limited. As the fuel used is the waste furnace gases, economical engines, pumps, etc., are necessary in order to save fuel at the power plant. The roaster is carried on steel legs supported by solid concrete foundations, and is divided into 16 sections each containing separate combustion, roasting and chimney chambers, the products of combustion passing through the ore to the chimney chambers where they are drawn by two Sturtevant 12-foot exhaust fans into a chimney. The draft, being controlled mechanically, admits of adjusting the supply of air according as the ore is fine or coarse, coarse ore requiring less air than the fine material.

The ore is elevated to the top of the roaster by means of a steam skip hoist discharging into an automatic railroad truck of the Mead-Morrison type, and is thence transferred to the roaster bins from which it feeds itself into the roasting chambers. The hot gases permeating the mass of ore heat it up to about 1,500 degrees F., driving off the sulphur, and as the action is one of oxidation converting the magnetic oxide to the peroxide form, corresponding to hematite, this change is beneficial in subsequent smelting operations. The ore remains in the roaster 24 hours, each chamber holding 25 tons, and the sulphur is reduced from an average 2.5 per cent. in the raw ore to an average of 0.75 per cent. in the roasted product. The roasting chambers discharge into bins provided at their bottom, the ore being delivered therefrom into an electrically operated stock transfer scale car, which conveys the roasted ore to the furnace skip cars. Provision is also made so that the roasted ore may be delivered into ordinary railroad cars for shipment, the roaster being designed to permit of additional units being added later if required, and the present hoisting equipment being of ample capacity to meet any requirements in this direction.

Limestone is obtained from Kelly Island in Lake Erie, favorable rates being secured on ore freighters which would otherwise return empty to the head of Lake Superior from lower lake ports. The stone is unloaded at the company's dock by 50-foot boom McMyler hoists equipped with orange-peel grabs, and is transferred to the furnace siding in drop bottom steel cars.

Coal for the coke oven plant is obtained from the New River and Crescent fields in West Virginia, transferred to boats at Lake Erie ports, and unloaded in Port Arthur at the coal docks of the Canadian Northern Coal and Ore Dock Company. The coal is supplied to the iron company on contract by the Pittsburg Coal Company, Limited, of Port Arthur, who control the dock company, the iron company taking the coal as required from the dock pockets, in 6-ton hopper bottom electric lorries, and charging it direct to the coke ovens. In this way the iron company avoids the trouble and expense of storing a large amount of coal.

The coke ovens are erected between the furnace and the coal docks, and are constructed on piling, capped with reinforced concrete, this method of construction being necessary from the nature of the ground on which the battery is built. The one hundred ovens are of the ordinary beehive type, built back to back in a double row. Each oven is charged

*The cuts of this article were loaned by the Bureau of Mines for Ontario, and the information was secured from their report.

with 4.5 tons of coal yielding about 2.8 tons of coke, a yield of 62.2 per cent. The coke is drawn by hand labor and loaded into hopper bottom cars which are transferred over the coke pockets at the furnace. Forty-eight hour coke only is made, the physical qualities being but fair, as it is soft and of dark color. The chemical analysis, however, given in the following table, leaves nothing to be desired. The composition of the coal, coke and limestone are also shown.

Material.	Fe.	SiO_2	Al_2O_3	P.	Mn.	CaO.	MgO.	S.	Fixed Carb.	Vol. Matt.	Ash.
Raw Ore	62.14	7.64	0.75	0.12	0.09	2.54	2.18	1.-4.	.....	.....	.....
Roasted Ore ..	60.06	9.33	0.98	0.162	0.12	2.93	2.3	0.2-0.75	.....	.....	.....
Coal A		....	....	0.029	....	....	...	0.66	71.24	22.12	6.64
Coal B		....	....	0.005	....	....	...	0.54	73.84	18.56	7.60
Coke		2.90	2.45	.....	....	0.34	0.10	0.66	88.08	3.89	8.07
Limestone		1.53	0.19	0.003	....	45.34	7.22	0.03	.....	.....	....

The Blast Furnace.

The blast furnace was designed with the view of increasing its capacity at any time to 200 tons per 24 hours with small additional cost. At present the stack is lined down to a capacity of 100 tons daily, the furnace being 75 feet high with diameters at the bosh and hearth of 14 and 8.5 feet respectively, the diameter at the throat being 9 feet. This lining may be enlarged for the second blast to 17 feet diameter at the bosh, with 11 feet hearth diameter, the present construction permitting of this alteration being made without disturbing the shell or its supporting columns. The furnace bosh is equipped with bronze cooling plates of the Scott type, one row being placed below the tuyeres. The hearth is protected by a 1-inch steel jacket cooled by outside water sprays, and is pierced for 9 tuyeres. Two slag notches are provided, one on each side of the furnace; one notch delivering the cinder over a short fall to an ordinary trough water granulator, while the other may be used for flushing off into ladles. By having the two notches the danger resulting from losing either of them is obviated.

The furnace charging apparatus consists of a double skip steam hoist and sealed top of the Roberts revolving type, the top gear constructed and operated in exactly the same manner as that described for B Furnace of the Hamilton Steel and Iron Company, Limited. The skip cars, each of 125 cubic feet capacity, are filled by means of an electrically operated scale car transferring the ore from the roaster and the limestone from overhead steel bins. The bin system consists of one large split coke pocket provided with bottom chutes that deliver to either skip car, breeze being got rid of by suitable screens, and 5 smaller pockets for limestone and ore. As the ore bins are located at the bottom of the roaster, only two of the stock-house pockets are utilized to provide against possible interruptions in the operation of the roaster. As distributed, the storage capacity of the stock-house pockets is as follows:—Coke, 250 tons; ore, 500 tons; limestone, 175 tons.

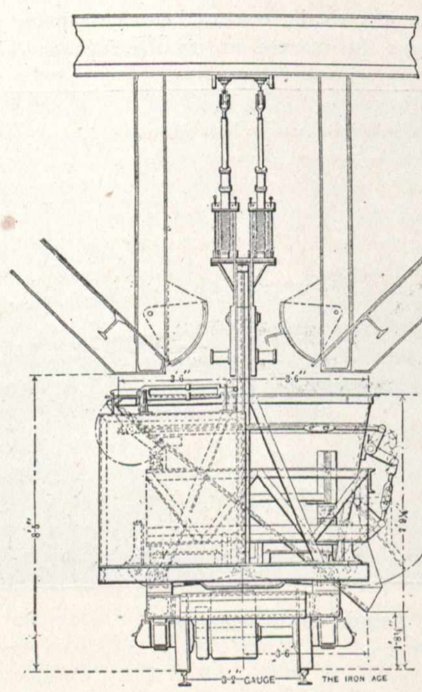


Fig. 5.—End View of Stock Transfer Weigh Car.

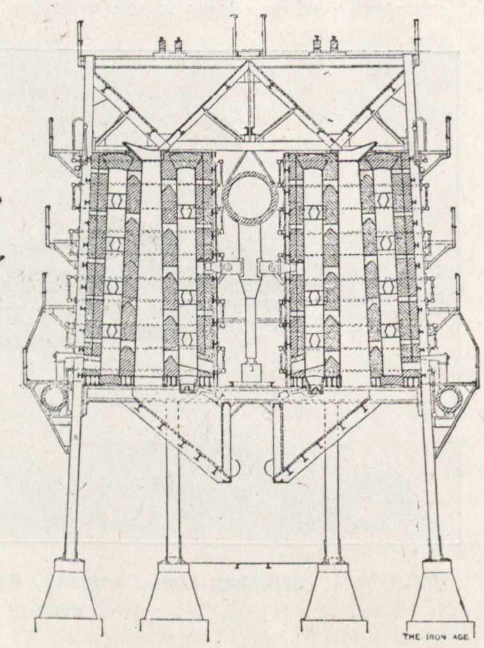


Fig. 4.—Sectional Elevation of the Ore Roasting Kilns, Showing Arrangement of Chambers.

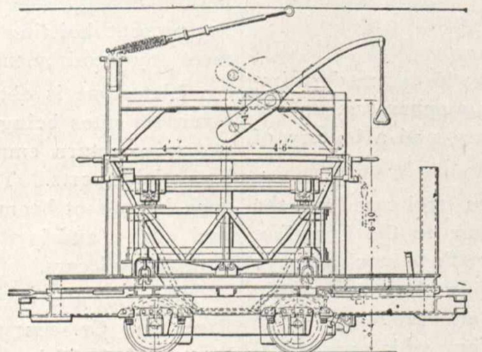
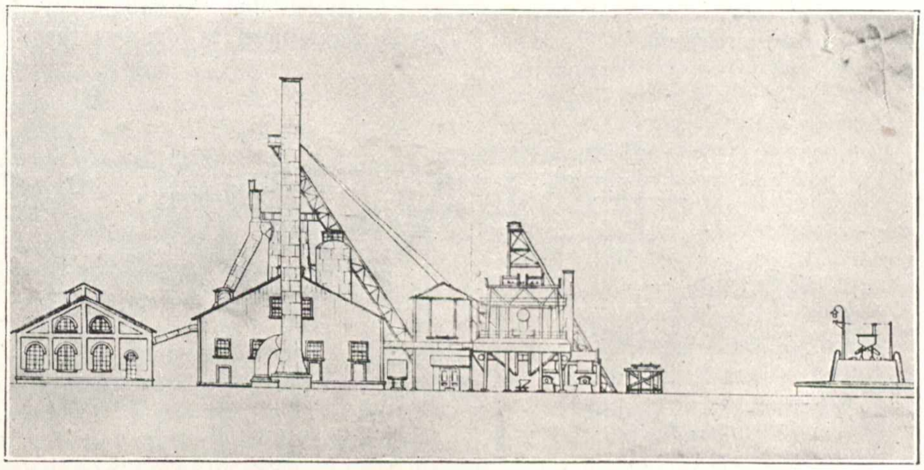
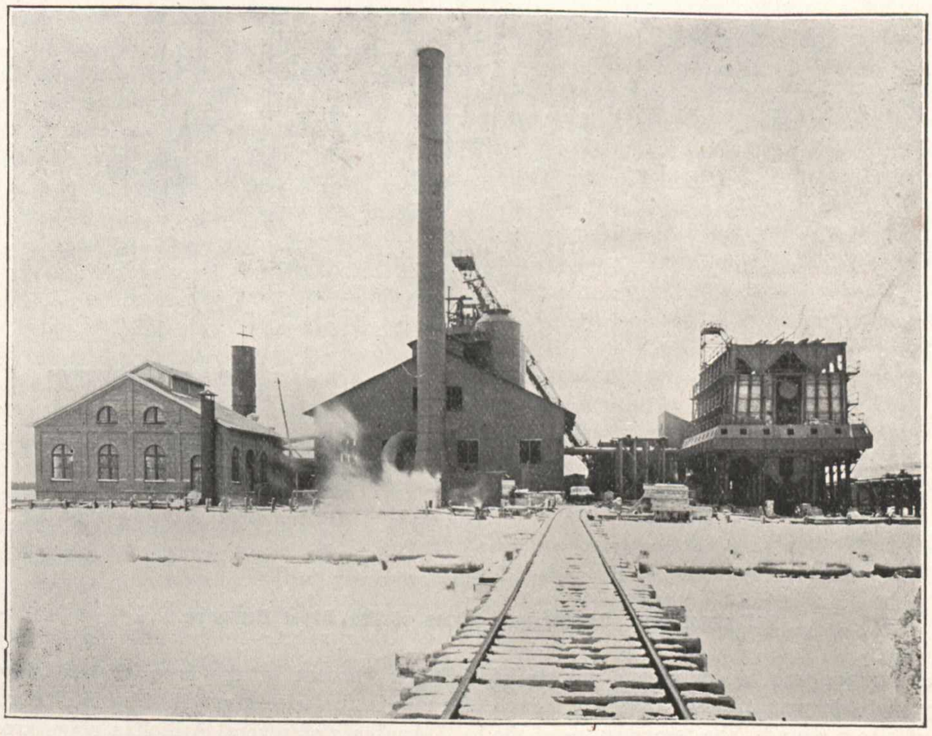


Fig. 6.—Side View of Transfer Car, Showing Lever for Opening Bin Chutes.

The furnace top is provided with a single 18-inch bleeder, and one circular explosion door four feet in diameter. The downcomer is connected to the shell at one point and at its lower end enters a centrifugal dust catcher of the Roberts type, the gas mains from this collector leading to the stoves and boilers. The hot blast stoves are situated in line behind the furnace, and comprise three Roberts-Cowper two-pass stoves 70 feet high and 18 feet in diameter, each having 18,500 square feet of heating surface. All valves are of the latest design, the hot blast and chimney valves being water-cooled. These stoves are capable of heating the blast to 1,600 degrees F., but under ordinary conditions not over 1,200 degrees is maintained. The pyrometers for indicating temperatures are placed in the superintendent's office, and were supplied by the Cambridge Scientific Instrument Company, Limited; they are of the electric recording type.



Atikokan Iron Company.—Elevation east end of plant, showing power house, boiler house, skip hoists, roaster and beehive coke ovens.



Atikokan Iron Company, Port Arthur.—View During Construction of Blast Furnace and Roaster.

The boilers are installed beside the stoves, both being contained in a steel and corrugated iron building behind the furnace. The battery consists of four Atlas water tube boilers of 225-horse-power each, manufactured by The Canada Foundry Company, Limited, of Toronto. The setting is of special Dutch oven design for the purpose of burning the furnace waste gases with efficiency, and has given very satisfactory results. Steam is supplied to the engine house at 125 pounds' pressure. The chimney gases from the boilers and the hot blast stoves are taken by a steel draft stack 150 feet high and 8 feet in diameter, erected on a solid concrete foundation behind the boiler room.

The engine house built alongside the boiler room is of brick and steel construction, and contains a disconnected cross compound condensing horizontal engine, manufactured by the Southwark Foundry and Machine Company of Philadelphia, high-pressure cylinder 32 inches, low-pressure 56 inches with 66-inch blowing cylinders and 48-inch stroke. The air valves are of the gridiron type operated positively, the air suction being through a conduit under the base of the blowing cylinders leading to the outside of the engine house, thereby providing a much drier air than if taken from inside the building. The engine is designed so that either the high or low pressure side may be operated independently. A jet condenser is arranged to operate with the waste water from the furnace and stoves, or with lake water. The pumps for furnace and stove circulation consist of two compound duplex steam pumps 14 x 32 x 14 inches, with 20-inch water cylinders, suction direct from the lake; the boiler pumps are two, 9 x 5 x 10-inch, of the ordinary plunger type. The pumping and condensing plant was supplied by The Canada Foundry Company, Limited. The electrical equipment consists of two 75 kilowatt generators directly connected with a pair of Robb-Armstrong engines, the system having ample capacity for all light and power requirements.

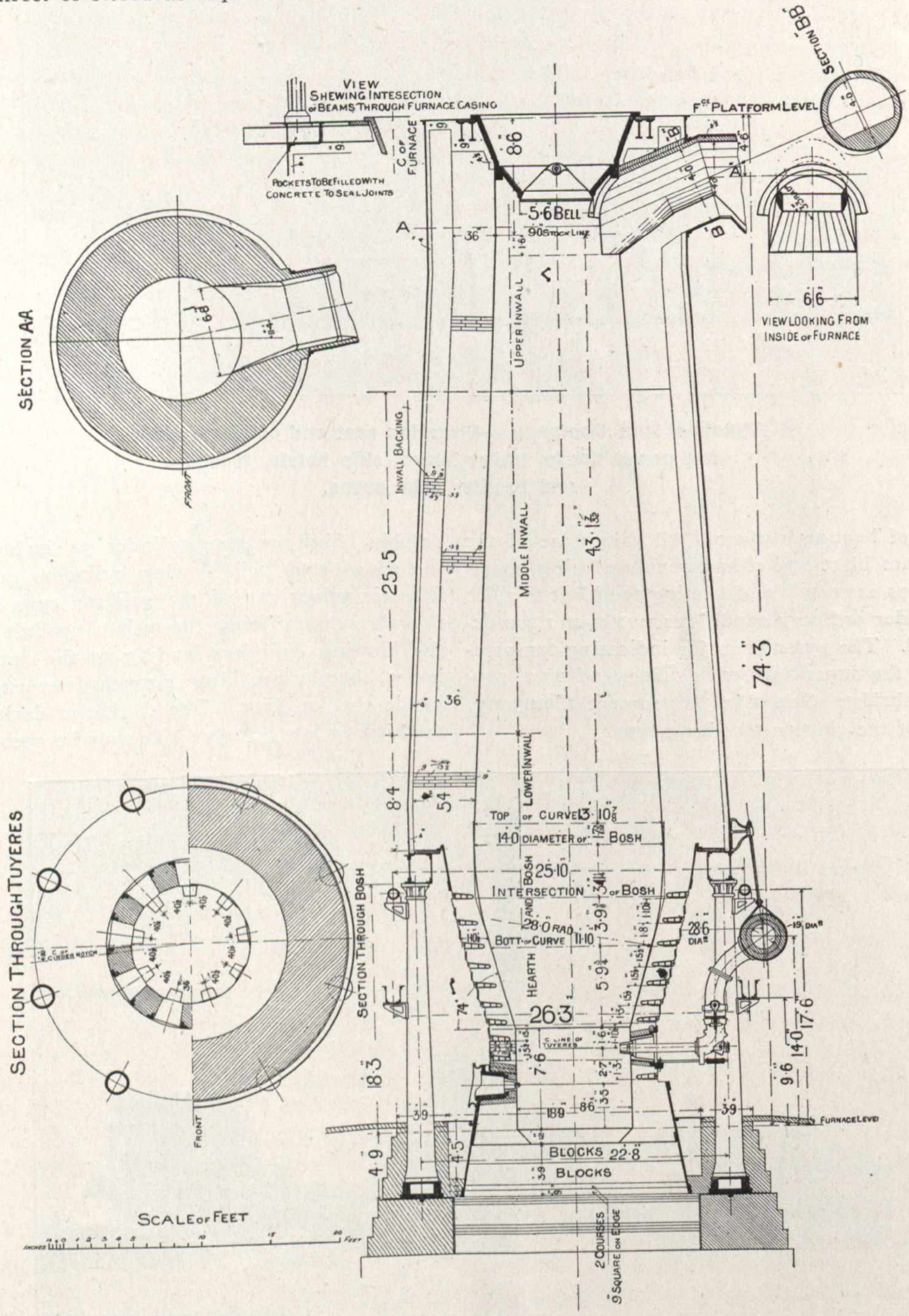
The cast house in front of the furnace is a steel and corrugated iron structure, 160 feet long and 55 feet wide provided with large sliding doors on both sides. The iron is cast in sand beds about 10 feet above the level of the yard, and after being cooled and broken is carried by hand labor to the side doors of the house and chuted to railroad cars alongside, to be either shipped direct or stored as required.

Fe_2O_3	Al_2O_3	SiO_2	P	CaO	MgO	K_2O	Na_2O	H_2O
9.21	13.57	67.0	0.081	0	0.8	1.36	0.9	2.27

The normal furnace charge is made up as follows:—

Coke	2,500 pounds.
Ore	3,200 "
Limestone	800 "
Gravel	100 "

It is apparent that the ratio of ore to coke is very low. This is necessitated by the fact that in order to keep the sulphur content of the iron within reasonable limits, the furnace is run with a very hot basic cinder.



Atikokan Iron Company.—Lines of the Blast Furnace.

While in blast the furnace was blown with a volume of about 12,000 cubic feet of air per minute, through 4-inch tuyeres at a pressure of 5 to 7 pounds, the temperature of the blast being kept in the neighborhood of 1,200 degrees F.

The average output per diem was 110 tons, the highest tonnage made in any one day being 132 gross tons. The fuel consumption during the campaign averaged 2,600 lbs., per gross ton of iron produced.

In the foregoing analyses it will have been noted that the ore, coke and limestone contain only small quantities of slag-forming ingredients and in order to secure a sufficient volume of slag for the removal of sulphur it was found necessary to use a certain proportion of gravel in the charge. This gravel is obtained from Nipigon Bay near Port Arthur and is of the following analysis.

Analyses of several Atikokan slags are supplied below:—

SiO_2	Al_2O_3	S
27.52	11.36	2.07
33.40	10.60	1.91
34.30	14.00	2.15
29.37	12.78	2.50

The plant was built under the design and inspection of Frank C. Roberts and Company, Philadelphia, Pa., the construction being carried on under the supervision of the superintendent, Mr. Robert R. Jones, to whom thanks are due for all of the above information and the many courtesies received during my visit.

CANADIAN CONCRETE AND CEMENT ASSOCIATION.

FIFTH DAY—AFTERNOON SESSION.

(Continued from last week's issue—Page 410.)

Friday, March 5th, 1909.

Convention resumed at 2.30 p.m.—President: Mr. Morssen, consulting engineer, Montreal, is to give us a paper this afternoon on "Factory-made Cement."

Mr. Morssen: After what you have seen at the Exhibition and after all these papers you have heard you will see that concrete has many points of real excellence. It is being now exploited by large numbers of practical men and by a goodly number of enthusiasts. But enthusiasm itself is not enough to produce good concrete. It is true that everything may be done in concrete, but to do it well is another question. You have a good idea how concrete may be used in field work, and I shall endeavor to tell you how it is being used in the factory. The first condition of a good concrete is its density. We have to bear in mind that concrete must be dense, and we have to use our machines in such a way as to produce dense concrete, and to be able to produce it by a careful study of the materials we are using, by grading them, by using materials of different size, and by mixing them together with knowledge, and not to depend on the machine itself to do the work. For artistic concrete goods the ordinary mixer and the mixing board are not sufficient. In Europe, where they produce a very large number of concrete goods, they are using some special machines for crushing and kneading together the materials. In the endeavor to produce goods of fine appearance and durable construction we are led to a careful study of the properties of the cement and the material, and each day we are getting better results and fewer failures. We must bear in mind that after you have mixed the concrete and got the cement blocks or statues, the work is not finished. We have to consider the concrete block or concrete statue as a new-born child; you have to nurse and take care of it. You know you require a certain amount of water for the setting, for the chemical reaction, and you have to take care that the work that is already given to the mix will not be taken away by the sunrise or the wind. You have to keep goods in a cool place; sometimes you have to keep them in water; you have to sprinkle them; in one word, you have to make a careful study of the materials you are using, and keep before you the result you will get. I propose to show you how cement goods may be produced, what is being done and what may be done in concrete. In Europe concrete has been used for a long time for sidewalks, and in many instances they are not laid as they used to be in the United States or here; the sidewalk blocks are produced of eight inches or twelve inches, and one and a half inches to two inches thick. Those blocks are produced by special machines under very great pressure. The surface may be corrugated or smooth, colored or not, and in many cities in Germany and France and Belgium they have nice sidewalks, which look like carpets after several years' use. In Germany concrete pipes for sewers, and water conduits consume about one-fifth of the output of cement. It is a matter of fact that concrete pipes give better satisfaction, as there is less seepage through; and many sewer pipes and conduit pipes are fifteen or eighteen years in use, reinforced or not, and are in perfect condition. Cement is being used on a great scale for artificial stone. In our Exhibition here we have some very fine specimens; and although all architects and a large number of the public do not want to accept the imitation, that should not astonish anybody. It is quite a general rule that in nature you need five times as much time to destroy anything as you need to put it up. If a tree takes 20 years to grow, it will live about 100 years; trees which are growing fifty years will live 250. Now, the large public and a great number of architects are used to certain kinds of stuff; they have been using it for a long time; but I hope it will not take five times as long to have them accept the imitations. I would say that arts are nothing else but imitation. The painter does not do anything else but imitate nature, and if it is possible by the use of concrete to imitate something and to do it cheaper, it is only a matter of time to get this article introduced. By factory-made concrete I mean not only little articles, but also the great large units which are used in plates and used for the erection of buildings. The use of steel for reinforcing is pushing ahead the small-sized factory articles, as they may be made lighter, and so they come cheaper because they do not take the same amount of material. Whole buildings may be put together by the unit system, using concrete elements cast in a factory or cast on the plates and put together in constructions. For foundations concrete piles are used to a great extent in Europe and in the States. As Mr. Watson has shown, readymade concrete floors have one objection at the stage they are now made—they cannot be made for a large stock, as live loads and spans vary, and as yet we have not concrete units which may be used for all buildings, and we know that to get a concrete beam is not an easy matter. In the States many buildings are now constructed by that system, and large savings may be gotten, as the cost of the centreing amounts sometimes to 30 and 35 per cent. of the cost of the building. We should make an endeavor to get all our articles of good quality, and the quantity will take care of itself.

Beaumont Jarvis: What about efflorescence and waterproofing of those blocks?

Mr. Morssen: That is one of the principal things we are up against.

Mr. Jarvis: You can't get it dense enough by tamping.

Mr. Morssen: Not by tamping, but by grading the material itself of different sizes. If the broken or crushed stone you use for the facing is made of different sizes you can get very dense concrete, and in many cases you may use, and many are using, special fluids, liquids that you put on the face, and you get a very water-proof concrete. I know of one system, the Tycrete system, which you mix with the concrete a certain compound or powder which, by crystallizing, closes up all voids, and you get your dense concrete. In Germany they have been using Kessler's fluids—a fluid you put on the surface, and a chemical action takes place and gets your concrete just as water-proof as you want it.

Mr. Jarvis: There is hardly an architect of any standing who has an artistic feeling that will use concrete blocks, for the reason that the appearance is so ugly and the color is so bad.

Mr. Morssen: I said at the beginning that we had to become used to it. Architects and the large public are used to a certain color, and they do not want to change. It is a matter of taste, and if you care to have a very expensive building I would suggest granite or stone; but in many instances, where you don't have the money to pay and you want to have a good looking building, you can get it by using concrete in a good way.

Mr. Jarvis: There are one or two companies here that make good work, but to take an ordinary cement and ordinary sand and make a concrete block, it is rotten.

Mr. Morssen: Sure; you have to use a special mix, you have to use white cement for the voids, and you have to put your stuff together in a very good way; then you can get a very good looking block.

Mr. Jarvis: Yes, if you use the right cement.

The President: I am very sorry to put an end to the very interesting discussion, but we have three papers ahead of us, and the next speaker, Mr. Thompson, has to get away on an early train. I will, therefore, now call upon him. Anyone who is familiar with concrete journals will know that Mr. Thompson is one of the experts in the business.

Selection of Concrete Materials.

Sanford E. Thompson: I am sorry to bring you down from the finished structures to the hard, cold, dry facts of sand and stone; and yet in order to produce these houses and factories and concrete piles, the ingredients have to be carefully selected and put together, so I will talk on the selection of concrete materials. As this paper will doubtless be in print later, I shall omit certain portions, and substitute some experiences.

Mr. Thompson: We hear a great deal about the difference between rounded and sharp sand. That is, we might say, an accepted theory. Sharp grains are in some cases slightly coarser than round grains under the same conditions; but the sand that you see in a pile, that you say is poor because it is round in grain, is dead sand not because it is round, but because the grains are coated with dirt.

I have found a concrete to be taken out of a building because it did not set in two months, and then it was spread out on a street where it was teamed over, and it had the rain and the moisture in the summer, and the blocks hardened up. At the end of about six months the pieces of concrete were in pretty good shape.

One way of approximately testing sand which was thought to have vegetable matter was brought to my attention by a cement man who has had quite a large experience. He went to a pile and took up two hands full of sand, and then rubbed his hands together about an inch apart. He did that half a dozen or a dozen times, and on his hand, between the fingers, was a coating of slime, fine dirt, which was largely vegetable matter, and that was the stuff that was giving trouble with that sand.

An engineer some times has to take the part of a coroner, and hold a post mortem on concrete, and in such cases interesting facts are brought out. I know of no case of any failure whatever in concrete where it was not possible to locate the cause of that failure by defect, and to bring it down to either poor design or poor workmanship or materials—in other words, poor quality of manufacture or use; and in those cases that have come to my attention the sand, as I have stated in the paper, was very largely contributory to the actual cause of the trouble. In one case there were some abutments for a small bridge built under water, and the concrete did not harden. The cement which was left passed the standard test for cement when tested in two laboratories. Finally the concrete was analyzed; it was a gravel concrete and we were able to analyze it by dissolving out the cement with acid—and we found the proportions 1:5:9, whereas the contract called for 1:1½:5. Now, on the face of it, that would look as though it was very poor workmanship on the part of the contractor, but when we came to go further into the case we decided that it was probably that the concrete was put into the work in approximately the correct proportions, but that the cement had not been washed away. The foundation was laid in the coffer-dam, which was pumped out more or less, and it was a very leaky, bad floor, so that the water flowed through the concrete. Then further tests of the sand showed that instead of testing at the end of seven days 200 pounds per square inch it tested about 25 pounds per square inch, and yet the sand looked as nice as any sand you ever find. We, therefore, went into the reason of the cement being poor. This slow setting of the concrete permitted the water to wash the cement away. We did not get down to the real cause of the difficulty in the sand; that is, they were laid between two or three different things.

In another case a covered reservoir fell down. It was a groined arch roof—a large reservoir of 100 or 200 feet, and a large portion of the roof was laid in the early winter, cold weather, and the forms were taken down in April, and a few sections fell down. An examination was made, and whereas the failure was due immediately to taking down the forms before the frost had entirely gotten out of the ground, there was also some truss of the arch which tended to increase the danger; but on going to examine the materials we found that the gravel was dirty and combined with a lot of sand so that the proportions, instead of being 1:3:5: were really 1:4:4; that is, there were four parts of sand instead of three, with the result that the concrete did not harden so quickly as it should. The arches were jacked back in place, and the rest of the roof was left, and hardened very satisfactorily. When I first saw it I took a piece away, and it was so soft that I could crumble it up, although it had been laid for about five months; but when it was exposed to the air it hardened up inside a month or two so that it was very good concrete, the slow hardening being affected partly by the materials and partly by the cold weather. Another case of some interest was a building, two or three sections of which fell down, and the result showed such a very poor construction as to be of considerable interest in a good many ways. Not only were the materials poor but the design was wrong, and the concrete had been placed with a beam. Of course the forms were built for the heads and beams in the regular way. Instead of making the heads and beams at first, the beam was made first and then the head was formed, consequently there was a joint right under the head, and the head did not help the beam at all in taking its load.

Another case was a building where simply the walls were of concrete, eight or ten inches thick, and a heavy storm occurred and the walls blew over. The fault was first laid to the cement, but we finally found that they were using a sand which came from an excavation, and although it had passed the examination of one or two very good concrete men, yet it showed on test a strength of something like no strength to 25 pounds per square inch in 7 days. It was during that examination that my attention was called to the test of rubbing between the hands lightly for discovering organic vegetable matter. We went carefully into it and traced the trouble very positively to the vegetable matter in the sand. It had a somewhat dirty appearance. We tested it chemically and it did not show to a very large extent, but by washing the silt out of the sand—which was done by putting some sand in a bottle, shaking the bottle and pouring off the water, and repeating this for a number of times—the silt came off with the water, that is, the lighter portion of the silt; and then by vibrating the water we got the residue, and by burning it we were able to take out the vegetable or organic matter. By weighing the residue we were able to compute the percentage of vegetable matter that was in the sand. Then just for experiment I took two per cent. of the silt that we washed out and put it with some standard sand, and it reduced the strength of the mortar about one half. The size of the sand was almost identical with the sand that we had used on some of the reservoir construction with very good results, but it was entirely due to this organic matter which scarcely showed up in appearance at all, and could not be detected by sifting; it did not have any more dirt in when it was sifted than other good sand. We also made some concrete of those same materials, and with the poorest sand we got a strength of 200 pounds to the square inch, whereas with the same cement and the other sand which I speak of, which was used in the reservoir construction, we got 1,500 pounds to the square inch at the age of eighteen days—seven times greater. These simply illustrate some of the troubles which sometimes occur; but these troubles are not to deter one from using cement; one is able to detect them, and when the concrete sets up they are all, you will notice, detected in the early stages. It is a pretty good rule to follow that in our present good stage of manufacture if our concrete or mortar really hardens it is all right. I never knew of any trouble with the sand or the aggregates to show after an ordinary length of time. Every case that ever came to my knowledge occurs in the placing of the concrete, resulting in slow hardening so as to give trouble to the sidewalk. When the concrete once sets up you can be pretty sure it is all right.

Mr. Jarvis: Crushed lime stone and briquettes that were made proved to be stronger with the dust left in than when it was taken out, but in actual practice I found in the Canada Foundry Office building, which I erected, that nearly every bar broke in shrinkage. I blamed it to the dust having been left in. While in the briquette it stood stronger in the test than those which the dust was taken from. Nearly every beam broke through shrinkage of the concrete, but the reinforcement in the beam was sufficient, so it did not matter.

Mr. Francis: In what condition of dryness could you have that sand in order to make that test and run it lightly through the end?

Mr. Thompson: It has to be quite moist. If the sand has stood out in a pile through ordinary dry weather you can't tell it at all. It has got to be in the moisture that comes from the bank when it is freshly excavated in order to apply that test, but when it is dry you frequently get that dead appearance.

Mr. Kahn: May I inquire about those striking disparities in strength which Mr. Thompson gets in stone? The first instance a certain kind of stone compacted with animal or organic matter stressed only 25 pounds to the square inch; in another instance he recites a strength of 200 pounds with standard sand, and in still another instance he claims to have found a strength of 1,500 pounds to the square inch. Now, may I ask what the formula was in each of those cases?

Mr. Thompson: The 1,500 per square inch was concrete in compressive strength. That perhaps will explain it. The 200 pounds was tension, and the small low test was tension.

Mr. Kahn: I quite understand now the extraordinary strength indicated by the 1,500, as a compressive result. I also understand why a certain kind of sand should produce only 200 pounds. It must be quite plain that a sand containing an unusual percentage of any matter should produce so low a result as 25 pounds to the square inch.

Mr. Thompson: I should perhaps add to that, that the percentage of organic matter in the sand amounted to about two-tenths of one per cent., not a very large quantity.

Mr. Kahn: Quite enough, however, to cause an immense shrinkage from normal to abnormal in point of tensile strength.

Mr. Thompson: Yes.

C. H. Thompson (Toronto): I would like to ask, if you take the proportions of 1:2:5, or 1:2:6, whether Mr. Thompson takes them in bulk or by weight.

Mr. Thompson: In laboratory tests I usually use weights, sometimes correcting them for bulk. The standard just now quite generally adopted throughout the United States in making proportions for concrete, and which in laboratory tests it is sometimes necessary to conform to, is a measurement based upon 100 pounds of cement per cubic foot, or a barrel of 3.8 cubic feet. In that way the sand and the stone is measured loosely, and the cement is measured in bags, and the proportions are a little different from what you get by weight in some cases.

C. H. Thompson: In making delicate tests you take it by weight?

Mr. Thompson: Yes, I take it by weight any way. If I want to correct it by volume I do so by varying the weight a little bit.

The President: To technical or scientific audiences in America, Mr. Richard T. Humphrey needs no introduction. Our regret is that we were not aware he was to be with us until he arrived this morning. Preliminary arrangements had been entered into looking to a speech from Mr. Humphrey to the Convention, but on account of his inability to come here on the first day we had fixed we were forced at a late hour to conclude that we would have to forego that pleasure. As director of the Federal testing laboratories for structural materials at St. Louis he has been doing very important work. The Federal Government has made a grant of a few thousands of dollars towards the maintenance of that laboratory, and at present it is their practice to allocate $100,000 annually for the investigation of structural materials of all kinds, not excluding cement. In charge of this work is Mr. Humphrey, who is to speak to us this afternoon on "Concrete Sewers"—a subject that is of particular interest to the citizens of Toronto just now.

Concrete Sewers.

Mr. Humphrey was received with applause and said: The subject of this address was given to me just before we came into the session, so my remarks are simply extempore. For that reason you will have to bear with me if they are not as complete as they otherwise would be. The matter of concrete sewers is one that is interesting a great many people. It was my good fortune to be early associated with the construction of such sewers, and during the last year I have been able to inspect sewers in various large cities that had been in existence for a great many years, for the purpose of examining their condition after such service. There has been only one case to my knowledge where a concrete sewer has been proven inefficient; and I might add that under that condition brick sewer also proved equally inefficient. I refer to the sewers in Great Falls, Montana, where the alkali has caused the disintegration, softening of the concrete in the sewer, and to an equal extent in the brick sewer in the same town. In all the other cities the concrete sewers have been in an excellent state of preservation and many of them have been in existence for twenty or more years. Many of the smaller-sized egg-shaped and pipe sewers I have examined have been in existence as long as 30 or 40 years. There does not seem to be any reason why concrete should not form one of the most admirable materials for the construction of sewers. I have seen concrete sewers in which the discharging waters of manufacturing plants have flowed through them, containing a great quantity of acids, and one would reasonably suppose that the surface of that sewer would be softened and disintegrated; but there seems to be a saving grace for the sewer in that the oily matters and scum that is to be found in sewage coats the surface of the sewer and renders it immune against action. So that in most of the sewers that I have examined, the original surface was intact, and in a better state than it was when originally laid. I speak particularly of the city of Philadelphia, because I saw a great many of those sewers go in, and, therefore, I am familiar with their condition; but it is quite true of sewers in Brooklyn and in New York. Of course there are conditions under which perhaps concrete cannot be used without some protection, that is, in sewers where there are very high grades, where the scouring of the sewage is likely to tend to rub or wear down the green concrete; and under those conditions, as there are a number of storm-water sewers in Philadelphia, it has been found necessary, even in brick sewers, to resort to very strong material like Belgium block or very dense vitrified brick in order to withstand those conditions. But under the conditions of ordinary flow such as are to be found in most cities, it has been found that ordinary concrete is a very satisfactory material. In the case of reclamation sewers, where they have used concrete pipes to a considerable extent, they have been used on very high grades with very good results and comparatively little wear. I have been impressed with some pipes that have been laid out in the West which have been used for drainage pipes, and I have examined sewers that have been laid for 31 or 32 years. Those great pipes were in splendid state of preservation; the original surface was there, and the ring of those pipes indicated that the hardening of the concrete had continued from the date of their original manufacture. In Minneapolis, just the other day, I saw egg-shaped sewers that they told me had been down over 30 years, and the condition of those sewers was so good that they would be used in the spring in laying another sewer, the cement pipe in question having been taken up and it was being replaced by a larger sewer. Of course when you get into the larger reinforced concrete sewers it seems that the character of the construction is particularly adapted, and the cost is in many cases a great deal less than would be the case with other forms, and as far as the durability is concerned, I think, it is even more so. I was told in Cleveland quite recently by the engineer in charge of sewers there that one of their trunk line sewers which was something like 18 or 20 feet in diameter, had been put in at a very large saving in cost over a brick sewer. In laying a sewer the essentials are that the concrete shall be well proportioned so as to secure the maximum density, that the concrete shall be put in wet, particularly if it is a reinforced sewer, and that the sewage water is not turned into it too suddenly or the sewer put into use too quickly, giving the concrete a chance to attain a fair degree of success. If these points be observed the sewer will be practically intact and indestructible. I don't know that I can add any more, but would be glad to answer any questions that may be propounded.

C. H. Thompson: Is it the general practice to make one continuous section, or to make it in small sections put together, and fill the joints?

(Continued on Page 434).

WASTE OF WATER.

The most important problems in connection with water supply is purity, but closely associated with that question is cost of supply and prevention of waste.

Recently we made a canvas of some fifty Canadian municipalities that have waterworks installed with a view of finding out the gallons of water used per day per capita and the cost of pumping. By the aid of these statistics we attempted to compile information as to the percentage of meters installed, and, if possible, secure information such as would enable engineers to draw conclusions as to the effect of meters on water consumption.

Success did not attend all our efforts, yet the published tables contain information not hitherto tabulated and information which will be valuable to the city engineer, the waterworks expert and the sanitary engineer.

A study of Table 1 will show that the consumption of water varies from 25 to 283 gallons per capita per day, a remarkable variation. In securing these reports we were not able in many cases to secure information as to the peculiar circumstances which go to make the consumption very high in certain places and very low in others.

Take again the column of costs. This must be studied carefully and we are afraid in some cases the figures are far from being correct, but we give them as they are returned by the town officials. No better plea could be urged for a uniform and systematic method of municipal accounting than the anomalies contained in these reports. . Take Gananoque, a thousand dollar fuel bill and a thirteen dollar labor account. Something very wrong. Parry Sound is not so bad, but yet the labor account is all out of proportion to the work done. With all its imperfections Table 1 will be of some considerable value.

The records are not complete enough to give returns, showing the effect of meters on water consumption and water waste; but Table 2, compiled from the returns of several American cities, does not in all cases indicate any great lessening of water consumption with the increase of percentage of meters installed, but it does show that with an increase in population there was an increase in the number of gallons consumed per capita per day.

Table No. 2.

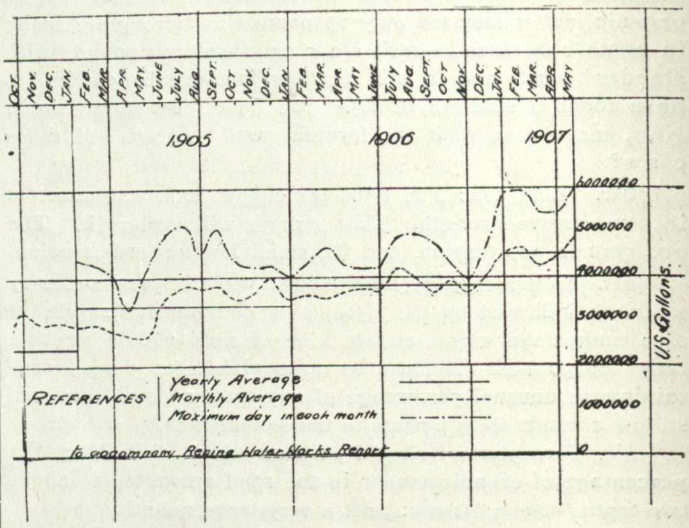
City.	Population.	Year.	Gallons per capita per day.	Per cent. of service metered.
Cleveland, Ohio ...	375,000	1898	138	4.3
" ..	455,000	1904	136.8	49.2
Detroit, Mich.	269,000	1898	146	19.0
"	327,000	1904	181	27.0
Fall River, Mass. .	64,000	1898	29.34	73.0
" .	107,653	1902	40.54	95.0
Harrisburg, Pa. ..	48,000	1898	112	....
" ..	60,000	1904	146	....
Lawrence, Mass. .	54,866	1898	60	....
"	66,603	1904	42	....
Richmond, Va. ...	83,000	1898	126	30
"	100,000	1904	129	41
Wellesley, Mass. ..	4,650	1898	47	....
"	5,793	1904	55	....

Comparing the water consumption given in Table 1, being the returns from Canadian cities, with those given in Table 2 for United States cities and Table 3 for German cities we find American cities show a much larger consumption, and they certainly do not show a higher standard of public health.

Table No. 3.

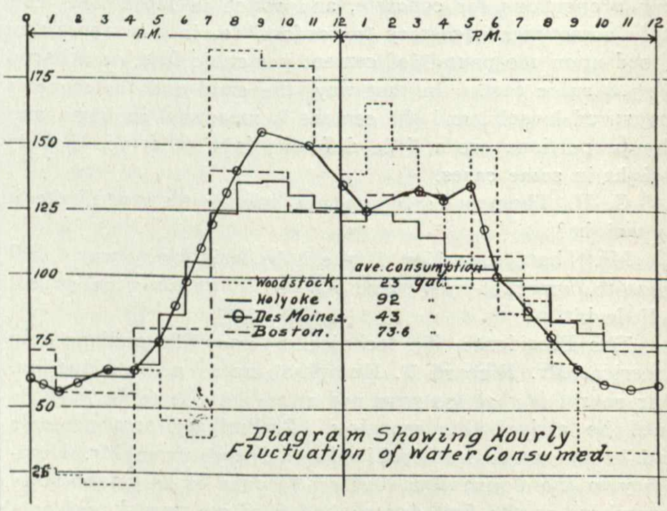
City.	Population.	Gallons per capita per day.	Percentage of supply metered.
Frankfort	59,049	14.3	43
Leipzig	422,000	17.7	..
Halle	117,500	21.7	78
Danzig	120,000	23.7	44
Mullhauser	84,000	27.0	64

In making a report for Regina, Sask., Messrs. Lea & Smith studied carefully the consumption of water in the city of Winnipeg, and the accompanying diagram contains three curves which show the relation of yearly and monthly aver-



age, and the maximum daily consumption. It was found impossible to publish the whole diagram, but the section used is a fair average of the whole. The excess of the monthly average over the yearly average is very noticeable, while the maximum day consumption was almost one million, in some cases, above the monthly average.

Another diagram from the same report gives, for Winnipeg the hourly fluctuations in water consumption expressed



in percentage of average daily consumption per capita.

Three of the curves are fairly uniform and indicate clearly the hours of heaviest consumption.

The rate of consumption varies to a certain extent with the population, and the following table, which was made from a study by Lea & Smith, of 75 places, with populations of from 1,000 to 1,000,000, illustrates this.

No. of Inhabitants.	Consumption per day per capita.
1,000	40 gallons
2,000	44 "
3,000	47 "
4,000	49 "
5,000	50 "
10,000	55 "
20,000	61 "
40,000	67 "
50,000	69 "
100,000	76 "
200,000	84 "
300,000	89 "
400,000	93 "
500,000	96 "

TABLE I.

MUNICIPALITY	Population	City Water Consumers	Gallons Pumped Annually: Domestic	Gallons Pumped Annually: Manfg.	Gallons per day per capita	Pounds Pressure at Station: Ordinary	Pounds Pressure at Station: Fire	Cost of Pumping: Fuel	Cost of Pumping: Oil and Waste	Cost of Pumping: Labor	Cost of Pumping: † Total	Cost per 1,000 gals.	Meters: Percentage in use	Meters: Rate
								$	$	$	$	$		
Aylmer, Que.	3,000	2,500	65,000,000		71	60	120	1,015 00	10 00	1,000 00	2,015 00	.30	...	30c. per 1,000 gallons.
Barrie, Ont.	7,000	7,000	69,796,300		27	79	125	1,030 29	24 40	1,675 00	2,729 69	.038	33%	500 gals. per day or under, 33c. 1000 " " " " 28c. 2000 " " " " 22c.
*Brockville, Ont.	9,000	8,000	930,118,487		283	65	100	3,684 66	329 00	2,210 16	6,130 82	.006	...	...
Brantford, Ont.	20,630	16,400	457,000,000	365,000,000	61	80	120	4,855 00	281 90	3,900 00	9,536 00	.011	...	5c. to 10½c. per 100 cubic feet.
Chatham, Ont.	10,000	9,000	247,753,214	67,409,249	90	40	110	4,001 86	...	...	10,427 04	.0425	47%	20c. 1000 gals. priv., steam users 10c.
Charlottetown, P.E.I.	13,000	13,000	232,955,327		62	92	65	1,848 00	77 10	1,020 00	8,293 53	.035	...	Meter 0.3 per 1,000 gallons.
Cornwall, Ont.	8,000	8,000	300,000,000	100,000,000	103	73	73	...	...	...	350 00	.0008	...	25 cents per 1,000 gallons.
Dawson, Y.T.	2,000	1,500	125,000,000		171	100	160	...	...	...	...	...	...	...
Fredericton, N.B.	7,100	6,000	195,547,000		90	40	80	5,786 40	123 75	1,971 76	8,455 00	.043	5%	15c. 1000 gals man'f. 25c. " " d'mstc. $2.00 Metre Rent
Galt, Ont.	9,200	9,200	331,507,586		98.9	...	...	3,349 01	83 18	988 78	...	...	21%	8 to 20 cents per 100 cubic feet.
Gananoque, Ont.	4,110	...	47,000,000		31	43	95	1,000 00	25 00	13 00	1,038 00	.022	100%	⅝, $5.00. ¾, $7.00.
Halifax.	45,500	40,000	3,741,418,000		256	...	...	Gravity		System	...	...	20%	7 to 15 cents per 1,000 gallons.
Hamilton, Ont.	65,000	65,000	2,515,191,600		105.6	104	104	15,422 00	16 00	8,175 12	25,302 00	.0103	...	7 " 12 " " " "
Kingston, Ont.	20,000	20,000	772,506,000		107	73	73	3,958 00	116 40	2,790 00	6,864 40	.0088	...	6c. to 30c. per 100 cubic feet.
London, Ont.	50,000	47,000	1,294,362,533	44,856,000	73	105	...	6,644 00	211 45	3,245 90	10,101 35	.029	2.38%	5c. to 11½c. per 100 cubic feet.
Montreal, Que.	312,500	...	12,439,889,725		109	90	...	99,678 61	...	35,665 82	141,449 00	.011	...	$1.15 per 1,000 cubic feet.
Moosejaw, Sask.	10,000	...	22,000,000		40	45	130	...	...	...	...	...	...	10 to 25 cents per 100 cubic feet.
Ottawa, Ont.	80,248	80,248	5,263,746,242		172	92	110	Water		Power	167,728 20	.0318	...	7⅛c. per 1,000 gals. under 2,00,000 5⅝c. " " " over "
Parry Sound, Ont.	4,000	3,000	60,801,600		55	75	120	475 00	25 00	113 00	1,800 00	.029	...	4½c. to 15c. per 1,000 gals.
Quebec, Que.	70,000	70,000	10,000,000,000		140	Gravity		...	...	...	...	...	...	...
Regina, Sask.	10,000	5,000	184,000,000	11,700,000	113	35	...	...	...	...	3,800 00	.022	...	Flat and meter 12½c. to 35c. per M.
Simcoe, Ont.	3,400	300	7,500,000	2,000,000	73	60	95	200 00	25 00	600 00	1,250 00	.013	95%	⅝, $4.00. ¾, —
St. Catherines, Ont.	13,000	13,000	456,250,000	282,500,000	175	79.9	...	...	Gravity	System	...	...	3%	100 cu. ft. per day 12c. per 100 cu. ft.
St. Thomas, Ont.	14,500	14,000	443,521,605		110	50	110	3,074 57	92 02	2,580 00	5,747 00	.016	11%	12c. per 100 cu. ft. Dis. 20 per cent.
St. Boniface, Man.	5,500	5,000	27,000,000		25	65	90	1,540 00	57 00	1,780 00	3,377 00	.125	100%	50c. per 1,000, dis. to 20 per cent.
Sydney, N.S.	13,000	12,000	712,702,574	72,713,797	150	...	...	...	...	...	...	...	...	...
St. John, N.B.	46,777	46,043	3,985,991,000		233	...	...	...	...	...	...	...	...	...
Sudbury, Ont.	3,900	...	109,500,000		77	75	120	3,520 00	15 00	1,500 00	5,035 00	.045	...	6c. and 8c.
Toronto, Ont.	350,000	310,000	10,356,547,168		91.5	90.1	120	48,380 46	...	43,160 00	‡540,715 03	.0522	...	...
Yarmouth, N.S.	7,000	6,730	270,553,064		89	60	80	2,833 00	146 00	1,310 00	4,289 00	.015	...	...

* Includes Railway and Asylum Supply. ‡ Includes Deb. debt. † Includes Miscellaneous.

(Continued from Page 432).

Mr. Humphrey: I think that depends largely on the size and conditions under which the sewer is laid? I know a number of cases in which it has been the practice to lay it in sections and to cast perhaps the invert, build the haunch of the sewer at one operation and cast the ring at another operation. If that is done carefully, and the surface where the new concrete comes in contact is kept clean, and there is a little neat cement mortar placed on the joint, very effective joints are made. Of course it is impossible to cast a sewer of any size continously at one operation. In the case of the concrete pipes, of course, they are cast in sections at one operation, if they are not too large, and then the joints simply cemented. In that connection I might add that in the matter of drainage—which perhaps I did not touch on this morning—there is a prevalent idea, in agricultural districts of the West particularly, that the drain tiles should be porous so that the water that is drained away could go through the walls of the pipe. I don't know where that idea originated, but there is nothing in it except perhaps that in the making of those drain tiles in those small machines the manufacturer found he had to make them very porous, and he used that as an argument in favor of the tile. Certainly it can have no other basis, because a tile should be absolutely dense when properly made, and it should have no absorption, or only the minimum amount, and certainly they should not be so porous that the water can flow through them. If the tiles are laid in land that has to be drained, the joints themselves are sufficient openings to allow the water to get in.

The President introduced Mr. E. H. Keating, formerly city engineer of Toronto, and now with the Toronto Railway Company.

Mr. Keating: I have had some little experience in the construction of concrete sewers. Twenty-four years ago I was engineer of the city of Halifax, and we undertook to build a brick sewer. We had endless trouble, and with great difficulty we managed to get it finished in time to get the Admiralty grant for its construction. One of the troubles we experienced was with union labor of bricklayers, and I decided to try concrete. The next year we made an arrangement with the Poorhouse authorities to get the pauper labor to make the concrete. I know there are objections to it, but under the conditions of the labor market we had to do something. We put up a large shed, made moulds for those sewers, built the sewers in blocks, and the following year all our sewers were made in concrete, and I continued that process for the few years I remained with them. The engineer who followed me has kept it on ever since. Two or three weeks ago, when the discussion was going on here as to whether concrete or brick should be used in the septic sewer, I wrote to the engineer at Halifax as to the condition of the sewers we built twenty-four years ago, especially with regard to the intakes, and the sewers which were the outlets down to the sea, and how the action of the waves affected the concrete. He wrote back and said that he had continued the same process of building the sewers in blocks about two and a half feet in length, and generally large enough for a couple of men to handle easily. They are of various sizes, from 20 x 30, and some a little smaller, up to 4 and 5 feet in diameter. He said he had never had a single complaint from any of them, and even on steep grades or concrete exposed to the action of the sea, except in one instance where he built a sea-wall recently, and a heavy storm came on before the concrete was dry. With that exception he had no complaint to find, and he still adhered to the same system of making those sewer blocks. I may say they were made in wooden moulds. The concrete was mixed in just about as green a proportion as it would be safe to adopt. I had 1:3:5, and that proportion the engineer tells me he still adheres to. He says he has tried some sewer pipes, but he found that the difference in cost was very little and he found that there was so much to be gained by building the sewers in blocks that he had given up this concrete sewer pipe altogether and adhered to blocks. especially where the grades are not very steep. We have as much as one in 12 per cent. grades. It was very gratifying to me to learn that there had been no failures at all.

Mr. Essery: What are the ingredients of concrete on the other side—limestone, granite, or rock?

Mr. Humphrey: The character of the aggregate differs in different parts of the country. In Philadelphia they use crushed stone as well as gravel. Through the West they use limestone. But it does not seem to make any difference as to the character of the ingredients if they are in a proper character. I have not had any occasion to examine any sewer in which they used any very soft limestone, but those I have examined in some Western points were limestone not of a particularly hard character.

Mr. Essery: What is the effect of the acid?

Mr. Humphrey: I don't think the question of the acid in the sewage is a matter that need be considered, because I find in most of the sewers that all along where the water flows the entire surface is coated with a greasy scum which practically makes the surface of the concrete immune against that acid action.

M. Morssen: What are the grades at which the bottoms of the sewers must be protected against corrosion?

Mr. Humphrey: They are grades of considerable fall; I mean, for instance, where free water will shoot down a very sharp grade. Under those conditions there is a tendency to scour, particularly if the sewer contains grit of any kind, and the practice seems to be then, in using an ordinary brick sewer, to pave that particular place with either a very vitrified paving brick or a Belgium block if it is available.

Mr. Essery: The reason why I ask that question is that it seems to me the main argument the bricklayers' union here is putting up is on the question of acid. My father took a three weeks' trip through the States, and in every place he brought up the question of acid where a concrete sewer was in construction, and there was only one person who asked him if we had large steel works or chemical works here that would give a high percentage of acid. He did not find a single place in the States that thought the acid should be considered. Would the acid affect the granite of the concrete any more than it would concrete?

Mr. Humphrey: The action would be on harder stone, but I don't believe you would get any acid unless it would be the concentrated discharge from a manufacturing plant, where you would not have enough acid to make any serious disintegration of the surface. I know there is a practice now of using concrete with paper digesters, but if there is a full flow of strong acids through the sewer and there is none of the protective coating formed there, there may be some action. But the action of the acid would be on the surface, and, of course, it would be somewhat slow.

Mr. Essery: What percentage would you consider injurious?

Mr. Humphrey: I could not tell you just what percentage the acid would be. I don't know, as I never examined any of the waters to know just how much acid you have. I know in Brooklyn there are several manufacturing plants where the discharge waters were strong acids, but even then there was apparently no action at all on the granite sewers themselves.

Mr. Murphy: What would be the effect on brick under similar conditions? Would the same acids not attack the brick?

Mr. Humphrey: When you say brick, it doesn't mean anything, there are so many varieties and grades of brick. Some of the bricks out in the West have limestone nodules in the clay, and I have seen some bricks out there, and tested some, in which the acid would act with far greater freedom than it would on any cement. On the other hand, there are these very hard burned bricks, such as you get in the vicinity of Philadelphia and the East, which are very hard and dense, made out of good brick clays, and those bricks are of rather a high order. Then again, there are some bricks, which I had occasion to examine recently, which would not stand ordinary weather conditions. Then again, the character of the bricks they use at Great Falls is very poor, I think decidedly inferior to a concrete sewer for that purpose. So without knowing the character of the bricks I could not answer that question any more definitely.

Sanford E. Thompson: I would like to ask Mr. Humphrey if in any case of matter from factories entering into the sewer, where there was also house drainage and ordinary sewage, he would hesitate in any way to lay a good concrete sewer?

Mr. Humphrey: Absolutely none. I think the point Mr. Thompson has amplified is that the water coming from the plants would be to a large extent already diluted, and still further diluted in the sewer. I would not have any hesitancy; in fact I think concrete is one of the best materials to use in the construction of sewers. If you can get a good smooth surface you reduce the trouble very much in the sewer, and I think there are many details of construction for which concrete is particularly adapted.

A. C. Blanchard: I should like to ask Mr. Humphrey his view with regard to the difference in flow, that is, the retardation of flow; whether a brick sewer will carry more or less than a concrete sewer of the same diameter; that is to say, the value of the old co-efficient—is it any greater or less in the case of the brick sewer than of the concrete sewer?

Mr. Humphrey: I should decidedly say it was in favor of the concrete sewers. It is impossible to lay a brick sewer with a decidedly smooth intake, and I should think it woul l be decidedly in favor of the concrete sewer.

Mr. Francis: I had occasion to examine considerable length of the new concrete conduit being constructed by the Montreal waterworks, having an interior depth area equal to about 8 feet 6 inches, circle, and that conduit has not been finished on the inside, and has been constructed so well that the surfaces throughout are practically as smooth as that wall.

Mr. Humphrey: Quite recently I went through one of the main trunk line sewers in Brooklyn, I think the diameter of the sewer was 22 feet, and they were using metallic forms, and the surface of that sewer after the forms were pulled were almost like granolithic finish; they were smooth. I think this applied where the forms are properly made; you get a smooth clean section in the line of your sewer.

Mr. Essery: Do you consider a brick invert any advantage in a concrete sewer?

Mr. Humphrey: If there were conditions where there was perhaps a large amount of silicious material carried by the sewage, and where the fal' was very great so that there would be a very hard scouring, I might be inclined to put in a very hard Belgium block or vitrified brick; but I certainly would not put in an ordinary brick in preference to the concrete. I think it would be no advantage whatever in the invert, and the only exception where I would do that would be under conditions of very great scouring, and I would use some very hard material like a trap rock block or hard paving material.

President: Have you ever known a case, such as is alleged of Milwaukee, I believe, of a sewer of high grade and rapid speed where the invert was lined with some kind of stone, and where on examination the concrete joints stood up, indicating that the scouring was more marked in the case of the stone than in the case of the joining?

Mr. Humphrey: When I got to Buffalo I expected to examine the condition of the conduit, brick lined, that laid in mortar for seventeen years, but I am told that the bricks showed more wear than the joints. I don't recall any other instance in which the joints have stood up better than the brick.

Sanford E. Thompson: I know of an instance of that kind. I think I have a letter in regard to it. It was in one of the Western States when there was a very steep grade, something like 10 per cent., and the overflow of the sewer was drained, and the joints after 10 or 15 years service stood up between the blocks. The blocks were worn down between them, and the mortar joints stood up to project.

The President: What kind of blocks?

Mr. Thompson: I don't know the kind of stone.

Mr. Blanchard: I was down in the Niagara Falls power tunnel five years ago when the water was off before, and the velocity of the water was somewhere in the neighborhood of 24 feet per second. As far as any of us could see, the joints were very nearly perfect. In only one or two instances was a little stream of water coming through the joints between the brickwork, and the joints did not seem to have lost their pointing at all, but the bricks appeared to have been covered with a very smooth coating of thin slime, or else it was the smoothing of the brick made by the movement of the water. One could not see any wear at that time. I don't know whether they have discovered anything since, in the last examination of it.

The President: The next item on our programme is "The Evolution of Concrete in Municipal Engineering," by Mr. A. C. Blanchard, sewers engineer, City Hall, Toronto. This paper was published in the "Canadian Engineer," March 19th, 1909.

Mr. Humphrey: Were not some of those old sewers in Brooklyn made out of natural cement?

Mr. Blanchard: I don't know.

President Gillespie in closing the Convention said: I wish to say that the Canadian Cement and Concrete Association, under whose auspices this Convention has been held, has an Exhibition which, in the opinion of those who know, is very creditable. The Association has conducted a Convention at which upwards of twenty papers have been contributed, dealing with the manufacture and uses of cement and concrete, and in which many discussions have taken place. The gentlemen who have contributed papers have received no reward for their time, and their only motive has been their devotion to good engineering construction. In view of that fact it seems to me that this Association, as an educational organization—and I wish to emphasize that feature—is entitled to the co-operation and support of engineers, architects, contractors and cement manufacturers. If the Association is ever going to attain and maintain the position of authority which is essential, I think it should receive the support of those persons. This is the last item on our programme, and unless there is some business to bring before the house the meeting will prorogue and adjourn.

Mr. C. H. Thompson: I wish to move that we tender our hearty thanks to those who have contributed to the success of the Convention.

Mr. Essery: I have much pleasure in seconding that motion. (Motion put and carried amid applause.)

The President: To the gentlemen included in this motion, I desire, on behalf of this Association, to tender this vote of thanks. The Association will prorogue as stated, to convene at some time not yet decided.

Convention closed at 5 p.m.

RIDES PER CAPITA.

In a hearing before the Wisconsin State Railway Rate Commission in the 3-cent. rate investigation, Mr. C. Nesbit Duffy, comptroller of the Milwaukee Electric Railway & Light Company, presented some valuable data on the rides per capita in eleven cities of the United States. The cities cited, with their population and amount per capita of the passenger earnings were as follows:—

New York, population, 2,500,000, $17.72; Denver, 200,000 population, $14.57; St. Louis, 750,000 population, $14.21; Kansas City, 375,000 population, $13.67; Boston, 1,000,000 population, $13.55; Chicago, 2,000,000 population, $12.61; Philadelphia, 1,500,000 population, $12.06; New Orleans, 350,000 population, $11.39; Cincinnati, 410,000 population, $10.63; Louisville, 225,000 population, $10.63; Milwaukee, 375,000 population, $8.37.

Mr. Duffy testified that the average fare per passenger was approximately 3.15 cents. He said there is a tendency in the direction of a rapidly increasing number of street car transfer passengers and a proportionate decrease in the number of revenue passengers.

The returns for three Canadian cities are as follows: Winnipeg, population, 100,000, $9.80; London, population, 50,000, $4.70; Toronto population, 350,000, $10.31.

LEGAL NOTES.

J. E. Parsons, B. A., Barrister-at-Law.

[This department will appear in the third issue of every month. Should there be any particular case you wish reported we would be pleased to give it special attention, providing it is a case that will be of special interest to engineers or contractors.—Ed.]

SURVEYOR'S NEGLECT TO TAKE PROPER DATA.

Moneypenny vs. Hartland et al.—The plaintiff was an architect and surveyor, and was employed by the defendants to make out plans and specifications for a bridge over the Severn River. When they refused to pay his bill he brought this action for compensation for his skill and labor in preparing the plans, estimates and specifications.

It appeared according to the evidence at trial that he had been negligent in not securing reliable information as to the nature of the soil beneath the foundations; he had not taken proper means by boring or otherwise to ascertain these and other facts, but chose to go upon the information of others, which turned out false.

Held, that his reliance upon the statements of others was no excuse, as it was his duty to ascertain the true facts for himself or to report to his employers, that he only went on the information of others, in which case, if they did not object within a reasonable time, they would be deemed to have accepted that manner of work as satisfactory. As he did not do this, and as the estimates are incorrect to a considerable amount, he can recover nothing for the work he professes to have done in preparing them.—1 Car. & P., 352.

FAILURE TO COMPLETE CONTRACT—DIVISIBILITY OF CONTRACT PRICE.

New York and Ottawa Ry. Co. vs. Collins Bay Rafting Co.—The plaintiffs were a railway company, one of whose lines crossed the St. Lawrence River at Montreal, and the bridge over the southerly channel of the said river had been wrecked and thrown into the stream, obstructing navigation.

On or about September 30th, 1898, the railway company entered into an arrangement with the defendants, a company of marine contractors, whereby it was agreed that the latter "should remove both spans of the wrecked bridge and put them ashore for the sum of $25,000, to be paid $5,000 as soon as one span was removed from the channel, another $5,000 as soon as one span was put ashore, and the balance as soon as the work was completed. . . . It being understood that they should push the work with all reasonable despatch, but if they failed to complete the work that season they should have the right to complete it next season."

The facts disclosed at trial were that the defendants had removed the southerly one of the two wrecked spans, whereupon they received the first instalment of $5,000, and upon placing it ashore they received a second instalment of $5,000. They also dragged the central span from its position athwart the stream, so that it lay lengthwise of the channel, but they did not succeed in freeing the channel altogether, much less in placing this span ashore in such condition that the material could be used again.

The following season elapsed without their completing the contract, and the evidence was to the effect that the railway company would never have contracted with the defendants at all if they had had any reason to expect a failure of the undertaking. The railway company then brought this action, denying liability for any part of the sum agreed upon and for the recovery of $10,000 already paid, as their calls for tenders had been for a fixed price for a completed job.

The court holds that whatever may have been the purpose for which bids were invited, or the exact wording of the call for tenders, it is bound to look at the contract as finally entered into and act accordingly. After being fought through three courts, the Supreme Court of Canada has interpreted the contract to be an approximate valuation of the work according to stages of progress and a division of the price accordingly, so that the defendants were entitled to receive $5,000 apiece for the removal of each span from the channel and $5,000 each for placing them ashore, with the remaining $5,000 as a final payment after completion. The defendants are, therefore, entitled to hold the $10,000 already paid.

The word "channel" as used was interpreted to mean "that part of the river in which vessels go on their voyages up and down the St. Lawrence, and in which either section of the fallen bridge, if permitted to remain, would become an obstruction to navigation." The contractors had dragged the central span some 500 feet and placed it parallel with the current, so that three-fourths of the water between those piers passed to the north of the wreck. Here it would not be likely to cause ice jams sufficient to carry away the piers, but, as it was not entirely out of the channel, the court refused to allow defendants the third instalment of $5,000 allotted for this portion of the work.—32 S.C.R., 216.

SURVEYOR'S CERTIFICATE—CONTRACT—SURVEYOR'S LIABILITY TO THIRD PARTIES.

Le Lievre vs. Gould.—A man by the name of Hunt, who was owner of certain lots, entered into a building agreement with one Lovering, a builder, for the erection of buildings on the lots, and, according to the agreement, the property was, after erection of the buildings, to be deeded to Lovering, who was to pay Hunt a stated sum per year in return.

Lovering had not funds sufficient to erect the buildings, so Hunt undertook to procure for him a loan of $5,000, to be advanced in instalments at specified stages of the work, and the balance upon completion of the whole work. Later, Hunt spoke to the plaintiff, Miss Le Lievre, and arranged with her to advance the money to Lovering as the work proceeded. Hunt then spoke to the defendant, Gould, who agreed with him to furnish progress certificates as the work reached the several stages set out in the schedule of advances, but the defendant, who was an architect and surveyor, was not informed for whose use the certificates were, and knew nothing about the mortgagee's interest; he simply undertook to furnish progress certificates to the owner, Hunt, as per the schedule of specifications then handed to him.

After the defendant had been engaged by Hunt, and in pursuance of arrangement made by Hunt with Miss Le Lievre, a mortgage from Lovering to Miss Le Lievre was drawn and executed. By this mortgage it was provided that "the mortgage money should be advanced in such instalments as the mortgagee or her surveyor should from time to time appoint, provided always that the mortgagee should not be bound to make any advance unless and until her surveyor should have certified in writing that the work had been proceeded with to the satisfaction of such surveyor and in conformity with the building agreement so as to entitle the mortgagor to the advance certified.

The defendant, Gould, was not aware of the provisions of this mortgage, but he did give certificates to Hunt, and on the faith of these certificates the plaintiff advanced moneys from time to time to the builder, Lovering, but she did not take the extra precaution to engage another surveyor, as she was entitled to do under the terms of the mortgage. The defendant's certificates were shown to her, and she saw fit to rely upon them and asked for no others.

At the trial the plaintiff claimed that Hunt was her agent when he employed the defendant to give the certificates, while the defendant denied this statement, and declared that he never undertook any duty towards her. It was, however, admitted that the certificates were inaccurate, and that the last certificate to the effect that the houses were complete was given upon the assurance of Lovering that the work would be finished by a tenant, but which the tenant never did. It was determined that Gould had not been guilty of fraud, but certainly had been of negligence.

The court held that as there was no contractual relationship between the plaintiff and defendant, the latter was under no duty towards her to exercise care in giving the certificates. Therefore, whatever may or might be his liability to other people for damages suffered through his negligence, the plaintiff has no claim against him, and the action was dismissed.—41 W. R., 468.

It should be noticed that if the court had come to the conclusion that Gould was guilty of fraud in giving the certificates as he did, his position would have been different. Fraud is a legal wrong, and any person who was injured by such wrongful act would have a right of action, and could recover a sum sufficient to cover any damages sustained. As there was no fraud, but only recklessness in carrying out his business responsibility, he cannot be liable to third parties, but only to those who have a legal right to his services.

CONTRACT DEFINED.

A very concise definition, and one frequently heard, is that "A contract is an agreement enforceable at law." It is, therefore, of the essence of contract that each party be able to enforce the agreement against all other parties thereto. But this does not extend to outsiders, for they are not within the circle, and acquire no rights over the contractors. Thus it will be seen that in the Le Lievre and Gould case, noted above, the mortgagee, Miss Le Lievre, was an entire stranger to the contract made by Hunt with the surveyor. Had Hunt suffered through the surveyor's negligence he could have held the defendant liable, but the mortgagee could not, for she was not a party to the surveyor's contract.

INTERPRETATION OF CONTRACT—CHANGE IN WORK.

Gilbert Blasting and Dredging Co. vs The King.—The plaintiff company contracted with the Government to do "all the dredging and other works connected with the deepening and widening of Section No. 8 of the Cornwall Canal . . . they to provide all labor, plant, etc., for the completion of the work by a date named, and that the several parts of this contract should be taken together to explain each other and to make the whole consistent . . . and that the engineer could, at any time before or during construction, order extra work to be done, or changes made, either to decrease or to diminish the work to be done, the contractor to comply with his written requirements therefore, and no contract on the part of the Crown should be implied from anything contained in the signed contract, or from the position of the parties at any time."

The plaintiff company commenced operations, and had executed part of the work by constructing dams as contemplated by the contract when the Government decided to abandon this scheme, adopted another plan, and gave the work, under the new plan, to other contractors. After it was completed the Blasting Co. filed a petition of right in the Exchequer Court, contending that the work had wrongfully been taken out of their hands, and claiming a sum equal to the profits they would have made had the work under the new scheme been given to them.

The Supreme Court interpreted the contract to mean that the Government was privileged at any stage to abandon the work, as they did, or otherwise change their plans as their engineer might advise. It is stated in the contract that the Government is not to be bound by any implied proviso, and, therefore, contractors cannot expect any assistance outside of the express terms of the contract. Further than this, the contract contains no express covenant by the Crown to give all the work done to the Blasting Co., and, therefore, the petition of the latter is dismissed.—33 S.C.R., 21.

WATER RATES, WATER WASTE, AND RESULTS OF THE METER SYSTEM.

Adolph Wurzburg, Clerk of Water Department of Grand Rapids, Mich.

Having been requested by General Manager Freshney to prepare an article on matters pertaining to the Inspection Department of the Board of Public Works, I take pleasure in submitting the following, which I trust will be of interest to the general public.

According to the Annual Report of the Board of Public Works for the fiscal year ended March 31, 1908, the total number of water services installed in this city was 16,226, of this number 9,675 taps supplied water to consumers at a flat or schedule rate, while 5,327 services have meters installed; 984 water services are laid to the street curb only, and will be extended into premises when use of water becomes necessary. After the common council has declared the grading and paving of a street a necessary public improvement, all of the property owners having frontage on the line of the proposed improvement are notified by the Board of Public Works to have water connections made. If done at that time the cost of laying the services is not only much less, but the street, if left undisturbed after the improvement is finished, will naturally wear much longer. About two hundred connections ranging in size from 4 to 8 inches are used for fire protection for factories and other large buildings, and the use of water through such connections for any other purpose is prohibited.

Water Rates.

The rates for water furnished on a schedule or flat rate are as follows:—

Sinks for families of four or less, per year....	$4.00
Closets for families of four or less, per year..	4.00
Bath tubs for families of four or less, per year	2.00
Hydraulic pumps	3.00
Washing machine motor	2.00
Sprinkling rate per season	5.00

These rates are for one family only, each additional family will be assessed extra according to fixtures supplied.

Water for horses, per year	$2.00
For each additional horse, per year	1.00

Building Purposes.

Brick for each 1,000 laid	$0.05
Plastering for each 100 yards.................	.20
Stone, per perch	.02

Rates for Metered Water.

Metered water will be rated at 5 cents per* 100 cubic feet. A discount of 10 per cent. will be allowed on bills paid on or before the 15th of the month in which they become due, but no metered bill shall be less than $1.75 net per quarter.

Consumers using over 10,000 cubic feet per day on quarterly average will be rated at 4 cents per 100 cubic feet.

In order to correct a wrong impression which some of the water consumers have, when a meter has been placed on the service supplying their premises, that the water must be used very sparingly, in order to keep down the size of the water bill, I will say that the consumer receives 20,000 gallons of water for the minimum price of $1.75, covering a period of three months use. This quantity of water is ample to permit of a liberal use for sanitary purposes as well as for sprinkling for lawn preservation. This fact, however, must be borne in mind, that the plumbing must be kept in good condition. I wish also to state in this connection that water meters do not over-register as some consumers, who receive excessive water bills firmly believe. The Water Department some time ago received proposals from all the meter manufacturers in the country to furnish this city with 1,000 meters for the coming year. All of them submitted one or more meters with their proposal, and they were sent to the city pumping station to be tested. After a thirty days' trial under the most favorable conditions, not any of the seventeen meters placed on the block had registered excessively. Thousands of our citizens who have availed

* Read at Ryerson Library, Grand Rapids, Mich.

themselves of the opportunity and have had meters installed in their premises, have no desire to change back to a schedule rate, for the very good reason that their water bills are moderate as compared with bills under the former system. However, as stated before, in order to obtain these results, the plumbing must be kept in good repair (and the careful consumer will see that this is done). It is the careless and indifferent consumer, be it tenant or owner, who neglects this important duty, that has to foot the large water bills, and who will almost invariably declare that the meter is "no good" and that it over-registers.

Water Waste.

The last Annual Report of the Board of Public Works issued shows that the average daily consumption of water pumped during the year ending March 31, 1908, was 14,728,615 gallons, or 147 gallons for each inhabitant, based on a population of 100,000. Other cities of about the same size as Grand Rapids, where practically all water services are metered, show a per capita consumption of from 40 to 80 gallons per day, or about one-half as large an amount as is pumped into the city mains. The excess pumpage is partially accounted for as follows: Water that is used for extinguishing fires, the flushing of sewers and the supply furnished for about fifty water troughs. A considerable amount of water which is pumped is lost through leaks in the mains and services outside of the street curb, but in my opinion this loss is insignificant as compared with the waste caused by the so-called hopper or hydrant closet.

After the Board of Public Works, by resolution, had ordered the installation of meters on services having hopper closets, a record was kept of the amount of waste registered by the meters, and I herewith submit a list of readings taken at sixteen houses:—

Meters set November 17, 1902, 0, reading December 22, 1902, 20,800 cubic feet.

Meter set November 18, 1902, 0, reading December 20, 1902, 15,200 cubic feet.

Meter set November 19, 1902, 0, reading December 27, 1902, 24,000 cubic feet.

Meter set November 24, 1902, 0, reading January 28, 1903, 43,100 cubic feet.

Meter set November 20, 1902, 0, reading January 27, 1903, 23,400 cubic feet.

Meter set November 25, 1902, 0, reading January 26, 1903, 15,700 cubic feet.

Meter set November 26, 1902, 0, reading January 26, 1903, 39,500 cubic feet.

Meter set November 22, 1902, 0, reading January 26, 1903, 37,300 cubic feet.

Meter set November 22, 1902, 0, reading January 26, 1903, 36,400 cubic feet.

Meter set November 28, 1902, 0, reading January 26, 1903, 12,900 cubic feet.

Meter set November 28, 1902, 0, reading January 26, 1903, 18,000 cubic feet.

Meter set May 4, 1903, 0, reading May 18, 1903, 12,700 cubic feet.

Meter set April 15, 1903, 0, reading June 5, 1903, 30,100 cubic feet.

Meter set April 25, 1903, 0, reading June 22, 1903, 39,600 cubic feet.

Meter set April 25, 1903, 0, reading June 21, 1903, 16,000 cubic feet.

Meter set June 6, 1903, 6,600 reading June 20, 1903, 22,100 cubic feet.

Making a total of 406,000 cubic feet equal to 2,862,300 gallons, and amounting to $182.70, figured at 5 cents per one hunderd cubic feet, with the usual discount of 10 per cent. The amount received from these services under a schedule rate covering the same period of time was $23.75.

These figures clearly indicate where a large amount of the excess pumpage of water goes.

The fifty water troughs supplied yield a yearly revenue to the water department amounting to $380. If a meter were placed on these service the amount realized therefrom would be about $2,000 for approximately 28,000,000 gallons of water supplied. These figures are submitted simply to illustrate the quantity of water pumped for this purpose.

Whilst the water department insists that a meter be installed on all services having hydrant or hopper closets, it is not adverse to giving all consumers the opportunity to place meters in their premises if they so desire, and make application at the waterworks office in the City Hall.

Leaks.

During the winter and early spring the inspectors are kept busy answering calls to shut off the water on account of bursted water pipes flooding their premises, and while our men are always willing and ready to respond to emergency calls, many midnight trips made on a stormy night could be avoided if the consumers would make an effort to learn how very easy it is to help themselves and cut off the service in the house in case it becomes necessary.

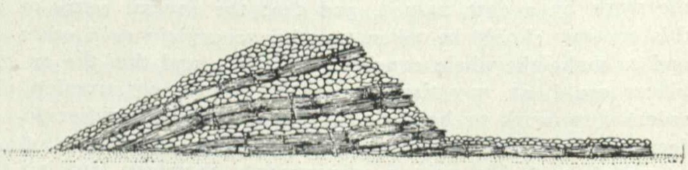
The plumbing rules require that a stop and waste cock be placed at a point where the service pipe enters the cellar or basement, close to the inside wall of the building. If every house owner or tenant would inform themselves as to the location of the shut-off, and also instruct their families along these lines, much annoyance and trouble could be avoided and possible damage averted.

In conclusion I wish to thank the ladies and gentlemen present for their kind attention and trust this article may be of some service to citizens generally, and especially to patrons of the City Water Department.

ROCK AND BRUSH DAMS AND PROTECTORS.*

The works of improvement, consisting of bank revetment, wing dams, closing dams and longitudinal dikes, are generally constructed of brush and rock. The bank revetment consists, below the water surface at the time of construction, of a mattress of brush fascines sunk in place by rip rap rock; above low water line, of a rip rap of 6 to 12 inches of rock. The width of brush mattresses varies from 20 to 60 feet, being affected by the stage of river at time of construction, and the depth of water. The fascines are preferably made of willow brush, which is found in large quantities on the islands and sand-bars in the river, but where there is a local scarcity of willows, the use of other varieties of wood sufficiently straight to be bound into fascines has been allowed. Recent specifications require that fascines shall be made of live brush sufficiently trimmed and choked

Section of Brush and Rock Dam.



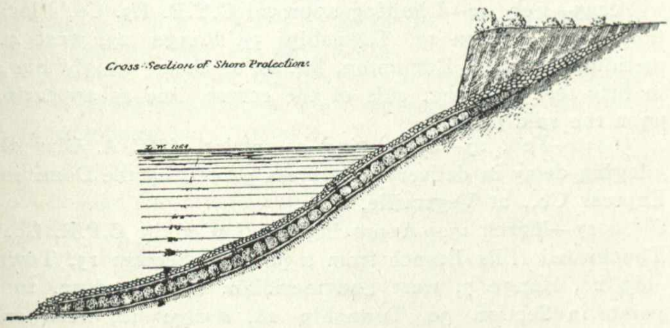
to form a compact mass twenty feet long and from twelve to fifteen inches in diameter, and tied with bands of lath yarn or wire not more than four feet apart. When made into mats they are closely packed and secured at distances of 8 to 12 feet by pairs of binding-poles joined by ties of lath yarn or wire about two feet apart. The fascines are laid with their butts pointed down stream. The early practice was to lay the fascines at right angles to the shore line, butts to the bank, but in this position on steep banks there was found a tendency of the stone covering to slip.

The mattresses are constructed on small flats having inclined ways upon them, which are locally known as "grasshoppers." The grasshopper is a small boat, the hull of which is about 2 feet deep, 14 to 22 feet in width, and 32 to 40 feet in length. On this hull are placed ways or skids running fore and aft, usually four or five pieces of scantling, rounded and smoothed on the upper side. They are given an angle of about 30 degrees with the water surface, to facili-

*Abridged from an article by C. McD. Townsend before the Western Society of Engineers on "Improvements of the Upper Mississippi River."

tate launching the mat, and extend over the forward end nearly to the water surface. When a length of mat equal to the length of the ways has been constructed, the grasshopper is dropped down the river a distance of about twenty feet, a corresponding length of the mattress sliding into the water, and another row of fascines is then added, lapping the preceding row from four to ten feet. In this manner a continuous mattress is constructed along the bank to be protected. It has been found advisable to employ small binding-poles, to give greater flexibility to the mat. In some portions of the river three or four good-sized willow brush are substituted for the binding-pole, with advantageous results. The necessity of flexibility in the mat is not only to prevent rupture while sinking, but it is found that as soon as the mat is in place the river currents produce a scour at the toe of the mat, and unless it is sufficiently flexible to conform to this scour, it is undermined and slips farther into the river, producing a break in the revetment at the water surface.

Cross Section of Shore Protection.



The upper bank is graded to a slope of from 1 on 1½ to 1 on 3 before the rip rap is placed. In the upper portions of the river, where the banks are low, the work is done by manual labor. In the vicinity of the mouth of the Missouri, where the banks are higher and more sandy, economic results have been obtained by the use of a drag scraper operated by the steam engine on a pile-driver. It has been the practice on certain portions of the river to sink the mattress one season and allow the river itself to grade the upper bank during the next flood, and complete the work another season. This method of procedure is economical, provided the completion of the work be not too long delayed.

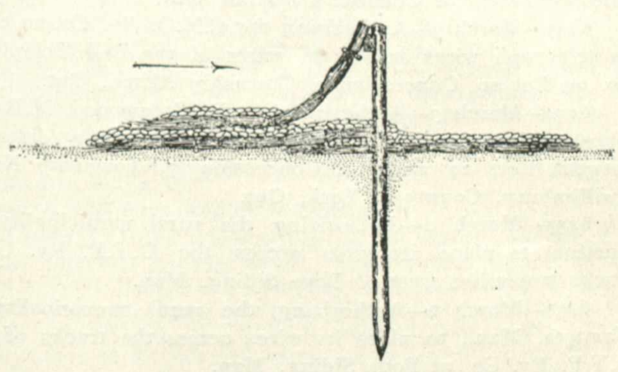
Wing dams are constructed for the purpose of contracting the width of the river at low stages. It was originally proposed to construct the dams in accordance with the practice on German rivers as described by Schlichting, giving them an inclination up stream, in straight reaches of 105-110 degs.; on concave banks, 100-102.5 degs., and on convex banks, 90-100 degs., and so locate them that their axes intersect in the middle of the channel. They were to be spaced at five-sevenths of channel width in straight reaches, half the channel width on concave banks, and on convex banks the width of the channel. While in general this plan has been adopted, there have been numerous exceptions, particularly in the spacing of the dams, due principally to economic considerations. The heights to which the dams have been constructed are also variable. The present practice is to build them to a grade four feet above low water on the upper portion of river and six feet above low water below the Des Moines Rapids. In their construction a mattress containing a single layer of brush fascines, bound with three sets of binding poles, is first sunk the entire length of the dam, to prevent scour during the process of construction and to serve as an apron to receive the flow over the dam. This is covered with a layer of rip rap rock about six inches thick on the upper side and one foot to eighteen inches on the lower side. A second mat is sunk on this rip rap from ten to fifteen feet further up stream and covered with stone. Additional mats are similarly placed and covered until the required grade is attained, each mat being placed two feet further up stream than the one immediately below it. In filling deep holes the use of multiple mats is permitted; i.e., mats composed of several layers of fascines. To prevent the erosion of the bank, it is revetted 25 to 50 feet above and about 50 to 75 feet below the point where the dam abuts against it.

In dam construction a building boat is required. The building boat is held in position by lines extending to anchors, anchor mats, or piles, previously put in position, and a barge of brush placed along its upper side. A barge of stone is held about twenty feet below by lines extending to it, and between the building boat and rock barge is placed the grasshopper on which the mat is constructed.

The mats for dams are constructed with the fascines laid across the grasshopper, butts down stream. They are usually bound with three sets of binding-poles securely tied with lath yarn or wire, usually at every third fascine. The length of the mat varies with the swiftness of the current and depth of water, but rarely exceeds 100 feet. Three-quarter inch lines are attached to the binding-poles over the tips about ten feet apart, and to the binding-poles over the butts about twenty feet. After the mat is launched these lines are fastened on kevels on the building boat. Care is required in sinking the mat to prevent the river currents from turning it over and dumping the load of rock. An excess of rock is placed on the upstream side of the mat, and the lines connecting it to the building boat are gradually eased off. In shoal water the up-stream edge of the mat is sunk to the bed of the river before the lines running from the butts to the building barge are loosened. After the mat is sunk, the rock is uniformly distributed over it, and the lines used in sinking it are then removed, having been originally attached with a turn to facilitate their removal.

On the lower sections of the river the mat is constructed from tilting ways on the building boat, instead of from a grasshopper as above described. The building boat is 165 feet by 26 feet by 4 feet, and is equipped with two steam capstans and a set of 100-foot tilting ways. There are also hand capstans for handling by hand (if necessary) the anchor lines and the lines extending to the stone barge. The hand capstans are the No. B Providence, and are convenient as idlers when the lines are manipulated by steam. The steam capstans are of the single cylinder steamboat type. The tilting ways are made of 4-inch by 5-inch by 18-foot oak timbers. These timbers are set on edge about 8 feet apart and securely fastened together by a fore-and-aft stringer on the in-board side. Four feet from their outer ends they are set in a block one foot high, to which they are joined by a heavy strap hinge. To each alternate way is attached a 4-inch by 4-inch pine timber that extends down through a hole in the deck to near the bottom of the boat, when the ways are horizontal. A wire rope runs from the lower end of each of these timbers to a pulley on the deck above it, and is joined to a wire rope extending along the back of the ways to a pair of triple blocks, which are connected with the drum of one of the steam capstans. After the mat has been constructed, by winding on this capstan the in-board ends of the ways are raised and the mat launched.

Section of Pile and Brush Dam.



The closing dams, which are employed to close chutes and side channels, are constructed similarly to wing dams, but usually contain more rock, and the bank revetment extends a greater distance both above and below them. In long chutes, at low stages, a head of water exceeding four feet may exist on the dam; in such cases breaks have been not infrequent, and the experiment has recently been made of multiplying the number of dams in the chute so as to diminish the head on each and to increase the tendency to deposit sediment in the chute.

Longitudinal dikes are similar in construction to wing dams, but, as their name indicates, instead of being built approximately at right angles to the current, they extend approximately parallel to it.

During the first years of the improvement, pile and brush dams were built quite extensively in the river above Hastings. In constructing these dams an apron was laid in the usual manner and piles were driven through it on the line of the dam. The distance between piles was about four feet. They were connected by a stringer at a height of about three feet above low water. Against this stringer brush fascines were laid side by side with their tips up stream and their butts extending over the stringer about one foot and bound to it with binding-poles and wire. A small amount of rock was then thrown on the tips. Due to the small quantity of sediment in the upper river these dams have not been as successful as similar ones in the river below St. Louis have been. They were cheaply constructed, but after a few years they became so dilapidated that it was necessary to convert them into the ordinary brush and rock dam.

ORDER OF THE RAILWAY COMMISSIONERS OF CANADA.

Copies of these orders may be secured from the Canadian Engineer for a small fee.

6429—Feb. 27—Authorizing the C.P.R. Co. to construct a branch line or spur in Abbottsford, B.C., to and into the premises of the Abbottsford Shingle Co., on the north-east quarter Section 15, Township 16, east coast meridian, B.C.

6430—March 3—Approving location of the Kootenay Central Railway Co. from a point on the southern boundary of Lot 109, G. 1,547, to a point on the British Columbia Southern Railway, north of Galoway, in Lot 3,063 A 320, East Kootenay, mileage 103.4 to mileage 173.29.

6431—March 3—Amending Order of the Board No. 6160, dated February 4th, 1909, authorizing the Manitoba Government Telephones to cross the C.P.R. tracks half mile west of Brookdale, Man., by adding the following clause, viz.: "It is further ordered that the poles on each side of the track be guyed back so as to make it impossible for them to fall on the track."

6432—March 3—Authorizing the Bell Telephone Co. to place its wires across the T.H. and B. Ry. Co.'s tracks half mile north-west of Chantler's Station, Ont.

6433—March 3—Authorizing the C.N.O. Ry. Co. to erect its telegraph wires across the wires of the Bell Telephone Co. on Lot 20, Concession 2, Township Alfred, Ont.

6434—March 3—Authorizing A. B. Greenwood, M.B., to place a telephone line across the G.T.R. tracks at sideroad between Lots 20 and 21, Concession 7, Township North Gwillimbury, County of York, Ont.

6435—March 2—Authorizing the rural municipality of Hamiota to place its wires across the G.T.P. Ry. Co.'s tracks two miles west of Pope Siding, Man.

6436—March 2—Authorizing the rural municipality of Hamiota, Man., to place its wires across the tracks of the G.T.P. Ry. Co. at Pope Siding, Man.

6437—March 2—Authorizing the rural municipality of Hamiota, Man., to place its wires across the tracks of the G.T.P. Ry. Co., three miles east of Pope Siding, Man.

6438—March 2—Authorizing the rural municipality of Hamiota to place its wires across the G.T.P. Ry. Co.'s tracks, two miles west of Okner, Man.

6439—March 2—Authorizing the city of Winnipeg to lay a sewer under the C.N.R. tracks where the same intersect Lombard Street, known as the Winnipeg Transfer Ry.

6440—Feb. 25—Directing that the crossings of the highway by the Michigan Central and Pere Marquette Railway Companies, in the village of Rodney, Ont., be protected by folding fence gates.

6441—Feb. 17—Dismissing application of city of Calgary respecting subway at Osler Street and First Street East, Calgary, Alta., under the C.P.R. tracks.

6442—Feb. 19—Dismissing application of Henry Harvey, Strathcona, Alta., alleging loss sustained on certain goods shipped from Edmonton to a flag station on the C.N.Ry.

6443—Feb. 8—Directing the C.N.R. Co. to stop the train known as the "St. Paul Flyer" at St. Agathe, and to stop No. 7, due to arrive at Winnipeg at 7.25 a.m. at St. Agathe.

6444—Feb. 19—Dismissing complaint of J. Gainer & Co., Strathcona, alleging excessive freight rates charged by the C.P.R. on live stock from Wetaskiwin, Alta., to Winnipeg, Man.

6445—Feb. 19—Limiting approval G.T.P. Ry. Co.'s location plan, Section 17, Township 53, Range 23, west 4th meridian, through Edmonton, known as their "freight line," to fifty feet on either side of the centre line as appearing upon the said plan.

6446—Feb. 19—Dismissing complaint of H. A. Glaspell, alleging delay in delivery of express parcels by the Dominion Express Co., at Vegreville, Alta.

6447—March 13.—Approving location of the C.P.R. Co.'s Touchwood Hills Branch from a point in Section 15, Township 28, Range 7, west 2nd meridian, at Theodore, to a point in Section 30, Township 28, Range 10, west 2nd meridian, and thence to a point in Section 20, Township 32, Range 17, west 2nd meridian, on the Quill Lakes Branch.

6448—March 3—Authorizing the C.W. and L.E. Railway Co. to operate its trains over the crossing under the tracks of the M.C.R.R. on west side of Town Line Road, near Charing Cross, Ont.

6449—March 2—Approving revised location of the C.P.R. Co.'s line through the Province of Saskatchewan, mileage 1 to mileage 12.3, between Stations Broadview and Grenfell.

6450—March 2—Approving location of the Burk's Falls and French River Ry. Co.'s line from Station 0 to Station 55, Lot No. 3, Concession 1, Township Armour, Parry Sound District, Ont.

6451—March 2—Authorizing the Can. Nor. Ont. Ry. Co. to open for traffic that portion of its railway between Rosedale and Queen Street, Toronto, Ont.

6452—March 2—Amending Order of the Board No. 5568, dated November 3rd, 1908, by adding after the word "crossing," in the sixth line of paragraph 1, the words, "or by establishing electric connection by any other device or method which will indicate whether or not the bell is in good working order."

6453—Feb. 19—Dismissing complaint of Dr. C. N. Corbett, Edmonton, Alta., alleging excessive express charges by express companies in the West.

6454—March 3—Authorizing the C.P.R. Co. to construct a branch line or spur in the town of St. Louis, Parish of Montreal, into the premises of the Hartt & Adair Coal Co.

6455—March 3—Authorizing the G.T.R. Co. to construct four branch lines of railway from a point on the applicant company's branch to the premises of the Erie Realty Co. and other traders north of Eastern Avenue, Toronto, and thence westerly to and into the premises of Lever Bros., south of Eastern Avenue.

6456—March 3—Authorizing the Canadian Machine Telephone Co., Limited, to place its wires across the T.H. and B. Ry. tracks at Mount Pleasant Street, Brantford, Ont.

6457—March 3—Authorizing the Canadian Machine Telephone Co., Limited, to place its wires across the T.H. and B. Ry. Co.'s tracks at Eagle Avenue, Brantford, Ont.

6458—March 3—Authorizing the Canadian Machine Telephone Co. to place its wires across the T.H. and B. tracks at Gilkinson Street, Brantford, Ont.

6459—March 3—Authorizing the Canadian Machine Telephone Co. to place its wires across the T.H. and B. tracks at Market Street, Brantford, Ont.

6460—March 3—Authorizing the Canadian Machine Telephone Co. to place its wires across the T.H. and B. tracks at Oxford Street, Brantford, Ont.

(Continued on Page 442.)

TEMISKAMING AND NORTHERN ONTARIO RAILWAY COMMISSION'S REPORT FOR 1908.

The Temiskaming and Northern Ontario Railway is owned by the Province of Ontario, and controlled by a Commission of three, of which Mr. J. L. Englehart is chairman. The chief officers of the railway are: A. J. McGee, secretary-treasurer; J. H. Black, superintendent; Cecil B. Smith, consulting engineer, and William Young, roadmaster. Mr. G. A. McCarthy, chief engineer, has recently resigned.

Altogether, there is 305 miles of track open for traffic, and a statement of the earnings and expenditures for 1908 show many interesting returns:—

The net earnings for 1908 totalled $284,668.18. The average miles operated during the year were 191. The net earnings per mile is given at $1,490.41. The total revenue of the road for 1908 was $973,065.61.

A memo. covering the cost of the road and equipment, interest charges, earnings, etc., accompanies the statement. It is as follows:—

Cost of Road.

Cost of road and equipment to December 31st, 1908	$13,441,704 89
Cost per mile	50,532 73
Average miles operated, year 1908	191
Cost for 191 miles	9,651,751 43

Earnings, 1908.

From operation	$ 284,668 18
From ore royalties	134,820 27
Total	$ 419,488 45
Interest on cost at 3.8 per cent.	366,866 55

The memo. of earnings, expenses and statistics, covering operation of the Temiskaming and Northern Ontario Railway Commission, year ended December 31st, 1908, is as follows:—

Revenue from Transportation.

Freight earnings	$ 471,203 41
Passenger earnings	366,504 53
Other passenger and freight train revenue	45,501 06

Operation Other than Transportation.

Telegraph and telephone	$ 27,950 22
Other	61,906 30
Total revenue	$ 973,065 61

Expenditures.

Maintenance of way and structures, 12.9 per cent.	$ 125,563 45
Maintenance of equipment, 12.3 per cent.	119,565 01
Traffic expenses, 1.3 per cent.	12,499 96
Transportation expenses, 43 per cent.	405,907 58
General expenses, 2.5 per cent.	24,863 45
Total operating expenses, 70.8 per cent.	$ 688,397 43
Net operating earnings	$ 284,668 18
Ore royalties	134,820 27
	$ 419,486 45
Paid treasurer of Ontario	350,000 00
Balance to profit and loss	$ 69,488 45
Operating ratio	70.8 per cent.

Number of Passengers.

Passengers carried. earning revenue	479,005
Passengers carried one mile	15,252,710
Passengers carried one mile per mile of road.	79,857
Freight carried earning revenue, tons	484,444
Freight carried one mile, tons	34,279,838
Freight carried one mile per mile of road, tons	179,475
Average distance each passenger carried, miles	32.05
Average distance haul of one ton of freight, Miles	70.7

Earnings per Mile.

Earnings, passenger, per mile of road (cents).	2.43
Earnings, freight, per mile of road (cents)	1.37
Average mileage operated during year	191
Gross earnings per mile of road	$ 5,094 58
Gross expenses per mile of road	3,604 17
Net earnings per mile of road	1,490 41

MILES OF ELECTRIC RAILWAYS IN QUEBEC.

Chateauguay and Northern (now Montreal Terminal)	12.00
Montreal Terminal	6.34
Levis County	10.25
Montreal Park and Island	37.99
Montreal Street	124.42
Quebec Railway, Light and Power (Citadel Division)	17.22
Quebec Railway, light and Power (Q.M. and Charlevoix—steam and electricity—30 miles).	
Hull Electric	14.50
Sherbrooke Street	7.00
Total	220.72

CROW'S NEST PASS CHANGES.

United States Control—Four Gentlemen Decline to Act on Board.

The annual meeting of the Crow's Nest Pass Coal Company last week, considerable changes were made in the directorate. Vice-President, Senator Jaffray; President, Mr. G. G. S. Lindsey; third managing director, Sir M. Pellatt and Mr. E. R. Wood, the last two being directors, declined further to serve on the board.

The Monetary Times has interviewed the gentlemen who have declined to act on the board.

Sir Henry Has Not Sold to Hill.

Sir Henry Pellatt stated, with regard to the rumour that J. J. Hill had secured control of the Crow's Nest Pass Coal Company by means of the purchase of a large block of Sir Henry's stock, that no such transfer of shares had taken place. He added that J. J. Hill's holding, of three-tenths, is the same as it was five years ago. He also said that Mr. G. G. S. Lindsey, Senator Jaffray, Mr. E. R. Wood and Sir Henry Pellatt had retired from the board because they were unable to reconcile their views with those of the remainder of the board.

Mr. E. R. Wood treated the matter somewhat lightly. His attention was called to the sensational and mysterious deductions which had been made from the changes. "There is nothing very serious in it," he said. Mr. G. G. S. Lindsey was not inclined to speak of the matter.

Senator Jaffray told the Monetary Times that the control of the company had passed to American interests. They were organizing the board so that it was entirely controlled by those interests. "We felt that the management was entirely independent of us," added Senator Jaffray, "while at the same time we were responsible. We were urged to continue, but the conditions were such that we could not feel justified in doing so."

James J. Hill Says Report is Untrue.

James J. Hill's commenting on the report that Mr. Hill or the interests he represents, has secured control of the Crow's Nest Pass Coal Company said, according to a despatch from St. Paul, Minn.: "The report is untrue. The Great Northern is not making investments in the Crow's Nest mines in British Columbia, or in any other section."

Anyway, it looks as though a fine property has left Canadian control.

FEBRUARY LAKE LEVELS.

The United States lake survey reports the stages of the Great Lakes for the month of February, as follows:—

Lakes.	Ft. above tide-water, New York.
Superior	601.48
Michigan-Huron	579.94
Erie	571.40
Ontario	245.28

RAILWAY ORDERS.

(Continued from Page 440.)

6461—March 3—Authorizing the Government of Alberta to place its wires across the Edmonton, Yukon and Pacific Railway tracks, 1½ miles east of Strathcona, Alta., between Sections 22 and 27, Township 52, Range 24, west 4th meridian.

6462—March 3—Authorizing the Great North-Western Telegraph Co. to place its wires across the G.T.R. tracks leading from its main tracks to the yards of the Canadian Shipbuilding Co. at foot of Bathurst Street, Toronto.

6463—March 3—Authorizing the Manitoba Government Telephones to place its wires across the C.P.R. tracks half mile west of Minnedosa Station, Man.

6464—Feb. 4—Authorizing the G.T.R. Co. to connect its tracks with the tracks of the Hamilton Radial Ry. Co. at a point near Burlington, Ont.

6465—Feb. 4—Authorizing the Hull Electric Railway Co. to cross the tracks of the C.P.R. Co. in the city of Hull, Que.

6466—Feb. 25—Directing that an electric bell be installed at the crossing of the L'Esperance Road, village of Tecumseh, Township Sandwich East, Ont., by the G.T.R.; cost of installation, to an amount not exceeding $300, to be borne by the township, and the maintenance to be at the expense of the railway company.

6467—March 5—Authorizing the C.W. and L.E. Ry. Co. to open for traffic portions of its line of railway on Union Street, Aberdeen Bridge, King Street, Third Street, Raleigh Street, from Raleigh to William Street, and on William and Queen Streets, Chatham, Ont.

6468—March 5—Approving Standard Passenger Tariff C.R.C. No. 190 of the Pere Marquette Railroad Co.

6469—March 5—Authorizing the C.P.R. Co. to use and operate twenty-five bridges on its Toronto-Sudbury line.

6470—March 5—Authorizing the C.P.R. Co. to construct a branch line or spur to and into the premises of the Okanagan Produce Co., situate on Lots 4, 3 and 2, Block 24, Vernon, B.C.

6471—March 8—Authorizing the C.N.R. Company to connect the Hallboro Extension of its line with its Neepawa Branch, near Hallboro, in Sec. 34, Tp. 13, R. 15, West Principal Mer., Man.

6472 to 6474—March 8—Authorizing the Bell Telephone Company to cross with its wires the tracks of the Central Ontario, C.P., and Brockville, Westport and N.W. Railways at various points in the Province of Ontario and Quebec.

6475—March 8—Authorizing the British Columbia Telephone company to erect, place, and maintain its wires across the track of the E. & N. Railway at Nanaimo, B.C.

6476 and 6477—March 8—Granting leave to the Caradoc & Ekfred Telephone Company to erect, place, and maintain its wires across the tracks of the M.C.R.R and G.T.R. at two points in the Province of Ontario.

6478—March 6—Authorizing the C.P.R. to use and operate the 23 bridges on its Guelph and Goderich Line.

6479—March 6—Granting leave to the South Leeds & Pittsburg Telephone Company to erect, place, and maintain its wires across the tracks of the 1,000 Island Railway at Cheesboro Crossing, South Lake, Ont.

6480—March 8—Approving location of the C.N.O. Railway through the Townships of Hardy, McConkey and Blair, District Parry Sound, Ont.

6481—March 8—Authorizing the C.P.R. to use and operate the bridges constructed on the Ottawa Section of its line of railway at mileage 10.0, over Mill Creek, and Back River.

6482—March 8—Authorizing the C.P.R. to use and operate 41 bridges constructed on the Quebec section of its railway, between mileage 10.1 and mileage 151.0.

6483—March 8—Authorizing the C.P.R. to construct bridges over the Lachine Canal, Montreal, near Ogilvie Flour Mills Company's premises; and rescinding Order No. 6,266, February 16th, 1909.

6484—March 6—Authorizing the C.N.R. to construct its railway, Hallboro Branch across the C.P.R. Rapid City Branch, in the N. E. ¼ of Sec. 28, Tp. 13, R. 19, West Principal Meridian, Rapid City, Man.

6485—March 6—Authorizing the G.T.R. to construct, maintain, and operate branch line of railway or siding, to and into the premises of Francis Addison Laurie, Lot 28, District of Parry Sound, Ont.

6486—March 6—Authorizing the C.P.R. to construct, maintain and operate branch line, or spur, for C. G. Johnson, in the city of Vancouver, B.C.

6487—March 9—Authorizing the G.T.R. to construct, maintain and operate branch line to and into the premises of W. D. Morris, on Lots 23 to 28 inclusive, Ottawa, Ont.

6488—March 8—Temporarily approving agreements of the Bell Telephone Company with various rural telephone companies, provided they are not higher than tolls charged immediately previous to 13th of July, 1906, authorized by law to charge.

6489—March 8—Granting leave to the Corporation of the city of Calgary to erect, place, and maintain its electric light and power wires across the tracks of the C.P.R. at 8th Street, Calgary, Alta.

6490—March 8—Ordering that the tender trucks (weighing 100,000 pounds or over when loaded) of locomotive engines used in passenger service by companies operating railways by steam power, be equipped with steel-tire wheels on or before the first day of December, 1909.

6491—March 9—Authorizing S. Hollingsworth, of Blueberry Creek, Castlegar, B.C., to lay and thereafter maintain a 14-inch wooden pipe under the tracks of the C.P.R.

6492—March 8—Granting leave to the Bell Telephone Company to erect, place, and maintain its aerial wires across the tracks of the G.T.R. Company at P. C. Kent Street, Simcoe, Ont.

6493—March 9—Authorizing the Credit Municipal Canadien, to lay and thereafter maintain a 12-inch pipe under the tracks of the G.T.R., where the same crosses the Upper Lachine Road at Rockfield, P.Q., and also under the G.T.R. near the boundary line between the town of St. Pierre and Montreal West, and a 6-inch pipe under the G.T.R. at a point west of the Simplex Railway Appliance Company's works, at St. Pierre aux Liens, P.Q.

6494—March 6—Authorizing the G.T.R. to construct, maintain and operate branch line of railway to and into the premises of the Dyment Mickle Lumber Company on Lot 4, Con. 7, Tp. of Airy, Nipissing District, Ont.

6495—February 19—Granting leave to the G.T.P. Railway to take parts of various lots in the N.W. ¼ of Sec. 18, Tp. 53, North Range 244, W. 4th Meridian, in the city of Edmonton, Alta.

6496—March 11—Authorizing the C.P.R. to construct, maintain, and operate branch line to and into the premises of the Columbia River Lumber Company, near Tappen Station, B.C.

6497—March 11—Authorizing the C.P.R. to construct branch line to and into the premises of the Manitoba Gypsum Company, Winnipeg, Manitoba.

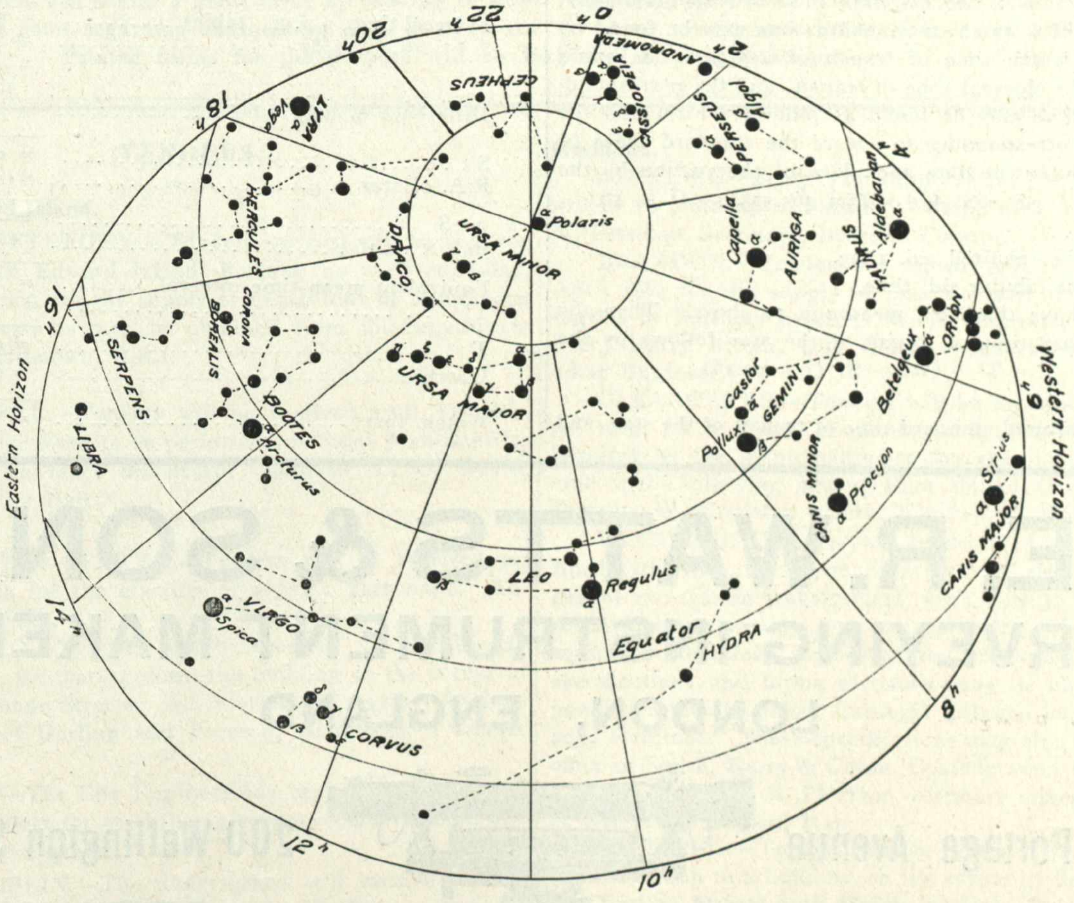
6498—March 10—Granting leave to the Bell Telephone Company to erect, place, and maintain its wires across the tracks of the C.V.R., one-half mile west of Farnham, P.Q.

6499—March 12—Granting leave to the C.P.R. to divert the original road allowance between Secs. 25 and 26, Tp. 16, R. 5, West 2nd Meridian, Sask.

A statement comparing the cost of maintenance of rolling stock per mile run:—

	Locomotive. mile. cents.	Passenger. mile. cents.	Freight car. mile. cents.
C.P.R.	.0772	.0176	.0105
C.N.R.	.1235	.0137	.0066
G.T.R.	.0712	.0106	.0078
T. & N. O. Ry.	.0633	.0202	.0117
I.C.R.	.0845	.0191	.0106

ASTRONOMICAL PAGE



CUT OUT FOR REFERENCE.

STAR MAP, SHOWING THE PRINCIPAL STARS, VISIBLE AT 10 P.M. APRIL 1st IN LATITUDE 45° N.

L. B. Stewart, D.T.S.

The table below gives the apparent places of the brightest of these stars for April 15th at transit across the meridian of 5h W. of Greenwich.

Star	Mag.	R. A. h. m. s.	Decl. ° ′ ″
β Cassiop	2.4	0 04 16.4	+ 58 38 40
α Cassiop	2.5	0 35 17.6	+56 02 58
γ Cassiop	2.3	0 51 09.5	+ 60 13 18
α Ursæ Min. (Polaris)	2.1	1 25 19.0	+ 88 49 12
α Tauri (Aldebaran) ..	1.1	4 30 40.6	+ 16 19 35
α Aurigæ (Capella) ...	0.2	5 09 56.4	+ 45 54 30
α Orionis (Betelgeux).	1.0	5 50 13.9	+ 7 23 23
α Canis Maj. (Sirius).	—0.4	6 41 07.5	— 16 35 37
α Geminorum (Castor)	2.0	7 28 47.4	+ 32 05 27
α Canis Min. (Procyon)	0.5	7 34 32.0	+ 5 27 27
β Geminorum (Pollux)	1.2	7 39 44.7	+ 28 14 53
α Leonis (Regulus) ..	1.3	10 03 32.2	+ 12 24 43
β Ursæ Maj.	2.4	10 56 23.2	+ 56 52 22
α Ursæ Maj.	2.0	10 58 09.3	+ 62 14 43
γ Ursæ Maj.	2.5	11 49 04.8	+ 54 12 07
δ Ursæ Maj.	3.4	12 10 57.9	+ 57 32 22
ε Ursæ Maj.	1.8	12 50 04.0	+ 56 27 14
ζ Ursæ Maj.	2.1	13 20 18.1	+ 55 24 00
α Virginis (Spica).....	1.2	13 20 24.9	+ 10 41 19
η Ursæ Maj.	1.9	13 43 59.4	+ 49 45 58
α Bootis (Arcturus)....	0.3	14 11 31.8	+ 19 39 13
α Lyræ (Vega)........	0.1	18 33 51.8	+ 38 41 36

Determination of Azimuth by the Pole Star.

The following table gives the azimuth of Polaris on April 1st, 1909, for places in longitude 5th (=75°) W., and at certain standard times T:

T	Sid. time	L = 44°		L = 48°		L = 52°	
P.M.		A	a	A	a	A	a
	h. m. s.	° ′ ″	″	° ′ ″	″	° ′ ″	″
8 00	8 38 56.9	358 27 13	+ 8	358 20 21	+ 9	358 11 49	+ 9
8 30	9 09 01.8	32 15	+11	25 48	+12	17 47	+13
9 00	9 39 06.8	38 47	+14	32 50	+15	25 26	+17
9 30	10 09 11.7	46 39	+17	41 18	+18	34 39	+20
10 00	10 39 16.6	55 44	+19	51 04	+21	45 16	+23
10 30	11 09 21.6	359 05 52	+21	359 01 57	+23	57 05	+25
11 00	11 39 26.5	16 54	+23	13 47	+25	359 09 56	+27
11 30	12 09 31.4	28 38	+24	26 22	+26	23 34	+28
12 00	12 39 36.3	40 52	+25	39 30	+27	37 47	+29

The methods described above do not take account of changes in the star places, but with ordinary field instruments and for short periods of time these are negligible.

In this table azimuths are reckoned from the N. in the direction E.S.W. The quantity a is the error in the azimuth resulting from an error of 1m. in the time. It will serve to show the best time to observe if the watch correction is not well determined. The azimuth for any other latitude may readily be found by interpolation.

The standard time corresponding to any azimuth given in the table for a place whose longtitude differs from 5h, and for some other date, may be found by the formula:—

$$T' = T + (L - 5h)\ (1 - 0s.16) - d \times (3m\ 55s.9).$$

Where

T' = the required time.

T = the time for April 1st.

L = the longitude.

d = number of days elapsed since April 1st.

The difference L—5h must be algebraic, and in multiplying by 0s.16 it must be expressed in minutes of time.

To illustrate this, take the following example:—At a place in latitude 49° 20′ N., longitude 80° (= 5h 20m) W, an observer wishes to take an observation for azimuth between 8 and 9 p.m. on April 8th.

Here the interpolated value of the azimuth for 8h 30m is 358″ 23′ 18.3″, interpolating by second differences, and the corresponding time for the given longitude and date is:—

8h 30m 00s
+ 19 56.8 (= 20m — 20 × 0s.16)
—27 31.3 (= 3m 55s.9 × 7)
=8h 22m 25s.5.

To determine the meridian the observer then points to the pole star at the above computed time, after setting his vernier at a reading equal to the above azimuth, clamps the horizontal circle, and then turns the vernier to zero.

Determination of Time.

If the direction of the meridian is known approximately, the correction of a watch on standard time may be found by observing the watch time of transit of a star. The star's R.A. is then the sidereal time of transit, and the corresponding standard time may be found as follows:—First find the sidereal time corresponding to one of the standard times of the above table for the date and place of observation by the formula: $S = S' + d \times (3^m\ 56^s.555) - (L - 5^h)$.

Where

S = the required sid. time.

S' = the tabular sid. time,

and d and L have the same meanings as above. Then the required standard time of transit of the star follows by the formula:— $T = T' + (\alpha - S)\ (1 - 0^s.16)$.

Where

T = the required standard time of transit of the star, and

T' = the tabular time corresponding to S'.

α = the star's R.A.

To illustrate the use of these formulae, let us assume that the meridian transit of the star Regulus is observed at the watch time, 9h 17m 03s., at the same place and date as above; to find its correction on standard time

	h. m. s.
Sidereal time, 9 p.m. (table)	= 9 39 06.8
7 × (3m 56s.555)	= 27 35.9
	10 06 42.7
Difference of longitude	= 20 00
S	= 9 46 42.7
R.A. of star	= 10 03 32.2
a—S	=— 16 49.5
16.8 × 0s.16	= 2.7
Equivalent mean time interval	= 16 46.8
T'	= 9 00.00
T	= 9 16 46.8
Watch	= 9 17 03
Watch fast	= 16.2

CONSTRUCTION NEWS SECTION

Readers will confer a great favor by sending in news items from time to time. We are particularly eager to get notes regarding engineering work in hand and projected, contracts awarded, changes in staffs, etc. Printed forms for the purpose will be furnished upon application.

TENDERS.

Prince Edward Island.

CHARLOTTETOWN.—Tenders for coal will be received by the Prince Edward Island Railway up to Wednesday, March 31st, 1909, for the supply of 13,500 tons of bituminous coal. Specifications may be obtained from the Superintendent at Charlottetown, P.E.I.

Quebec.

MONTREAL.—Tenders will be received until Tuesday, 30th March, for work to be performed at Saint Jean-Baptiste Market, St. Lawrence Boulevard. Address, L. O. David, City Clerk, City Hall.

Ontario

YARMOUTH CENTRE.—Tenders will be received up to March 30th for the erection of a brick parsonage. Address—H. Huntley.

TORONTO.—Tenders will be received up till Monday the 29th inst., for tearing down the building at the corner of Queen and Yonge Streets. All information may be obtained at the office of Darling and Pearson, Architects, 2 Leader Lane.

BERLIN.—The City Engineer has been instructed to advertise for tenders for catch basin covers, concrete tile, Portland cement and gravel.

NEW DUBLIN.—The undersigned will receive tenders up to Monday, the 5th of April, 1909, for crushing 1,000 cords of stone. Address, J. B. Barry, Township Clerk.

OTTAWA.—Tenders for electric light fixtures, etc., for the public building, Owen Sound, Ont., will be received until Friday, April 2nd, 1909. Address, Napoleon Tessier, Secretary, Public Works Department.

OTTAWA.—Tenders will be received until Tuesday, March 30th, 1909, for the supply of oil and grease required for the Government Dredging Plant, for the season of navigation of 1909. Address, Napoleon Tessier, Secretary, Department of Public Works.

TORONTO.—Tenders will be received up to noon on April 30th, 1909, for supply of Underground Cable. Address, Joseph Oliver, (Mayor), Chairman, Board of Control.

WATERLOO.—Tenders will be received up to Friday, March 26th, for the construction of sewer connections in the town of Waterloo for the year 1909, and also for the flushing of the sewers. Address, F. S. Kumpf, Secretary.

ST. THOMAS.—Tenders will be received until 2nd April, for the construction of a bridge over Catfish Creek at Jamestown, Township of Yarmouth; also for the construction of concrete abutments for a bridge to be built over the Otter Creek at Richmond, Township of Bayham. Both to have concrete floors. Also for furnishing and driving about 250 piles in Kettle Creek at Port Stanley. Address, Jas. A. Bell, County Engineer.

OTTAWA.—Tenders will be received at the office of the Commissioners of the Transcontinental Railway until the 8th of April, 1909, for the construction and erection of a steel and concrete bridge and approach spans over the Red River between Winnipeg and St. Boniface. Plans may be seen and full information obtained at the office of the Chief Engineer at Ottawa and also at the office of the district engineer at St. Boniface, Man.

TORONTO.—Tenders are invited for the erection of a timber bridge in North Toronto. W. Scott Brooke, Engineer, 24 Adelaide Street East. (Advertised in the Canadian Engineer.)

Manitoba.

WINNIPEG—Tenders for supply of quantity of brass goods will be received up to Saturday, March 27th, 1909. Address, M. Peterson, Secretary, Board of Control.

BRANDON.—Tenders for cement will be received until April 16th for the supply of one thousand to two thousand barrels of Portland cement. W. H. Shillinglaw, City Engineer; Harry Brown, City Clerk. (Advertised in the Canadian Engineer.)

CLEARWATER.—Tenders will be received up to March 30, 1909, for a supply of plank, bridge timber and lumber required by the municipality for the year 1909, to be delivered at the following places: Pilot Mound, Crystal City, and Purves. W. Cranston, Clerk, Clearwater, Manitoba.

WINNIPEG.—Tenders will be received up to Thursday, April 15th, 1909, for the manufacture and delivery at Winnipeg of two testing transformers, viz.: One 30 k.w. at 80,000 volts, and one 200 k.w. at 200,000 volts, also for control equipment therefor. Copies of the instructions to bidders, specifications and forms of tender may be obtained at the power engineer's office, Carnegie Library building, Winnipeg, Manitoba. These specifications may also be seen at the office of Smith, Kerry & Chace, Confederation Life Building, Toronto, Ontario. M. Peterson, secretary, office of the Board of Control, Winnipeg, Man.

WINNIPEG.—Tenders will be received for the erection of an addition to a building on the corner of Portage Avenue and Carlton Streets until March 30, 1909. Address—Wardell & Nichols, 499 Main Street.

WINNIPEG.—Tenders will be received until March 29th for a three storey brick extension to the Chaffey and Verhoeven building, 289 Garry Street. Address—J. Woodman, Free Press Building.

Saskatchewan.

BELLE PLAINE.—Tenders will be received up to April 15th, 1909, for the construction of the Stony Beach Rural Telephone Company's telephone lines. All material will be supplied, and the poles distributed. Address, John Poyser, Secretary-Treasurer.

SASKATOON.—Tenders will be received until Tuesday, April 13th, 1909, for all labor necessary for laying water mains and sewer pipes, and furnishing certain materials therefor. Plans and specifications may be seen at the office of the Chief Engineer. J. H. Truesdale, Esq., City Clerk, Saskatoon; Willis Chipman, C.E., 103 Bay Street, Toronto.

WEYBURN.—Tenders will be received until April 7th, 1909, for pipe-laying, water tower, cast iron pipe, and fire hydrants and valves for the town of Weyburn. Geo. Ross, secretary-treasurer; Willis Chipman, chief engineer. (Advertised in The Canadian Engineer.

Alberta.

CALGARY.—Tenders will be received up to Thursday, April 15th, for the erection of a public library in Calgary. Address, E. L. Hill, Secretary.

LETHBRIDGE.—Tenders will be received up to April 10th, for the whole of the work required in the erection of a fireproof hospital for the trustees of the Galt Hospital. Address, C. B. Bowman.

MEDICINE HAT.—Tenders for drilling a gas well will be received until April 30th. W. P. Morrison, City Engineer. (Advertised in the Canadian Engineer.)

Foreign.

ADELAIDE, AUSTRALIA.—Tenders addressed to the undersigned will be received until April 28th, for the supply of one bucket dredger, one tug, and two hopper barges.

CONTRACTS AWARDED.

New Brunswick

FREDERICTON.—Hon John Morrissy has awarded a contract for the completion of the masonry superstructure of the Fredericton Highway Bridge to Joseph McVey & Son, of St. Stephen. It calls for the building of three masonry piers and a new stone abutment and ambankment at the St. Mary's end of the bridge. The work is to be completed by February 1st, 1910. The contract price for the work is about $40,000, and then a superstructure of steel will be put in over the whole bridge.

Quebec.

MONTREAL.—The Northern Commercial Telegraph Company have awarded a contract to Michael Connolly, of Montreal, to build one thousand miles of telegraph and telephone line from Point Levis to Windsor, Ont., as well as several branches.

MONTREAL.—The contract for 22,250 bags Portland cement to be used during 1909, in the improvements that are now being carried out in the port, has been awarded, by the Harbor Commissioners, to the Lakefield Portland Cement Company, of Longue Pointe.

MONTREAL.—At a meeting of the Road Committee held last week, the tender of Leger & Company for rough stone, to be dressed into curbs by the city, at 25 and 30 cents a foot was accepted.

Prices submitted for the supply of curbstones were as follows:—

	Straight, per foot. cents.	Curved, per foot. cents.
O. Mandeville	43	53
Latreille Bros	50	60
H. Crevier	46	56
Sicily Asphalt Co.	98	1.05
Picard & Valin	48	58
Leger & Co.	45	55

It was decided to pay as high as 48 cents for straight and 58 cents for curved curbs.

Ontario.

BERLIN.—The Sewage Commission of the town of Berlin have awarded contracts as follows:—Allan Shoemaker & Company, Berlin, Portland cement, $1.55 per barrel delivered; Philip Gies, Berlin, manhole castings, $2.40 per 100 lbs., delivered. The tenders for the sewer pipe has not yet been awarded.

TORONTO.—The Aikenhead Hardware Company, of Toronto, have been awarded the hardware contract for the new Union Depot of the Canadian Northern Railway at Winnipeg.

WINDSOR.—The city of Windsor have awarded to Messrs. E. Leonard & Sons, of London, Ont. The contract for the steel boiler and engine required for their electric light works. The following is a list of the tenders submitted:—E. Leonard & Sons, London, Ont., steel boiler, $1,090; 250-horse-power Cross Compound engine, $3,250.

Other bidders and prices.	Boiler.	Engine.
John Inglis & Co., Toronto	$1,425	$.....
W. J. Bradley	1,650	.....
Clinton Engine Co.	1,750	.....
Waterous Engine Co., Brantford	1.087	3,477
Polson Iron Company, Ltd., Toronto	1,825	.....
Canada Foundry Co., Ltd., Toronto	1,460	.....
Robb Engine Co., Amherst, N.S.	1,340	3,098
Goldie & McCulloch, Galt, Ont.	1,137	3,345

TORONTO.—The Temiskaming & Northern Ontario Railway Commission received nineteen tenders for buildings at Cochrane. The contracts for the round-house, machine shop, locomotive foreman's office, coal chute and trestle, and reinforced concrete arch culverts, were awarded to the Forest City Paving and Construction Company, London, while that for the heating system in the round house and machine shop was given to Sheldons Limited, of Galt. The lowest tenders were accepted in every case. The work will be commenced as soon as the contracts are drawn up and signed.

Manitoba.

MINNEDOSA.—The town of Minnedosa have awarded the contract for building a six-roomed schoolhouse to Fred. W. Mercer, of Minnedosa, whose tender was $16,350. Twelve tenders were submitted and prices ranged from $16,350 to $21,250.

Foreign.

BOSTON, MASS.—The Boston Insulated Wire & Cable Company, Bay Street, Dorchester, Mass., have closed contract with the Aberthaw Construction Company, Boston, Mass., for the construction of a new concrete mill, comprising a main two-story building, 180 feet by 82 feet, a one-story vulcanizing building, 96 feet by 25 feet, and an engine and boiler room, 50 feet by 38 feet. Work is to be started April 1st.

ARMSTEAD, MONT.—MacArthur Brothers Company, contractors, New York City, have been awarded the contract for the construction of the Gilmore & Pittsburg Railroad. This railroad begins at Armstead, Mont., connecting with the Oregon Short Line Railway, and runs west to Salmon City, Idaho, with a branch line of about 20 miles from Junction to Gilmore. The road is about 120 miles in length, and there are approximately 2,500,000 cubic yards of excavation exclusive of the tunnel. The tunnel is a short tunnel of about 750 feet. The right-of-way has all been procured and the contract work will begin immediately. Mr. T. H. Bacon is the Chief Engineer of the line.

RAILWAYS—STEAM AND ELECTRIC.

Ontario.

PORT ARTHUR.—The Kingston Locomotive Company, Ltd., have just completed their order with the Canadian Northern Railway Company, per 25 engines of the 400 class.

HAMILTON.—The engineers of the Hamilton, Waterloo & Guelph Railway are now at work staking out a route in the vicinity of Galt. Construction will probably be started early.

British Columbia.

NEW WESTMINSTER.—The new Chilliwack train line bridge over the Serpentine River has been completed and the grade from the city to Cloverdale is now ready for the steel.

Foreign.

DULUTH, MINN.—For the purpose of constructing a railroad from Virginia to Duluth. The Duluth, Winnipeg and Pacific Railroad has been incorporated. The incorporators are: Wirt H. Cook, president; J. L. Washburn, vice-president; W. D. Bailey, secretary; L. C. Foetham, treasurer; and J. F. Walsh. The company is understood to have been formed for the purpose of building the extension of the Rainy Lake road, now a part of the Canadian Northern, from Virginia to Duluth.

LIGHT, HEAT, AND POWER.

New Brunswick.

ST. JOHN.—Two carloads of plant, consisting of engines, boilers, steam drills, derricks, and other machinery, have arrived at Grand Falls, N.B., and are now being set up for the beginning of operations. Mr. William Askin (formerly of Nova Scotia and afterwards of Boston) and Mr. Clarence A. Conrad (formerly of St. John), representing the Frank B. Gilbreth organization, have already arrived and taken charge of the preliminary work. The development of 100,000 horse-power at Grand Falls is of great importance to the Province of New Brunswick, as it will foster new manufacturing industries on account of the low price for power that will be secured from this undertaking when completed.

Ontario.

OTTAWA.—The Hill Electric Switch Company, Montreal, Que., have secured the contract for the switchboard and panels for the new Y.M.C.A. building here.

British Columbia.

KAMLOOPS.—The general scheme for the reorganization of the civic light and power department laid before the City Council involves an expenditure of $16,500, which includes the purchase of a compound direct engine with a capacity of 150 kw., costing $9,000, a 120 kw. dynamo indirect, $3,200; 150 horse-power boiler at $2,100, new wiring, $2,200; contingencies, $1,000.

VANCOUVER.—The work of putting in a new unit of 10,000 horse-power at the power house of the British Columbia Electric Railway is progressing. Considerable work has been done, and it is expected that the additional power can be delivered by July. At present a new pressure pipe from the dam to the power house, five or six feet in diameter, with a 400 foot head or pressure at the lower end is being laid. This pipe will supply the water for the new water-wheel and generator of 10,000 horse-power. The water-wheel and the electric generator are expected to arrive in July and that will mark the completion of the scheme.

SEWERAGE AND WATERWORKS.

Ontario.

FORT FRANCES.—At a meeting of the Town Council on Saturday evening the by-law to raise $20,500 for extending the water mains was passed. Tenders are now being asked for a supply of material and labor.

British Columbia.

VICTORIA.—The city engineer has been asked to estimate the cost of extending the Queen's Avenue sewer to deep water, as a result of complaints made concerning the unsanitary condition of the spot where the sewage was discharged.

COBALT.—Mr. O. W. Smith, of Galt and Smith, Toronto, has been retained by the town to report on sewerage system and water supply.

TORONTO.—Mayor Oliver and City Engineer Rust have intimated that no time will be lost in commencing the work on the trunk sewer and sewage disposal plant. The Godson Contracting Company will be awarded the contract for the work at the next meeting of the Board of Control, and the probability is that the City Council at the special meeting to be held this week will ratify the recommendation.

Saskatchewan.

YORKTON.—Waterworks and sewerage system to cost $70,000 will be installed this year. An engineer has been engaged to take charge of the work.

TELEPHONY

Ontario.

TILBURY.—The Tilbury Telephone Company, Ltd., has ordered a large quantity of material, and expects to commence the construction of its line at a very early date.

Saskatchewan.

BLENFAIT.—A meeting of the farmers in this district was held last week for the purpose of organizing the Blenfeit Rural Telephone Company, Ltd. The estimated cost of constructing and equipping the line is $50 per phone, which includes a metallic circuit.

British Columbia.

NELSON.—The Cranbrook Telephone Company, which bought out the Fernie telephone system from the Crow's Nest Pass Coal Company last November, has decided to string a wire from Fernie to Lethbridge, connecting there with the Alberta Government system. In addition to this extension is the project of the same company to construct a line to Port Hill, Wash., and so obtain connection with Spokane.

MISCELLANEOUS

New Brunswick.

ST. JOHN.—Louis Coste, consulting engineer of the Public Works Department, says the scheme afoot to develop the port of St. John may necessitate the expenditure of $10,000,000 in the future. A series of seven new docks is planned to be located south of Sanpoint.

Quebec.

MONTREAL.—It is expected that when Major Stephens, president of the Harbour Commissioners returns to Montreal next month, decisive steps will be taken towards constructing a dry dock for the St. Lawrence route.

Ontario.

HAMILTON.—The Dominion Power and Transmission Company have purchased a Koehring street paving mixer, which they are now using on construction work.

HAMILTON.—The general offices of the Hamilton Steel & Iron Company, Ltd., of Hamilton, Ont., have been removed. They are now in their new office building at the Furnace Plant, East Hamilton. The old office at the foot of Queen Street, by the Grand Trunk station is closed. The mills at Queen Street are operating as usual.

British Columbia.

FERNIE.—Work on the new bridge across the Elk River connecting West Fernie with the city is being rushed with all possible speed, and it is hoped to have it completed before the spring freshets occur. The new C. P. R. depot will be ready for occupancy in a few days. The building is modelled after the old one and is large and conveniently arranged.

CURRENT NEWS

Ontario.

OTTAWA.—According to information recently received by the Government, the harbor at Fort Churchill was open on the 15th November. Up to that date there was no ice that would impede a good steamer.

THAMESVILLE.—Mr. W. J. Cryderman, clerk of the village, is advertising for an electrician to take charge of a small steam plant.

Manitoba.

WINNIPEG.—The Red River and Assiniboine Bridge Co. will hold a meeting on April 7th to consider the sale to the City of St. Boniface of the Broadway Bridge, which connects the cities of Winnipeg and St. Boniface.

Alberta.

MEDICINE HAT.—The Old Glory gas well has developed a daily output of 8,353,000 cubic feet, capable of developing 3,800 horse-power. The gas is now being used by the C.P.R. to pump water to Bow Island station, five miles away, and it will also be piped across to Suffield, on the main line, to be used for the same purpose there.

British Columbia.

VANCOUVER.—The C.P.R. is negotiating for an elevator site at Vancouver in connection with its plans to ship wheat via the Pacific.

VANCOUVER.—Mr. J. C. White, of Duluth, purchased a site for an elevator at Eburne, last week. The land is now being cleared and construction work will commence without delay.

PERSONAL.

MR. S. B. CLEMENT, A.M., Can. Soc. C.E., has been appointed chief engineer of the T.N.O. Ry. succeeding G. A. McCarthy, resigned.

MR. THOMAS H. McCAULEY, superintendent of the Port Arthur franchises, has been appointed manager of the new electric street railway in Calgary.

MR. J. R. HEDDLE, late assistant city engineer at Hamilton, Ont., has been appointed city engineer of Brandon, Man. Duties to commence not later than May 1st.

MR. A. F. McARTHUR, city engineer of Guelph, has been appointed city engineer for Yorkton.

MR. WALTER B. SNOW, publicity engineer, Boston, Mass., has been elected a member of the Corporation of the Massachusetts Institute of Technology.

MR. C. W. STOKES, formerly manager of the Kenora Electric and Telephone system, has joined forces with the Northern Electric and Manufacturing Company taking charge of the electrical apparatus for the Toronto district.

MR. EDMUND PENNINGTON, of Minneapolis, since July 31, 1905, vice-president and general manager of the Minneapolis, St. Paul & Sault Ste. Marie Railway Company, the "Soo Line," was on March 10 elected president of the company, to succeed the late Thomas Lowry. Mr. Pennington is known as a practical railroad man, a man who has grown up in the operative part of the business and who has reached the top because of a thorough knowledge of all branches of the work, combined with remarkable ability of an executive nature. Edmund Pennington was born in September 16, 1848, at La Salle, Ill. He entered railway service in 1869, since which he has been consecutively warehouseman one year, brakeman two years, conductor three years, roadmaster two years, superintendent of construction two years, general roadmaster three years, assistant superintendent two years, Chicago, Milwaukee & St. Paul Railway; superintendent Minneapolis & Pacific road until June, 1888; July 1888, to April 15, 1898, superintendent Minneapolis, St. Paul & Sault Ste. Marie Railway; April 15, 1898, to February 1, 1899, general superintendent; February 1, 1899, to July 31, 1905, general manager; July 31 1905 to March 10, 1909, vice-president and general manager.

MESSRS. S. GAGNE, B.A.Sc., and GORDON T. JENNINGS, B.Sc., have opened an office as consulting engineers in the Lawlor Building, corner Yonge and King Sts., Toronto, Ont.

MR. J. F. B. VANDELEUR, 3 Dineen Building, Toronto, Canadian Agent for Messrs. Reavell & Co., Ipswich; Gilbert Arc Lamp Co., Chingford; Laurence, Scott, Norwich; Evershed & Vignoles, London, and several other well-known English firms, has just returned from England after a three months' business trip. While abroad Mr. Vandeleur called on his different principals, and the prospects for the development of trade relations between English engineering concerns and Canada look promising.

MARKET CONDITIONS.

Toronto, March 25th.

Respecting steel and iron products, there are no definite changes announced from the United States since last week. The market seems to have steadied, although some Canadian manufacturers seem to think prices must go up in certain directions of domestic manufacture. The Old Country pig-iron market maintains a very fair level; holders are moderately firm, and no wonder, for last year at this time the price was 52s., while now it is 6s. lower.

Bricks are active in Toronto market at an advance in price. This is because of some considerable structures to be proceeded with in spring, we note a list of these elsewhere. Much residential building is also going on in April or May. Cement is not yet active.

Builders and contractors have a considerable list of new structures in Toronto for the opening of spring. Among them we note the new Bell Telephone building, the new Exhibition buildings, Copp, Clark & Company's warehouse, St. Joseph's Convent addition, Shea's new theatre, corner Victoria and Richmond, the Massey School of Cookery, an extensive residence for Mr. John Eaton, stores on college street, many residences in choice residential parts of the city as well as in the outskirts. We learn, besides, that work is to be resumed at once on the brick brass foundry premises for James Morrison & Company, which had been "hung up" for several months.

The following are wholesale prices for Toronto, where not otherwise explained, although for broken quantities higher prices are quoted:—

Antimony.—The market more active; price continues at 9½c.

Axes.—Standard makes, double bitted, $8 to $10; single bitted, per dozen, $7 to $0.

Boiler Plates.—1-4-inch and heavier, $2.20. Boiler heads 25c. per 100 pounds advance on plate.

Boiler Tubes.—Orders continue active. Lap-welded, steel, 1¼-inch, 10c.; 1½-inch, 9c. per foot; 2-inch, $8.75; 2¼-inch, $10; 2½-inch, $10.60; 3-inch, $12.10; 3½-inch, $15; 4-inch, $18.50 to $19 per 100 feet.

Building Paper.—Plain, 30c. per roll; tarred, 40c. per roll. A moderate demand can be now reported, for shipment about 1st April.

Bricks.—An active demand is now reported for common, and the market is firmer at $9.50 to $10. Pressed also selling freely. Red and buff pressed are worth, delivered, $18; at works, 17.

Cement.—Price in 1,000-barrel lots $1.70 per barrel, including bags, or $1.30 without bags. Smaller quantities, $1.55 to $1.60 per barrel, in load lots delivered in town, and bags extra. No marked activity.

Coal Tar.—Nothing doing, price maintained at $3.50 per barrel.

Copper Ingot.—Outside market firmer and quite active. Price here unchanged at 13½ to 14c., with more enquiry.

Detonator Caps.—75c. to $1 per 100; case lots, 75c. per 100; broken quantities, $1.

Dynamite, per pound, 21 to 25c., as to quantity.

Roofing Felt.—Some little requests of late, principally for repairing. Price maintained at $1.80 per 100 lbs.

Fire Bricks.—English and Scotch, $30 to $35; American, $27.50 to $35 per 1,000. The demand has become quite active.

Fuses.—Electric Blasting.—Double strength, per 200, 4 feet, $4.50; 6 feet, $5; 8 feet, $5.50; 10 feet, $6. Single strength, 4 feet, $3.50; 6 feet, $4; 8 feet, $4.50; 10 feet, $5. Bennett's double tape fuse, $6 per 1,000 feet.

Galvanized Sheets.—Apollo Brand.—Sheets 6 or 8 feet long, 30 or 36 inches wide; 10-gauge, $3.05; 12-14-gauge, $3.15; 16, 18, 20, $3.35; 22-24, $3.50; 26, $3.75; 28, $4.20; 29, $4.50; 10¾, $4.50 per 100 lbs. Fleur de Lis—28-gauge, $4.30; 26-gauge, $4.05; 22-24-gauge, $3.50. Queen's Head—28-gauge, $4.50; 26-gauge, $4.25. Sheets continue in active request.

Iron Chain.—¼-inch, $5.75; 5-16-inch, $5.15; ¾-inch, $4.15; 7-16-inch, $3.95; ½-inch, $3.75; 9-16-inch, $3.70; ⅝-inch, $3.55; ¾-inch, $3.45; ⅞-inch, $3.40; 1-inch, $3.40.

Bar Iron.—$1.95 to $2, base, from stock to wholesale dealer. Market well supplied.

Iron Pipe.—Black, ¼-inch, $2.03; ⅜-inch, $2.26; ¾-inch, $2.63; ¾-inch, $3.16; 1-inch, $4.54; 1¼-inch, $6.19; 1½-inch, $7.43; 2-inch, $9.90; 2½-inch, $15.81; 3-inch, $20.76; 3½-inch, $26.13; 4-inch, $29.70; 4½-inch, $38; 5-inch, $43.50; 6-inch, $56. Galvanized, ¼-inch, $2.86; ⅜-inch, $3.08; ½-inch, $3.48; ¾-inch, $4.31; 1-inch, $6.19; 1¼-inch, $8.44; 1½-inch, $10.13; 2-inch, $13.50. Makers are holding prices stiff, and talk of an advance.

Lead.—Prices steady outside. This market still held at $3.80 to $3.90, and more doing.

Lime.—Retail price in city 35c. per 100 lbs. f.o.b., car; in large lots at kilns outside city 22c. per 100 lbs. f.o.b., car. Small but steady consumptive demand.

Lumber.—We quote dressing pine $32 to $35 per thousand; common stock boards higher at $26 to $30.00; cull stocks, $20; sidings, $17.50. Norway pine is neglected in favor of Southern, which is much stronger in fibre and the price well maintained. Hemlock continues to sell pretty freely, and in car lots brings $16.50 to $17.00. Spruce flooring is worth $22.00 in car lots with stiffer feeling. Shingles firmer, price for British Columbia, $3.20. Lath higher at $4.25 for No. 1 and $3.75 for No. 2 white pine 48-inch; the 32-inch are now in market and bring $1.30 per thousand. Spruce laths are scarcer in this market and prices keep up. More spruce and hemlock have moved than pine. Prices are maintained all over the list.

Nails.—Wire, $2.25 base; cut, $2.70; spikes, $3. The usual demand.

Pitch.—A little demand is perceptible; price continues at 70c. per 100 lbs.

Pig Iron.—Business continues quiet; prices are fairly well maintained. Clarence quotes at $20.50 for No. 3; Cleveland, $20.50 to $21.00; in Canadian pig, Hamilton quotes $19.50 to $20.

Plaster of Paris.—Calcined, wholesale, $2; retail, $2.15. Trade quiet.

Putty.—In bladders, strictly pure, per 100 lbs., $2.25; in barrel lots, $2.05.

Rope.—Sisal, 9½c. per lb.; pure Manila, 12½c., Base.

Sewer Pipe.—

	4-in.	6-in.	9-in.	10-in.	12-in.	24-in.
Straight pipe per foot	$0.20	$0.30	0.6	$0.75	$1.00	$3.25
Single junction, 1 or 2 ft. long.	.90	1.35	2.70	3.40	4.50	14.65
Double junctions	1.50	2.50	5.00	....	8.50	.....
Increasers and reducers	....	1.50	2.50	....	4.00	.....
P. traps	2.00	3.50	7.50	....	15.00	.....
H. H. traps	2.50	4.00	8.00	....	15.00	.....

In steady demand; price 73 per cent. off list at factory for car-load lots; 65 per cent. off list retail.

Steel Beams and Channels.—Quiet. We quote:—$2.50 to $2.75, according to size and quantity; if cut, $2.75 to $3; angles, 1 1-4 by 3-16 and larger, $2.50; tees, $2.80 to $3 per 100 pounds. Extra for smaller sizes of angles and tees.

Steel Rails.—80-lb., $35 to $38 per ton. The following are prices per gross ton, for 500 tons or over: Montreal, 12-lb. $45, 16-lb. $44, 25 and 30-lb. $43.

Sheet Steel.—Market steady, with fairly good demand; 10-gauge, $2.50; 12-gauge, $2.55; American Bessemer, 14-gauge, $2.35; 17, 18, and 20-gauge, $2.45; 22 and 244-gauge, $2.50; 26-gauge, $2.65; 28-gauge, $2.85.

Tank Plate.—3-16, $2.40 100 lbs.

Tool Steel.—Jowett's special pink label, 10½c. Cyclops, 16c. "H.R.D." high speed tool steel 65c.

Tin.—Market more steady, with moderate activity. The price is maintained at 30½ and 31c.

Wheelbarrows.—Navvy, steel wheel, Jewel pattern, knocked down, $21.35 per dozen; set up, $22.35. Pan Canadian, navvy, steel tray, steel wheel, per dozen, $3.30 each; Pan American, steel tray, steel wheel, $4.25 each.

Zinc Spelter.—Business quiet; market firm at $5.25 to $5.50, outside market weaker.

* * * *

Montreal, March 24th, 1909.

So far as can be learned, there is no truth in the report heard last week to the effect that a new steel amalgamation was being formed in the United States. Whether such an amalgamation is likely to take place some time in the future or not, it seems to be a certainty that the companies are not ready to go in at the moment. Nothing has been done during the past week in the pig-iron market outside a few transactions in car lots and similar small tonnage for immediate delivery. Southern iron is offered at lower prices than a week ago, and Northern is nominally unchanged. Pennsylvania reports that buyers are taking no interest at all in the market although concessions from former prices could easily be obtained. Foundry and malleable iron is quoted at $14.50 to $14.75, Valley. Tariff discussions occupy the centre of the arena. The Payne Bill has been reported by the Commission, and it has recommended the placing of iron ore on the free list, the reduction of the duty on pig from $4, to $2.50 per ton, and reductions in other iron and steel material averaging from 40 per cent. to 50 per cent. of the duties now in force. These changes must come before the House of Representatives and the Senate.

The situation in England is very uncertain, but prices show little change, there being little business put through. The market is waiting on the outcome of tariff matters in the United States. Local English and export conditions remain about the same as previously. The general tone is easy, and purchases could probably be made at about two shillings less than formerly.

In Canada, business is reported fairly satisfactory, quite a heavy tonnage having been closed lately, although there is considerable hesitation on the part of buyers, owing to the hope that they may be able to make purchases later at lower prices. The general situation appears to be improving slightly, and this is inducing some purchasing. The trade is waiting on the United States, and there is little doubt that any real evidence of a strengthening of prices would occasion active purchasing.

Owing to the general hesitation and dullness, the market for finished and semi-finished products is quite uninteresting, so far as changes are concerned, no alteration in quotations having taken place.

Antimony.—The market is steady at 9 to 9½.

Bar Iron and Steel.—Prices are steady all round, and trade is dull. Bar iron, $1.90 per 100 pounds; best refined horseshoe, $2.15; forged iron, $2.05; mild steel, $2.00; sleigh shoe steel, $1.90 for 1 x ⅜-base; tire steel, $1.95 for 1 x ⅜-base; toe calk steel, $2.40; machine steel, iron finish, $2.10; smooth finish, $2.75.

Boiler Tubes.—The market is steady, quotations being as follows:—2-inch tubes, 8½c.; 2½-inch, 10c.; 3-inch, 11½c.; 3½-inch, 14¾c.; 4-inch, 19c.

Building Paper.—Tar paper, 7, 10, or 16 ounces, $1.60 per 100 pounds; felt paper, $2.40 per 100 pounds; tar sheathing, No. 1, 35c. per roll of 400 square feet; No. 2, 35c.; dry sheathing, No. 1, 45c. per roll of 400 square feet, No. 2, 28c. (See Roofing; also Tar and Pitch).

Cement.—Quotations are for car lots, f.o.b., Montreal. Canadian cement is $1.55 to $1.65 per 350-lb. bbl., in 4 cotton bags, adding 10c. for each bag. Good bags re-purchased at 10c. each. Paper bags cost 2½c. extra, or 10c. per bbl. weight. English cement is $1.65 to $1.85 per 350-lb. bbl. in 4 jute sacks (for which add 8c. each) and $2.20 to $2.40 in wood. Begian cement is $1.60 to $1.65 in bags—bags extra—and $2.10 in wood.

Chain.—The market is steady as follows:—¼-inch, $5.30; 5-16-inch, $4.05; ⅜-inch, $3.65; 7-16-inch, $3.45; ½-inch, $3.20; 9-16-inch, $3.15; ⅝-inch, $3.05; ¾-inch, $3; ⅞-inch, $2.95; 1 inch, $2.95.

Copper.—The market is about steady at 14½ to 15c. per lb. Demand continues limited.

Explosives and Accessories.—Dynamite, 50-lb. cases, 40 per cent. proof, 18c. in single case lots, Montreal. Blasting powder, 25-lb. kegs, $2.25 per keg. Special quotations on large lots of dynamite and powder. Detonator caps, case lots, containing 10,000, 75c. per 100; broken lots, $1. Electric blasting apparatus:—Batteries, 1 to 10 holes, $15; 1 to 20 holes, $25; 1 to 30 holes, $35; 1 to 40 holes, $50. Wire, leading, 1c. per foot; connecting, 50c. per lb. Fuses, platinum, single strentgh, per 100 fuses:—4-ft. wires, $3.50; 6-ft. wires, $4; 8-ft. wires, $4.50; 10-ft. wires, $5. Double strength fuses, $1 extra, per 100 fuses. Fuses, time, double-tape, $6 per 1,000 feet.

Galvanized Iron.—The market is steady. Prices, basis, 28-gauge, are:—Queen's eHad, $4.40; Comet, $4.25; Gorbal's Best, $4.25; Apollo, 10¾ oz., $4.35. Add 25c. to above figures for less than case lots; 26-gauge is 25c. less than 28-gauge. American 28-gauge and English 26 are equivalents, as are American 10¾ oz., and English 28-gauge.

Galvanized Pipe.—(See Pipe, Wrought and Galvanized).

Iron.—Prices are rather higher, and the outlook is steady. The following prices are ex-store: Canadian pig, $18.50 to $19.50 per ton; No. 1 Summerlee, $21 to $22; No. 2 selected Summerlee, $20.50 to $21.50; Carron soft, $20.25 to $20.75; No. 3 Clarence, $19 to $20 per ton.

Laths.—See Lumber, etc.

Lead.—Trail lead is firmer, at $3.75 to $3.85 per 100 pounds, ex-store.

Lead Wool.—$10.50 per hundred, $200 per ton, f.o.b., factory.

Lumber, Etc.—Prices on lumber are for car lots, to contractors, at mill points, carrying a freight rate of $1.50. At the moment, the market is exceptionally irregular and prices are uncertain. Red pine, mill culls out, $18 to $22 per 1,000 feet; white pine, mill culls, $22 to $25. Spruce, 1-in. by 4-in. and up, $16 to $18 per 1,000 ft.; mill culls, $14 to $16. Hemlock, log run, culls out, $14 to $16. Railway Ties; Standard Railway ties, hemlock or cedar, 35 to 45c. each, on a 5c. rate to Montreal. Telegraph Poles: Seven-inch top, cedar poles, 25-ft. poles, $1.35 to $1.50 each; 30-ft., $1.75 to $2; 35-ft., $2.75 to $3.25 each, at manufacturers' points, with 5c. freight rate to Montreal. Laths: Quotations per 1,000 laths, at points carrying $1.50 freight rate to Montreal, $2 to $3. Shingles: Cedar shingles, same conditions as laths, X, $1.50; XX, $2.50; XXX, $3.

Nails.—Demand for nails is moderate, but prices are steady at $2.30 per keg for cut, and $2.25 for wire, base prices.

Pipe.—Cast Iron.—The market continues steady at $33 for 8-inch pipe and larger; $34 for 6-inch pipe; $34 for 5-inch, and $34 for 4-inch at the foundry. Pipe, specials, $3.10 per 100 pounds. Gas pipe is quoted at about $1 more than the above.

Pipe.—Wrought and Galvanized.—The market is steady, moderate-sized lots being: ¼-inch, $5.50 with 63 per cent. off for black, and 48 per cent. off for galvanized; ⅜-inch, $5.50, with 59 per cent. off for black and 44 per cent. off for galvanized. The discount on the following is 69 per cent. off for black and 59 per cent. off for galvanized; ½-inch, $8.50; ¾-inch, $11.50; 1-inch, $16.50; 1¼-inch, $22.50; 1½-nch, $27; 2-inch, $36; 2½-inch, $57.50; 3-inch, $75.50; 3½-inch, $95; 4-inch, $108.

Rails.—Quotations on steel rails are necessarily only approximate and depend upon specification, quantity and delivery required. A range of $31.50 to $32.50 is given for 60-lb., 70-lb., 80-lb., 85-lb., 90-lb., and 100-lb. rails, per gross ton of 2,240 lbs., f.o.b. mill. Re-laying rails are quoted at $27 to $29 per ton, according to condition of rail and location.

Railway Ties.—See lumber, etc.

Roofing.—Ready roofing, two-ply, 64c. per roll; three-ply, 86c. per roll of 100 square feet. (See Building Paper; also Tar and Pitch).

Rope.—Prices are steady, at 9½c. per lb. for sisal, and 12c. for Manila. Wire rope, crucible steel, six-strands, nineteen wires; ¼-in., $2.75; 5-16, $3.75; ⅜, $4.75; ½, $6; ⅝, $7.25; ¾, $8.50; ⅞, $10; 1-in., $12 per 100 feet.

Spikes.—Railway spikes are in dull demand and prices are steady at $2.30 per 100 pounds, base of 5½ x 9-16. Ship spikes are also dull and steady at $2.85 per 100 pounds, base of ⅝ x 10-inch, and ⅝ x 12-inch.

Steel Shafting.—Prices are steady at the list, less 25 per cent. Demand is on the dull side.

Steel Plates.—The market is steady. Quotations are: $2.15 for 3-16; $2.25 for ⅛, and $2.15 for ¼ andthicker; 12-gauge being $2.30; 14-gauge, $2.15; and 16-gauge, $2.10.

Telegraph Poles.—See lumber, etc.

Tar and Pitch.—Coal tar, $4 per barrel of 40 gallons, weighing about 500 pounds, roofing tar, $3.15 per barrel; roofing pitch, No. 1, $1 per 100 pounds; and No. 2, 50c. per 100 pounds; pine tar, $8.50 per barrel of 40 gallons, and $4.75 per half-barrel; pine pitch, $4 per barrel of 180 to 200 pound. (See building paper; also roofing.

Tin.—Prices are 32c. to 32½c.

Zinc.—The market is steady at 5½ to 5¾c.

* * * *

Winnipeg, March 23rd, 1909.

Anvils.—Per pound, 10 to 12½c.; Buckworth anvils, 80 lbs., and up, 10¾c.; anvil and vise combined, each, $5.50.

Bar Iron.—$2.50 to $2.60.

Beams and Channels.—$3 to $3.25 per 100 up to 15-inch.

Building Paper.—4½ to 7c. per pound. No. 1 tarred, 84c. per roll; plain, 60c.; No. 2 tarred, 62½c.; plain, 56c.

Bricks.—$11, $12, $13, per M, three grades.

Cement.—$2.25 to $2.50 per barrel, in cotton bags.

Chain.—Coil, proof, ¼-inch, $7; 5-16-inch, $5.50; ⅜-inch, $4.90; 7-16-inch, $4.75; ½-inch, $4.40; ⅝-inch, $4.20; ¾-inch, $4.05; logging chain, 5-16-inch, $6.50; ⅜-inch, $6; ½-inch, $8.50; jack iron, single, per dozen yards 15c. to 75c.; double, 25c. to $1; trace-chains, per dozen, $5.25 to $6.

Dynamite.—$11 to $13 per case.

Hair.—Plaster's, 80 to 90 cents per bale.

Hinges.—Heavy T and strap, per 100 lbs., $6 to $7.50; light, do., 65 per cent.; screw hook and hinge, 6 to 10 inches, 5½c. per lb.; 12 inches up, per lb., 4¼c.

Iron.—Swedish iron, 100 lbs., $4.75 base; sheet, black, 14 to 22 gauge, $3.75; 24-gauge, $3.90; 26-gauge, $4; 28-gauge, $4.10. Galvanized—American, 18 to 20-gauge, $4.40; 22 to 24-gauge, $4.65; 26-gauge, $4.65; 28-gauge, $4.90; 30-gauge, $5.15 per 100 lbs. Queen's Head, 22 to 24-gauge, $4.65; 26-gauge English, or 30-gauge American, $4.90; 30-gauge American, $5.15; Fleur de Lis, 22 to 24-gauge, $4.50; 28-gauge American, $4.75; 30-gauge American, $5.

Lead Wool.—$10.50 per hundred, $200 per ton, f.o.b., Toronto.

Pipe.—Iron, black, per 100 feet, ¼-inch, $2.50; ⅜-inch, $2.80; ½-inch, $3.40; ¾-inch, $4.60; 1-inch, $6.60; 1¼-inch, $9; 1½-inch, $10.75; 2-inch, $14.40; galvanized, ½-inch, $4.25; ¾-inch, $5.75; 1-inch, $8.35; 1¼-inch, $11.35; 1½-inch, $13.60; 2-inch, $18.10. Lead, 6½c. per lb.

Picks.—Clay, $5 dozen; pick mattocks, $6 per dozen; clevishes, 7c. per lb.

Pitch.—Pine, $6.50 per barrel; in less than barrel lots, 4c. per lb.; roofing pitch, $1 per cwt.

Plaster.—Per barrel, $3.

Roofing Paper.—60 to 67½c. per roll.

CITY OF MEDICINE HAT

TENDERS FOR GAS WELL.

TENDERS for the drilling of a well for the City will be received at the office of the undersigned up to April 30th, 1909.

Tenders to be given as follows:

The contractor to furnish all labor, pipe, machinery and material, anchor and shut in well in a practical manner, the City to pay for all pipe which it is necessary to leave in the well, or the contractor may tender to furnish labor only, anchor and shut in well in a practical manner.

Specifications may be obtained by applying to the undersigned.

W. P. MORRISON,
City Engineer and Commissioner.

TENDERS FOR BRIDGES

Tenders will be received by the undersigned until noon on Friday, the 2nd April, for the construction of a bridge over Catfish Creek at Jamestown, Township Yarmouth; also for the construction of concrete abutments for a bridge to be built over the Otter Creek at Richmond, Township of Bayham. Both these bridges to have concrete floors. Also for the furnishing and driving of about 250 piles in Kettle Creek at Port Stanley. Plans and specifications can be seen at this office, where blank forms of tender can be obtained.

JAS. A. BELL,
County Engineer.

St. Thomas, Ont., March 20th, 1909.

CONTRACTOR'S SUPPLIES

NEW INCORPORATIONS.

New Brunswick.—McLellan & Smith Lumber Co., $24,000; R. W. McLellan, W. A. McLellan, Fredericton; G. Smith, Burton.

AMONG THE MANUFACTURERS

A department for the benefit of all readers to contain news from the manufacturer and inventor to the profession.

LARGE FOREIGN CONTRACT FOR BRITISH FIRM.

The contract for the erection of a 450 ton per day refuse destructor for the city of Rotterdam has been placed with Messrs. Heenan & Froude, Limited, of Manchester and Worcester. This plant will consist of 40 cells, with their complement of boilers, regenerators, fans, etc. The refuse will be handled mechanically throughout on an improved system. The contract was secured in the face of the keenest competition from the whole of the makers on the Continent and in this country. The work will involve an expenditure of about £130,000.

This firm have destructors on order for the following places: Portsmouth; New York, U.S.A.; Vancouver, B.C.; Wellington, New Zealand; Adelaide, Australia; Penang, Straits Settlements; Ixelles, Brussels; Havre, France, and many other important towns.

It is of interest to note that the enterprise of a British firm has encircled the Globe with these important factors in modern sanitation.

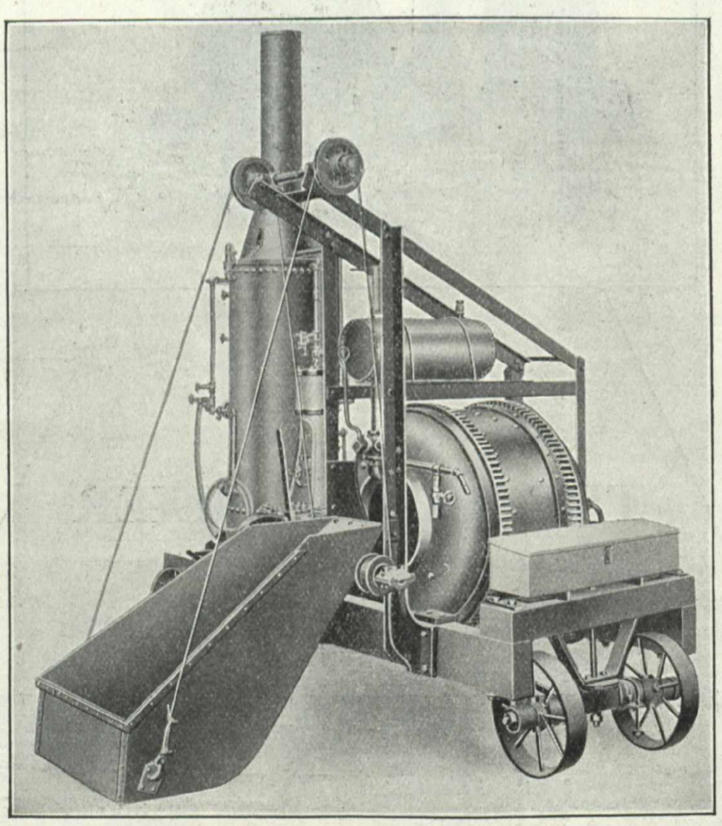
THE WM. HAMILTON COMPANY.

The Wm. Hamilton Company with a number of other companies tendered for the supply of lock machinery for twenty-four locks on the Trent Canal, and their tender being the lowest, and their equipment sufficient for the work the contract has been awarded to them. The company received word of this fact and will start work at once upon the contract. It includes the supplying of all the operating machinery. anchorage fittings and pivots for twenty-four locks made up of the following: Two at Trenton, three at Glen Miller, one at Frankford, five at Glen Ross, one at Raney Falls, one at Campbellford, three at Middle Falls, one at Healey's Falls, one at Hastings, one at Rosedale, one at Lindsay, three at Holland's Landing, and one at Newmarket. The contract amounts to about $100,000 with extras, and is of the greatest importance to the company and to Peterborough generally, as it will mean steady work for an increased number of hands. In all some forty new men will be added as the machine shop and moulding staffs will be increased.

KOEHRING MIXER.

Among the various types of concrete mixers exhibited at the recent show held in the St. Lawrence Arena, Toronto, the accompanying cut shows the Kœhring machine, equipped with elevating charging bucket and water measuring tank.

The elevating charging bucket is a substitute for the platform usually required for dumping the material into the drum. This equipment will greatly reduce the cost per cubic yard of mixing concrete, to say nothing of the money saved for material and labor which is required to erect and take down the platform every time the mixer is moved. The bucket can be filled while a batch is being discharged from the drum, and as soon as the drum is empty the bucket is hoisted into a discharging position and the entire batch emptied into the drum. It requires about five seconds to elevate the discharging bucket so that there is only a few seconds' interval from the time the batch is discharged from the drum until another complete batch is dumped into it. If the material can be brought close enough to the machine it can be shoveled directly into the bucket, for the same can be provided with movable partition to regulate the proper proportions. The height of the bucket depends on the size of mixer, varying from 12 to 18 inches. As can be seen by studying the illustration, the two wire cables are fastened to the extreme outer corner of the bucket, from where they pass over a sheave to the winding-drums. These drums are keyed on to a shaft, which is driven by gearing from the main driving-shaft, and is operated by a friction clutch of a pattern, especially designed to withstand hard usage. When the bucket is to be elevated, push in the friction clutch lever. The bucket will then rise to discharging position. When it has reached the desired height, an automatic stop is provided which will throw out the clutch, apply the brake, and the bucket will be held in an upward position. To lower the bucket it is only necessary to release the brake slightly. The mixer should be set level and carefully blocked up so the weight of the machine does not rest on the truck wheels. Blocking should also be placed at the point where the upright angles are fastened, which support the loading bucket, as there is a heavy strain at that point. When material has to be brought from any distance by wheelbarrows it can be dumped into the bucket by making a plank runway six inches to twelve inches high. The Canada Foundry Co., Limited, are making and marketing these mixers, and the exhibit was in charge of their representative. The mixer shown was equipped with the Peterboro' Lubricator Co.'s patent Philadelphia grease cups attached to parts of the machine where lubrication was required, thus protecting the bearings from the dirt and grit met with in concrete work



The D. P. Battery Co., Limited, have been favored with an order from Messrs. Rowntree & Co. to install in their large cocoa works at York one of their L.S.H. type batteries, with a capacity of 323,000 watt hours; also, an automatic reversible booster and switchboard to deal with the fluctuations of the load. A special feature of this installation consists of two inter-connected stations, 330 yards apart, one gas and the other steam-driven. The battery will be at the former station, which will supply a portion of the load at the latter station, but occasionally the inter-connected cable will be reversed and the steam set will assist the gas station.

WHERE TO BUY
An Engineering Trades Directory.

FOR INDEX TO ADVERTISERS SEE PAGE 3.

Air Compressors
Mussens Limited, Montreal, Que.
Reavell & Co., Ltd., Ipswich, Eng.

Anvils
Leslie & Co., A. C., Montreal, Que.

Automatic Railways
Babcock & Wilcox, Ltd., Montreal,

Bars, Steel.
Priddle, Arthur San Francisco, Cal.

Batteries, Storage
D. P. Battery Co., Ltd., Bakewell, Derbyshire, England.

Belting
McLaren, D. K., Ltd., Montreal, Que.
McLaren Belting Co., J. C., Montreal,

Boilers, Marine, Stationary and Water Tube
Babcock & Wilcox, Ltd., Montreal,
Petrie, H. W., Ltd., Toronto, Montreal, Vancouver.

Bonding for Concrete.
Canada Wire Goods Mfg. Company, Hamilton, Ont.
Priddle, Arthur San Francisco, Cal.

Books, Technical
John A. Hart & Co.,

Boring Tools
Armstrong Bros. Tool Co., Chicago, Ill., U. S. A.
Mussens Limited, Montreal, Que.

Bridges, Roof Trusses, etc.
Canadian Bridge Co., Ltd., Walkerville, Ont.
Cleveland Bridge & Engineering Co., Ltd., Darlington, England.
Dominion Bridge Co., Ltd., Montreal,
Hamilton Bridge Works Co., Ltd., Hamilton.
Pennsylvania Steel Co., Steelton, Pa.
Structural Steel Co., Ltd., Montreal Que.

Buckets (Clam Shell, Coal and Concrete)
Mussens Limited, Montreal, Que.

Cableways
Mussens Limited, Montreal, Que.

Cement, Machinery
Mussens Limited, Montreal, Que.
Senator Mill Mfg. Co., Ltd., Galt,

Coal Crushers
Babcock & Wilcox, Ltd., Montreal,
Senator Mill Mfg. Co., Ltd., Galt,

Coal Handling Machinery
Northern Engineering Works, Detroit, Mich.

Contractors
Cleveland Bridge & Engineering Co., Ltd., Darlington, England.

Concrete Mixers
Mussens Ltd., Montreal, Que.
Rogers Supply Co., Toronto.

Converters, Rotary
Toronto & Hamilton Electric Co., Hamilton, Ont.

Conveyors
Babcock & Wilcox, Ltd., Montreal.

(Continued on page 50.)

WHERE TO BUY.

(Continued from Page 48).

Cranes
Advance Machine Works, Ltd., Walkerville, Ont.
Dominion Bridge Co., Ltd., Montreal.
Mussens Limited, Montreal, Que.
Northern Engineering Works, Detroit, Mich.
Pennsylvania Steel Co., Steelton, Pa.
Structural Steel Co., Ltd., Montreal, Que.

Damper, Regulators
Babcock & Wilcox, Ltd., Montreal.
D'Este Co., Julian, Boston, Mass.

Derricks
Dominion Bridge Co., Ltd.. Montreal,
Mussens Limited, Montreal, Que.
Northern Engineering Works, Detroit, Mich.
Structural Steel Co., Ltd., Montreal, Que.

Draughting Supplies
Berger & Sons, C. L., Boston, Mass.,
Hart Co., John A., Winnipeg, Man.

Drawing Material.
Keuffel & Esser Co., Hoboken, N. J.

Drills
Canadian Buffalo Forge Co., Montreal and Toronto.
Mussens Limited, Montreal, Que.

Dust Separators.
Canadian Buffalo Forge Co., Montreal and Toronto.

Drying Apparatus.
Canadian Buffalo Forge Co., Montreal and Toronto.

Dynamos and Motors
Toronto & Hamilton Electric Co., Hamilton, Ont.

Economizers
Babcock & Wilcox, Ltd., Montreal.

Electric Apparatus
Hill Electric Mfg. Co., Montreal, Que.
Toronto and Hamilton Electric Co., Hamilton, Ont.

Electrical Supplies
Hill Electric Mfg. Co., Montreal, Que.
Phillips, Eugene F., Electrical Works, Ltd., Montreal, Canada.

Elevators
Northern Engineering Works, Detroit, Mich.

Engineers, Consulting
Beaubien, Gaspe de, Montreal.
Francis, W. J. Montreal, Que.
Fuce, Ed. O., Galt.
Metcalf Engineering Co., Ltd., Montreal, Que.
Mitchell, C. H., C.E., Toronto, Ont.
Nold, Henry N., Hamilton.
Richmond, J. Stanley, Toronto.
Standard Inspection Bureau, Limited, Toronto, Ont.

Engineering Instruments.
Keuffel' & Esser Co., Hoboken, N. J

Engines
Canadian Buffalo Forge Co., Montreal and Toronto.
Mussens Limited, Montreal, Que.
Northern Engineering Works, Detroit, Mich.
Reavell & Co., Ltd., Ipswich, Eng.
Petrie, H. W., Ltd., Toronto, Montreal, Vancouver.

Fans and Blowing Apparatus
Canadian Buffalo Forge Co., Montreal and Toronto.

Feed Water Heaters and Purifiers
Babcock & Wilcox, Ltd., Montreal.

Fence, Fencing, Wire
Owen Sound Wire Fence Co.

Fire Brick and Clay
Leslie & Co., A. C., Montreal.

Forgings, Drop
Coghlin & Co., B. J. Montreal, Que.

Foundry Supplies
Mussens Limited, Montreal, Que.

Generators, Alternating and Direct Current
Toronto & Hamilton Electric Co., Hamilton, Ont.

Heating and Ventilating Machinery.
Canadian Buffalo Forge Co., Montreal and Toronto.

Hoists, Electric and Pneumatic
Northern Engineering Works, Detroit, Mich.

Hydraulic Machinery.
Canadian Buffalo Forge Co., Montreal and Toronto.

Iron Bar, etc.
Leslie & Co., A. C., Montreal

Inspections
Standard Inspection Bureau, Limited, Toronto, Ont.
Dominion Bureau, Montreal, Que.

Ladles
Northern Engineering Works, Detroit, Mich.

Mechanical Draft Motors.
Canadian Buffalo Forge Co., Montreal and Toronto.

Motors
Mussens Limited, Montreal, Que.
Toronto & Hamilton Electric Co., Hamilton, Ont.

Patent Attorneys
Budden, Hanbury A., Montreal, Que.
Ridout & Maybee, Toronto, Ont.

Planer Tools
Armstrong Bros. Tool Co., Chicago, Ill., U. S. A.
Mussens Limited, Montreal, Que.

Poles, Telegraph and Telephone.
Lindsley Bros. Co., Spokane, Wash.
Sterling, W. C. & Son Co., Monroe, Mich.

Portland Cement
Hartranft Cement Co., Wm., Montreal, Que.

Posts
Lindsley Bros. Co., Spokane, Wash.

Presses, Hydraulic and Power
Mussens Limited, Montreal, Que.
Wood & Co., R. D., Philadelphia, Pa.

Pressure Regulators
D'Este Co., Julian, Boston, Mass.

Prison Work.
Canada Wire Goods Mfg. Company, Hamilton, Ont.

Pulleys
Mussens Limited, Montreal, Que.

Pumps—Steam and Power.
Canadian Buffalo Forge Co., Montreal and Toronto.
Mussens Limited, Montreal, Que.
Petrie, H. W., Ltd., Toronto, Montreal, Vancouver.
Reavell & Co., Ltd., Ipswich, Eng.
Wood & Co., R. D., Philadelphia, Pa.

Purifiers
Babcock & Wilcox, Ltd., Montreal,
Wood & Co., R. D., Philadelphia, Pa.

Railway Supplies
Coghlin & Co., B. J. Montreal, Que.
Mussens Limited, Montreal, Que.
Koppel Co., Arthur, New York City.

Railways, Industrial and Portable
Koppel Co., Arthur, New York City.

Ratchet Drills, Universal
Armstrong Bros. Tool Co., Chicago, Ill., U.S.A.
Mussens Limited, Montreal, Que.

Reinforcing Materials.
Canada Wire Goods Mfg. Company, Hamilton, Ont.
Priddle, Arthur San Francisco, Cal.

Rock Crushers
Mussens Limited, Montreal, Que.

Rope, Manilla and Wire
Mussens Limited, Montreal, Que.

Screens.
Canada Wire Goods Mfg. Company, Hamilton, Ont.

Separators, Steam
Babcock & Wilcox, Ltd., Montreal.

Sewage Disposal
Cameron Septic Tank Co., Chicago, Ill., U.S.A.

Sewer Pipe
Hamilton & Toronto Sewer Pipe Co.

Sheet Metal Work.
Canadian Buffalo Forge Co., Montreal and Toronto.

Shovels, Steam
Mussens Limited, Montreal, Que.

Springs
Coghlin & Co., B. J., Montreal, Que.
Montreal Steel Works, Montreal, Que.

Steel, Speedicut High-speed
Montreal Steel Works, Montreal, Que.

Steel, Structural
Cleveland Bridge & Engineering Co., Ltd., Darlington, England.
Dominion Bridge Co., Ltd., Montreal,
Hamilton Bridge Works Co., Hamilton, Ont.
Pennsylvania Steel Co., Steelton, Pa.
Structural Steel Co., Ltd., Montreal,

Steel, Tool
Montreal Steel Works, Montreal, Que.
Mussens Limited, Montreal, Que.
Allen & Co., Edgar, Sheffield, Eng.

Stokers, Mechanical
Babcock & Wilcox, Ltd., Montreal,

Stone Crushers and Screens
Mussens Limited, Montreal, Que.

Surveying Instruments
Berger & Son, C. L., Boston, Mass.
Gurley & Co., W. & L. E., Troy, N.Y.
Hart Co., John A., Winnipeg, Man.

Tanks, Steel and Iron
Structural Steel Co., Ltd., Montreal,
Wood & Co., R. D., Philadelphia, Pa

Ties, Railroad
Lindsley Bros. Co., Spokane, Wash.

Tool Grinders
Armstrong Bros. Tool Co., Chicago, Ill., U.S.A.

Track Jacks
Montreal Steel Works, Montreal, Que.
Mussens Limited, Montreal, Que.

Transformers
Toronto and Hamilton Electric Co., Hamilton, Ont.

Transmission Machinery
Mussens Limited, Montreal, Que.
Toronto and Hamilton Electric Co., Hamilton, Ont.

Trucks
Northern Engineering Works, Detroit, Mich.

Valves
Babcock & Wilcox, Ltd., Montreal,
Wood & Co., R. D., Philadelphia, Pa.

Waterworks Supplies
Wood & Co., R. D., Philadelphia, Pa.

Wire
Coghlin & Co., B. J., Montreal, Que.

Wire Rope
Coghlin & Co., B. J., Montreal, Que.
Mussens Limited, Montreal, Que.

Wirework.
Canada Wire Goods Mfg. Company, Hamilton, Ont.